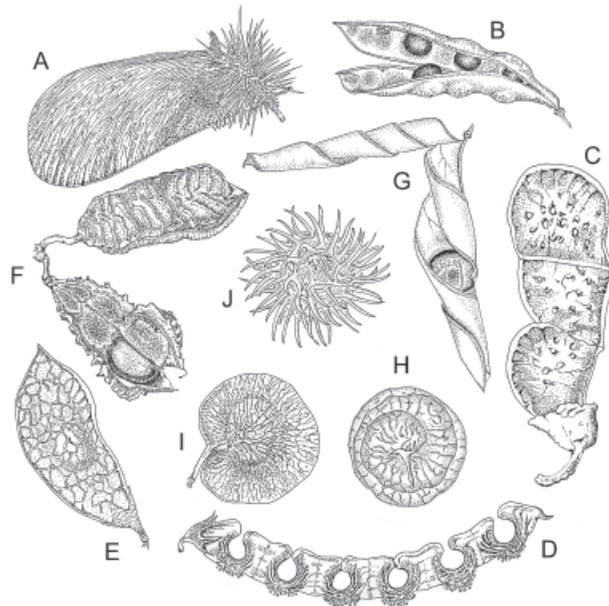


Fruits and Seeds of Genera in the Subfamily Faboideae (Fabaceae)

Volume I

Joseph H. Kirkbride, Jr., Charles R. Gunn, and
Anna L. Weitzman



Fruits of A, *Centrolobium paraense* E.L.R. Tulasne. B, *Laburnum anagyroides* F.K. Medikus. C, *Adesmia boronoides* J.D. Hooker. D, *Hippocrepis comosa*, C. Linnaeus. E, *Campylotropis macrocarpa* (A.A. von Bunge) A. Rehder. F, *Mucuna urens* (C. Linnaeus) F.K. Medikus. G, *Phaseolus polystachios* (C. Linnaeus) N.L. Britton, E.E. Stern, & F. Poggenburg. H, *Medicago orbicularis* (C. Linnaeus) B. Bartalini. I, *Riedeliella graciliflora* H.A.T. Harms. J, *Medicago arabica* (C. Linnaeus) W. Hudson.

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Abstract

Kirkbride, Joseph H., Jr., Charles R. Gunn, and Anna L. Weitzman. 2003. Fruits and seeds of genera in the subfamily Faboideae (Fabaceae). U. S. Department of Agriculture, Technical Bulletin No. 1890, 1,212 pp.

Technical identification of fruits and seeds of the economically important legume plant family (Fabaceae or Leguminosae) is often required of U.S. Department of Agriculture personnel and other agricultural scientists. This bulletin provides relevant information for identifying faboid legumes.

Data are derived from extensive sampling of the species of 435 of the 452 genera of faboid legumes. The fruits and seeds of 18 of the genera and only fruits of 7 other genera are unknown. Two keys provide for (1) the differentiation of faboid from other legume seeds and (2) the identification of faboid genera based on seed characters and rarely fruit characters.

An updated explanation and discussion of fruit and seed characters precede the generic descriptions. The information on fruit characters extends and corrects that presently in the literature. Nearly all descriptive data on fruits and seeds are new.

In general, faboid legumes have been considered to lack endosperm. The majority of faboid genera do have endosperm, although the most agriculturally important legumes lack it. Lenses—testa structures often contiguous to the hilum—occur in all three legume subfamilies, though less frequently in Caesalpinioideae, and have no diagnostic value for the subfamilies. No faboid seed has a pleurogram or pseudopleurogram, while they are common in Mimosoideae and rare in Caesalpinioideae. Some seed characteristics are very useful for faboid generic identifications: aril presence or absence, endosperm presence or absence, radicle concealment by the cotyledons, cotyledon lobes over the radicle presence or absence and condition, overall radicle shape, radicle tip shape, and radicle length relative to that of the cotyledons.

Keywords: Abreae, Adesmieae, Aeschynomeneae, Amorphaeae, androecial sheath, areola, aril, Astragaleae, Bossiaeeae, Brongniartiaeae, Caesalpinioideae, Caesalpinioideae, calyx, Carmichaelieae, chalaza, Cicereae, corolla, Coronilleae, cotyledon, cotyledon lobe, cotyledon-

radicle junction, Crotalariaeae, cuticle, Cytiseae, Dalbergieae, Daleeae, dehiscence, DELTA, Desmodieae, Dipteryxaeae, distribution, embryo, embryonic axis, endocarp, endosperm, epicarp, epicotyl, Euchresteeae, Fabeae, fracture line, follicle, funiculus, Galegeae, Genisteae, gynophore, halo, Hedysareae, hilar groove, hilar groove lips, hilum, Hypocalypteae, hypocotyl, indehiscent, Indigofereae, interactive computer, legume, Leguminosae, lens, Liparieae, loment, Loteae, mesocarp, micropyle, Millettieae, Mimosaceae, Mimosoideae, Mirbelieae, nutlet, Papilionaceae, Phaseoleae, plumule, Podalyrieae, Psoraleeae, radicle, radicle lobe, raphe, replum, rim-aril, Robinieae, seed, seed coat, Sophoreae, spermoderm, stipe, suture, Swartzieae, testa, Thermopsidaeae, Trifolieae, valve, Viciaeae, wing.

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Acknowledgments

We express our appreciation to the following associates and correspondents who supplied fruits, seeds, or information: Frits Adema, Rijksherbarium, Leiden, The Netherlands; Shinobu Akiyama, Department of Botany, National Science Museum, Amakubo, Japan; Ana M. Arambarri, Jardín Botánico y Arboretum "C. Spegazzini," Universidad Nacional de La Plata, La Plata, Argentina; Rupert C. Barneby, New York Botanical Garden, Bronx, NY; Malcolm Beasley, Botany Library, The Natural History Museum, London, England; Frank A. Bisby, School of Plant Sciences, University of Reading, Reading, England; R.K. Brummitt, Royal Botanic Gardens, Kew, England; J.F.M. Cannon, Herbarium, The Natural History Museum, London, England; Anna Chrtková-Žertová, Botanical Institute, Czechoslovakian Academy of Sciences, Pruhonice near Prague, Czech Republic; Richard S. Cowan (deceased), Western Australian Herbarium, Como, WA, Australia; M.D. Crisp, Division of Botany and Zoology, Australian National University, Canberra, Australia; Michael J. Dallwitz, Division of Entomology, Commonwealth Scientific and Industrial Research Organization, Canberra, Australia; David J. Du Puy, Royal Botanic Gardens, Kew, England; Paul R. Fantz, Department of Horticultural Science, North Carolina State University, Raleigh, NC; David F. Farr, U.S. Department of Agriculture (USDA), Agricultural Research Service (ARS), Systematic Botany and Mycology Laboratory, Beltsville, MD; Robert Geesink (deceased), Rijksherbarium, Leiden, The Netherlands; Patrick S. Herendeen, Department of Biological Sciences, George Washington University, Washington, DC; Chaia Clara Heyn, Department of Botany, The Hebrew University, Jerusalem, Israel; Patricia K. Holmgren, New York Botanical Garden, Bronx, NY; Stephen J. Hurst, USDA, Agricultural Marketing Service, Seed Regulatory and Testing Branch, Beltsville, MD; Duane Isely (retired), Department of Botany, Iowa State University, Ames, IA; Frances K. Kupicha (retired), Iden, Rye, East Sussex, England; James A. Lackey, USDA, Animal and Plant Health Inspection Service, Riverdale, MD; Matt Lavin, Department of Biology, Montana State University, Bozeman, MT; Nels Lersten, Department of Botany, Iowa State University, Ames, IA; G.P. Lewis, Royal Botanic Gardens, Kew, England; Haroldo Cavalcante de Lima, Jardim Botânico do Rio de Janeiro, Rio de Janeiro, Brazil; Aaron Liston, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR; Alicia Lourteig (retired), Laboratoire de Phanérogamie, Muséum National d'Histoire Naturelle, Paris, France; Nigel Maxted, School of Biological Sciences, University of Birmingham, Birmingham, England; Magdalena Peña Muñoz, Departamento de Botánica, Universidad Nacional Autónoma de México,

Ciudad de México, DF, México; Hiroyoshi Ohashi, Biological Institute, Tohoku University, Sendai, Japan; Richard J. Pankhurst, Royal Botanic Garden, Edinburgh, Scotland; R.T. Pennington, Royal Botanic Garden, Edinburgh, Scotland; Dieter Podlech, Institut für Systematische Botanik, Universität München, München, Germany; Roger M. Polhill (retired), Royal Botanic Gardens, Kew, England; M. de Lourdes Rico-Arce, Royal Botanic Gardens, Kew, England; Amy Y. Rossman, USDA, Agricultural Research Service, Systematic Botany and Mycology Laboratory, Beltsville, MD; Velva E. Rudd (retired), Reseda, CA; Alfonso Delgado Salinas, Departamento de Botánica, Universidad Nacional Autónoma de México, Ciudad de México, DF, México; Charles F. Simpson, USDA, ARS, Texas Agricultural Experiment Station, Stephenville, TX; Ernest Small, Agriculture and Agri-Food Canada, Ottawa, Canada; Andrey Sytin, V.L. Komarov Botanical Institute, St. Petersburg, Russia; K. Thothathri, Botany Field Research Laboratory, Madras University, Madras, India; B.L. Turner (retired), Botany Department, University of Texas, Austin, TX; L.J.G. van der Maesen, Department of Plant Taxonomy, Landbouwniversiteit, Wageningen, The Netherlands; Ben-Erik van Wyk, Department of Botany, Rand Afrikaans University, Johannesburg, South Africa; José Francisco M. Valls, CENARGEN, EMBRAPA, Brasília, DF, Brazil; Bernard Verdcourt (retired), Royal Botanic Gardens, Kew, England; John H. Wiersma, USDA, Agricultural Research Service, Systematic Botany and Mycology Laboratory, Beltsville, MD; Richard P. Wunderlin, Department of Biology, University of South Florida, Tampa, FL; and, James Zarucchi, Missouri Botanical Garden, St. Louis, MO.

We also express our appreciation to Lynda E. Chandler, now of Temple Terrace, FL, who created the basic plate design for this series of bulletins. Karen Parker, of Bowie, MD, prepared most of the seed drawings and some of the fruit and seed photographs and assembled many of the plates. Leslie Ann Gilbert, of Mt. Airy, MD, prepared some of the seed drawings, assembled many of the plates, prepared the literature cited and scientific name index, and assisted with proofreading. James Plaskowitz, USDA, ARS, Systematic Botany and Mycology Laboratory, MD, prepared most of the fruit and seed photographs and all of the scanning electron micrographs. Michael Jeffe, now with the Peace Corps in Senegal, Africa, prepared the fruit drawings for the cover. Carole A. Ritchie, of Laurel, MD, assisted in the preparation of the character list. Doris Mason, of Beltsville, MD, entered the data into computer files and formatted the generic descriptions.

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Fruits and Seeds of Genera in the Subfamily Faboideae (Fabaceae)

The Fabaceae (Leguminosae of authors including Isely and Polhill 1980, Polhill and Raven 1981, and Polhill 1994a,b) traditionally is divided into three subfamilies:

Caesalpinioideae, Mimosoideae, and Faboideae (Papilionoideae in Polhill and Raven 1981 and Polhill 1994a,b). Hutchinson (1964) and Cronquist (1981) recognized the subfamilies as three separate families. The Fabaceae comprises 686 genera, has more than 18,000 species (Polhill 1997), and is the third largest flowering plant family after Asteraceae and Orchidaceae (Mabberley 1997). However, only Poaceae rivals Fabaceae in agricultural importance, although the spectrum of legume uses is much greater. The past, present, and future value of the Fabaceae has been documented recently by Schery (1972), Skerman (1977), National Academy of Sciences (1979), Duke (1981), ILDIS and CHCD (1994), Simpson and Ogorzaly (1995), Polhill (1997), Vaughan and Geissler (1997), and Summerfield and Bunting (1980).

Polhill (1981a, 1994a, 1997) has loosely divided the Faboideae into the following four groups of tribes:

1. The basal tribes, Swartzieae (1) and Sophoreae (2), which are transitional to the subfamily Caesalpinioideae.
2. The genistoid alliance, mainly temperate tribes occurring in the northern and southern hemispheres.
3. The tropical tribes with some woody tribes, such as Dalbergieae (4), Millettieae (7), and Robinieae (8), whose limits and phylogenetic history are unclear, and with a number of predominantly herbaceous tribes such as Indigofereae (9), Desmodieae (11), Phaseoleae (10), and Aeschynomeneae (14), whose limits are better defined and which are considered to be relatively more advanced.
4. The temperate herbaceous tribes or epulvinate series, which includes, for example, Galegeae (16), Hedysareae (18), Trifolieae (21), and Fabaeae (Vicieae) (19).

Above and throughout this publication, numbers in parentheses following a tribe or genus name refer to the phylogenetic number associated with that name. Phylogenetic numbers and associated names are found in the section Synopses of Fruit and Seed Characters. Phylogenetic numbers without a decimal are tribe numbers. Phylogenetic numbers having a decimal contain a tribe number before the decimal and a genus number after the decimal. For example, a phylogenetic number of 4.07 represents the fourth tribe (Dalbergieae) in Faboideae and the seventh genus (*Fissicalyx* G. Bentham) within the tribe Dalbergieae (see

page 226). Genera in the Millettieae (7) tribe do not have phylogenetic numbers; instead, these genera are ordered alphabetically (Polhill 1994b) rather than by phylogenetic number in the synopses.

The basal tribes are predominantly tropical and subtropical. Swartzieae has been placed in the subfamily Caesalpinioideae or even considered to be a fourth subfamily, but the general consensus of opinion among legume taxonomists is that it should be in the Faboideae (Cowan 1981a). Recent cladistic studies (Herendeen 1995) and *rbcL* data (Doyle et al. 1997) indicate that Swartzieae and Sophoreae should be merged into a single tribe in the Faboideae.

The genistoid alliance was characterized (Polhill 1994a) by progressive contraction of vegetative structures and inflorescences, progressive joining of stamens and dimorphic anthers, development on the seed of a hilar lobe from extension of the radicle, and an abundance of alkaloids as compared to other advanced tribal groupings. This alliance has three distinct regional groupings. Genisteae (30) and Thermopsidae (29) are in the northern hemisphere; Crotalariae (27), Hypocalypeteae (26), and Podalyrieae (25) are centered in southern Africa; and Bossiaeeae (23) and Mirbelieae (24) are found in Australia.

The tropical tribes are distinguished by a series of character transitions (Polhill 1994a). These tribes have strongly papilionoid flowers, staminal fusion late in development, more distinct stigmas, and the appearance of canavanine, a nonprotein amino acid. The delimitation and separation of Millettieae from Sophoreae has remained difficult, and the generic groupings within Millettieae are unresolved. The more advanced tropical tribes centered in the Old World, Desmodieae (11), Indigofereae (9), Phaseoleae (10), and Psoraleae (12), are differentiated from those centered in the New World, Adesmieae (15), Amorpheae (6), and Aeschynomeneae (14), by their pollen wall structure (Ferguson 1984, Ferguson and Skvarla 1981). The Old World tribes tend to have an increase in the thickness of the endexine and a reduction of the foot layer, and New World ones tend to have a reduction of the endexine and a thicker foot layer, usually associated with longer columellae.

The temperate herbaceous tribes are characterized by the lack of a foliar pulvinus, which correlates with a closed vascular system and loss of secondary thickening (Polhill 1981a). This also correlates with a lack of the inverted repeat from the chloroplast DNA, stipels, ridge bundles in petioles and rhachides, anomalous secondary thickening, secretory reservoirs, and leucoanthocyanidins.

Subfamily Faboideae consists of 30 tribes (Polhill 1981a, 1994a,b; Polhill and Raven 1981), 452 genera, and more than 12,725 species. Polhill (1981a) proposed merging the tribe Coronilleae into Loteae and did so in his latest classification scheme for the legumes (Polhill 1994a,b), which reduced the number of tribes to 30. Faboideae are distributed throughout the world in all habitats, including aquatic ones. Three hundred and five genera have 10 or fewer species, of which 102 are monotypic. One hundred and sixteen genera have more than 10 and less than 100 species, 22 genera have 100 to 200 species, and nine genera have more than 200 species. *Astragalus* C. Linnaeus (16.15), with more than 2,000 species, is the largest genus of legumes and probably the largest genus of seed plants. The distributions, generic names, and parameters in the section on Synopses of Fruit and Seed Characters are based on Polhill and Raven (1981) except as noted.

Charles R. (Bob) Gunn participated in the First International Legume Conference at the Royal Botanic Gardens, Kew, in 1978. The principal objective of the conference was to arrive at a consensus on the tribal and generic classification of the legumes, and the objective was met (Polhill and Raven 1981). Gunn recognized that this would enable sweeping family-wide studies of many aspects of legumes. As a first step in his studies, he surveyed legume seed characters (Gunn 1981a,b) and then prepared a nomenclature of legume genera for use in his databases (Gunn 1983). He soon decided that legume fruits should be included in his studies because fruits are the units of dispersal for some legumes.

Legume fruits and seeds were gathered from institutions and individuals throughout the world and incorporated into the U.S. National Seed Herbarium, BARC, Beltsville, MD. Using these resources, Gunn prepared and published treatments covering the fruits and seeds for genera of the subfamilies Caesalpinioideae (Gunn 1991) and Mimosoideae (Gunn 1984). This volume, on the faboid legumes, completes the studies for all legume genera. The overall objectives of this bulletin, and of the previous two, were threefold:

1. Collect complete, comparative fruit and seed data for all legume genera, illustrating their fruit and seed morphology and correcting traditional errors in legume literature.
2. Develop keys, illustrations, and descriptions for accurate and rapid identification to genus of either isolated fruits and seeds or herbarium specimens bearing only fruits or seeds.

3. Contribute to our understanding of the evolutionary history of legumes and their tribal and generic systematics by providing essential fruit and seed data for all genera.

Neither mature fruit or seed material nor published data were available for the following 19 genera: *Burkilliodendron* A.R.K.R. Sastry (Millettieae), *Carrissoa* E.G. Baker (10.79), *Clitoriopsis* R. Wilczek (10.17), *Erichsenia* W.B. Hemsley (24.05), *Exostyles* H.W. Schott (1.10), *Jansonia* R. Kippist ex J. Lindley (24.17), *Leptosema* G. Bentham (24.07), *Luzonia* A.D.E. Elmer (10.23), *Margaritolobium* H.A.T. Harms (Millettieae), *Neocolletia* W.B. Hemsley (11.26), *Neodunnia* R. Viguier (Millettieae), *Peltiera* D.J. Du Puy & J.-N. Labat (14.02A), *Petaladenium* A. Ducke (2.25), *Sartoria* P.E. Boissier & T.H.H. von Heldreich (18.05), *Sellocharis* P.H.W. Taubert (30.07), *Spongiocarpella* G.P. Yakovlev & N. Ulziykhutag (16.13), *Stirtonanthus* B.-E. Van Wyk & A.L. Schutte (25.07), *Vaughania* S. Moore (9.02), and *Weberbauerella* O.E. Ulbrich (14.18). These genera are omitted from the seed keys and from the section on Synopses of Fruit and Seed Characters. The phylogenetic number system is based on Polhill (1994b). The following five other genera were represented only by fruits or valves: *Arthrocarpum* I.B. Balfour (14.22), *Dahlstedtia* G.O.A. Malme (Millettieae), *Herpyza* C. Wright (10.28), *Nephrodesmus* A.K. Schindler (11.04), and *Spirotropis* E.L.R. Tulasne (2.32). These genera are omitted from the seed keys, but are included in the section Synopses of Fruit and Seed Characters. One genus, *Mildbraediendron* H.A.T. Harms (1.07), was only represented by seeds.

Unpublished data for several tribes were supplied by the following reviewers: Aeschynomeneae, Vela E. Rudd; Amorpheae, Rupert C. Barneby; Cicereae, L.J.G. van der Maesen; Dalbergieae, R.T. Pennington, Vela E. Rudd, and K. Thothathri; Desmodieae, Shinobu Akiyama; Euchrestae, Hiroyoshi Ohashi; Fabae, Nigel Maxted; Galegeae, Rupert C. Barneby, Aaron Liston, Dieter Podlech, and Andrey Sytin; Genisteae, Chaia Clara Heyn; Hedysareae, K. Thothathri; Loteae, Ana M. Arambarri and Chaia Clara Heyn; Millettieae, Frits Adema and K. Thothathri; Phaseoleae, Paul R. Fantz, Alfonso Delgado Salinas, and L.J.G. van der Maesen; Robinieae, Matt Lavin; Sophoreae, Patrick S. Herendeen and Vela E. Rudd; Swartzieae, Patrick S. Herendeen; Thermopsideae, B.L. Turner; and Trifolieae, Chaia Clara Heyn and Ernest Small.

Procedures

Critical materials were authenticated by an expert for each tribe and by recent annotation labels. Authenticated fruit and seed samples, selected to exhibit the range of morphological characters within a genus, were used to collect descriptive data that were transformed into keys and descriptions and to prepare illustrations. Samples were documented either by voucher herbarium specimens or by specimens deposited in the U.S. National Seed Herbarium, and a list of these specimens was filed in the herbarium. Additional fruit and seed samples, many identified by comparison, were used to augment the survey of each genus.

Fruit and seed topography was observed at magnifications of 10 to 30 using a dissecting stereoscopic microscope equipped with an ocular micrometer. Recorded observations were made at a magnification of 10 except as noted.

In preparing seeds for dissection, mature seeds of representative size and shape were drilled with a miniature electric drill. The testa was penetrated one or more times, depending on seed size, in areas removed from the embryonic axis. Drilled seeds were placed in a softening solution of 74 percent distilled water, 25 percent methyl alcohol, and 1 percent dioctyl sodium sulfosuccinate (aerosol OT). They were kept in solution for one-half to 24 hours, depending on the consistency of the testa. The testa was easily removed along with the endosperm when present. Embryos were drawn with the aid of a camera lucida fitted on a stereoscopic microscope. Illumination was provided by an above-stage fiber optic system, which split the light into one beam for the microscope and one for the camera lucida. Drawings were prepared first in pencil and then in india ink on Dupont Cronaflex U-C Tracing Film.

The light photographs were made with a Leitz copy camera that was mounted on a light stand and that used 4×5 Polaroid type 55 film. Mature fruits and seeds usually were photographed in face view at 1 magnification and either enlarged or printed contact size, using standard printing techniques.

For the scanning electron micrographs, seeds were cleaned by hand and attached by adhesive to aluminum specimen stubs, then stored in a desiccator for at least 24 hours before coating. Coating with gold palladium was done in a Technics Hummer V Sputter Coater. Chamber pressure was reduced to 20 millitorrs and then flushed five times with argon before the chamber was stabilized at 100 millitorrs. Coating time was 4.5 minutes at an operating potential of 700-1,200 V and a current of 15 mA. Although measurements were not made of its thickness, the gold-palladium

coat was not deemed excessive for the desired magnifications of 50 and 1,000. Seeds were scanned with an AMRAY 1200b scanning electron microscope (SEM). Accelerating voltage was 15 kV, final aperture size 100 μm , and the working distance to the specimen was 15 mm. In most instances, the external surface of mature testas was photographed at magnifications of 50 and 1,000.

All data were recorded in an ASCII text file in DELTA format (Dallwitz 1980, Dallwitz et al. 1997) on an IBM-compatible microcomputer. DELTA format is a free-form, unlimited data-coding format that accepts multistate, numeric, and text characters and provides for linking of image files to both characters and taxa. Once recorded, the data were checked for syntax and maintained using the DELTA software system (Dallwitz 1980, Dallwitz et al. 1997) developed by Michael J. Dallwitz of the Division of Entomology, Commonwealth Scientific and Industrial Research Organisation (CSIRO), Canberra, Australia. The final character list had 303 characters (see Character List, p 1130) which included 154 fruit characters, 128 seed characters, and 5 distributional characters. When the data were completed for all available genera, generic descriptions were generated using the CONFOR program of the DELTA system. The data were moved from the DELTA system file format to that of the PANKEY software system (Pankhurst 1988, 1991, 1995) developed by Richard J. Pankhurst of the Royal Botanic Gardens, Edinburgh, Scotland. The interactive key construction program, KConI, of the PANKEY system was used to prepare the keys.

Fruit Morphology

At the family and subfamily levels, much less morphological data exist for fruits than seeds. In the three most recent systematic treatments of all Fabaceae genera, fruit characters have played a minor role (Hutchinson 1964, Polhill and Raven 1981, Polhill 1994a,b). Generalized and noncircumscribing fruit characters were used, such as “indehiscent or not,” “pods various,” “pericarp chaffy,” “angled,” “2-valved,” “continuous within,” and “tipped by style.” Lima (1989) did a complete study of the fruits and seeds of tribe Dalbergieae (4) with generic descriptions and a key to genera using fruit characters.

The faboid pistil comprises a single ovary that is usually unilocular. In two faboid genera, *Swainsona** (16.02) and *Astragalus* (16.15) of tribe Galegeae, the ovary is usually unilocular and rarely bilocular. In two other genera, *Biserrula* (16.15A) of Galegeae and *Chordospartium* (17.03) of Carmichaelieae, the ovary is always bilocular.

Mature dry fruits were studied, and their characters are discussed in the order given in the sections Synopses of Fruit and Seed Characters and Character List. Selected fruit characters are illustrated in figures 1-3. In the discussions that follow on fruit morphology, the number of genera exhibiting the character is usually identified in parentheses. The total number of genera for any suite of characters may exceed 435 (the number of genera studied) because a genus may be variable for the characters. For example, a genus may have stipitate, substipitate, or nonstipitate fruits. The fruit data are presented in the following order:

Fruit—type, size, persistence of flower parts, declination, twist and outline, inflation, transection, apex, base, texture, seed chamber external visibility, margin, wing, stipe, dehiscence, replum.

Loment—presence of epicarp, dehiscence, segmentation, size, shape.

Epicarp—sheen, coloration, texture, pubescence, surface, exfoliation, cracking.

Mesocarp—presence, relative thickness, venation, layering, composition, density.

Endocarp—presence, sheen, opacity, coloration, surface traits, testa adherence, septation, density, exfoliation, fusion to mesocarp and epicarp, wings, separation into segments.

Seeds—number per fruit, position, proximity, number of series.

Funiculus—length, thickness, shape.

Aril—presence, texture, shape, margin, relative size, presence and number of tongues or flaps on 2-lipped rim-aril, color.

Fruit

Type. Most fruits of faboids are legumes (true for 402 genera), that is, they have a carpel opening along two sutures and the seeds attached along the ventral suture (Spjut 1994). There are a significant number of variations on the typical legume. The most frequent involve dehiscence. Many genera have legumes that dehisce along just one suture or are indehiscent. Some fruits are loment (50 genera), that is, they have a single carpel that disarticulates into seed-bearing segments, or nutlets (20 genera), that is, a small, hard, indehiscent, one-seeded fruit.

Almost all fruits are unilocular (400 genera). Two genera are unilocular or bilocular, and two genera have bilocular fruits. The genera are named above.

Size. Fruit size is recorded in centimeters for length, width, and thickness, frequently as a range. Length is measured from the apex to the base of the stipe, width at the widest part of the fruit, and thickness at the thickest part of the fruit. Width and thickness were measured with a caliper prior to dehiscence.

The shortest faboid fruits (less than or equal to 0.15 cm long) are found in *Marina* (6.07), *Melilotus* (21.03), and *Trifolium* (21.06). The longest recorded (more than 50 cm long) occur in *Mucuna* (10.03), but the 53-cm-long *Mucuna* fruits do not approach the 200-cm-long fruits of *Entada* M. Adanson (Mimoseae, Mimosoideae), the longest in the family. The mean fruit length is 5.6. The fruit width ranges from 0.04 to 15.5 cm with a mean of 1.5, and the thickness ranges from 0.01 to 13 cm with a mean of 0.7.

Persistence of flower parts. The androecil sheath is rarely persistent (59 genera) on the fruit and frequently is deciduous (437 genera). The corolla is rarely persistent (only 33 genera) and is frequently deciduous (407 genera). When the corolla is persistent, different petals persist on different fruits. The persisting petals are categorized as keel petals (4 genera), standard petals (10 genera), or various petals (19 genera). The calyx is approximately equally persistent (281 genera) or deciduous (251 genera). When the calyx persists, it is frequently shorter than the fruit (267 genera) and rarely the same length (15 genera) or longer (30 genera). Persistence of floral parts was a difficult character to use.

* For authors of studied genera and species, see Synopses of Fruit and Seed Characters.

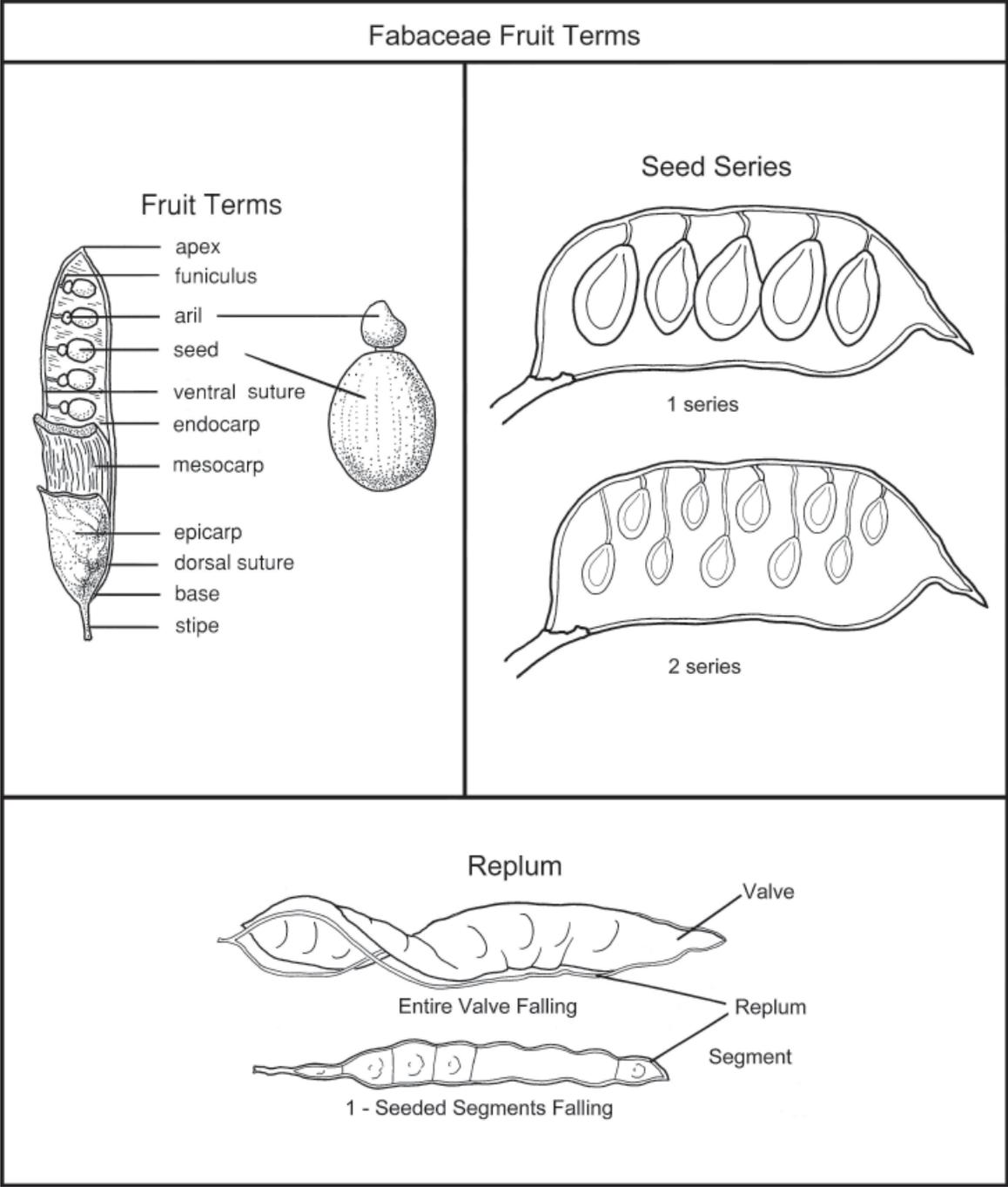


Figure 1. Selected terms for describing fruits in the subfamily Faboideae

Frequently during collection, drying, storage, or study, the floral parts were knocked off the fruits.

Declination. Fruit declination prior to dehiscence is categorized as 0.5-coiled (13 genera); 1-coiled (18 genera); 1.5-coiled (5 genera); 2-coiled (3 genera); 3-coiled (2 genera); 4-coiled (3 genera); 5- to 10-coiled (1 genus); contorted (5 genera); curved, including slightly curved (169 genera); S-curved (6 genera); or straight (397 genera). The curving or coiling creates orifices in a few fruits (16 genera), but the vast majority of fruits lack such orifices (427 genera).

Twist and outline. A few fruits are plicate (13 genera), that is, folded along their length, and several, such as *Uraria cordifolia* N. Wallich (11.16) of Desmodieae (11), were so strongly folded that they appear accordionlike. The vast majority of fruits are not plicate (431 genera). Fruit outlines occasionally are modified by a twist (11 genera) that has no role in dehiscence. The vast majority of fruits are not twisted (432 genera). More fruits are asymmetrical in outline (354 genera) than symmetrical (272 genera). Fruit outlines prior to dehiscence and disregarding declination (figure 3) are categorized as C-shaped (18 genera), circular (53 genera), coiled (9 genera), didymous (2 genera), dolabriform (3 genera), elliptic (71 genera), falcate (87 genera), fusiform (36 genera), irregularly fusiform (3 genera), harp-shaped (7 genera), irregular (36 genera), lanceolate (13 genera), linear (175 genera), moniliform (54 genera), oblanceolate (4 genera), obliquely oblanceolate (1 genus), oblong (148 genera), obovate (23 genera), obliquely obovate (16 genera), ovate (68 genera), obliquely ovate (3 genera), quadrangular (1 genus), rectangular (2 genera), reniform (11 genera), rhombic (11 genera), S-shaped (1 genus), samaroid (17 genera), or triangular (2 genera). For asymmetrical fruits, the parallelism of the sutures is recorded as one straight and one curved suture (120 genera), both sutures nearly straight (95 genera), both sutures parallelly curved (210 genera), or both sutures unequally curved (91 genera). Also for asymmetrical fruits, the position of the widest part is indicated as widest near apex (7 genera), widest near middle or D-shaped (86 genera), widest at base (1 genus), narrowing in several places, resembling *Desmodium* (9.09) fruit (21 genera), narrowest near middle, B-shaped (4 genera), or narrowing slightly once or twice on one side (2 genera).

Inflation. Some fruits are inflated (56 genera) but most are not (413 genera).

Transection. Fruit transections are categorized as compressed (266 genera); cruciform (1 genus); flattened (155

genera); quadrangular (4 genera); subtriangular (2 genera); or terete, including subterete (127 genera).

Apex. Most fruit apices do not have beaks (323 genera), but some do (230 genera). Declination of fruit apices is categorized as straight (170 genera), declined (70 genera), hooked (32 genera), or coiled (9 genera). The vast majority of beaks are solid and the same color and texture as the rest of the fruit (221 genera) or are rarely papery fragile and rarely as long as 1 cm (9 genera).

The apex shape is categorized as abruptly long acuminate (1 genus), blunt (9 genera), cordate (1 genus), emarginate (11 genera), rounded (195 genera), long tapered (gradually attenuate) (47 genera), tapered (attenuate) (127 genera), short tapered (abruptly attenuate) (217 genera), or truncate (14 genera). Apex orientation relative to the longitudinal axis of the fruit is categorized as aligned (339 genera), oblique (231 genera), right-angled (46 genera), bent over almost to the longitudinal axis of the fruit (5 genera), or bent over so far that they cross the longitudinal axis of the fruit (3 genera).

Base. The shape of the fruit base is categorized as cordate (1 genus), emarginate (2 genera), rounded (177 genera), long tapered (gradually attenuate) (56 genera), tapered (attenuate) (161 genera), short tapered (abruptly attenuate) (194 genera), or truncate (17 genera). Base orientation relative to the longitudinal axis of the fruit is aligned (372 genera), oblique (148 genera), or right-angled (20 genera).

Texture. The apical and basal textures are either uniform (432 genera) or rarely different (8 genera). When they differ, the differences are categorized as follows: upper 1/2 inflated and reticulate over seed cavity and lower 1/2 adnate and wrinkled to scurfy over seed cavity (1 genus); upper 3/4 barely inflated, reticulate, and pubescent and lower 1/4 not inflated, reticulate, or pubescent (3 genera); or upper 1/4-2/3 firm and/or pubescent and lower 3/4-1/3 fragile and glabrous (1 genus). The overall texture of the fruit is characterized as chartaceous (107 genera); coriaceous, including subcoriaceous (274 genera); drupaceous (8 genera); fleshy, including subfleshy (12 genera); fragile, thinner than chartaceous, like *Trifolium* (21.06) (17 genera); leathery (29 genera); ligneous, including subligneous (92 genera); or membranous (58 genera).

Seed chamber external visibility. Approximately half of the fruits have externally visible seed chambers (260 genera) and half do not (244 genera). Of those fruits with externally visible seed chambers, some are torulose (33 genera), that is, somewhat cylindrical with alternate

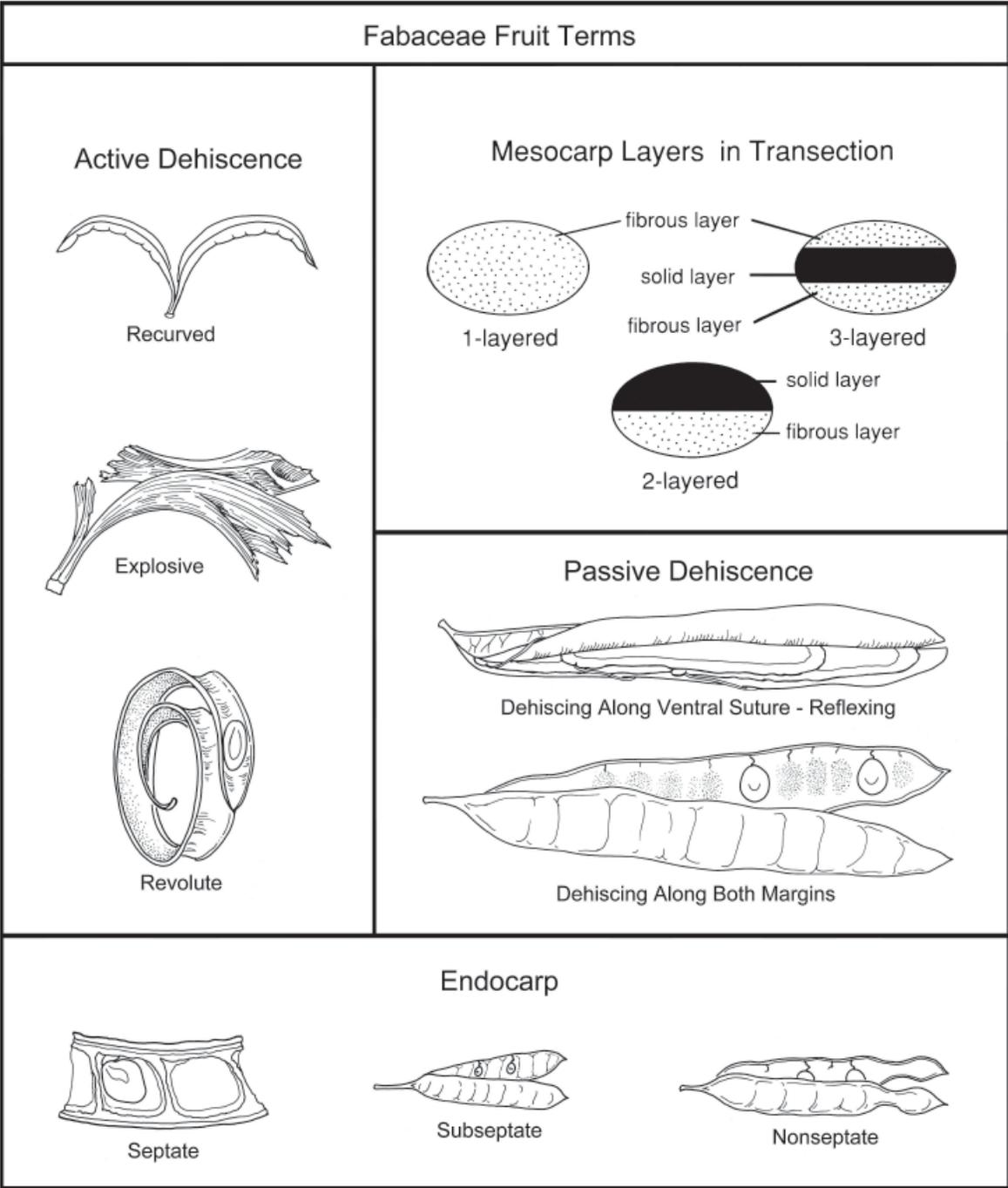


Figure 2. Selected terms for describing fruits in the subfamily Faboideae

swellings and contractions (Harris and Harris 1994), while most are not (181 genera).

Margins. Some fruits have constricted margins (143 genera), but most do not (379 genera). The constrictions are categorized as constricted along both margins (63 genera), slightly constricted along both margins (65 genera), constricted only on one margin (16 genera), slightly constricted only on one margin (12 genera), or constricted on one margin and slightly constricted on the other (8 genera). A few fruits have a sulcus, or groove, running along the margin (22 genera), but the overwhelming majority do not (421 genera). Some fruits have one or more types of embellishments on the margin (173 genera), while most do not (358 genera). The embellishments are characterized as flanges (2 genera), fringe (8 genera), prickles (12 genera), ridges (21 genera), spines (6 genera), thickened sutural areas (78 genera), or wings (86 genera).

Wing. Some fruits have wings (88 genera), while most do not (370 genera). The number of wings per fruit varies from one on most fruits up to a maximum of 30 on a few individuals of *Machaerium* (4.06). The wing width ranges from 0.1 to 130 mm and averages 11 mm. The largest wing is found on *Centrolobium* (4.12) of Dalbergieae (4) and ranges from 76 to 130 mm wide. Fruit wings are categorized as samaroid (26 genera); valvular, on the face of the valve (13 genera); sutural, on the suture (47 genera); or continuous around the fruit (9 genera). Wings in the first three categories are located in different positions on the fruit. The samaras are either apical (5 genera) or basal (9 genera), the valvular wings are on one valve (2 genera) or on both (16 genera), and the sutural wings are on one suture (44 genera) or on both (30 genera).

Stipe. Approximately half of the fruits do not have a stipe (281 genera). Of those with a stipe, the majority are substipitate (192 genera), that is, the stipe is only 0.1–5 mm long, and the remainder clearly are stipitate (107 genera), that is, the stipe is 5 mm or longer. The length of 5 mm was chosen as an arbitrary division between substipitate and stipitate so that the large number of fruits with very short stipes could be more easily identified. The stipes range from 0.1 to 70 mm long and average 8.5 mm.

Dehiscence. The majority of fruits exhibit complete, typical legume dehiscence (276 genera). Two genera, *Endosamara* of the Millettieae (7) and *Glottidium* (8.01A) of the Robinieae (8), have a dehiscent epicarp and mesocarp and an indehiscent endocarp. Two other genera, *Piptanthus* (29.02) of the Thermopsidae (29) and rarely *Sophora* (2.45) of the Sophoreae (2), have epicarp and mesocarp that

break near the center of the valve and an endocarp that dehisces along the suture. The remainder of the fruits are indehiscent (188 genera), a condition normally not associated with legumes.

Five genera have unique types of fruit dehiscence. *Cyclocarpa* (14.16) of Aeschynomeneae (14) have fruits that separate from the suture and along loment segment margins. *Antopetita* (13.16) of Loteae (13) have fenestrating fruits that open via a coiling strip of tissue. *Anthyllis* (13.02) of Loteae has fruits that open following deterioration of a delicate strip of tissue along the inner suture or both sutures. *Endosamara* of Millettieae (7) has fruits in which the epicarp and mesocarp dehiscence along the suture and the endocarp lomented forming an indehiscent, winged segment around each seed. *Glottidium* (8.10A) of Robinieae has fruits in which the epicarp and mesocarp dehiscence along the suture and the endocarp is indehiscent and entire with flat winglike areas.

Of those fruits with complete sutural dehiscence, most dehiscence along both sutures (239 genera), while some dehiscence only along one suture (43 genera) (figure 2). Those dehiscing along just one suture should be called follicles (Spjut 1994), but we have chosen to describe them as legumes because most previous authors have done so.

The vast majority of valvular dehiscence starts at the apex and progresses toward the base (241 genera). On a few fruits, however, it starts in the middle and progresses both up and down (11 genera) or starts at the base and progresses upward (5 genera). Valvular dehiscence is mainly active (193 genera) but is sometimes passive (95 genera). The condition of the valves after valvular dehiscence is described as breaking (2 genera), coiling (1 genus), enrolling (16 genera), reflexing (8 genera), revolute (6 genera), or twisting (166 genera) (figure 2).

Replum. In a few dehiscent fruits, a replum is visible (9 genera), but in the vast majority no replum is visible (399 genera). The replum consists of the intact sutures with their veins from which the valves have separated or dehisced (figure 1). The replum can only be observed in dehiscent fruits.

Loment

Presence of epicarp. When the epicarp is present, the article is intact or complete (7 genera).

Dehiscence. A few loment dehiscence along one suture (4 genera), but most were indehiscent (47 genera).

Segmentation. Few loments have conspicuous segments, or articles, with distinct lines of cleavage (7 genera), but most have inconspicuous segments (41 genera).

Size. The loment segments range from 1 to 35 mm in length and average 7.3 mm. All of the loments are widest across the seed area (48 genera) except for those of *Coronilla* (13.11) of Loteae (13) which varies—some are widest across the seed area and some widest across the ends.

Shape. Most of the time the loment segments of a single fruit have essentially the same shape (31 genera). Sometimes, however, the segments differ and are categorized as upper one different from the middle ones (16 genera), lower one different from the middle ones (14 genera), or upper one different from the lower one (1 genus). The overall shape of the loment segments is categorized as circular (10 genera), curved (3 genera), D-shaped (25 genera), elliptic (2 genera), hippocrepiform (horseshoe or ring-shaped) (1 genus), linear (1 genus), oblong (16 genera), ovate (1 genus), quadrangular (9 genera), rectangular (7 genera), trapezoid (1 genus), or triangular (3 genera).

Epicarp

Sheen. Most epicarps are dull (413 genera) but a few are glaucous (2 genera), glossy (27 genera), or semiglossy (13 genera).

Coloration. Most epicarps are monochrome (398 genera), but some are multicolored (115 genera). Of the multicolored ones, some are bichrome (17 genera), most are mottled (99 genera), and some are streaked (12 genera). The basic background color of the epicarp is categorized as black (53 genera), brown (359 genera), gray (15 genera), green (36 genera), orange (5 genera), purple (8 genera), red (6 genera), tan (151 genera), or yellow (19 genera). The predominant epicarp color is brown.

For multicolored epicarps, the overlaying colors are categorized as black (11 genera), brown (85 genera), gray (3 genera), green (5 genera), purple (8 genera), red (6 genera), tan (4 genera), or yellow (1 genus). The majority of mottling color combinations are variable (56 genera), but some are constant (34 genera). Some of the mottled epicarps also have mottled seed chambers (24 genera)

Texture. The vast majority of epicarps have a uniform surface texture (448 genera). For the few that are not uniform, the variation is not confined to the base or apex (8 genera).

Pubescence. Presence or absence of hairs is categorized as glabrous, that is, completely without hairs (246 genera); glabrate, with just a few scattered hairs (40 genera); pubescent and indurate, with abundant, persistent hairs (282 genera); or pubescent and soon deciduous, with abundant hairs that are expected to fall off soon (64 genera). The hairs are frequently erect (273 genera) but are often appressed against the epicarp surface (105 genera). The majority of the time the hairs are all of the same type (296 genera), but sometimes the hairs were of two types (34 genera) or rarely three (3 genera). The hair types are characterized as hirsute (1 genus), peltate (densely micropuberulous) (2 genera), pilose (58 genera), puberulent (128 genera), sericeous (57 genera), strigose (12 genera), tomentose (57 genera), velutinous (42 genera), or villous (70 genera). When the hairs are all the same color, they are described as black (3 genera), brown (58 genera), golden (158 genera), gray, including silver (136 genera), gray-brown (7 genera), red (5 genera), tan (9 genera), white (41 genera), or yellow (4 genera).

A few epicarps have variable, often-unique color patterns in hairs on a single epicarp. The variable hair color patterns are categorized as longitudinal bands of lighter and darker brown (1 genus); appressed dark-brown hairs and scattered, erect gray hairs intermixed (1 genus); long, appressed brown hairs and short and shorter white hairs intermixed (1 genus); golden glandular hairs and short-pilose reddish-brown hairs intermixed (1 genus); erect, golden hairs and white hooked or not hooked hairs (1 genus); golden hooked hairs and gray plain hairs (3 genera); gray and black hairs intermixed (2 genera); long and short gray plain-tipped hairs (2 genera); gray hairs on valves and golden hairs on sutures (1 genus); long and short white hairs intermixed (1 genus); long and short yellow hairs intermixed (1 genus); long and short golden-to-brown hairs intermixed (1 genus); long, white and short, golden hairs intermixed (1 genus); or contiguous areas of golden and white hairs (1 genus).

The vast majority of epicarps have hairs uniformly distributed over them (283 genera). A few epicarps have unevenly distributed hairs and are described as having apical pubescence differing from basal pubescence (9 genera) or pubescence denser near the sutures and sparser centrally (4 genera). A few epicarps have distinct or unique patterns of pubescence that are described as apical 1/4 tomentose and basal 3/4 glabrous (3 genera), apical 3/4 tomentose and basal 1/4 glabrous (2 genera), apical 1/2 crinkly tomentose and basal 1/2 densely villose with straight hairs (1 genus), apical 1/3–1/2 pubescent and basal 1/2–2/3 glabrous (3 genera), apical 3/4 glabrous and basal 1/4 pilose (1 genus),

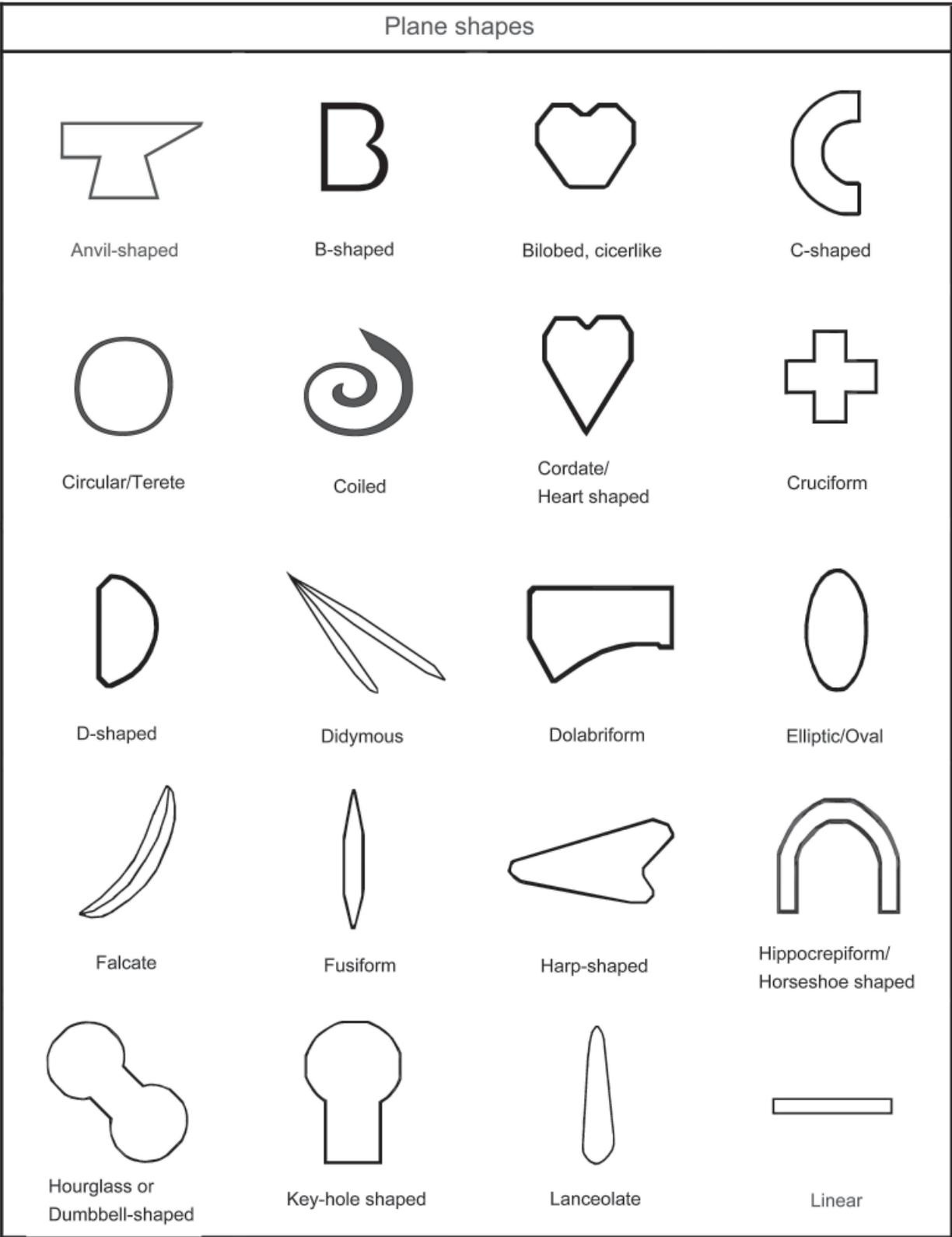


Figure 3. Plane shapes

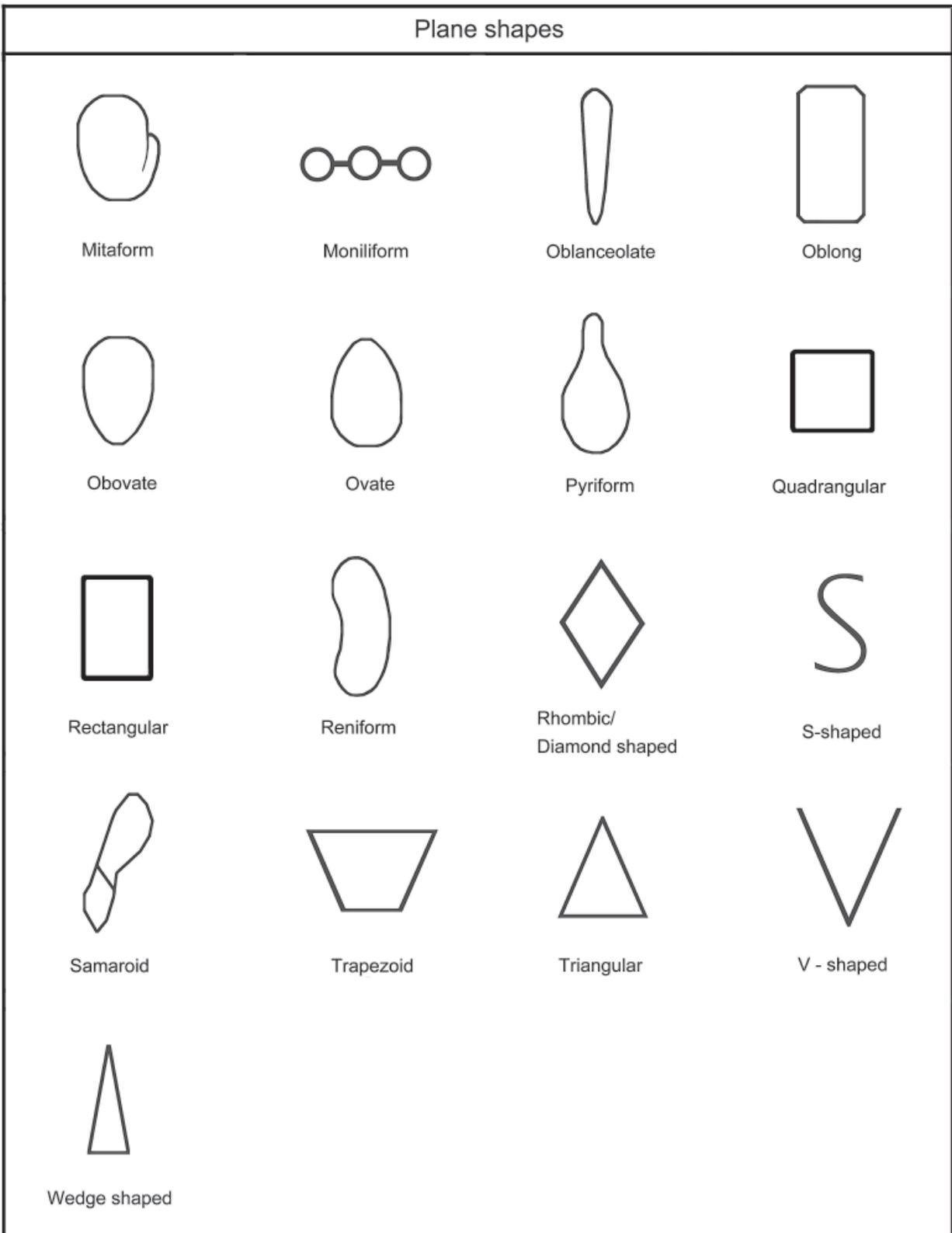


Figure 3 (continued). Plane shapes

or stipe (only) sericeous, [*Styphnolobium* (2.44), in literature] (1 genus).

The vast majority of epicarp hairs are simple in structure (301 genera), but a few are more complicated and are labeled as glandular (18 genera) or complex (9 genera). The complex hairs are categorized as bristlelike (6 genera), plumose (2 genera), setae (1 genus), or T-shaped (3 genera).

Most of the epicarp hairs are pliable (273 genera), but some are stiff (50 genera). Most of the epicarp hairs also have plain bases (299 genera), but some have swollen, or enlarged, bases (34 genera). When the hairs are bristlelike, some are erect (10 genera), while others are bent and either pointed toward the apex (antrorse) (7 genera) or the base (retorse) (4 genera). The apices of the bristlelike hairs are characterized as straight (14 genera), coiled (1 genus), curved (1 genus), or hooked (3 genera).

Surface. Some epicarp surfaces are glandular (66 genera), but most are not (378 genera). The glandular structures are categorized as disks (1 genus), dots (38 genera), hairs (28 genera), papillae (1 genus), or setae (4 genera). The glands are limited to a portion of the fruit (6 genera) or are uniformly distributed over the entire fruit (1 genus). When the glands are limited to a portion of the fruit, their distribution is described as upper 1/4-2/3 glandular and lower 3/4-1/3 eglandular (1 genus), upper 1/2 glandular and lower 1/2 eglandular (1 genus), upper 2/3 glandular and lower 1/3 eglandular (1 genus), or upper 3/4 glandular and lower 1/4 eglandular (3 genera).

The vast majority of epicarps are spineless (421 genera), but a few have spines (18 genera). The spines mainly are persistent (10 genera), and on some epicarps the spines are broken off but their bases are evident (5 genera). Usually the spines are the same color as the rest of the fruit (10 genera), but in two cases the spines or their basal remnants are a different color from the rest of the fruit.

The epicarp surface is usually not smooth (389 genera) but sometimes is smooth (99 genera). The nonsmooth nature of the epicarp surface mostly is caused by elevated or raised features (369 genera), and rarely by recessed or depressed features (35 genera).

Veins are usually elevated (or raised), and more than half of the epicarps are veined (274 genera). Slightly less than half of the epicarps have no apparent veins (221 genera).

Venation patterns vary and are categorized as longitudinally veined relative to fruit length (25 genera), obliquely veined relative to fruit length (12 genera), transversely veined

relative to fruit length (34 genera), reticulately veined (net-like veins) (223 genera), or irregularly veined (17 genera).

The vast majority of epicarps do not have tubercles (428 genera), but a few do (16 genera). All of the tubercles are solid (11 genera).

The elevated features of nonsmooth epicarp surfaces are categorized as blistered (2 genera); concentric whorls like a fingerprint (1 genus); dotted (18 genera); faveolate (1 genus); glandular dotted, including resinous globular (10 genera); knobbed (1 genus); lenticular (11 genera); muricate (5 genera); papillose (25 genera); pusticulate (4 genera); raised reticulate (2 genera); ribbed (6 genera); rugose (35 genera); scaly (2 genera); scurfy (3 genera); shagreen (13 genera); striate (5 genera); subvesicular (2 genera); tessellate (2 genera); tuberculate (16 genera); verrucose-rugose (10 genera); warty (17 genera); or wrinkled (111 genera). The recessed features of nonsmooth epicarp surfaces are characterized as glandularly punctate (3 genera), grooved (7 genera), pitted (11 genera), punctate (5 genera), or slitted obliquely (9 genera).

Exfoliation. Most epicarps do not exfoliate (404 genera). Rarely do epicarps exhibit exfoliation or checking. Exfoliation is categorized as exfoliating (11 genera), exfoliating in part (31 genera), or checking (3 genera).

Cracking. Most epicarps do not crack (406 genera), but some do (67 genera). The patterns of cracking on the surface of the epicarp are described as oblique to fruit length (46 genera), transverse to fruit length (12 genera), or irregular (11 genera).

Mesocarp

Presence. The majority of fruits have a mesocarp (361 genera), but some do not (89 genera). Those valves that twist during dehiscence always have a mesocarp.

Relative thickness. Mesocarp thickness is subjectively described as thick (95 genera), thin (267 genera), or trace (22 genera).

Venation. Most mesocarps are not veined (294 genera). A few are uniformly veined (24 genera), and one [*Pterodon* (3.03) of Dipteryx] is veined over the seed chamber and inconspicuously veined on the wing.

Layering. Most mesocarps consist of a single layer of material (306 genera). Some, however, are either two-layered (67 genera) or three-layered (12 genera) (figure 2).

Composition. Most mesocarps lack balsamic vesicles (344 genera), but a few have them (15 genera). Most mesocarps also lack fibers (311 genera), while a few have them (13 genera). Only fruits of one genus, *Bobgunnia* (1.01A) of Swartzieae (1), have large reniform canals running through the mesocarp from the base to the apex.

The composition of single-layered mesocarps is categorized as firm-walled cells that are open and empty (6 genera); fibrous throughout (shreds) (5 genera); fleshy, including pulpy (7 genera); glassy beads (2 genera); mealy (soft) (7 genera); spongy (soft) (11 genera); vitreous* (glasslike, as in lava rock obsidian) (7 genera); or solid, of uniform texture but not having the above traits (273 genera).

The composition of two-layered types is sorted out according to whether or not they include fibers. The fibrous, two-layered types are characterized as fibers over solid layer (7 genera), fibers embedded in mealy tissue over solid layer (1 genus), or fibers below solid or compacted fibrous layer (1 genus). The nonfibrous, two-layered types are categorized as empty space (with or without spongy tissue) within solid layer (2 genera), honeycomb layer over solid layer (1 genus), solid layer over solid layer (26 genera), solid layer over spongy layer (5 genera), solid layer over vitreous layer (1 genus), spongy layer over solid layer (18 genera), veins over solid layer (1 genus), or vitreous layer over solid layer (14 genera).

The composition of three-layered types is categorized as solid layer over spongy layer over solid layer (2 genera), solid layer over two distinct spongy layers (1 genus), solid layer over two distinct solid layers (3 genera), solid layer over vitreous layer over solid layer (3 genera), spongy layer over vitreous layer over solid layer (2 genera), or vitreous layer over two distinct solid layers (4 genera).

Density. The overall mesocarp density is characterized as chartaceous (100 genera), coriaceous (226 genera), fleshy (4 genera), or ligneous, including subligneous (85 genera).

Endocarp

Presence. The vast majority of fruits have an endocarp (420 genera). However, two genera, *Cullen* (12.01) of Psoraleae (12) and *Sutherlandia* (16.03) of Galegeae (16), have no endocarp. In one genus, *Amphicarpea* (10.44) of Phaseoleae (10), some fruits have an endocarp and others do

not. Three genera, *Aldina* (1.04) of Swartzieae (1) and *Myrocarpus* (2.05) and *Uribea* (2.04) of Sophoreae (2), have endocarps, but in the first two genera the endocarp is concealed by an adnate seed testa and in the last genus by a fleshy mesocarp.

Sheen. Most endocarps appear dull (353 genera), but some are glossy (86 genera).

Opacity. The vast majority of endocarps are opaque (412 genera), but a few are translucent (17 genera).

Coloration. Most endocarps are monochrome (371 genera), but some are multicolored. The multicolored endocarps are bichrome (9 genera), mottled (72 genera), or streaked (14 genera). The basic background colors of the endocarp are black (6 genera), brown (159 genera), gray (8 genera), green (3 genera), purple (3 genera), orange (2 genera), red (2 genera), tan (268 genera), white (52 genera), or yellow (23 genera). The predominant endocarp color is brown, of which many shades exist.

Some endocarps are generally mottled (44 genera), a few are mottled over the seed chambers (21 genera), and very few (5 genera) genera are mottled above and below the seed chambers. Two genera have generalized streaking on their endocarps, one genus has endocarps with streaking over the seed chambers, and three genera have endocarps with streaking above and below the seed chambers. The overlaying colors are categorized as black overlay (6 genera), brown overlay (71 genera), gray overlay (3 genera), green overlay (1 genus), purple overlay (1 genus), red overlay (1 genus), tan overlay (6 genera), or yellow overlay (2 genera).

Surface. The appearance of the endocarp inner surface is categorized as cobwebby (25 genera), cracked (11 genera), fibrous (21 genera), floury-filamentous (20 genera), hairy (10 genera), pithy (5 genera), pulpy (1 genus), reticulate (3 genera), rugose (5 genera), scurfy (63 genera), smooth (341 genera), spongy (25 genera), veined (3 genera), vitreous* (1 genus), or transversely wrinkled (4 genera). Most endocarps are smooth on the inner surface. Hairs on the endocarp are restricted to sutures (2 genera), are found in longitudinal rows (2 genera), are scattered over the endocarp (10 genera), or surround the seed chambers (2 genera).

Testa adherence. For the vast majority of endocarps, the seed testa do not adhere to the endocarp (419 genera). Two genera, however, *Myroxylon* (2.07) of Sophoreae (2) and *Ostryocarpus* of Millettieae (7), have some endocarps that have adhering pieces of seed testa and some endocarps that

* "Vitreous" replaces "vitriol," used in the previous two volumes of this series (Gunn 1984, 1981).

do not. One genus, *Kunstleria* of Millettieae, has endocarps that have adhering seed testa.

Septation. Most endocarps are nonseptate (290 genera). The remainder are either septate (134 genera) or subseptate, that is, weakly or partially septate (67 genera) (figure 2). The septa textures are categorized as thin (tissue paper-like), flexible (99 genera); thicker than paper, firm (90 genera); or composed of a minute fringe of hairs (1 genus). This last characteristic is found only in *Cytisus* (30.15) of Genisteae (30).

Only one genus, *Indigofera* (9.07) of Indigofereae (9), has septa with and without glands. All the other genera only had septa without glands (169 genera).

Density. Endocarp density is characterized as chartaceous (376 genera); coriaceous (42 genera); ligneous, including subligneous (5 genera); osseous (2 genera); or pulpy (6 genera).

Exfoliation. Most endocarps do not exfoliate (379 genera). Some endocarps do exfoliate, either almost entirely (10 genera) or partially (52 genera).

Fusion to mesocarp and epicarp. When the mesocarp is present, most endocarps remain fused to the epicarp and mesocarp (402 genera). In some cases, the endocarps separate from the mesocarp (19 genera), and in three genera the endocarps together with the mesocarp separate from the epicarp. When there is no mesocarp, the vast majority of endocarps remain fused to the epicarp (80 genera) and rarely separate (4 genera).

Wings. Most endocarps have no wings (368 genera). When present, the wings either extend into the epicarp (83 genera) or do not (2 genera). The wings of *Endosamara* of Millettieae (7) and *Glottidium* (8.01A) of Robinieae (8) do not extend into the epicarp.

Separation into segments. The vast majority of endocarps remain entire (401 genera). Three genera—*Endosamara* of Millettieae (7), *Oxytropis* (16.17) of Galegeae (16), and *Piptanthus* (29.02) of Thermopsidae (29)—have endocarps that are separated into one-seeded, winged segments.

Seeds

Number per fruit. The number of seeds per fruit ranges from 1 to 80 and averages 4.6. Frequently the number of seeds per fruit is less than the number of ovules per locule. Seed set can be affected by many external factors, both

biotic and abiotic, such as lack of pollinators or unfavorable macroclimatic or microclimatic conditions.

Position. Most seeds are oriented in the fruit paralleling the length of the fruit (328 genera). Some seeds are obliquely oriented to the length of the fruit (87 genera), and others are transversely oriented (100 genera).

Proximity. Most of the seeds in fruits are separated from each other; that is, they are neither overlapping nor touching (353 genera). Sometimes the seeds overlap (23 genera) or touch (44 genera). Frequently the seeds that overlap also touch, and vice versa. But, sometimes seeds touch at their edges without overlapping, or overlap without touching. When seeds touch, the pressure of adjacent seeds sometimes modifies their shape.

Number of series. The vast majority of fruits have the seeds in a single series (361 genera). In a few genera, the seeds are arranged in two series in the fruit (16 genera) (figure 1). Fruits with their seeds in two series have their seeds aligned in two distinct rows within the fruit. The funiculi of the two rows are distinctly different in length and alternate short and long. This arrangement packs more seeds in the fruit. A few species of *Astragalus* (16.15) in Galegeae (16) have two-series fruits.

Funiculus

Length. Slightly less than half of the funiculi are less than 0.5 mm long (201 genera), and the remainder are 0.5 mm or more long (238 genera). The length of the funiculi ranges from 0.1 to 70 mm and averages 2.4 mm. The vast majority of fruits have funiculi that were approximately the same length (358 genera). Three genera—*Candolleodendron* (1.03) of Swartzieae (1), *Myriocarpus* (2.05) of Sophoreae (2), and *Lotononis* (27.09) of Crotalarieae (27)—have funiculi of two distinctly different lengths in their individual fruits.

Thickness. Funiculus thickness is characterized as filiform (90 genera), flattened (143 genera), partially filiform and partially thick (5 genera), thick (156 genera), or triangular (31 genera).

Shape. Funiculus shape is categorized as anvil-shaped (2 genera), contorted (12 genera), convoluted (5 genera), curved (68 genera), S-curved (13 genera), hooked (15 genera), plicate (1 genus), straight (289 genera), or triangular (80 genera). Most funiculi are straight.

Aril

Presence. More than half of the seeds have arils (267 genera), and less than half do not (202 genera). The presence or absence of a seed aril is one of the most useful characters for generic identifications.

Texture. Arils are either fleshy (74 genera) or dry (210 genera).

Shape. Fleshy arils exhibit a greater diversity of shapes than dry ones. The shapes of fleshy arils are categorized as annular (11 genera), caplike (3 genera), cupshaped (21 genera), expanded funiculus (1 genus), flat from apex to near base (2 genera), hippocrepiform rim-aril (11 genera), hooked (4 genera), horseshoe-shaped (1 genus), knotty (1 genus), leaflike and attached to marginal hilum (2 genera), two-lipped rim-aril (12 genera), marginal around seed (1 genus), marginal hilar (9 genera), or topknot-like (13 genera). The shapes of the dry arils are characterized as cupshaped (2 genera), hippocrepiform rim-aril (10 genera), hooded (1 genus), two-lipped rim-aril (36 genera), rim-aril (162 genera), partial rim-aril (8 genera), or tongue-aril (68 genera). Several aril shapes are shown in figure 5.

Margin. Fleshy and dry arils have the same types of margin shapes. Entire margins are typical of both types (fleshy, 61 genera; dry, 197 genera). Dissected margins are characterized as crenate (fleshy, 11 genera; dry, 5 genera), fimbriate (fleshy, 7 genera; dry, 14 genera), or laciniate (fleshy, 2 genera; dry, 1 genus).

Relative size. No aril completely covers its seed. The vast majority of fleshy arils cover less than half of their seed (70 genera), and only four genera have arils that cover half to nearly all of their seed. Only a small fraction of dry arils have their relative size indicated, and they all cover less than half of their seed (38 genera).

Presence and number of tongues or flaps on two-lipped rim-aril. The majority of the two-lipped rim-arils had tongues or flaps on their lips (42 genera), and less than half of them do not (25 genera). Of the two-lipped rim-arils with tongues or flaps on their lip, most have a single tongue or flap on one lip (38 genera) (figure 5), and a few have two tongues or flaps, one on each lip of the two-lipped rim-aril (18 genera).

Color. Aril color is categorized as black (5 genera), brown (76 genera), cream (75 genera), gray (2 genera), green (2 genera), ivory (11 genera), olive (2 genera), orange (3

genera), red (4 genera), tan (118 genera), white (45 genera), or yellow (12 genera). The predominant aril color is brown, followed by white, and various shades of each color exist.

Seed Morphology

Seed characters support the concept of all legumes being in one family, Fabaceae, as advocated by Candolle (1825*a,b*). He divided this large family into two unequal groups, the much larger Curvembriae, which has a curved embryonic axis, and the smaller Rectembriae, which has a straight embryonic axis. The Curvembriae approximately encompassed the Faboideae, and the Rectembriae included the Caesalpinioideae and Mimosoideae. Although curvature of the embryonic axis is no longer regarded as the best character for primary division of the legumes, it is an indicator of better protection for the radicle and may be part of a suite of seed characters, which especially include hilar characters, separating Faboideae from Caesalpinioideae and Mimosoideae. Another characteristic supporting this bipartite division is the presence of a tracheid bar in the subhilar tissue in Faboideae (figure 6) or the absence of a tracheid bar in Caesalpinioideae and Mimosoideae (Corner 1951, 1976; Lersten 1982; Manning and Staden 1987*b*; Lersten et al. 1992). Presence or absence of a visible lens has also been proposed as a trait supporting this bipartite division. Detailed anatomical studies (Lersten et al. 1992) proved that lenses occur throughout all three subfamilies. Selected seed characters for the three subfamilies are enumerated in the section Seed Key to Three Subfamilies of Fabaceae and are shown in figure 4.

Bentham (1865) used floral characters to divide the legumes into three suborders corresponding to Faboideae, Caesalpinioideae, and Mimosoideae. Taubert (1894) maintained the tripartite division of the family, treating the suborders as subfamilies, and moved the tribe Swartzieae (2), most of whose genera have a straight embryonic axis, to Caesalpinioideae as the last tribe before Faboideae. Corner (1951, 1976) recognized four subfamilies using seed characteristics, the fourth being Swartzioideae with the single tribe Swartzieae. Cowan (1981*a*) and Polhill and Raven (1981) returned Swartzieae (and Swartzioideae) to Faboideae as its first tribe. The tripartite division has been universally accepted (Cronquist 1981; Hutchinson 1964; Mabberley 1997; Polhill 1994*a,b*; Polhill and Raven 1981). Recently, only El-Gazzar and El-Fiki (1976) have insisted that Candolle's bipartite division of legumes is superior to the tripartite division used by other authors.

In the 20th century, interest in legume seed morphology was renewed. Capitaine (1912) studied the seed morphology of the entire family. He concluded that legume seed morphology was useful in legume classification and identification at the tribal, generic, and specific levels. In the 40 years following Capitaine, Jensen (1998) documented just 27 publications dealing principally with legume seed morphol-

ogy. In the last 30 years there has been a resurgence of interest in seed morphology, and Jensen has recorded 225 publications on the subject. Most of the studies have dealt with seeds of tribes, genera, or species, many of which are cited in Synopses of Fruit and Seed Characters, and some have dealt with particular geographic regions, especially countries, or classes of plants, such as noxious weeds.

The multifamily studies of Martin (1946) and Isely (1947) laid the basis for the overview by Gunn (1972). Although Corner (1951, 1976) primarily dealt with seed anatomy, he also discussed and illustrated several morphological characters of legumes. Isely (1955), without citing the foregoing literature, restated the similarities and differences among the seeds of the three subfamilies. One of his students (Kopooshian 1963, Kopooshian and Isely 1966) confirmed Isely's findings, using a much larger sample of genera. The reports of Kopooshian and Isely laid the foundations for Gunn's studies (Gunn 1981*a,b*, 1984, 1991) as well as for this bulletin. Gunn (1981*a*) summarized the seed characteristics for 510 legume genera, including 347 genera of Faboideae.

This section of this bulletin reports information from studies on mature, dry seeds. Seed characters are discussed in the order given in the sections Synopses of Fruit and Seed Characters and Character List. Selected seed characters are illustrated in figures 3–52. In the discussions that follow on seed morphology, the number of genera exhibiting the character is usually identified in parentheses. The total number of genera for any suite of characters may exceed 428 (the number of genera studied) because a genus may be variable for the characters. For example, a genus may have terete, compressed, or flattened seeds. The seed data are presented in the following order:

- Seed—size, overgrown vs. not overgrown, shape, transection, surface.
- Cuticle—exfoliation, inflation, wrinkling.
- Testa—presence, epicarp adherence, endocarp adherence, sheen, bloom, coloration, surface traits, thickness, pleurogram, fracture lines, rim, wings.
- Raphe—visibility, position, bifurcation, coloration, elevation.
- Hilum—concealment, faboid split, size, shape, position, elevation, encircling structures.
- Lens—visibility, size, shape, position, elevation, coloration, encircling structures.
- Endosperm—presence, thickness, pluglike vs. not pluglike, covering of embryo, adnation.

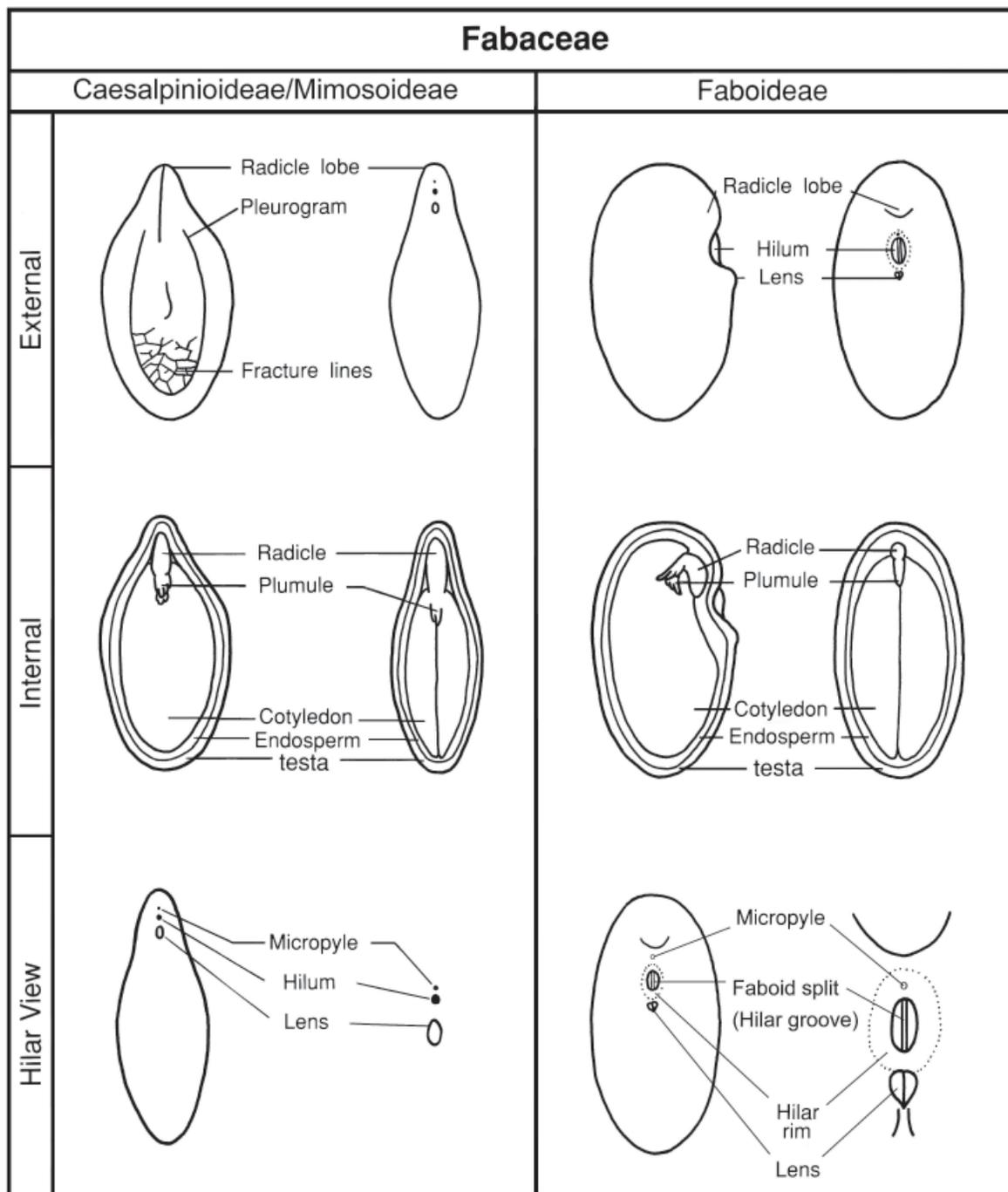


Figure 4. Terms used to describe seeds of subfamilies Caesalpinioideae, Mimosoideae, and Faboideae

Cotyledons—surface, topography, relative thickness and length, folding, margin, coloration, inner face topography, pubescence.

Embryonic axis—alignment of cotyledons and radicle, joint location.

Radicle—differentiation, shape, alignment with cotyledons, relative length.

Plumule—development, pubescence.

Seed

Size. Seed size is recorded in millimeters and mostly as a range. Length is measured along the long axis of the seed without regard to hilum position. Width is measured at a right angle to and in the same plane as the long axis and at the widest point of the seed. Thickness, or short axis of the seed, is measured through the thickest part.

The seed length ranges from 0.5 to 80 mm and averages 9.1 mm, width ranges from 0.4 to 60 mm and averages 6.1 mm, and thickness ranges from 0.1 to 60 mm and averages 3.5 mm. The four genera with the largest seeds are *Andira* (4.04) of Dalbergieae (4), 20–80 mm long; *Clathrotropis* (2.26) of Sophoreae (2), 17–70 mm long; *Mildbraediendron* (1.07) of Swartzieae (1), 42–72 mm long; and *Swartzia* (1.01) of Swartzieae, 2–70 mm long. There are seven genera with seeds less than one millimeter long, and the smallest are of *Ononis* (21.01) of Trifolieae (21) at 0.5–5.5 mm long.

Statements that caesalpinoid and mimosoid seeds generally are larger than faboid ones are confirmed by this study and studies by Gunn (1981a,b, 1984, 1991). Caesalpinoid seed ranges are 1.2–180 × 0.7–120 × 0.2–70 mm and average 14, 11, and 6.5 mm, respectively, and mimosoid seed ranges are 2.3–130 × 1.5–70 × 0.1–40 mm and average 18, 10, and 3.5 mm, respectively. The mean seed length for caesalpinoids and mimosoids are 135–200 percent greater than for faboids, and the mean seed width for caesalpinoids and mimosoids is 139–145 percent greater than for faboids.

Overgrown. The term “overgrown seeds” was coined by Corner (1951) and defined as follows:

“The Leguminous seed has normally a specific size set by differentiation of the palisade at a certain stage of development of the fruit and seed. As a result the pod conforms with the seeds. In some cases, in contrast, the seed enlarges and fills the seed-cavity of the pod without differentiation of the features of the Leguminous testa. Such seeds,

conforming with the pod, are exalbuminous and have the nature of tumours, the growth of which is limited by the size of the pod: hence I refer to them as *overgrown seeds*. Their main character is the lack of differentiation of the testa, which remains embryonic.”

Corner established two criteria for determining whether a seed is overgrown: (1) unlimited growth of seeds which is restrained only by the size of the fruit cavity and (2) a lack of differentiation or development of the seed coat. The determination of unlimited seed growth is difficult or impossible from preserved specimens. When overgrown seeds are in physical contact in the fruit, their shapes are distorted, and these seeds can be identified as overgrown. When seed shapes are not distorted, the determination of overgrowth is very difficult or impossible. Anatomical examination of the testa is the certain way to determine overgrowth. The testas of overgrown seeds are always poorly differentiated and lack some of the typical structures of the legume testa (Maumont 1993), such as Malpighian cells with the light line or hourglass cells.

Most faboid seeds are not overgrown (414 genera), but a few are (25 genera). Overgrown seeds are found in genera of 12 tribes: 5 genera of Swartzieae (1), 2 genera of Sophoreae (2), 1 genus of Dipteryx (3), 3 genera of Dalbergieae (4), 2 genera of Millettieae (7), 3 genera of Indigofereae (9), 1 genus of Phaseoleae (10), 2 genera of Aeschynomeneae (14), 1 genus of Adesmieae (15), 2 genera of Galegeae (16), 1 genus of Carmichaelieae (17), 1 genus of Cicereae (20), and 1 genus of Mirbelieae (24). In our opinion, the occurrence of overgrown seeds in Faboideae has no relationship to its tribal classification and frequently is not a good indicator of generic relationships. Maumont (1993) studied the testa anatomy of overgrown seeds in the tribe Ingeae of Mimosoideae and concluded “that overgrown seeds evolved in parallel at least three times in the Ingeae.”

Shape. The vast majority of seeds have nonangular shapes (417 genera), but many have angular shapes (128 genera). Obviously, most of the genera with nonangular seeds also have angular seeds (114 genera). Most seeds are asymmetrical in shape (333 genera), but many are symmetrical (171 genera). Seed shape in outline (figure 3) is categorized as bilobed, cicerlike (bilobular to subglobular and beaked) (5 genera); C-shaped (10 genera); circular (100 genera); cordate (8 genera); D-shaped (37 genera); elliptic (103 genera); falcate (1 genus); hippocrepiform (1 genus); irregular (63 genera); linear (13 genera); mitaform (mitten shaped) (50 genera); oblong (154 genera); obovate (6

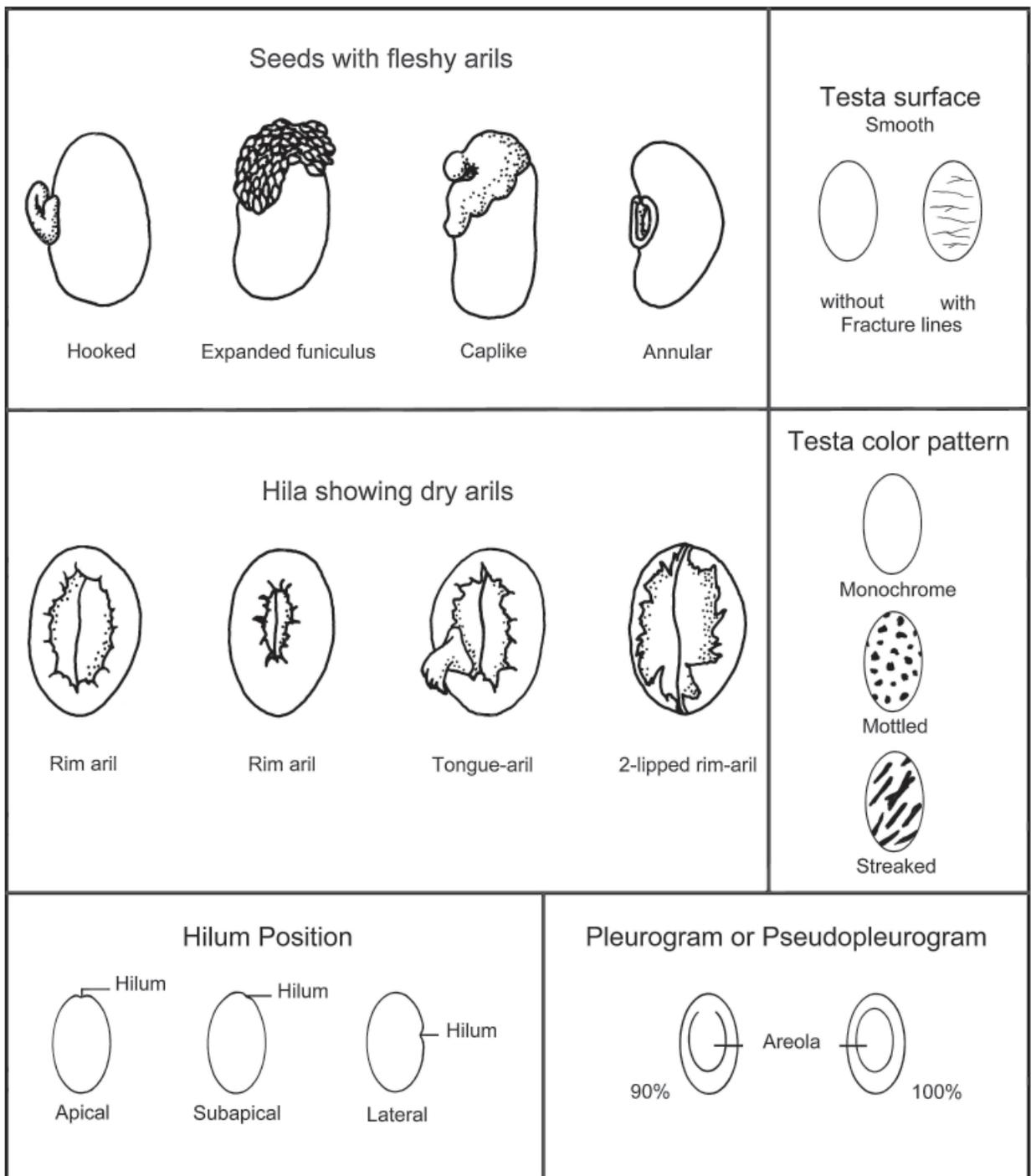


Figure 5. Selected terms for describing seeds of the subfamily Faboideae

genera); ovate (117 genera); pyriform (2 genera); quadrangular (30 genera); rectangular (40 genera); reniform (206 genera); rhombic (20 genera); samaroid (2 genera); trapezoid (2 genera); or triangular, including cuneate (26 genera). The most common shape is reniform; the next most common shapes are circular, elliptic, oblong, and ovate. These observations indirectly confirm the historic observation that faboid embryos are curved.

Transection. Seed transections are characterized as terete with a 1:1 ratio, including subterete (126 genera); quadrangular with a 1:1 ratio (10 genera); compressed with a more-or-less 2:1 ratio (337 genera); flattened with a greater than 4:1 ratio (62 genera); or mounded on one side and straight on the other side (5 genera). The separation between compressed and terete is arbitrary because there was no distinct break between the 2:1 and 1:1 ratios. On the other hand, flattened seeds clearly are flat.

Surface. The seed surface is categorized as grooved (10 genera), ridged (7 genera), smooth (306 genera), or wrinkled (15 genera). Grooves are described as longitudinal (5 genera), oblique (3 genera), reticulate (1 genus), or transverse (3 genera). On some seeds the raised outline of the radicle and cotyledon lobes is visible (181 genera), but on most it is not visible (305 genera). When the radicle and cotyledon lobes are evident, most seeds have a groove between them (160 genera), but some do not (35 genera). The color of the groove is either the same color as the testa (34 genera) or is lighter [1 genus, *Astracantha* (16.16) of Galegeae (16)].

Most seeds have no hilar sinus (369 genera). Of those with a hilar sinus, some have a shallow one (27 genera), and the rest have a deep one (14 genera). The vast majority of seeds are not umbonate, that is, they lack an umbo on the seed faces (411 genera), but a few are umbonate (23 genera) (figure 7). Of those that are umbonate, six genera have an umbo on both faces and one genus, *Tadehagi* (11.13) in Desmodieae (11), has an umbo on only one face. Only one genus, *Craibia* in Millettieae (7), has a medial ridge on each face of the seed.

Cuticle. None of the faboid seeds have an exfoliating cuticle (417 genera), unlike those in Caesalpinioideae and Mimosoideae. Two genera, *Gompholobium* (24.01) and *Phyllota* (24.19), both in Mirbelieae (24), have an inflated cuticle; the rest do not (416 genera). The cuticle of *Phyllota* is inflated around the hilum. Three genera, *Chamaecytisus* (30.15A) and *Echinospartum* (30.23) in Genisteae and *Jacksonia* (24.08) in Mirbelieae (24), have a wrinkled

cuticle, and the rest have a nonwrinkled cuticle (415 genera).

Testa

Presence. The vast majority of seeds have a testa or seed coat (424 genera). Seven genera, *Aldina* (1.04) in Swartzieae (1), *Angylocalyx* (2.13) in Sophoreae (2), *Bituminaria* (12.02) in Psoraleeae (12), *Cordyla* (1.06) in Swartzieae, *Mildbraediodendron* (1.07) in Swartzieae, *Monopteryx* (2.31) in Sophoreae, and *Vatairea* (4.02) in Dalbergieae (4), do not have a testa when mature. In four genera, *Andira* (4.04) in Dalbergieae, *Carmichaelia* (17.05) in Carmichaelieae (17), *Geoffroea* (4.15) in Dalbergieae, and *Myroxylon* (2.07) in Sophoreae, some seeds have a testa and others do not. Therefore, when the testa is absent, its associated structures, raphe, hilum, and lens, are also absent, and their characteristics are not recorded.

Epicarp adherence. The vast majority of seeds do not have pieces of adhering epicarp (420 genera), but a few do (10 genera).

Endocarp adherence. The vast majority of seeds do not have the testa adhering to the endocarp (417 genera). Some seeds have the testa partially adhering to the endocarp (39 genera), and the seeds of just one genus, *Ostryocarpus* in Millettieae (7), have the entire testa adhering to the endocarp. The vast majority of seeds have the testa free from the endocarp (419 genera), and four genera, *Kunstleria* and *Ostryocarpus* in Millettieae and *Myrocarpus* (2.05) and *Myroxylon* (2.07) in Sophoreae (2), have seeds with their testa fused to the endocarp.

Sheen. Most seeds appear dull (344 genera), but many appear glossy (164 genera). Four genera, *Centrosema* (10.14), *Dumasia* (10.42), and *Teramnus* (10.36) in Phaseoleae (10) and *Pericopsis* (2.17) in Sophoreae (2), have seeds with a glaucous testa, and one genus, *Vicia* (19.01) in Fabaeae (19), has some seeds with a velvet testa.

Bloom. The vast majority of seeds do not have a bloom (409 genera), but a few do (19 genera).

Coloration. The vast majority of testas are opaque (418 genera), and therefore have a coloration. A few are transparent, that is, they lack pigment in the testa (13 genera). The opaque testas are either monochrome (384 genera), mottled (179 genera), streaked (84 genera), or bichrome, with two different colored areas (18 genera) (figure 5). Those with mottles are recorded as frequently mottled (137 genera), meaning they have more than three marks per seed face, or

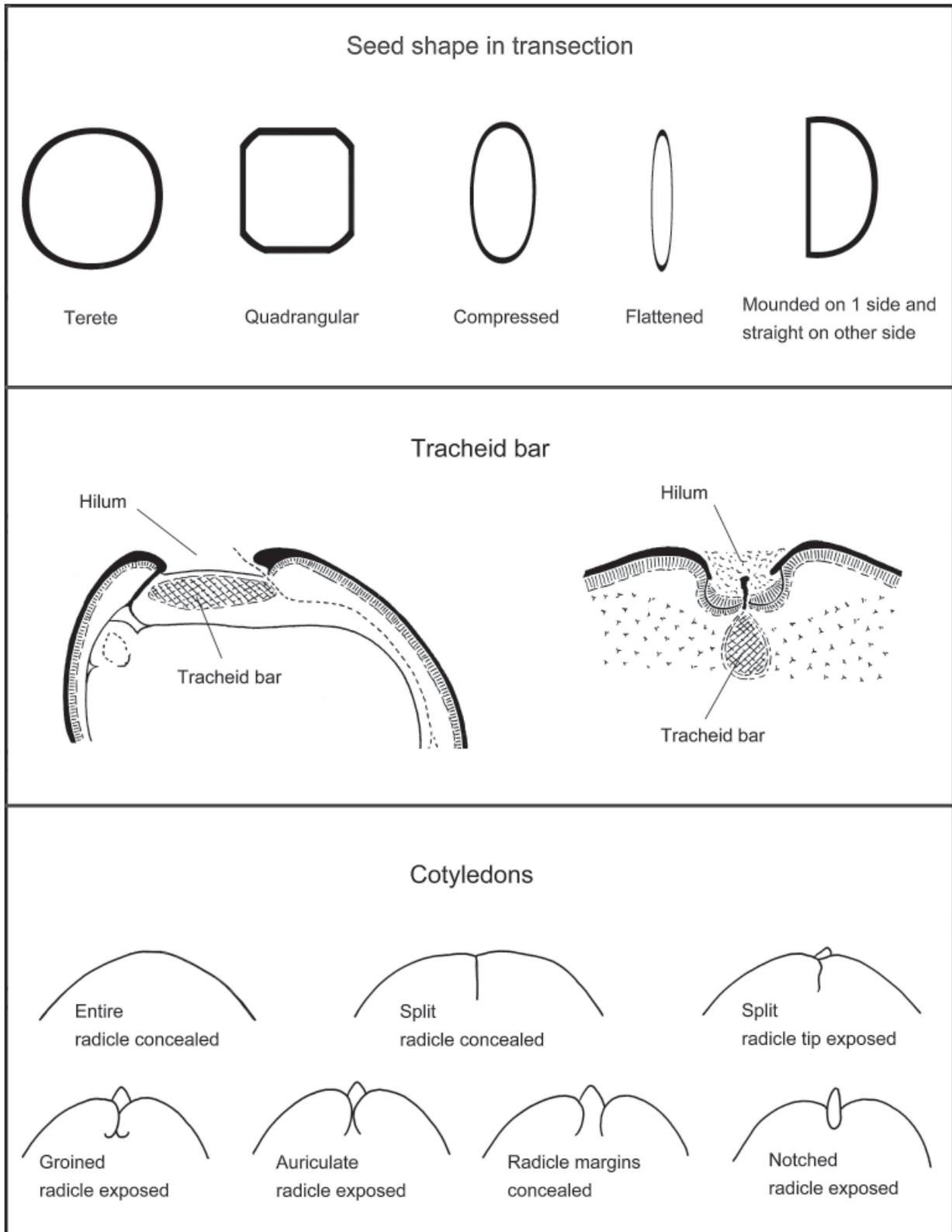


Figure 6. Selected terms for describing seeds of the subfamily Faboideae. Tracheid bar illustrations are adapted from Corner (1976).

infrequently mottled (42 genera), meaning they have one to three marks per seed face. Those with streaks are also recorded as frequently streaked (69 genera), meaning they have more than three marks per seed face, or infrequently streaked (11 genera), meaning they have one to three marks per seed face. The basic background colors of the testa are black (99 genera), blue (5 genera), brown (377 genera), cream (15 genera), gray (9 genera), green (51 genera), ivory (4 genera), olive (19 genera), orange (34 genera), pink (3 genera), purple (16 genera), red (33 genera), scarlet (1 genus), tan (120 genera), white (12 genera), or yellow (41 genera). The most common testa color is brown (397 genera), and many shades of brown exist. For multicolored testas, the overlaying colors were characterized as black (83 genera), brown (106 genera), gray (4 genera), green (3 genera), orange (2 genera), pink (1 genus), purple (26 genera), red (7 genera), tan (11 genera), or yellow (2 genera).

Surface. The vast majority of testas are glabrous, that is, hairless (415 genera). Two genera, *Callerya* of Millettieae (7) and *Myrospermum* (2.06) of Sophoreae (2), have only very short hairs on their testas, while two other genera, *Harpalyce* (22.02) of Brongniartieae (22) and *Psophocarpus* (10.51) of Phaseoleae (10), have pubescent testas and glabrous testas.

Most testas are smooth (346 genera), but many are not (178 genera). The nonsmooth testas have either elevated (154 genera) or recessed features (52 genera). The elevated features are categorized as bearing endocarp remnants (3 genera), having a blistered cuticle (2 genera), echinate (1 genus), papillate (5 genera), powdery and not rubbing off (2 genera), reticulate (20 genera), with one longitudinal ridge on each face (2 genera), ridged longitudinally more than once (1 genus), transversely ridged (3 genera), rugose (24 genera), shagreen (22 genera), tessaroid (1 genus), tuberculate (21 genera), veined (5 genera), verrucose (1 genus), warty (11 genera), or wrinkled (91 genera). The recessed features are characterized as concaved (3 genera), cracked (1 genus), large depressions on each face (2 genera), grooved (4 genera), pitted with large concatenated pits (1 genus), pitted with small separate pits (31 genera), pitted with stomata in the bottom of the pits (1 genus), punctate (7 genera), or striate (6 genera). Lersten (1981) conducted a survey of faboid testa topography at high magnification using the scanning electron microscope (SEM), and Bridges and Bragg (1983) added three genera and five species to the survey.

If faboid seeds are viewed at relatively high magnifications of 50 and 1,000 magnifications, few would have a testa that

could be described as smooth. The illustrations in the section Synopsis of Fruit and Seed Characters usually contain two SEM micrographs of a selected testa at 50 and 1,000 magnifications for those genera for which sufficient seeds were available. Representative testa surfaces are illustrated in figures 8–52.

Thickness. Testa thickness is described as chartaceous (152 genera); coriaceous, including subcoriaceous (277 genera); or osseous, including subosseous (13 genera).

Pleurogram. No faboid seeds or testas have pleurograms or pseudopleurograms (figure 5). Thirty-nine mimosoid genera (Gunn 1984), and only four caesalpinoid genera (Gunn 1991)—*Burkea* W.J. Hooker, *Dimorphandra* H.W. Schott, *Pachyelasma* H.A.T. Harms, and *Senna* P. Miller—have pleurograms.

Fracture lines. Most testas lack fracture lines (419 genera), but a few have them (21 genera) (figure 5). Fracture lines are classified as concentric (1 genus), irregular (4 genera), reticulate (6 genera), or transverse (10 genera).

Rim. The vast majority of testas lack a rim (413 genera), and only a few have one (10 genera). The winglike rims are either around the seed (1 genus) or along one side of the seed (1 genus).

Wings. The vast majority of testas do not have a wing (375 genera); only three genera, *Amburana* (1.15) in Swartzieae (1), *Inocarpus* (2.10) in Sophoreae (2), and *Phylacium* (11.22) in Desmodieae (11), have one. The wing of *Amburana* is described as being at one end of the seed

Raphe

Visibility. The raphe is the part of the funiculus that is fused to the ovule. Consequently the site of funicular abscission, that is, the hilum, is further from its place of insertion. The vascular bundle runs through the raphe (Werker 1997). On many seeds, the raphe is not visible (336 genera), though it is visible on some (135 genera).

Position. The raphe is described as running from the hilum through the lens to the base of the seed and then terminating (39 genera), running from the hilum through the lens to the base of the seed and then bifurcating (5 genera), running from the hilum to the lens (28 genera), running from the hilum to near the base of the seed and then terminating (34 genera), running from the hilum through the lens and the base of the seed to a point opposite the hilum (13 genera), running from the hilum through the lens and terminating

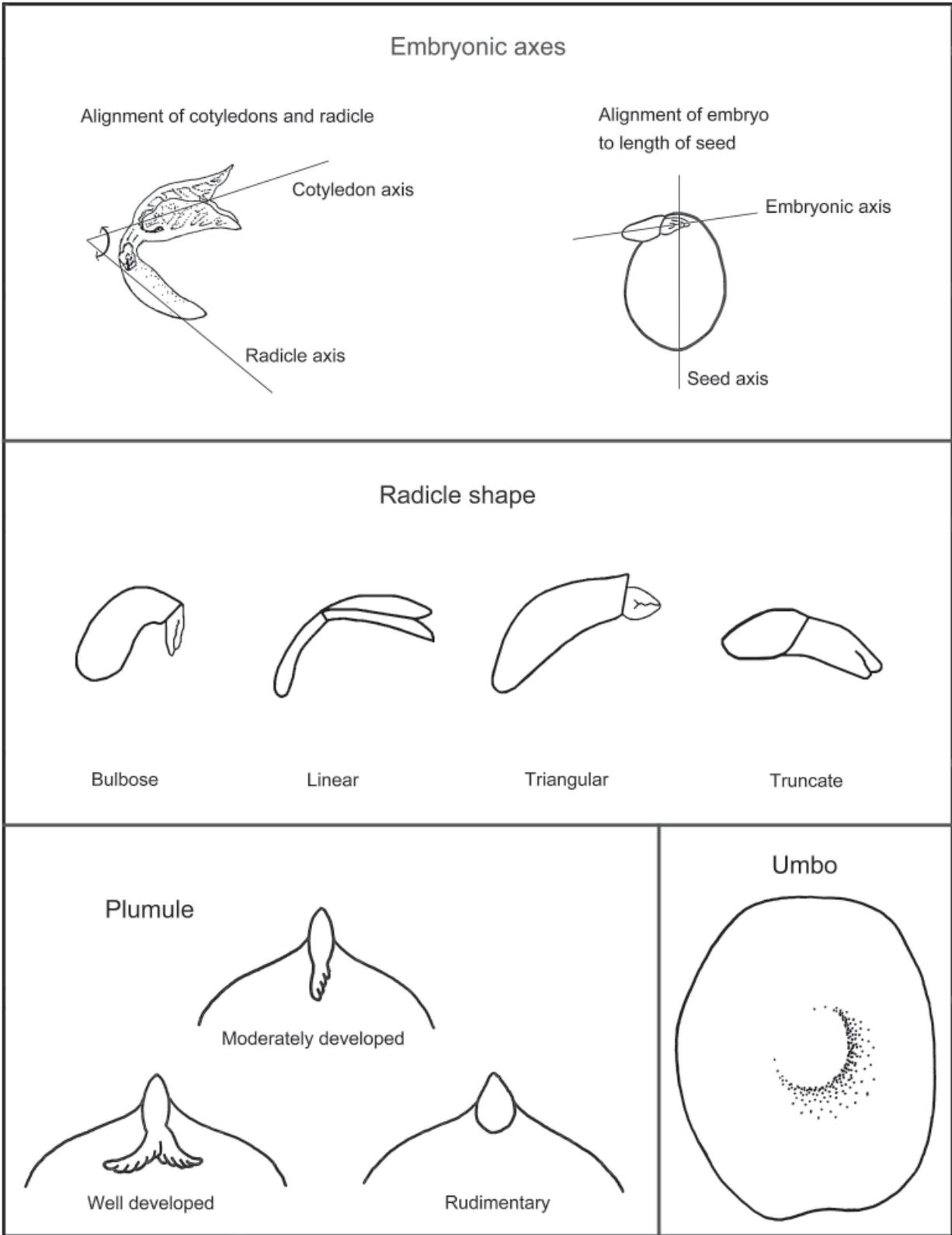


Figure 7. Selected terms for describing seeds of the subfamily Faboideae

before the base of the seed (15 genera), running from the hilum through the base of the seed and then up the other side (6 genera), running from the lens to the base of the seed and then terminating (9 genera), or running from the lens to the base of the seed and then bifurcating (3 genera).

Bifurcation. The vast majority of the raphes do not bifurcate (123 genera), but the raphes of 7 genera do.

Coloration. The color of the raphes is described as the same color as the testa (62 genera), a lighter color than the testa (9 genera), or a darker color than the testa (80 genera). Those raphes that are not the same color as the testa are black (25 genera), brown (63 genera), reddish purple (1 genus), or tan (5 genera).

Elevation. Raphes are categorized as raised (66 genera), flush (55 genera), or recessed (26 genera).

Hilum

Concealment. The majority of seeds have the hilum concealed, either fully (146 genera) or partially (179 genera). Slightly less than half have the hilum completely visible or exposed (204 genera). When the hilum is concealed, it is concealed by an aril (141 genera), an aril remnant (4 genera), a funiculus (24 genera), a funicular remnant (127 genera), fusion to an endocarp (1 genus), a radicle lobe (18 genera), or a wing (24 genera). Lackey (1981a) pointed out the taxonomic usefulness of the funicular remnant, which he called the epihilum, in defining the subtribes of Phaseoleae (10). We found that 72 genera in 18 tribes have their hila partially concealed by funicular remnants and that 96 genera in 23 tribes have their hila fully concealed by funicular remnants. Given the widespread occurrence of hila concealed by funicular remnants, this characteristic should be further investigated to confirm our conclusions, which were formed based on a limited sample.

Faboid split. The faboid split, or hilar groove, bisects the hilum lengthwise. It is found only in the Faboideae and is an important characteristic defining the subfamily. Most faboid hila have a faboid split (321 genera), but some do not (94 genera). Of the 94 genera lacking a faboid split, 86 have overgrown seeds and 13 do not. The most reliable feature of overgrown seeds is the poorly differentiated seed testa. Obviously one of the features not developed on overgrown seeds of Faboideae is the faboid split. The testas of the 86 genera should be examined anatomically to determine whether or not their seeds are overgrown. Their lack of a faboid split probably indicates that their seeds are overgrown. Of those hila with a faboid split, most have the lips of the faboid split the same color as the rest of the testa (290 genera), but some have the lips that are lighter colored than the rest of the testa (36 genera).

Size. Most hila are 0.3 mm or more in diameter (292 genera), but many are less than 0.3 mm in diameter, that is, punctiform (157 genera). Hilar length ranges from 0.1 to 90 mm and averages 3.0 mm. Only 17 genera have hila longer than 10 mm, and the longest hila are found in the genus *Mucuna* (10.03) in Phaseoleae (10), which range in length from 6 mm to 90 mm.

Shape. Hilar shape is organized according to the form of the overall outline as follows: angular (10 genera); curved (247 genera); or straight, including linear (66 genera). Those with curved outlines were categorized as circular (91 genera), elliptic (162 genera), fusiform (8 genera), heart-shaped (1 genus), or oval (40 genera) (figure 3). Those with angular outlines are characterized as irregular (3 genera), triangular (4 genera), or wedge-shaped (4 genera). And those with straight outlines are either oblong (35 genera) or linear (35 genera).

Figures 8–22. Selected surface patterns of testa of faboid seeds (left column, $\times 1$; middle column, $\times 50$; right column, $\times 1,000$):

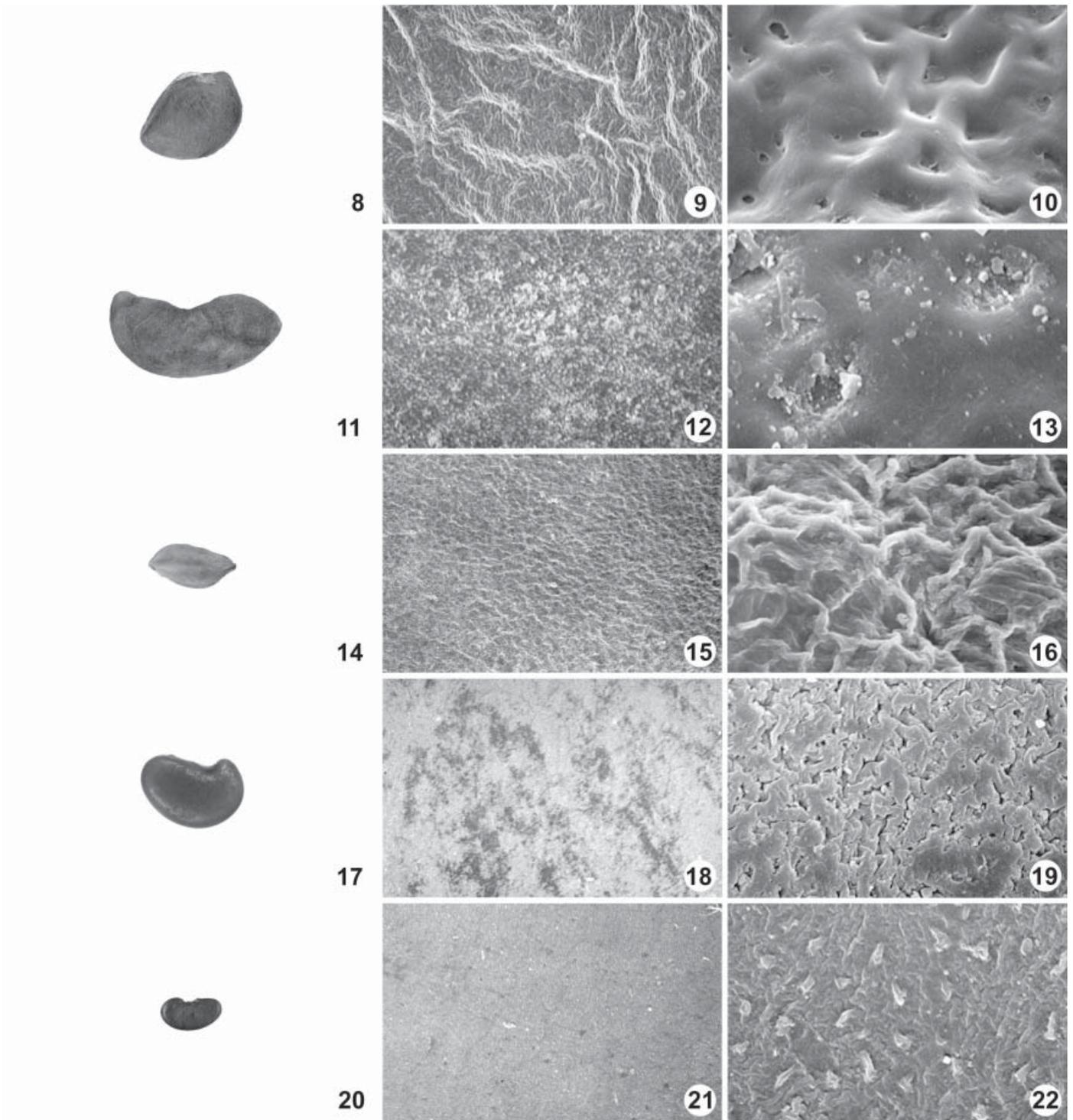
8–10, *Candolleodendron brachystachyum* (A.-P. de Candolle) R.S. Cowan

11–13, *Baphiopsis parviflora* G. Bentham ex J.G. Baker

14–16, *Luetzelburgia praecox* (H.A.T. Harms) H.A.T. Harms

17–19, *Ateleia herbert-smithii* H.F. Pittier

20–22, *Cyathostegia matthewsii* (G. Bentham) R.W. Schery



Position. The position of the hilum is described relative to the radicle. The seed must be carefully dissected to determine this. The relative hilum position is categorized as apical at apex of radicle tip, or nearly so (38 genera); subapical to radicle tip (51 genera); apical according to radicle tip but marginal according to seed length (105 genera); marginal according to radicle tip, or nearly so (146 genera); or between cotyledon and radicle lobe (150 genera) (figure 5).

Elevation. Hila are either raised (29 genera), flush (159 genera), or recessed (252 genera).

Encircling structures. The majority of hila have a structure around them that is described as a corona (31 genera), halo (103 genera), or rim (198 genera). The minority of hila have no structure around them (199 genera). The hilar coronas are either lighter in color than the testa (8 genera) or darker (25 genera). The hilar halos are the same color as the testa (11 genera), lighter in color than the testa (45 genera), or darker in color than the testa (59 genera). The hilar rims are also described as the same color as the testa (116 genera), lighter in color than the testa (33 genera), or darker in color than the testa (103 genera).

Lens

Visibility. On most of the testas, the lens is discernible (344 genera), but in some it is not (145 genera). On some seeds the lens is difficult to discern and can only be studied using anatomical techniques.

Size. The lens ranges from 0.1 mm to 9 mm long and averages 0.8 mm. Only one genus, *Physostigma* (10.52) in Phaseoleae (10), has a lens longer than 5 mm. Its lenses range from 0.9 mm to 9 mm long. One hundred and twenty five genera have lenses shorter than 0.5 mm.

Shape. Overall lens shape is classified as either straight (231 genera) or curved (217 genera). The straight lens shapes are categorized as diamond-shaped (10 genera), irregular (14 genera), linear (135 genera), oblong (57 genera), rectangular (2 genera), rhombic (5 genera), square (1 genus), triangular (31 genera), or wedge-shaped (28 genera). The most common straight shape is linear. The curved lens shapes are characterized as circular (115 genera), elliptic (57 genera), hourglass- or dumbbell-shaped (3 genera), irregular (13 genera), key-hole shaped (5 genera), two circular mounds separated by groove (6 genera), two oblong mounds separated by a groove (4 genera), oblong (49 genera), ovate (8 genera), or punctiform (8 genera). The most common curved shape is circular, and the next most common curved shapes are elliptic and oblong.

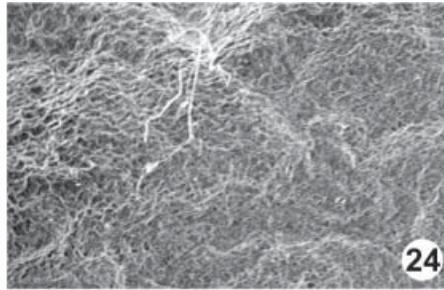
Position. Rarely the lens is in the groove of the raphe (14 genera), but in the vast majority of cases it is not (337 genera). The position of the lens is described relative to the hilum. The vast majority of lenses are relatively close to the hilum. The majority of lenses are confluent with the hilum (touching the hilum or hilar rim) (208 genera), and most of the rest are adjacent to the hilum (not touching the hilum or the hilar rim but less than 45 degrees of the seed circumference away from the hilum) (164 genera). Two genera, *Hymenolobium* (4.03) in Dalbergieae (4) and *Pictetia* (14.05) in Aeschynomeneae (14), have the lens 180 degrees from the hilum, and two other genera, *Poitea* (8.05) in Robinieae (8) and *Vicia* (19.01) in Fabeae (19), have some of their lenses 180 degrees from the hilum. Only one genus, *Lennea* (8.03) in Robinieae, has its lens positioned 270 degrees from the hilum, and one genus, *Vicia* in Fabeae, rarely has its lenses 270 degrees from the hilum.

When the lens does not touch the hilum or the hilar rim, its distance from the hilum ranges from 0.1 mm to 13 mm and

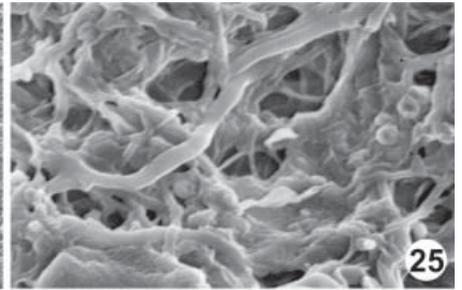
Figures 23–37. Selected faboid testa surface patterns (left column, $\times 1$; middle column, $\times 50$; right column, $\times 1,000$).
23–25, *Platymiscium filipes* G. Benth
26–28, *Myrocarpus frondosus* F.F. Allemão e Cysneiro
29–31, *Leucomphalos capparideus* G. Benth ex L.D. Planchon
32–34, *Dussia lehmannii* H.A.T. Harms
35–37, *Platycephium voense* (H.G.A. Engler) H. Wild



23



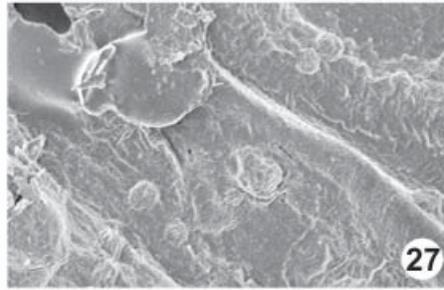
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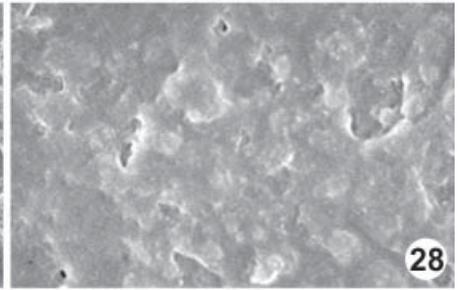
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26



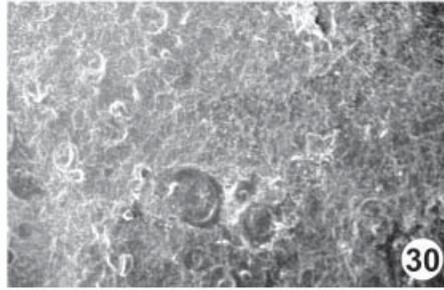
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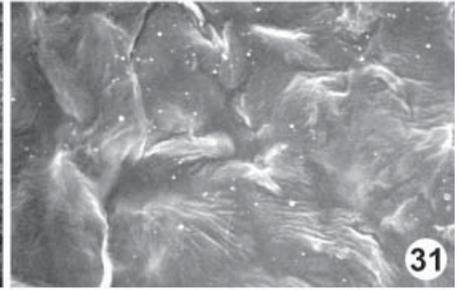
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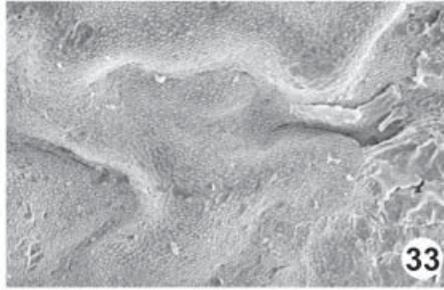
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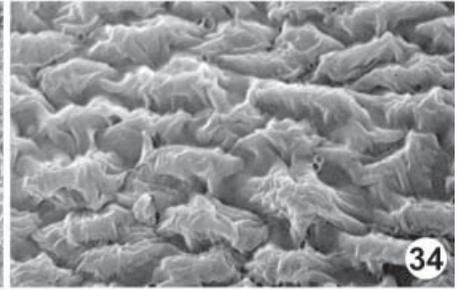
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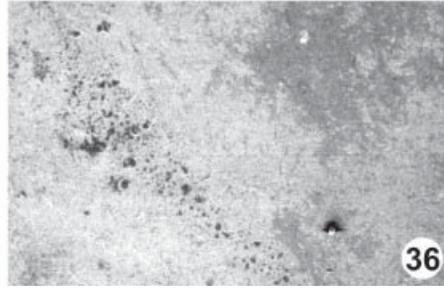
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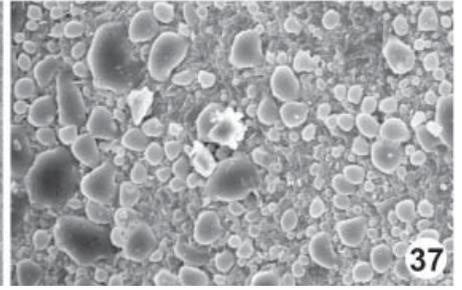
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averages 0.8 mm. The lens of *Vicia* is furthest from the hilum, ranging from 0.1 mm to 13 mm away. Ninety-six genera have lenses less than 0.5 mm from the hilum.

Elevation. Lenses are either mounded (203 genera), flush (128 genera), or recessed (49 genera).

Coloration. The majority of lenses are the same color as the testa (91 genera) or a similar color (156 genera). A minority of lenses are a dissimilar color from that of the testa (156 genera). Amongst those lenses similar in color to the testa, most are darker than the testa (263 genera) and the remainder are lighter (43 genera). The lens colors are categorized as black (112 genera); brown, including various shades of brown (209 genera); gray (1 genus); green (2 genera); orange (1 genus); reddish purple (2 genera); red (15 genera); tan (36 genera); or yellow (1 genus). The commonest lens color is brown, followed by black.

Encircling structures. The majority of lenses have no structure around them (289 genera). Those with a structure have either a corona (20 genera), halo (30 genera), or rim (41 genera). The coronas are either lighter in color than the testa (4 genera) or darker (16 genera). The halos are described as the same color as the testa (1 genus), lighter in color than the testa (7 genera), or darker in color than the testa (23 genera). Also, the rims are described as the same color as the testa (28 genera), lighter in color than the testa (3 genera), or darker in color than the testa (20 genera).

Endosperm

Presence. Most seeds have endosperm (289 genera), but some do not (154 genera). The presence or absence of endosperm is a useful characteristic for the identification of legume seeds. It is slightly more difficult than external characteristics because it requires that the seed be dissected, and when the endosperm is very reduced it can be difficult

to detect. Most agriculturally important legumes lack endosperm. From our observations and from a survey of the literature, there is no perisperm or chalazosperm in legumes (Gunn 1981a,b, 1984, 1991).

Thickness. Endosperm thickness is described as thick (97 genera), thin (177 genera), or trace (34 genera). Sometimes when the endosperm is merely a trace, it can be difficult to detect.

Pluglike. Two genera, *Isotropis* (24.06) in Mirbelieae (24) and *Rhynchosia* (10.80) in Phaseoleae (10), are described as having endosperm that is pluglike and resembles the tip of the radicle. For the remainder of the genera with endosperm, the endosperm is not pluglike and does not resemble the radicle (286 genera).

Covering of embryo. The endosperm of most seeds completely covers the embryo (252 genera). For a few seeds the endosperm covers at least half of the embryo but not all of it (15 genera), and for some seeds the endosperm is restricted to the region of the embryo (36 genera).

Adnation. In most seeds the endosperm is adnate to the testa (218 genera), but in some it is adnate to the embryo encasing it (112 genera).

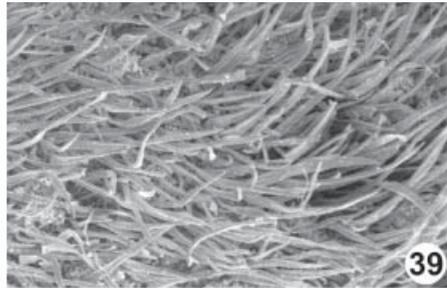
Cotyledons

Surface. The outer or abaxial surface of most cotyledons is smooth (365 genera), but on some cotyledons it is not (90 genera). The features of the outer surface of nonsmooth cotyledons are categorized as convoluted (3 genera), dimpled once (2 genera), glandular dotted (yellow latex-like substance inside) (2 genera), 1 to 3 grooves on each face (14 genera), 4 to 6 grooves on each face (1 genus), 5–7-branched grooves (from veins of testa) on each face (5 genera), pitted (1 genus), rugose (4 genera), ruminant (1 genus), sulcate (14 genera), or wrinkled (33 genera).

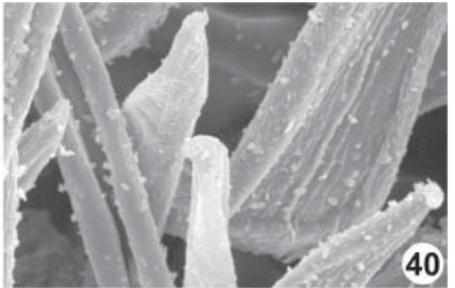
Figures 38–52. Selected faboid testa surface patterns (left column, $\times 2$; middle column, $\times 50$; right column, $\times 1,000$)
38–40, *Cullen americanum* (C. Linnaeus) P.A. Rydberg
41–43, *Cochlianthus gracilis* G. Bentham
44–46, *Tripodion teraphyllum* (C. Linnaeus) J.P. Fourreau
47–49, *Rhynchosia poggei* (P.H.W. Taubert) H.A.T. Harms
50–52, *Hesperolaburnum platycarpum* (R.C.J.E. Maire) R.C.J.E. Maire.



38



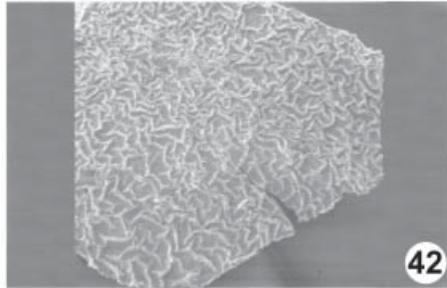
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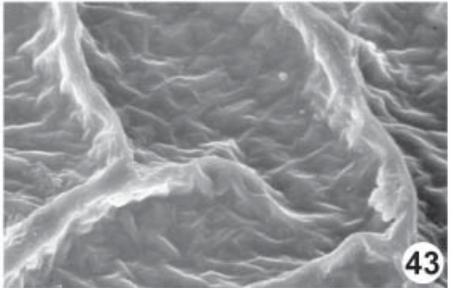
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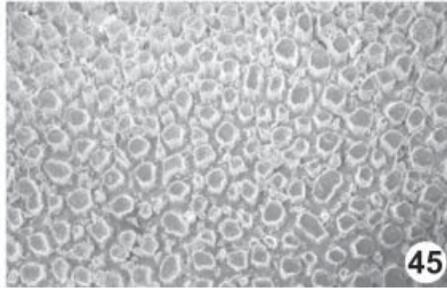
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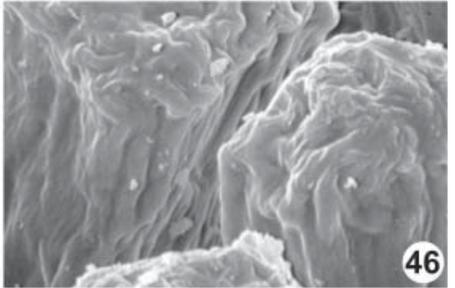
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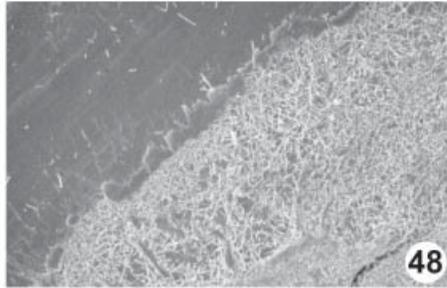
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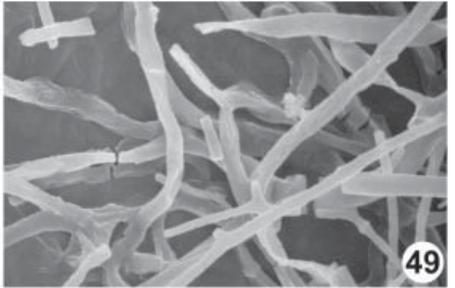
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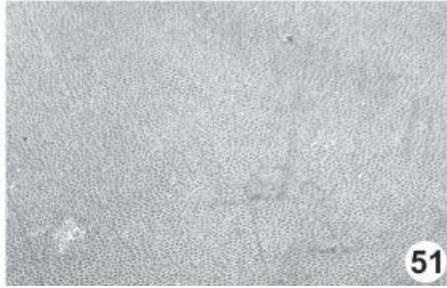
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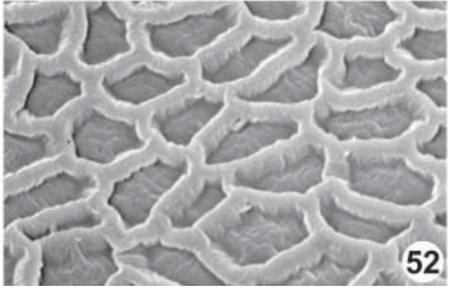
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Topography. The overall topography of the outer surface of the cotyledons is characterized as outer face of one cotyledon flat and the other cotyledon convex (5 genera), outer face of one cotyledon flat and the other cotyledon concave (1 genus), both outer faces convex (414 genera), outer face of one cotyledon concave and the other cotyledon convex (2 genera), both outer faces flat (4 genera), or with two outer faces on each cotyledon, one flat and the other convex (1 genus). The vast majority of cotyledons had both outer faces convex.

Relative thickness and length. In the vast majority of seeds, the two cotyledons are the same thickness (418 genera), but in a few seeds one cotyledon is thicker than the other (13 genera). Again in the vast majority of seeds, the two cotyledons are about the same approximate length (418 genera), but a few have one cotyledon longer than the other (12 genera).

Folding. The vast majority of cotyledons are not folded (414 genera). Of those that are folded, a few have both cotyledons folded (16 genera), and very few have just a single cotyledon of the pair folded (5 genera). Sometimes the cotyledons are folded over so far that their inner face touches itself (9 genera), but most are not folded that far (14 genera). Generally the cotyledons' portions of the inner folded face were unequal (17 genera), but in one genus, *Melilotus* (21.03) in Trifolieae (21), the cotyledons' portions of the inner folded face were equal.

Margin. Most cotyledons have the margin 180 degrees opposite the base of the radicle entire (407 genera), but a few do not (27 genera). Nonentire margins 180 degrees from the base of the radicle are described as bearing flaps (2 genera), notched (15 genera), or wavy (6 genera). The vast majority of cotyledons are similar at the apex (413 genera), but six genera have cotyledons differing at the apex (one cotyledon concealed by the overarching radicle and the other auriculate and concealing the radicle).

A slight majority of cotyledons do not conceal the radicle (241 genera), that is, the radicle is exposed and visible (figure 6). Those that conceal the radicle do so either fully (30 genera) or partially (179 genera). Concealment of the radicle by the cotyledons is a useful characteristic for identifications of seeds.

The cotyledon margin over the radicle is described as entire (170 genera), notched (133 genera), or split (134 genera) (figure 6). The arrangement of cotyledon and radicle in two genera, *Chordospartium* (17.03) and *Streblorrhiza* (17.01),

both in Carmichaelieae (17), is rare in that one cotyledon is scooped out to accommodate a plicate radicle and the other cotyledon is entire.

The occurrence and condition of cotyledon lobes over the radicle are important characteristics for identification of genera. Most of the cotyledons do not have lobes over the radicle (307 genera), but some do (137 genera) (figure 6). The lobes are either overlapping (8 genera), touching (auriculate) (27 genera), or not touching (59 genera). Some of the lobed cotyledons have a basal groin formed by the lobes (17 genera), but most do not (43 genera).

The vast majority of cotyledons have the interface division terminating at the base of the radicle (412 genera). Only a few cotyledons have the interface division terminating in the radicle tissue (11 genera).

Most cotyledons do not have recessed cotyledon margins (398 genera), but a few do (33 genera), mainly in the tribes Phaseoleae (10) and Sophoreae (2). Most of the recessed cotyledons are recessed on just one margin (25 genera); just six genera are recessed on both margins so that the cotyledons are dumbbell-shaped in transection. The position of the recession is described as on the same side as the hilum (terminal radicle) (5 genera), on the same side as the radicle (17 genera), or on the side opposite from the radicle (3 genera).

Coloration. Cotyledon color was categorized as brown (76 genera), green (46 genera), orange (8 genera), pink (4 genera), red (12 genera), tan (217 genera), white (75 genera), or yellow (144 genera). The most common cotyledon color was various shades of brown, followed by yellow.

Inner face topography. Most cotyledons have flat inner faces (408 genera). Some cotyledon inner faces are not flat and are described as concave (16 genera), wavy (8 genera), having a central ridge on one cotyledon inner face and a matching central groove on the other (6 genera), or wrinkled (7 genera). One genus, *Antheroporum* in Millettieae (7), has some flat cotyledon inner faces and some with glands having the inside dotted with a yellow latex-like substance.

Pubescence. One genus, *Haplormosia* (2.16) in Sophoreae (2), has pubescent cotyledons around the base of the radicle; the rest have glabrous cotyledons around the base of the radicle (421 genera).

Smith (1983) studied cotyledon anatomy of approximately 900 species representing all major legume tribes and

recognized the following four cotyledon types: foliar, intermediate (sharing characteristics of foliar and storage types), storage, and anomalous (not fitting the first three types). The anomalous type is found in the following Faboideae: *Caragana* (16.11) in Galegeae (16), *Hippocrepis* (13.13) in Loteae (13), *Leptoderris nobilis* (F.M.J. Welwitsch ex J.G. Baker) S.T. Dunn in Millettieae (7), *Scorpiurus* (13.14) in Loteae, and *Sophora davidii* (A.R. Franchet) H.C. Skeels (2.45) in Sophoreae (2). Table 1 shows the distribution of the three cotyledon types in the Faboideae.

Table 1. Distribution of cotyledon types in the Faboideae

Tribe	Cotyledon type		
	Foliar	Intermediate	Storage
	------(%)-----		
Swartzieae	10	0	90
Sophoreae	35	5	60
Dipteryx	0	0	100
Dalbergieae	70	10	20
Abreae	0	0	100
Amorpheae	100	0	0
Millettieae	30	20	50
Robinieae	90	0	10
Indigofereae	100	0	0
Phaseoleae	20	5	75
Desmodieae	100	0	0
Psoraleae	100	0	0
Loteae	100	0	0
Aeschynomeneae	90	0	10
Adesmieae	100	0	0
Galegeae	80	0	20
Carmichaelieae	100	0	0
Hedysareae	93	5	2
Fabeae	0	0	100
Cicereae	0	0	100
Trifolieae	100	0	0
Brongniartieae	0	100	0
Bossiaeeae	15	55	30
Mirbelieae	55	35	10
Podalyrieae	100	0	0
Crotalariaeae	100	0	0
Euchrestaeae	0	0	100
Thermopsidaeae	100	0	0
Genisteae	92	5	3

Source: Smith 1983.

Embryonic axis

Alignment of cotyledons and radicle. The embryonic axis is characterized by the alignment of the cotyledons and radicle relative to each other (figure 7). The embryonic axis is described as deflexed (radicle-cotyledon axis deflexed) (228 genera), oblique (radicle-cotyledon axis oblique) (122 genera), parallel (radicle length parallel to cotyledon length) (13 genera), right angled (radicle right angled to length of cotyledons) (53 genera), or straight (radicle-cotyledon axis aligned) (58 genera). Most embryonic axes are bent, that is, not straight (375 genera), but there are 58 genera that have straight embryonic axes, the predominant type in the Caesalpinioideae and Mimosoideae (Gunn 1984, 1991).

The other orientation recorded was that between the axis of the embryo and the longest axis of the seed (which was also measured and recorded as the length of the seed). The orientation of these two axes is categorized as oblique (328 genera), parallel (73 genera), perpendicular (71 genera), or plicate (1 genus). Most embryonic axes are oblique to the longest axis of the seed.

Joint. A few embryonic axes have an evident joint between the radicle and the cotyledons (18 genera), but most do not (407 genera).

Radicle

Differentiation. The vast majority of radicles are clearly differentiated from the cotyledons (425 genera). Two genera, however, *Dussia* (2.24) in Sophoreae (2) and *Holocalyx* (1.12) in Swartzieae (1), have radicles and cotyledons not differentiated from each other. One genus, *Swartzia* (1.01) also in Swartzieae, mostly has radicles that are differentiated from the cotyledons and rarely has radicles that are not differentiated from the cotyledons. The undifferentiated radicle-cotyledons usually occur when the entire embryo is poorly developed.

Shape. The radicle shape is characterized as bulbous (191 genera), linear (230 genera), triangular (55 genera), or truncate (3 genera). Radicle shape is very useful for identification, especially when linear is contrasted against bulbous, triangular, and truncate. The very tip of the radicle has its own shape, independent of the overall radicle shape and is described as either straight (217 genera), curved (116 genera), or hooked (13 genera). Radicle tip shapes are also useful for identification.

Alignment with cotyledons. The alignment of just the radicle with the cotyledons is categorized as deflexed and parallel to cotyledon length (164 genera); deflexed and parallel to cotyledon width (92 genera); oblique to cotyledons (146 genera); with 90-degree turn (20 genera); with 180-degree turn (8 genera); with 360-degree turn (3 genera); or straight with embryonic axis, as is the case for mimosoids and caesalpinoids (43 genera). The vast majority of radicles are centered between the two cotyledons (411 genera). A few radicles are not centered between the two cotyledons, rather the radicle is outside of one cotyledon and inside of the other, so that the junction for each of the two cotyledons is different (15 genera).

Relative length. Radicle length is recorded relative to cotyledon length and is categorized as less than 1/2 the length of the cotyledons (360 genera), 1/2 to nearly the length of the cotyledons (82 genera), equal to the length of the cotyledons (16 genera), or exceeding the length of the cotyledons (10 genera). This characteristic is also useful for identifications.

Plumule

Development. Plumule development is characterized as rudimentary (283 genera), moderately developed (144 genera), or well developed (71 genera) (figure 7). This is especially useful for identification when rudimentary is contrasted against moderately and well developed. Most of the rudimentary plumules occur on embryos that have well-developed radicles.

Pubescence. The vast majority of plumules are glabrous, that is, completely lacking hairs (419 genera). Two genera, *Haplormosia* (2.16) in Sophoreae (2) and *Ormocarpopsis* (14.02) in Aeschynomeneae (14), have pubescent plumules.

Seed Key to Three Subfamilies of Fabaceae

1. Hilum split longitudinally (the faboid split), except flattened seeds; tracheid bar present in subhilar tissue; pleurogram absent; embryonic axis usually deflexed so that radicle nearly parallel to cotyledons or radicle once coiled; radicle not concealed by cotyledons Faboideae
Hilum without longitudinal split; tracheid bar absent from subhilar tissue; pleurogram present or absent; embryonic axis usually straight, rarely deflexed, thus radicle rarely parallel to cotyledons; radicle either concealed or exposed 2
2. Pleurogram usually present; radicle straight or at most slightly deflexed and tip not near cotyledons, either concealed or partially concealed by cotyledons or cotyledons notched and radicle exposed Mimosoideae, see Gunn (1984)
Pleurogram usually absent; radicle straight to deflexed and not concealed by cotyledons Cesalpinioideae, see Gunn (1991)
9. Endosperm present Subkey 6
Endosperm absent Subkey 7
10. Hilum raised or flush Subkey 8
Hilum recessed Subkey 9
11. Cotyledons entire over radicle 12
Cotyledons notched at or split over radicle or 1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire 14
12. Endosperm present 13
Endosperm absent Subkey 10
13. Hilum raised or flush Subkey 11
Hilum recessed Subkey 12
14. Cotyledons notched at or split over radicle 15
1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire Subkey 13
15. Cotyledons notched at radicle Subkey 14
Cotyledons split over radicle 16
16. Hilum raised or flush Subkey 15
Hilum recessed Subkey 16

Seed Keys to Genera of Subfamily Faboideae

Master Key to 16 Seed Keys and One Genus

1. Aril present 2
Aril absent 11
2. Aril fleshy 3
Aril dry 5
3. Cotyledons entire over radicle Subkey 1
Cotyledons notched at or split over radicle 4
4. Cotyledons notched at radicle Subkey 2
Cotyledons split over radicle Subkey 3
5. Cotyledons entire over radicle 6
Cotyledons notched at or split over radicle or 1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire 7
6. Hilum raised or flush Subkey 4
Hilum recessed Subkey 5
7. Cotyledons notched at or split over radicle 8
1 cotyledon scooped out to accommodate plicate radicle and other cotyledon entire *Panurea*, 2.30
8. Cotyledons notched at radicle 9
Cotyledons split over radicle 10
9. Endosperm present 2
Endosperm absent 20
10. Radicle bulbous 3
Radicle linear 12
11. Endosperm thick 4
Endosperm thin 9
12. Plumule rudimentary 5
Plumule moderately or well developed 6
13. Seed 10–12 mm long; aril crenate; testa dull; raphe not visible; hilum marginal according to radicle tip; lens linear *Vandasina*, 10.49
Seed 2.5–3.5 mm long; aril entire; testa glossy; raphe visible; hilum apical according to radicle tip but marginal according to seed length; lens oblong *Xiphotheca*, 25.01

6. Hilum flush; seed terete; raphe not visible; cotyledons not smooth *Kennedia*, 10.47
Hilum recessed; seed compressed; raphe visible; cotyledons smooth 7
7. Hilum visible, with straight outline; radicle oblique to cotyledons *Podalyria*, 25.06
Hilum partially concealed, with curved outline; radicle deflexed and parallel to cotyledon width .. 8
8. Aril annular; seed with umbo on seed faces; embryonic axis oblique, perpendicular to length of seed; raphe lighter than testa *Cyclopia*, 25.05
Aril cupshaped; seed without umbo on seed faces; embryonic axis deflexed, oblique to length of seed; raphe darker than testa *Liparia*, 25.04
9. Hilum punctiform; seed terete; testa black; cotyledons with margins recessed; radicle 1/2 to nearly length of cotyledons *Goodia*, 23.05
Hilum larger than punctiform; seed compressed; testa brown; cotyledons without margins recessed; radicle less than 1/2 length of cotyledons 10
10. Plumule rudimentary; seed without umbo on seed faces; aril brown; lens discernible 11
Plumule moderately or well developed; seed with umbo on seed faces; aril tan; lens not discernible *Codariocalyx*, 11.10
11. Testa dull; hilum visible, with curved outline, between cotyledon and radicle lobe, within halo or rim; cotyledons green *Coelidium*, 25.03
Testa glossy; hilum partially concealed, with straight outline, marginal according to radicle tip, not within halo or rim; cotyledons tan ... *Nemcia*, 24.15
12. Hilum punctiform 13
Hilum larger than punctiform 14
13. Seed 2 mm long; aril cupshaped; seed compressed; testa brown; hilum within rim; cotyledons without margins recessed *Latrobea*, 24.18
Seed 2.7–4 mm long; aril hooked; seed terete; testa black; hilum not within rim; cotyledons with margins recessed *Goodia*, 23.05
14. Plumule rudimentary 15
Plumule moderately or well developed 18
15. Hilum partially concealed; seed without umbo on seed faces 16
Hilum fully concealed; seed with umbo on seed faces *Platylobium*, 23.07
16. Cotyledons partially concealing radicle; testa chartaceous; embryonic axis straight; hilum with curved outline *Ophrestia*, 10.11
Cotyledons not concealing radicle; testa coriaceous; embryonic axis deflexed; hilum with straight outline 17
17. Endosperm thick; aril white; radicle deflexed and parallel to cotyledon width; cotyledons yellow; lens circular *Hypocalyptus*, 26.01
Endosperm thin; aril brown; radicle deflexed and parallel to cotyledon length; cotyledons tan; lens oblong *Nemcia*, 24.15
18. Hilum flush *Leptodesmia*, 11.20
Hilum recessed 19
19. Hilum within rim; endosperm thin, adnate to testa; embryonic axis deflexed, parallel to length of seed *Abrus*, 5.01
Hilum not within rim; endosperm thick, adnate to embryo; embryonic axis oblique, oblique to length of seed *Virgilia*, 25.08
20. Hilum flush 21
Hilum recessed 22
21. Hilum punctiform; seed not angular; without umbo on seed faces; testa coriaceous; hilum not within halo *Bocoa*, 1.02
Hilum larger than punctiform; seed angular; with umbo on seed faces; testa chartaceous; hilum within halo *Candolleodendron*, 1.03
22. Testa coriaceous 23
Testa chartaceous 24
23. Seed 3.6–4.7 mm long; radicle less than 1/2 length of cotyledons; rim-aril 2-lipped; seed symmetrical; without visible radicle and cotyledon lobes; hilum partially concealed *Chrysoscias*, 10.78
Seed 2.7–3 mm long; radicle 1/2 to nearly length of cotyledons; aril cupshaped; seed asymmetrical, with visible radicle and cotyledon lobes; hilum visible *Amphithalea*, 25.02
24. Hilum with faboid split; cotyledons with margins recessed; radicle linear; seed with shallow hilar sinus; cuticle absent; lens discernible *Platysepalum*, Millettieae
Hilum without faboid split; cotyledons without margins recessed; radicle triangular; seed without hilar sinus; cuticle present; lens not discernible *Swartzia*, 1.01

Seed Key 2: Aril present; fleshy. Cotyledons notched at radicle.

1. Radicle lobe tip curved 2
Radicle lobe tip straight 19
2. Plumule rudimentary 3
Plumule moderately or well developed 8
3. Hilum flush 4
Hilum recessed 5
4. Testa osseous or coriaceous; hilum marginal according to radicle tip; embryonic axis oblique, oblique or perpendicular to length of seed; radicle triangular, oblique to cotyledons *Mucuna*, 10.03
Testa chartaceous; hilum apical at apex of or subapical to radicle tip; embryonic axis straight, parallel to length of seed; radicle bulbous, straight with embryonic axis *Alexa*, 2.12a
5. Seed asymmetrical; aril brown or tan; hilum not within rim 6
Seed symmetrical; aril cream or white; hilum within rim 7
6. Testa mottled; hilum circular or oval; endosperm absent; cotyledons yellow, without lobes *Xeroderris*, *Millettieae*
Testa monochrome; hilum elliptic; endosperm present; cotyledons brown, with lobes *Uribea*, 2.04
7. Endosperm present; cotyledons not smooth, white or yellow; radicle with 90 degree turn *Teramnus*, 10.36
Endosperm absent; cotyledons smooth, tan; radicle oblique to cotyledons *Piscidia*, *Millettieae*
8. Radicle linear or triangular 9
Radicle bulbous 14
9. Cotyledons brown or tan *Mucuna*, 10.03
Cotyledons white 10
10. Testa coriaceous 11
Testa chartaceous 12
11. Hilum raised or flush; lens within rim, punctiform; cotyledons without margins recessed *Eriosema*, 10.81
Hilum recessed; lens not within rim, oblong or ovate; cotyledons with margins recessed *Vigna*, 10.66
12. Hilum flush, marginal according to radicle tip; lens flush *Dipogon*, 10.63
Hilum recessed, apical according to radicle tip but marginal according to seed length; lens mounded 13
13. Endocarp cobwebby or fibrous; lens linea *Macroptilium*, 10.71
Endocarp pithy or smooth; lens oblong or ovate *Vigna*, 10.66
14. Endocarp nonseptate; hilum raised or flush; lens punctiform *Eriosema*, 10.81
Endocarp septate or subseptate; hilum recessed; lens much larger than punctiform 15
15. Endosperm absent 16
Endosperm present 17
16. Hilum apical according to radicle tip but marginal according to seed length; lens not within rim, oblong or ovate *Vigna*, 10.66
Hilum marginal according to radicle tip; lens within rim, elliptic or linear *Lablab*, 10.61
17. Lens mounded, oblong or ovate; endosperm trace, restricted to region of embryo *Vigna*, 10.66
Lens flush, circular or linear; endosperm thick, covering entire embryo 18
18. Seed without umbo on seed faces; testa not smooth; lens linear; embryonic axis perpendicular to length of seed *Teyleria*, 10.39
Seed with umbo on seed faces; testa smooth; lens circular; embryonic axis oblique to length of seed *Teramnus*, 10.36
19. Cotyledons margin not entire 180 degrees from base of radicle 20
Cotyledons margin entire 180 degrees from base of radicle 22
20. Seed 11–12 mm long; testa red, smooth; hilum recessed; cotyledons without lobes; radicle triangular *Baphiastrum*, 2.22
Seed 17–70 mm long; testa brown, not smooth; hilum raised or flush; cotyledons with lobes; radicle bulbous or truncate 21
21. Testa mottled; hilum raised, within rim; radicle truncate *Uleanthus*, 2.29
Testa monochrome; hilum flush, not within rim; radicle bulbous *Clathrotropis*, 2.26
22. Testa absent 23
Testa present 24

23. Seed ca. 35 mm long, ca. 25.5 mm wide, ovate, flattened, with surface smooth; cotyledons with lobes; radicle bulbose *Monopteryx*, 2.31
Seed 15–20 mm long, 9–10 mm wide, elliptic, terete, with surface wrinkled; cotyledons without lobes; radicle triangular *Angylocalyx*, 2.13
24. Plumule rudimentary 25
Plumule moderately or well developed 28
25. Seed D-shaped or reniform; endosperm present; embryonic axis deflexed, oblique to length of seed; radicle linear *Dalbergiella*, *Millettieae*
Seed bilobed (cicerlike), circular, elliptic, oblong, or ovate; endosperm absent; embryonic axis straight, parallel to length of seed; radicle bulbose or triangular 26
26. Aril ivory, olive, or tan; hilum recessed, within corona; radicle triangular *Bowringia*, 2.21
Aril black, brown, or yellow; hilum flush, not within corona or within rim; radicle bulbose 27
27. Seed 23–38 mm long; aril crenate, black or brown; testa brown, chartaceous *Alexa*, 2.12a
Seed 13.5–20 mm long; aril fimbriate, yellow; testa black or red, coriaceous *Leucomphalos*, 2.23
28. Hilum recessed 29
Hilum raised or flush 32
29. Cotyledons white 30
Cotyledons pink or tan 31
30. Aril cream; lens equal to or greater than 0.5 mm in length, not within corona, oblong or ovate *Vigna*, 10.66
Aril tan; lens less than 0.5 mm in length, within corona, linear *Austrodolichos*, 10.59
31. Endosperm present; cotyledons tan; radicle bulbose *Rhynchosia*, 10.80
Endosperm absent; cotyledons pink; radicle linear *Decorsea*, 10.54
32. Endosperm present 33
Endosperm absent 34
33. Hilum with straight outline; lens punctiform, similar color as testa; cotyledons white *Eriosema*, 10.81
Hilum with curved outline; lens elliptic or linear, dissimilar color from testa; cotyledons tan *Rhynchosia*, 10.80
34. Hilum with straight outline 35
Hilum with curved outline 37
35. Testa chartaceous *Dolichos*, 10.64
Testa coriaceous 36
36. Seed elliptic, oblong, or quadrangular; hilum within rim; lens mounded, within rim, punctiform *Eriosema*, 10.81
Seed ovate; hilum not within rim; lens flush, not within rim, linear *Nesphostylis*, 10.58
37. Testa chartaceous; lens within corona or rim; fruit rounded or short tapered at base *Dolichos*, 10.64
Testa coriaceous; lens not within corona or rim or within halo; fruit tapered at base 38
38. Seed compressed; lens circular, mounded, within halo *Dunbaria*, 10.74
Seed terete; lens linear, flush, lens not within halo *Cajanus*, 10.73

Seed Key 3: Aril present; fleshy. Cotyledons split at radicle.

1. Cotyledons completely or partially concealing radicle 2
Cotyledons not concealing radicle 15
2. Hilum raised or flush 3
Hilum recessed 8
3. Testa not smooth; endosperm absent; cotyledons not smooth 4
Testa smooth; endosperm present; cotyledons smooth 5
4. Cotyledons margin not entire 180 degrees from base of radicle, with lobes touching (auriculate) or not touching, brown; embryonic axis oblique to length of seed *Clathrotropis*, 2.26
Cotyledons margin entire 180 degrees from base of radicle, with lobes overlapping, orange; embryonic axis parallel to length of seed *Dalhousiea*, 2.20
5. Plumule moderately or well developed; raphe visible; radicle bulbose 6
Plumule rudimentary; raphe not visible; radicle linear 7
6. Hilum marginal according to radicle tip; lens similar color as testa, brown; embryonic axis oblique to length of seed *Hovea*, 23.04
Hilum subapical to radicle tip; lens dissimilar color from testa, black; embryonic axis parallel to length of seed *Plagiocarpus*, 23.03

7. Aril flat from apex to near base, tan; hilum marginal according to radicle tip, not within rim; cotyledons with lobes not touching *Bossiaea*, 23.06
Aril caplike or cupshaped, brown; hilum subapical to radicle tip, within rim; cotyledons with lobes touching (auriculate) *Templetonia*, 23.01
8. Plumule moderately or well developed; fruit long tapered or tapered at base 9
Plumule rudimentary; fruit rounded or short tapered at base 10
9. Aril brown or tan; lens adjacent to hilum, elliptic or linear; cotyledons tan; embryonic axis straight *Brongniartia*, 22.01
Aril cream; lens confluent with hilum, oblong or ovate; cotyledons white; embryonic axis oblique or right angled *Vigna*, 10.66
10. Radicle linear or triangular 11
Radicle bulbous 13
11. Seed 3–3.5 mm long; aril flat from apex to near base; cotyledons with lobes not touching, yellow; radicle deflexed and parallel to cotyledon width *Bossiaea*, 23.06
Seed 5–37 mm long; aril cupshaped, hooked, 2-lipped rim-aril, or topknotlike; cotyledons with lobes overlapping or touching (auriculate), tan or white; radicle oblique to cotyledons or straight with embryonic axis 12
12. Seed 5–15 mm long; hilum fully concealed, elliptic; endosperm present; cotyledons both more or less of equal length; radicle linear *Harpalyce*, 22.02
Seed 20–37 mm long; hilum visible, heart-shaped or oval; endosperm absent; cotyledons 1 longer than other; radicle triangular *Camoensia*, 2.39
13. Seed 20–37 mm long; hilum heart-shaped or oval, within corona or rim; lens lighter than testa; endosperm absent; cotyledons 1 longer than other *Camoensia*, 2.39
Seed 5.3–8 mm long; hilum elliptic, not within corona or rim or within halo; lens darker than testa; endosperm present; cotyledons both more or less of equal length 14
14. Seed oblong; aril cupshaped; endosperm covering entire embryo; cotyledons with lobes, yellow *Lamprolobium*, 23.02
Seed reniform; aril hippocrepiform rim-aril; endosperm covering at least 1/2 of embryo but not entire embryo; cotyledons without lobes, green *Crudasia*, 10.13
15. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons 16
Radicle less than 1/2 length of cotyledons 26
16. Seed with umbo on seed faces; cuticle wrinkled *Chamaecytisus*, 30.15A
Seed without umbo on seed faces; cuticle not wrinkled 17
17. Endosperm thin 18
Endosperm thick 22
18. Aril yellow; seed mitaform; hilum flush *Eutaxia*, 24.26
Aril brown, red, tan, or white; seed circular, D-shaped, irregular, oblong, ovate, quadrangular, rectangular, reniform, rhombic, or triangular; hilum recessed 19
19. Radicle linear 20
Radicle bulbous 21
20. Hilum visible or fully concealed, circular; lens elliptic or oblong *Genista*, 30.22
Hilum partially concealed, elliptic; lens circular *Urodon*, 24.22
21. Fruit rounded at apex; epicarp smooth; funiculus flattened *Stauracanthus*, 30.24
Fruit tapered or short tapered at apex; epicarp not smooth; funiculus filiform, thick, or triangular *Genista*, 30.22
22. Hilum within halo; endocarp glossy .. *Dillwynia*, 24.25
Hilum within rim; endocarp dull 23
23. Hilum elliptic or oval; epicarp smooth 24
Hilum circular; epicarp not smooth 25
24. Seed 2–3 mm long; aril brown, cream, ivory, or tan; hilum fully concealed; radicle bulbous; lens key-hole shaped or oblong *Ulex*, 30.25
Seed 4–5 mm long; aril yellow; hilum partially concealed; radicle linear; lens circular *Cytisophyllum*, 30.12
25. Testa glossy *Genista*, 30.22
Testa dull *Cytisus*, 30.15
26. Plumule moderately or well developed 27
Plumule rudimentary 31
27. Hilum flush, marginal according to radicle tip 28
Hilum recessed, apical according to radicle tip but marginal according to seed length or between cotyledon and radicle lobe 29

28. Seed with umbo on seed faces; endosperm thin, adnate to testa; cotyledons with lobes, white or yellow; radicle triangular *Vicia*, 19.01
Seed without umbo on seed faces; endosperm thick, adnate to embryo; cotyledons without lobes, tan; radicle bulbous *Hardenbergia*, 10.48
29. Aril cream; hilum apical according to radicle tip but marginal according to seed length; cotyledons white; lens oblong or ovate *Vigna*, 10.66
Aril brown or tan; hilum between cotyledon and radicle lobe; cotyledons tan or yellow; lens circular or key-hole shaped 30
30. Hilum with curved outline; lens key-hole shaped; endosperm thick, adnate to embryo *Brachysema*, 24.16
Hilum with straight outline; lens circular; endosperm thin, adnate to testa *Almaleea*, 24.24
31. Aril covering 1/2 to nearly all of seed 32
Aril covering less than 1/2 of seed 33
32. Aril cupshaped; hilum not within rim or within halo; lens elliptic; cotyledons yellow *Daviesia*, 24.04
Aril marginal hilar or topknotlike; hilum within rim; lens circular or oblong; cotyledons brown or tan *Gastrolobium*, 24.13
33. Hilum elliptic, within rim; endosperm thin; lens circular *Pultenaea*, 24.23
Hilum circular or oval, not within rim or within halo; endosperm thick; lens key-hole shaped or oblong 34
34. Aril cupshaped; testa monochrome; hilum oval; lens key-hole shaped *Brachysema*, 24.16
Aril topknotlike; testa streaked; hilum circular; lens oblong *Dillwynia*, 24.25
- Seed Key 4: Aril present; dry. Cotyledons entire over radicle. Hilum raised or flush.**
1. Radicle 1/2 to nearly length of cotyledons 2
Radicle less than 1/2 length of cotyledons 8
2. Radicle linear; fruit compressed 3
Radicle bulbous; fruit flattened or terete 5
3. Seed 3–4 mm long, with surface grooved; hilum not within halo or rim; cotyledons with both folded, differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) *Cyamopsis*, 9.06
- Seed 1.2–2.3 mm long, with surface smooth; hilum within halo or rim; cotyledons not folded, similar at apex; radicle centered between cotyledons 4
4. Seed 1.5–2.3 mm long; hilum within halo; endosperm adnate to testa; cotyledons tan; radicle deflexed and parallel to cotyledon width; plumule moderately developed *Kummerowia*, 11.25
Seed 1.2–1.3 mm long; hilum within rim; endosperm adnate to embryo; cotyledons white; radicle deflexed and parallel to cotyledon length; plumule rudimentary *Melliniella*, 11.19
5. Aril brown; testa chartaceous; hilum within rim; lens diamond-shaped; plumule moderately developed *Biserrula*, 16.15A
Aril white; testa coriaceous; hilum not within rim or within halo; lens circular, elliptic, or linear; plumule rudimentary 6
6. Seed 2–2.5 mm long; lens elliptic; endosperm thin *Sphaerophysa*, 16.07
Seed 3.5–4 mm long; lens circular or linear; endosperm thick 7
7. Seed with external groove between radicle and cotyledon lobes; hilum between cotyledon and radicle lobe; cotyledons outer face of 1 cotyledon flat and other cotyledon convex .. *Swainsona*, 16.02
Seed without external groove between radicle and cotyledon lobes; hilum marginal according to radicle tip; cotyledons both outer faces convex *Clianthus*, 16.01
8. Endosperm absent 9
Endosperm present 11
9. Seed 25–30 mm long, D-shaped or rectangular; testa mottled, osseous; hilum not within rim; cotyledons 1 thicker than the other... *Macropsychanthus*, 10.22
Seed 7–12 mm long, circular, elliptic, ovate, or reniform; testa monochrome, coriaceous or chartaceous; hilum within rim; cotyledons both the same thickness 10
10. Aril fimbriate; testa coriaceous; cotyledons margin not entire 180 degrees from base of radicle; embryonic axis perpendicular to length of seed, with a joint evident between the radicle and the cotyledons *Cleobulia*, 10.20
Aril entire; testa chartaceous; cotyledons margin entire 180 degrees from base of radicle; embryonic axis parallel to length of seed, without a joint evident between the radicle and the cotyledons *Apurimacia*, Millettieae

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| <p>11. Hilum punctiform 12
Hilum larger than punctiform 17</p> <p>12. Aril brown; epicarp pubescent and indurate or
pubescent but soon deciduous 13
Aril white; epicarp glabrous 14</p> <p>13. Lens similar color as testa, elliptic; cotyledons tan;
radicle bulbose; plumule rudimentary
..... <i>Oxytropis</i>, 16.17
Lens dissimilar color from testa, oblong; cotyledons
white; radicle linear; plumule moderately
developed <i>Mecopus</i>, 11.15</p> <p>14. Endosperm thick; radicle bulbose <i>Clianthus</i>, 16.01
Endosperm thin; radicle linear 15</p> <p>15. Aril tongue-aril; hilum within halo; cotyledons margin
not entire 180 degrees from base of radicle
..... <i>Ptychosema</i>, 23.09
Aril hooded or rim-aril; hilum not within halo;
cotyledons margin entire 180 degrees from base of
radicle 16</p> <p>16. Aril hooded; testa black; hilum concealed by aril;
cotyledons yellow; radicle oblique to cotyledons
..... <i>Aenictophyton</i>, 23.10
Aril rim-aril; testa brown or orange; hilum concealed
by funicular remnant; cotyledons tan; radicle
deflexed and parallel to cotyledon length
..... <i>Caragana</i>, 16.11</p> <p>17. Cotyledons not concealing radicle 18
Cotyledons completely or partially concealing radicle
..... 20</p> <p>18. Endosperm adnate to embryo; radicle bulbose
..... <i>Cologania</i>, 10.43
Endosperm adnate to testa; radicle linear 19</p> <p>19. Aril white; hilum circular; cotyledons tan; embryonic
axis oblique to length of seed; lens circular,
elliptic, or wedge-shaped <i>Caragana</i>, 16.11
Aril tan; hilum elliptic; cotyledons yellow; embryonic
axis parallel to length of seed; lens linear
..... <i>Psoralea</i>, 12.09</p> <p>20. Cotyledons white <i>Ophrestia</i>, 10.11
Cotyledons brown or tan 21</p> <p>21. Cotyledons inner face with central ridge on 1 and
central groove on other; embryonic axis parallel
..... <i>Chadsia</i>, Millettiae
Cotyledons inner face flat; embryonic axis deflexed,
oblique, or straight 22</p> | <p>22. Seed ca. 4 mm long; lens circular, mounded; en-
dosperm covering entire embryo; cotyledons
completely concealing radicle; radicle deflexed and
parallel to cotyledon length <i>Eleiotis</i>, 11.21
Seed 5–27 mm long; lens linear, flush or recessed;
endosperm covering at least 1/2 of embryo, but not
entire embryo or restricted to region of embryo;
cotyledons partially concealing radicle; radicle
oblique to cotyledons, with 90-, or with 180-degree
turn 23</p> <p>23. Seed elliptic, rectangular, or reniform; lens flush, not
within halo or rim; radicle linear; radicle lobe tip
curved <i>Ophrestia</i>, 10.11
Seed oblong or ovate; lens recessed, within halo or
rim; radicle bulbose or triangular; radicle lobe tip
straight <i>Dioclea</i>, 10.18</p> <p>Seed Key 5: Aril present; dry. Cotyledons entire over
radicle. Hilum recessed.</p> <p>1. Radicle bulbose 2
Radicle linear, triangular, or truncate 29</p> <p>2. Embryonic axis with a joint evident between the
radicle and the cotyledons 3
Embryonic axis without a joint evident between the
radicle and the cotyledons 6</p> <p>3. Hilum punctiform; aril white 4
Hilum larger than punctiform; aril brown 5</p> <p>4. Testa coriaceous; hilum visible; endosperm thick,
adnate to embryo; cotyledons partially concealing
radicle <i>Lessertia</i>, 16.04
Testa chartaceous; hilum partially or fully concealed;
endosperm thin, adnate to testa; cotyledons not
concealing radicle <i>Eremosparton</i>, 16.09</p> <p>5. Seed ca. 20 mm long; symmetrical; aril crenate; testa
chartaceous; endosperm absent; cotyledons with
lobes <i>Panurea</i>, 2.30
Seed 3.5–4.5 mm long; asymmetrical; aril entire; testa
coriaceous; endosperm present; cotyledons without
lobes <i>Galega</i>, 16.20</p> <p>6. Endosperm present 7
Endosperm absent 26</p> <p>7. Endosperm thick 8
Endosperm thin 18</p> <p>8. Cotyledons similar at apex 9
Cotyledons differing at apex (1 concealed by over-
arching radicle and other auriculate and concealing
radicle) <i>Carmichaelia</i>, 17.05</p> |
|---|---|

9.	Hilum punctiform	10	25.	Hilum marginal according to radicle tip; endocarp glossy	<i>Nemcia</i> , 24.15
	Hilum larger than punctiform	14		Hilum between cotyledon and radicle lobe; endocarp dull	<i>Astragalus</i> , 16.15
10.	Seed with umbo on seed faces; rim present	<i>Smirnowia</i> , 16.08	26.	Cotyledons with lobes, with margins recessed	<i>Sophora</i> , 2.45
	Seed without umbo on seed faces; rim absent	11		Cotyledons without lobes, without margins recessed	27
11.	Endocarp present	12	27.	Seed 10–20 mm long; radicle lobe tip straight; hilum within corona, halo, or rim	28
	Endocarp absent	<i>Sutherlandia</i> , 16.03		Seed ca. 6 mm long; radicle lobe tip curved; hilum not within corona, halo, or rim	<i>Craspedolobium</i> , Millettieae
12.	Endocarp dull	13	28.	Seed 10–11 mm long; hilum visible; lens discernible; epicarp veined; testa glossy; cotyledons tan	<i>Sakoanala</i> , 2.35
	Endocarp glossy	<i>Jacksonia</i> , 24.08		Seed 16–20 mm long; hilum partially concealed; lens not discernible; epicarp not veined; testa dull; cotyledons brown	<i>Craibia</i> , Millettieae
13.	Epicarp veined	<i>Astragalus</i> , 16.15	29.	Plumule rudimentary	30
	Epicarp not veined	<i>Crotalaria</i> , 27.07		Plumule moderately or well developed	71
14.	Cotyledons with lobes; cotyledons with margins recessed	<i>Sophora</i> , 2.45	30.	Testa coriaceous	31
	Cotyledons without lobes; cotyledons without margins recessed	15		Testa chartaceous	64
15.	Cotyledons inner face flat	16	31.	Seed symmetrical	32
	Cotyledons inner face concave	<i>Colutea</i> , 16.05		Seed asymmetrical	35
16.	Radicle deflexed and parallel to cotyledon length; endocarp dull, nonseptate	17	32.	Epicarp veined; seed wings present .	<i>Phylacium</i> , 11.22
	Radicle deflexed and parallel to cotyledon width; endocarp glossy, septate	<i>Bobgunnia</i> , 1.01A		Epicarp not veined; seed wings absent	33
17.	Epicarp veined	<i>Astragalus</i> , 16.15	33.	Hilum elliptic; raphe visible	34
	Epicarp not veined	<i>Crotalaria</i> , 27.07		Hilum oval; raphe not visible	<i>Camptosema</i> , 10.24
18.	Hilum within corona, halo, or rim	19	34.	Cotyledons with lobes, with margins recessed; hilum with faboid split	<i>Sophora</i> , 2.45
	Hilum not within corona, halo, or rim	23		Cotyledons without lobes, without margins recessed; hilum without faboid split	<i>Craibia</i> , Millettieae
19.	Cotyledons with lobes	<i>Sophora</i> , 2.45	35.	Embryonic axis oblique to length of seed	36
	Cotyledons without lobes	20		Embryonic axis parallel or perpendicular to length of seed	62
20.	Embryonic axis oblique to length of seed	21	36.	Testa not modified by a bloom	37
	Embryonic axis parallel to length of seed	<i>Astracantha</i> , 16.16		Testa modified by a bloom	61
21.	Fruit a legume; endocarp nonseptate	22	37.	Cotyledons 1 longer than other; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different)	<i>Lennea</i> , 8.03
	Fruit a loment (or a loment segment); endocarp septate	<i>Urania</i> , 11.16		Cotyledons both more or less of equal length; radicle centered between cotyledons	38
22.	Fruit with persistent calyx	<i>Astragalus</i> , 16.15			
	Fruit with deciduous calyx	<i>Halimodendron</i> , 16.10			
23.	Epicarp glabrous	24			
	Epicarp pubescent	25			
24.	Fruit with persistent calyx	<i>Astragalus</i> , 16.15			
	Fruit with deciduous calyx	<i>Poitea</i> , 8.05			

38. Raphe visible 39
 Raphe not visible 40
39. Seed 3–5 mm long; endosperm present; hilum not within rim; hilum with faboid split *Poitea*, 8.05
 Seed 16–20 mm long; endosperm absent; hilum within rim; hilum without faboid split *Craibia*, *Millettieae*
40. Radicle deflexed and parallel to cotyledon length ... 41
 Radicle deflexed and parallel to cotyledon width 60
41. Radicle less than 1/2 length of cotyledons 42
 Radicle 1/2 to nearly length of cotyledons 58
42. Testa smooth 43
 Testa not smooth 56
43. Seed angular 44
 Seed not angular 46
44. Epicarp veined; endocarp glossy *Oxylobium*, 24.09
 Epicarp not veined; endocarp dull 45
45. Endosperm adnate to testa; fruit inflated; endocarp nonseptate *Crotalaria*, 27.07
 Endosperm adnate to embryo; fruit not inflated; endocarp septate *Alhagi*, 16.21
46. Epicarp veined 47
 Epicarp not veined 53
47. Hilum within corona, halo, or rim 48
 Hilum not within corona, halo, or rim 50
48. Endocarp septate; fruit wings present *Desmodium*, 11.09
 Endocarp nonseptate; fruit wings absent 49
49. Hilum marginal according to radicle tip; endosperm thin; rim-aril; endocarp dull *Lespedeza*, 11.24
 Hilum between cotyledon and radicle lobe; endosperm thick; tongue-aril; endocarp glossy *Oxylobium*, 24.09
50. Fruit wings present *Desmodium*, 11.09
 Fruit wings absent 51
51. Endosperm thick *Oxylobium*, 24.09
 Endosperm thin 52
52. Endocarp dull; epicarp glabrous; fruit with deciduous calyx *Poitea*, 8.05
 Endocarp glossy; epicarp pubescent; fruit with persistent calyx *Nemcia*, 24.15
53. Seed with visible radicle and cotyledon lobes 54
 Seed without visible radicle and cotyledon lobes 55
54. Endosperm thick; fruit inflated *Crotalaria*, 27.07
 Endosperm thin; fruit not inflated *Poitea*, 8.05
55. Fruit wings present; fruit with persistent calyx *Desmodium*, 11.09
 Fruit wings absent; fruit with deciduous calyx *Poitea*, 8.05
56. Seed with visible radicle and cotyledon lobes; lens adjacent to hilum, mounded; fruit wings absent; endocarp nonseptate 57
 Seed without visible radicle and cotyledon lobes; lens confluent with hilum, flush; fruit wings present; endocarp septate *Desmodium*, 11.09
57. Lens less than 0.5 mm in length; endocarp glossy; fruit not inflated *Jacksonia*, 24.08
 Lens equal to or greater than 0.5 mm in length; endocarp dull; fruit inflated *Crotalaria*, 27.07
58. Endosperm thick; fruit inflated *Crotalaria*, 27.07
 Endosperm thin; fruit not inflated 59
59. Seed 2–2.5 mm long; hilum within rim; epicarp pubescent *Melolobium*, 30.01
 Seed 3–5 mm long; hilum not within rim; epicarp glabrous *Poitea*, 8.05
60. Endosperm thick; radicle lobe tip curved *Mirbelia*, 24.11
 Endosperm thin; radicle lobe tip straight .. *Poitea*, 8.05
61. Seed 2.5–4.5 mm long, with visible radicle and cotyledon lobes; endosperm present; cotyledons not concealing radicle; radicle lobe tip curved *Baptisia*, 29.05
 Seed 16–20 mm long, without visible radicle and cotyledon lobes; endosperm absent; cotyledons partially concealing radicle; radicle lobe tip straight *Craibia*, *Millettieae*
62. Hilum visible; not within corona, halo, or rim; with faboid split; lens discernible; fruit a loment (or a loment segment) *Trifidacanthus*, 11.05
 Hilum partially or fully concealed; within corona, halo, or rim; without faboid split; lens not discernible; fruit a legume 63
63. Testa dull; hilum larger than punctiform; endosperm absent; cotyledons partially concealing radicle; brown *Craibia*, *Millettieae*
 Testa glossy; hilum punctiform; endosperm present; cotyledons not concealing radicle; yellow *Cullen*, 12.01

64. Cotyledons with lobes *Sophora*, 2.45
Cotyledons without lobes 65
65. Seed with shallow hilar sinus; cotyledons with margins recessed *Platysepalum*, Millettiae
Seed without hilar sinus; cotyledons without margins recessed 66
66. Lens discernible 67
Lens not discernible 70
67. Lens less than 0.5 mm in length 68
Lens equal to or greater than 0.5 mm in length 69
68. Cotyledons partially concealing radicle; embryonic axis straight; lens similar color as testa; radicle oblique to cotyledons *Ophrestia*, 10.11
Cotyledons not concealing radicle; embryonic axis deflexed; lens dissimilar color from testa; radicle deflexed and parallel to cotyledon length *Desmodium*, 11.09
69. Lens confluent with hilum, flush, dissimilar color from testa; embryonic axis deflexed, oblique to length of seed *Desmodium*, 11.09
Lens adjacent to hilum, mounded, similar color as testa; embryonic axis oblique, parallel to length of seed *Cladrastis*, 2.41
70. Seed 16–20 mm long; hilum elliptic, concealed by aril; raphe visible; cotyledons partially concealing radicle; embryonic axis without a joint evident between the radicle and the cotyledons *Craibia*, Millettiae
Seed ca. 11 mm long; hilum oval, concealed by funicular remnant; raphe not visible; cotyledons not concealing radicle; embryonic axis with a joint evident between the radicle and the cotyledons *Hesperothamnus*, Millettiae
71. Cotyledons 1 longer than other 72
Cotyledons both more or less of equal length 74
72. Testa coriaceous; endosperm present; cotyledons completely or partially concealing radicle; embryonic axis deflexed, oblique to length of seed 73
Testa chartaceous; endosperm absent; cotyledons not concealing radicle; embryonic axis oblique, perpendicular to length of seed *Bergeronia*, Millettiae
73. Seed 3.2–6 mm long, with visible radicle and cotyledon lobes; hilum punctiform; cotyledons smooth *Thermopsis*, 29.04
Seed 9–12 mm long, without visible radicle and cotyledon lobes; hilum larger than punctiform; cotyledons not smooth *Lennea*, 8.03
74. Seed with umbo on seed faces 75
Seed without umbo on seed faces 78
75. Hilum visible; radicle less than 1/2 length of cotyledons 76
Hilum fully concealed; radicle 1/2 to nearly length of cotyledons *Polhillia*, 30.04
76. Endosperm adnate to testa 77
Endosperm adnate to embryo *Pseudarthria*, 11.11
77. Seed 1.2–1.5 mm long; hilum punctiform; endosperm thin; cotyledons not folded, partially concealing radicle; embryonic axis without a joint evident between the radicle and the cotyledons *Aphyllodium*, 11.08
Seed 2.5–3.7 mm long; hilum larger than punctiform; endosperm thick; cotyledons both folded, not concealing radicle; embryonic axis with a joint evident between the radicle and the cotyledons *Tadehagi*, 11.13
78. Fruit inflated 79
Fruit not inflated 81
79. Seed with visible radicle and cotyledon lobes; lens mounded *Crotalaria*, 27.07
Seed without visible radicle and cotyledon lobes; lens flush 80
80. Lens confluent with hilum; fruit wings present; endocarp septate *Desmodium*, 11.09
Lens adjacent to hilum; fruit wings absent; endocarp nonseptate *Pycnospora*, 11.12
81. Cotyledons both folded 82
Cotyledons not folded 84
82. Hilum circular, not within halo or rim; raphe not visible; embryonic axis with a joint evident between the radicle and the cotyledons... *Tadehagi*, 11.13
Hilum elliptic, within halo or rim; raphe visible; embryonic axis without a joint evident between the radicle and the cotyledons 83
83. Cotyledons with lobes; margins recessed; hilum with faboid split *Sophora*, 2.45
Cotyledons without lobes; margins not recessed; hilum without faboid split *Craibia*, Millettiae
84. Seed symmetrical 85
Seed asymmetrical 90
85. Hilum within corona, halo, or rim 86
Hilum not within corona, halo, or rim *Phyllodium*, 11.07

86. Hilum punctiform; epicarp veined *Muelleranthus*, 23.08
Hilum larger than punctiform; epicarp not veined ... 87
87. Cotyledons with lobes 88
Cotyledons without lobes 89
88. Testa dull; cotyledons with margins recessed, with basal groin formed by lobes *Sophora*, 2.45
Testa glossy; cotyledons without margins recessed, without basal groin formed by lobes *Abrus*, 5.01
89. Seed 16–20 mm long; testa dull; hilum without faboid split; endosperm absent; cotyledons partially concealing radicle; radicle oblique to cotyledons *Craibia*, Millettieae
Seed 3.5–7 mm long; testa glossy; hilum with faboid split; endosperm present; cotyledons not concealing radicle; radicle deflexed and parallel to cotyledon length *Abrus*, 5.01
90. Hilum within corona, halo, or rim 91
Hilum not within corona, halo, or rim 95
91. Seed 16–20 mm long; cotyledons partially concealing radicle; lens not discernible; raphe visible *Craibia*, Millettieae
Seed 0.7–12.5 mm long; cotyledons not concealing radicle; lens discernible; raphe not visible 92
92. Lens same color as testa; embryonic axis right angled; radicle oblique to cotyledon *Cratylia*, 10.25
Lens dissimilar color from testa; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length 93
93. Lens mounded *Uraria*, 11.16
Lens flush 94
94. Fruit wings present; endocarp septate *Desmodium*, 11.09
Fruit wings absent; endocarp nonseptate *Lespedeza*, 11.24
95. Fruit wings present *Desmodium*, 11.09
Fruit wings absent 96
96. Testa coriaceous; epicarp glabrous; fruit with deciduous calyx *Poitea*, 8.05
Testa chartaceous; epicarp pubescent; fruit with persistent calyx *Phyllodium*, 11.07
- Seed Key 6: Aril present; dry. Cotyledons notched at radicle. Endosperm present.**
1. Seed with umbo on seed faces 2
Seed without umbo on seed faces 4
2. Seed 12–18 mm long, ovate; testa mottled, tan; hilum visible, not within halo or rim *Platycelyphium*, 2.38
Seed 2.8–5.5 mm long, circular, oblong, or reniform; testa monochrome, brown; hilum partially concealed or fully concealed, within halo or rim 3
3. Seed oblong or reniform; hilum within rim; endosperm thick, covering entire embryo; cotyledons white or yellow; radicle bulbous; radicle lobe tip curved *Teramnus*, 10.36
Seed circular; hilum within halo; endosperm trace, restricted to region of embryo; cotyledons orange; radicle triangular; radicle lobe tip straight *Nogra*, 10.33
4. Radicle lobe tip curved 5
Radicle lobe tip straight 59
5. Plumule moderately or well developed 6
Plumule rudimentary 36
6. Radicle bulbous 7
Radicle linear or triangular 23
7. Hilum raised or flush 8
Hilum recessed 13
8. Hilum visible, with straight outline; cotyledons margin not entire 180 degrees from base of radicle *Canavalia*, 10.21
Hilum partially concealed or fully concealed, with curved outline; cotyledons margin entire 180 degrees from base of radicle 9
9. Testa coriaceous 10
Testa chartaceous 11
10. Lens adjacent to hilum, dissimilar color from testa; embryonic axis deflexed or right angled; radicle deflexed and parallel to cotyledon length or oblique to cotyledons *Periandra*, 10.15
Lens confluent with hilum, same color as testa or similar color as testa; embryonic axis oblique or straight; radicle with 180-degree turn *Glycine*, 10.35
11. Hilum raised; fruit terete, liginous *Disynstemon*, Millettieae
Hilum flush; fruit compressed or flattened, chartaceous or coriaceous 12
12. Testa papillate, reticulate, or tuberculate when not smooth; fruit wings absent; fruit with all layers dehiscing *Glycine*, 10.35
Testa wrinkled when not smooth; fruit wings present; fruit indehiscent *Derris*, Millettieae

13. Hilum visible 14
Hilum partially or fully concealed 17
14. Lens oblong or ovate; cotyledons with margins recessed, white *Vigna*, 10.66
Lens linear; cotyledons without margins recessed, green, tan, or yellow 15
15. Seed terete, with shallow hilar sinus; embryonic axis parallel to length of seed; radicle with 90-degree turn *Sarcodum*, Millettiae
Seed compressed, without hilar sinus; embryonic axis oblique or perpendicular to length of seed; radicle oblique to cotyledons or with 180-degree turn ... 16
16. Lens recessed, not within corona; cotyledons partially concealing radicle, yellow *Macrotyloma*, 10.65
Lens mounded or flush, within halo or rim; cotyledons not concealing radicle, green or tan *Calopogonium*, 10.45
17. Lens oblong, ovate, or triangular 18
Lens linear 19
18. Lens oblong or ovate; cotyledons white .. *Vigna*, 10.66
Lens triangular; cotyledons brown or tan *Derris*, Millettiae
19. Cotyledons brown or tan 20
Cotyledons white or yellow 21
20. Testa papillate, reticulate, or tuberculate when not smooth; radicle with 180-degree turn; fruit wings absent; fruit with all layers dehiscent *Glycine*, 10.35
Testa wrinkled when not smooth; radicle oblique to cotyledons or with 90-degree turn; fruit wings present; fruit indehiscent *Derris*, Millettiae
21. Hilum concealed by funicular remnant; mesocarp thick *Macrotyloma*, 10.65
Hilum concealed by aril; mesocarp thin 22
22. Testa papillate, reticulate, or tuberculate when not smooth; lens mounded or recessed; embryonic axis parallel to length of seed; plumule well developed *Glycine*, 10.35
Testa rugose; lens flush; embryonic axis oblique to length of seed; plumule moderately developed *Pseudeminia*, 10.30
23. Testa minutely pubescent *Callerya*, Millettiae
Testa glabrous 24
24. Hilum visible 25
Hilum partially or fully concealed 28
25. Hilum raised or flush; cotyledons margin not entire 180 degrees from base of radicle *Canavalia*, 10.21
Hilum recessed; cotyledons margin entire 180 degrees from base of radicle 26
26. Lens oblong or ovate; cotyledons white, with margins recessed *Vigna*, 10.66
Lens linear; cotyledons brown, green, or tan, without margins recessed 27
27. Hilum marginal according to radicle tip; cotyledons not concealing radicle; plumule well developed *Calopogonium*, 10.45
Hilum apical according to radicle tip but marginal according to seed length; cotyledons partially concealing radicle; plumule moderately developed *Lonchocarpus*, Millettiae
28. Cotyledons brown or tan 29
Cotyledons white or yellow 32
29. Aril crenate; testa rugose; lens circular or diamond-shaped *Ateleia*, 1.13
Aril entire; testa wrinkled; lens linear or triangular 30
30. Rim-aril entire *Derris*, Millettiae
Rim-aril 2-lipped 31
31. Seed ovate or reniform; testa mottled; hilum within rim; radicle triangular *Amphicarpaea*, 10.44
Seed circular, elliptic, or irregular; testa bichrome or monochrome; hilum not within or rim within corona; radicle linear *Baphia*, 2.18
32. Cotyledons not smooth; lens circular or diamond-shaped 33
Cotyledons smooth; lens linear, oblong, or ovate 34
33. Aril entire, cream or tan; seed elliptic, irregular, or ovate; hilum concealed by aril; cotyledons not concealing radicle *Calpurnia*, 25.09
Aril crenate, white; seed C-shaped or reniform; hilum concealed by funicular remnant; cotyledons partially concealing radicle *Ateleia*, 1.13
34. Lens less than 0.5 mm in length; hilum marginal according to radicle tip; cotyledons yellow *Dolichopsis*, 10.69
Lens equal to or greater than 0.5 mm in length; hilum apical according to radicle tip but marginal according to seed length; cotyledons white 35
35. Lens mounded, oblong or ovate; cotyledons with margins recessed *Vigna*, 10.66
Lens flush, linear; cotyledons without margins recessed *Amphicarpaea*, 10.44

36. Cotyledons not concealing radicle 37
Cotyledons partially concealing radicle 40
37. Aril tan or yellow; seed elliptic or oblong; testa smooth; cotyledons margin not entire 180 degrees from base of radicle *Bolusanthus*, 2.37
Aril cream; seed rectangular or reniform; testa not smooth; cotyledons margin entire 180 degrees from base of radicle 38
38. Seed rectangular; hilum punctiform, not within corona or rim; cotyledons both outer faces flat; radicle 1/2 to nearly length of cotyledons *Sphinctospermum*, 8.12
Seed reniform; hilum larger than punctiform, within corona or rim; cotyledons both outer faces convex; radicle less than 1/2 length of cotyledons 39
39. Lens recessed; endosperm thick, adnate to embryo *Shuteria*, 10.41
Lens flush; endosperm thin, adnate to testa *Sinodolichos*, 10.34
40. Radicle linear or triangular 41
Radicle bulbous 50
41. Testa minutely pubescent *Callerya*, Millettieae
Testa glabrous 42
42. Aril crenate *Ateleia*, 1.13
Aril entire 43
43. Hilum partially concealed or fully concealed 44
Hilum visible 47
44. Testa glaucous; lens diamond-shaped; endocarp septate; funiculus filiform *Pericopsis*, 2.17
Testa dull or glossy; lens linear or triangular; endocarp subseptate or nonseptate; funiculus flattened 45
45. Testa reticulate; cotyledons green, white, or yellow, inner face wrinkled *Tephrosia*, Millettieae
Testa wrinkled; cotyledons brown or tan, inner face flat or concave 46
46. Rim-aril entire; fruit indehiscent *Derris*, Millettieae
Rim-aril 2-lipped; fruit with all layers dehiscing *Baphia*, 2.18
47. Seed symmetrical; lens linear 48
Seed asymmetrical; lens diamond-shaped or triangular 49
48. Aril cream; testa reticulate; hilum within corona; lens within halo; cotyledons inner face wrinkled *Tephrosia*, Millettieae
Aril tan or white; testa rugose or wrinkled; hilum not within corona or within halo or rim; lens not within halo or within rim; cotyledons inner face flat *Lonchocarpus*, Millettieae
49. Seed 2.5–3.5 mm long; aril tan; testa mottled; hilum within halo; cotyledons yellow; radicle 1/2 to nearly length of cotyledons *Ptychlobium*, Millettieae
Seed 7.2–12.5 mm long; aril white; testa monochrome; hilum within rim; cotyledons white; radicle less than 1/2 length of cotyledons *Maackia*, 2.40
50. Lens diamond-shaped 51
Lens linear or triangular 52
51. Seed 6.3–7 mm long; hilum concealed by radicle lobe, circular, not within halo; cotyledons without lobes *Salweenia*, 2.42
Seed 9–16.5 mm long; hilum concealed by aril remnant or funiculus, elliptic, within halo; cotyledons with lobes *Pericopsis*, 2.17
52. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; cotyledons margin not entire 180 degrees from base of radicle *Barbieria*, 10.16A
Hilum with the lips of the faboid split the same color as the rest of the hilum; cotyledons margin entire 180 degrees from base of radicle 53
53. Seed with deep or shallow hilar sinus 54
Seed without hilar sinus 56
54. Aril cream; hilum within corona; lens within halo; cotyledons inner face wrinkled *Tephrosia*, Millettieae
Aril brown or tan; hilum within halo or rim; lens not within halo; cotyledons inner face flat 55
55. Seed 5–7.5 mm long; testa monochrome; seed terete; hilum within rim; lens linear; radicle less than 1/2 length of cotyledons *Sarcodum*, Millettieae
Seed 2.5–3.5 mm long; testa mottled; seed compressed; hilum within halo; lens triangular; radicle 1/2 to nearly length of cotyledons *Ptychlobium*, Millettieae
56. Cotyledons brown or tan; fruit wings present; fruit indehiscent *Derris*, Millettieae
Cotyledons green, white, or yellow; fruit wings absent; fruit with all layers dehiscing 57

57. Aril with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; lens flush; embryonic axis parallel to length of seed *Pseudovigna*, 10.31
Aril with 1 tongue or flap on 1 lip of 2-lipped rim-aril; lens recessed; embryonic axis oblique or perpendicular to length of seed 58
58. Lens within corona or within rim; cotyledons inner face flat; embryonic axis oblique to length of seed *Shuteria*, 10.41
Lens within halo; cotyledons inner face wrinkled; embryonic axis perpendicular to length of seed *Tephrosia*, Millettieae
59. Testa absent *Monopteryx*, 2.31
Testa present 60
60. Cotyledons with lobes 61
Cotyledons without lobes 76
61. Cotyledons with basal groin formed by lobes 62
Cotyledons without basal groin formed by lobes 70
62. Hilum raised or flush, marginal according to radicle tip *Canavalia*, 10.21
Hilum recessed, apical at apex of radicle tip, subapical to radicle tip, or apical according to radicle tip but marginal according to seed length 63
63. Seed with shallow hilar sinus 64
Seed without hilar sinus 65
64. Lens mounded, oblong or ovate, not within rim; cotyledons white; plumule moderately or well developed *Vigna*, 10.66
Lens recessed, circular, within rim; cotyledons tan; plumule rudimentary *Pongamia*, Millettieae
65. Cotyledons white or yellow 66
Cotyledons brown, green, or tan 68
66. Cotyledons white; fruit nonstipitate; funiculus flattened *Vigna*, 10.66
Cotyledons yellow; fruit stipitate or substipitate; funiculus filiform or thick 67
67. Testa dull; hilum apical according to radicle tip but marginal according to seed length; lens linear or triangular; cotyledons notched *Sophora*, 2.45
Testa glaucous; hilum subapical to radicle tip; lens diamond-shaped; cotyledons wavy *Pericopsis*, 2.17
68. Rim-aril 2-lipped; hilum not within halo or rim or within corona *Baphia*, 2.18
Rim-aril not 2-lipped; hilum within halo or rim 69
69. Testa dull; hilum apical according to radicle tip but marginal according to seed length; lens linear or triangular; cotyledons notched *Sophora*, 2.45
Testa glaucous; hilum subapical to radicle tip; lens diamond-shaped; cotyledons wavy *Pericopsis*, 2.17
70. Cotyledons margin not entire 180 degrees from base of radicle *Canavalia*, 10.21
Cotyledons margin entire 180 degrees from base of radicle 71
71. Cotyledons white or yellow 72
Cotyledons brown or tan 74
72. Aril white; lens linear; cotyledons yellow; plumule rudimentary *Peteria*, 8.10
Aril brown or cream; lens circular, oblong, or ovate; cotyledons white; plumule moderately or well developed 73
73. Lens oblong or ovate, equal to or greater than 0.5 mm in length, mounded *Vigna*, 10.66
Lens circular, less than 0.5 mm in length, recessed *Schefflerodendron*, Millettieae
74. Tongue-aril; hilum punctiform *Genistidium*, 8.11
Rim-aril 2-lipped; hilum larger than punctiform 75
75. Rim-aril entire or fimbriate; fruit indehiscent 113
Rim-aril 2-lipped; fruit with all layers dehiscing *Baphia*, 2.18
76. Testa osseous or coriaceous 77
Testa chartaceous 94
77. Hilum raised or flush 78
Hilum recessed 84
78. Cotyledons not concealing radicle 79
Cotyledons partially concealing radicle 80
79. Testa brown; hilum marginal according to radicle tip; lens confluent with hilum, brown *Physostigma*, 10.52
Testa black, orange, or red; hilum subapical to radicle tip or apical according to radicle tip but marginal according to seed length; lens adjacent to hilum, red *Ormosia*, 2.15
80. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; cotyledons margin not entire 180 degrees from base of radicle *Canavalia*, 10.21
Hilum with the lips of the faboid split the same color as the rest of the hilum; cotyledons margin entire 180 degrees from base of radicle 81

81. Seed without hilar sinus 82
Seed with shallow hilar sinus 83
82. Testa coriaceous; lens mounded or flush, dissimilar color from testa; endosperm trace *Rhynchosia*, 10.80
Testa osseous; lens recessed, similar color as testa; endosperm thin *Dioclea*, 10.18
83. Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; hilum partially concealed, flush; endosperm trace *Flemingia*, 10.77
Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; hilum fully concealed, raised; endosperm thin *Bolusafr*, 10.75
84. Cotyledons tan 85
Cotyledons pink, white, or yellow 88
85. Radicle bulbous *Rhynchosia*, 10.80
Radicle linear 86
86. Rim-aril not 2-lipped; seed with shallow hilar sinus; hilum with straight outline; cotyledons not concealing radicle *Adenodolichos*, 10.83
Rim-aril 2-lipped; seed without hilar sinus; hilum with curved outline; cotyledons partially concealing radicle 87
87. Seed 6–9.5 mm long; aril cream or white; seed reniform, terete; testa mottled; hilum visible *Paracalyx*, 10.82
Seed 10–25 mm long; aril ivory or tan; seed circular, elliptic, or irregular, compressed or flattened; testa bichrome or monochrome; hilum partially or fully concealed *Baphia*, 2.18
88. Plumule moderately or well developed 89
Plumule rudimentary 92
89. Aril gray or tan 90
Aril cream 91
90. Testa brown; lens confluent with hilum, mounded; radicle linear *Adenodolichos*, 10.83
Testa black, orange, or red; lens adjacent to hilum, flush; radicle bulbous *Ormosia*, 2.15
91. Lens confluent with hilum, mounded, not within rim *Vigna*, 10.66
Lens adjacent to hilum, flush, within rim *Ormosia*, 2.15
92. Lens red, adjacent to hilum *Ormosia*, 2.15
Lens brown, confluent with hilum 93
93. Seed compressed; hilum not within halo or rim or within rim; lens darker than testa, not within halo or within rim *Physostigma*, 10.52
Seed terete; hilum within halo; lens lighter than testa, within halo *Xanthocercis*, 2.14
94. Cotyledons inner face wavy, with central ridge on 1 and central groove on other, or wrinkled 95
Cotyledons inner face flat or concave 98
95. Hilum within corona; lens confluent with hilum, recessed, within halo; cotyledons inner face wrinkled *Tephrosia*, Millettieae
Hilum within rim; lens adjacent to hilum, mounded or flush, not within halo or within rim; cotyledons inner face wavy or with central ridge on 1 and central groove on other 96
96. Lens brown; cotyledons with both folded, partially concealing radicle; radicle linear *Pongamiopsis*, Millettieae
Lens red; cotyledons not folded, not concealing radicle; radicle bulbous 97
97. Lens not within rim; endosperm thick or thin, covering entire embryo; cotyledons inner face with central ridge on 1 and central groove on other *Bowdichia*, 2.28
Lens within rim; endosperm trace, restricted to region of embryo; cotyledons inner face wavy *Ormosia*, 2.15
98. Cotyledons pink, white, or yellow 99
Cotyledons brown, green, or tan 104
99. Lens within corona or rim 100
Lens not within corona or rim 101
100. Hilum rim color darker than testa; lens brown, confluent with hilum, within corona; cotyledons partially concealing radicle *Pueraria*, 10.32
Hilum rim color same as testa; lens red, adjacent to hilum, within rim; cotyledons not concealing radicle *Ormosia*, 2.15
101. Plumule moderately or well developed 102
Plumule rudimentary 103
102. Lens oblong or ovate; cotyledons white .. *Vigna*, 10.66
Lens circular, elliptic, or linear; cotyledons pink or yellow *Sphenostylis*, 10.57

103. Testa black; hilum elliptic; lens linear; endosperm covering entire embryo; radicle linear *Cochlianthus*, 10.08
 Testa brown; hilum circular; lens diamond-shaped; endosperm restricted to region of embryo; radicle bulbous *Salweenia*, 2.42
104. Testa minutely pubescent *Callerya*, Millettieae
 Testa glabrous 105
105. Hilum visible 106
 Hilum partially or fully concealed 109
106. Lens linear 107
 Lens circular 108
107. Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; endosperm restricted to region of embryo; radicle bulbous or triangular *Dioclea*, 10.18
 Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; endosperm covering entire embryo or at least 1/2 of embryo, but not entire embryo; radicle linear *Lonchocarpus*, Millettieae
108. Seed 4.7–11.6 mm long, without hilar sinus; hilum raised; lens mounded or flush, within halo; plumule moderately or well developed ... *Centrosema*, 10.14
 Seed 12–35 mm long, with shallow hilar sinus; hilum recessed; lens recessed, within rim; plumule rudimentary *Pongamia*, Millettieae
109. Cotyledons green; hilum marginal according to radicle tip *Pueraria*, 10.32
 Cotyledons brown or tan; hilum apical at apex of radicle tip, subapical to radicle tip, or apical according to radicle tip but marginal according to seed length 110
110. Seed with shallow hilar sinus; hilum concealed by funicular remnant, within rim *Pongamia*, Millettieae
 Seed without hilar sinus; hilum concealed by aril, funiculus, or radicle lobe, not within rim or within corona or halo 111
111. Seed with visible radicle and cotyledon lobes; hilum concealed by radicle lobe; lens diamond-shaped *Salweenia*, 2.42
 Seed without visible radicle and cotyledon lobes; hilum concealed by aril or funiculus; lens linear or triangular 112
112. Rim-aril entire; fruit indehiscent *Derris*, Millettieae
 Rim-aril 2-lipped; fruit with all layers dehiscing *Baphia*, 2.18

113. Aril fimbriate; cotyledons with lobes not touching, inner faces with central ridge on one and central groove on other; fruit without wings *Acosmium*, 2.01
 Aril entire; cotyledons with lobes touching (auriculate), inner faces flat or concave; fruit with wings *Derris*, Millettieae

Seed Key 7: Aril present; dry. Cotyledons notched at radicle. Endosperm absent.

1. Cotyledons not concealing radicle 2
 Cotyledons completely or partially concealing radicle 21
2. Radicle lobe tip curved 3
 Radicle lobe tip straight 9
3. Cotyledons green or tan 4
 Cotyledons white or yellow 6
4. Seed 1.8–2.2 mm long, circular or terete; hilum within halo; radicle with 90-degree turn, 1/2 to nearly length of cotyledons *Requienia*, Millettieae
 Seed 4–15 mm long, elliptic, irregular, or reniform, compressed or flattened; hilum within rim; radicle oblique to cotyledons, less than 1/2 length of cotyledons 5
5. Seed elliptic or reniform; hilum visible, elliptic; lens circular; cotyledons tan *Piscidia*, Millettieae
 Seed irregular; hilum partially concealed, circular; lens wedge-shaped; cotyledons green *Neoharmsia*, 2.34
6. Aril tan; hilum flush; lens adjacent to hilum, flush *Cyathostegia*, 1.14
 Aril cream or white; hilum recessed; lens confluent with hilum, mounded or recessed 7
7. Plumule moderately or well developed; cotyledons with margins recessed *Vigna*, 10.66
 Plumule rudimentary; cotyledons without margins recessed 8
8. Testa green or tan; seed with shallow hilar sinus; lens less than 0.5 mm in length, mounded *Mundulea*, Millettieae
 Testa brown; seed without hilar sinus; lens equal to or greater than 0.5 mm in length, recessed *Dicraeopetalum*, 2.33
9. Cotyledons with lobes 10
 Cotyledons without lobes 12

10. Seed ca. 20 mm long, flattened; testa black; cotyledons with both outer faces flat; embryonic axis with a joint evident between the radicle and the cotyledons *Panurea*, 2.30
Seed 2–18 mm long, terete or compressed; testa brown, cream, red, tan, or white; cotyledons with both outer faces convex; embryonic axis without a joint evident between the radicle and the cotyledons 11
11. Cotyledons not sufficiently folded for inner face to touch itself, white *Vigna*, 10.66
Cotyledons sufficiently folded for inner face to touch itself, brown, green, tan, or yellow ... *Sophora*, 2.45
12. Plumule rudimentary 13
Plumule moderately or well developed 15
13. Rim-aril entire or partial or tongue-aril, tan or white; seed with shallow hilar sinus; testa chartaceous *Wisteria*, Millettiaeae
Rim-aril hippocrepiform or 2-lipped, cream; seed without hilar sinus; testa coriaceous 14
14. Rim-aril hippocrepiform; seed symmetrical; hilum fully concealed, with curved outline; radicle with 90-degree turn *Otoptera*, 10.56
Rim-aril 2-lipped; seed asymmetrical; hilum visible or partially concealed, with straight outline; radicle oblique to cotyledons, with 180-degree turn, or straight with embryonic axis *Physostigma*, 10.52
15. Lens not within corona or rim 16
Lens within corona or rim 18
16. Hilum flush; lens circular, elliptic, or linear *Sphenostylis*, 10.57
Hilum recessed; lens oblong, ovate, or triangular 17
17. Aril cream; hilum visible or fully concealed; cotyledons white *Vigna*, 10.66
Aril tan or white; hilum partially concealed; cotyledons tan or yellow *Wisteria*, Millettiaeae
18. Seed with shallow hilar sinus; aril tan or white; lens mounded *Wisteria*, Millettiaeae
Seed without hilar sinus; aril cream; lens flush or recessed 19
19. Hilum with the lips of the faboid split the same color as the rest of the hilum, not within halo or rim or within corona; cotyledons tan, white, or yellow *Dolichos*, 10.64
Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, within halo or rim; cotyledons brown 20
20. Seed 5.5–9.5 mm long, compressed or flattened; tongue-aril; hilum within rim; lens darker than testa; radicle linear *Ramirezella*, 10.66A
Seed 35–39 mm long, mounded on 1 side and straight on other side; rim-aril; hilum within halo; lens lighter than testa; radicle bulbous *Castanospermum*, 2.12
21. Testa osseous or coriaceous 22
Testa chartaceous 51
22. Hilum raised or flush 23
Hilum recessed 32
23. Hilum with curved outline 24
Hilum with straight outline 28
24. Radicle linear; epicarp glandular; funiculus hooked *Cajanus*, 10.73
Radicle bulbous or triangular; epicarp eglandular; funiculus contorted, curved, straight, or triangular 25
25. Radicle lobe tip curved 26
Radicle lobe tip straight 27
26. Embryonic axis right angled or straight to seed length; seed length transverse to fruit length *Mucuna*, 10.03
Embryonic axis oblique to seed length; seed length parallel with fruit length *Erythrina*, 10.01
27. Rim-aril 2-lipped; fruit quadrangular; epicarp warty *Psophocarpus*, 10.51
Rim-aril partial (not 2-lipped) or tongue-aril; fruit compressed or terete; epicarp muricate or wrinkled *Erythrina*, 10.01
28. Radicle triangular; endocarp septate or nonseptate 29
Radicle bulbous or linear; endocarp subseptate 30
29. Testa dull; cotyledons smooth, brown or tan; radicle lobe tip curved *Mucuna*, 10.03
Testa glossy; cotyledons not smooth, yellow; radicle lobe tip straight *Afgekia*, Millettiaeae
30. Plumule rudimentary; cotyledons with margins recessed *Oxyrhynchus*, 10.68
Plumule well developed; cotyledons without margins recessed 31
31. Aril cream; hilum fully concealed; cotyledons margin entire 180 degrees from base of radicle *Strophostyles*, 10.70
Aril tan; hilum visible; cotyledons margin not entire 180 degrees from base of radicle *Canavalia*, 10.21

32. Radicle linear or triangular 33
 Radicle bulbous 40
33. Radicle triangular 34
 Radicle linear 37
34. Lens black *Erythrina*, 10.01
 Lens brown or red 35
35. Hilum within corona; lens less than 0.5 mm in length,
 within corona *Austrodolichos*, 10.59
 Hilum not within corona or within halo or rim; lens
 equal to or greater than 0.5 mm in length, not
 within corona or within rim 36
36. Hilum visible or fully concealed; lens mounded,
 oblong or ovate *Vigna*, 10.66
 Hilum partially concealed; lens flush, linear
 *Amphicarpaea*, 10.44
37. Cotyledons pink or white 38
 Cotyledons brown, green, tan, or yellow 39
38. Aril without tongue (or flaplike) on lips of 2-lipped
 rim-aril; lens mounded, oblong or ovate; cotyle-
 dons white *Vigna*, 10.66
 Aril with tongues (or flaplike) on lips of 2-lipped rim-
 aril; lens flush, linear; cotyledons pink
 *Decorsea*, 10.54
39. Rim-aril not 2-lipped; testa bearing endocarp rem-
 nants; hilum within halo or rim *Sophora*, 2.45
 Rim-aril 2-lipped; testa not bearing endocarp; hilum
 not within halo or rim or within corona
 *Baphia*, 2.18
40. Hilum within corona; cotyledons pubescent around
 base of radicle *Alistilus*, 10.62
 Hilum not within corona or within halo or rim;
 cotyledons glabrous around base of radicle 41
41. Cotyledons with lobes 42
 Cotyledons without lobes 45
42. Cotyledons white 43
 Cotyledons brown, green, tan, or yellow 44
43. Aril without tongue (or flaplike) on lips of 2-lipped
 rim-aril; testa smooth; hilum visible or fully
 concealed; lens not within rim *Vigna*, 10.66
 Aril with tongues (or flaplike) on lips of 2-lipped rim-
 aril; testa not smooth; hilum partially concealed;
 lens within rim *Neorautanenia*, 10.60
44. Rim-aril hippocrepiform or 2-lipped, fimbriate
 *Neorautanenia*, 10.60
 Rim-aril entire *Sophora*, 2.45
45. Cotyledons orange *Dysolobium*, 10.50
 Cotyledons tan, white, or yellow 46
46. Lens not within halo or rim 47
 Lens within halo or rim 48
47. Lens brown or red *Vigna*, 10.66
 Lens black *Erythrina*, 10.01
48. Aril fimbriate 49
 Aril entire 50
49. Rim-aril hippocrepiform or 2-lipped; cotyledons
 completely concealing radicle
 *Neorautanenia*, 10.60
 Rim-aril partial (not 2-lipped) or tongue-aril; cotyle-
 dons partially concealing radicle
 *Erythrina*, 10.01
50. Lens within rim; radicle with 90-degree turn or
 straight with embryonic axis *Pachyrhizus*, 10.46
 Lens within halo; radicle oblique to cotyledons or
 with 180-degree turn *Erythrina*, 10.01
51. Plumule moderately or well developed 52
 Plumule rudimentary 80
52. Hilum raised or flush 53
 Hilum recessed 64
53. Testa minutely pubescent 54
 Testa glabrous 55
54. Testa with 1 longitudinal ridge on each face; cotyle-
 dons yellow; radicle bulbous or triangular
 *Psophocarpus*, 10.51
 Testa rugose, veined, or wrinkled; cotyledons green or
 tan; radicle linear *Callerya*, *Millettieae*
55. Cotyledons white or yellow 56
 Cotyledons brown or tan 60
56. Lens flush 57
 Lens mounded 58
57. Testa wrinkled; lens within corona or rim
 *Dolichos*, 10.64
 Testa with 1 longitudinal ridge on each face; lens not
 within corona or rim *Psophocarpus*, 10.51
58. Aril fimbriate *Phaseolus*, 10.72
 Aril entire 59
59. Hilum oval; lens within rim; cotyledons white; radicle
 linear; radicle lobe tip curved ... *Mysanthus*, 10.72A
 Hilum elliptic; lens not within rim; cotyledons yellow;
 radicle bulbous or triangular; radicle lobe tip
 straight *Psophocarpus*, 10.51

60. Hilum not within halo or rim or within corona 61
Hilum within halo or rim 62
61. Fruit wings absent; fruit with all layers dehiscing;
epicarp not veined, wrinkled; endocarp septate,
without wings *Dolichos*, 10.64
Fruit wings present; fruit indehiscent; epicarp veined,
dotted; endocarp nonseptate, with wings extending
into epicarp *Derris*, *Millettieae*
62. Tongue-aril, fimbriate *Phaseolus*, 10.72
Rim-aril 2-lipped or rim-aril, entire 63
63. Hilum concealed by funicular remnant; fruit wings
absent; fruit with all layers dehiscing; epicarp not
veined *Fordia*, *Millettieae*
Hilum concealed by aril or funiculus; fruit wings
present; fruit indehiscent; epicarp veined
..... *Derris*, *Millettieae*
64. Cotyledons white or yellow 65
Cotyledons brown, green, or tan 74
65. Radicle lobe tip straight 66
Radicle lobe tip curved 70
66. Cotyledons white 67
Cotyledons yellow 68
67. Lens circular or triangular *Phaseolus*, 10.72
Lens oblong or ovate *Vigna*, 10.66
68. Aril fimbriate; hilum fully concealed
..... *Phaseolus*, 10.72
Aril entire; hilum visible or partially concealed 69
69. Seed reniform; cotyledons without lobes; embryonic
axis parallel to length of seed; radicle triangular,
with 180-degree turn *Eminia*, 10.29
Seed circular, elliptic, ovate, or rhombic; cotyledons
with lobes; embryonic axis oblique to length of
seed or perpendicular to length of seed; radicle
bulbose or linear, oblique to cotyledons or with 90-
degree turn *Sophora*, 2.45
70. Lens circular, oblong, ovate, or triangular 71
Lens linear 72
71. Lens circular or triangular *Phaseolus*, 10.72
Lens oblong or ovate *Vigna*, 10.66
72. Lens recessed; cotyledons yellow; radicle
bulbose *Macrotyloma*, 10.65
Lens mounded or flush; cotyledons white; radicle
linear or triangular 73
73. Hilum not within rim or within corona or halo; lens
mounded; radicle linear *Macroptilium*, 10.71
Hilum within rim; lens flush; radicle triangular
..... *Amphicarpaea*, 10.44
74. Aril fimbriate *Phaseolus*, 10.72
Aril entire 75
75. Seed with deep hilar sinus; rim-aril hippocrepiform
..... *Platycyamus*, *Millettieae*
Seed without hilar sinus; rim-aril 2-lipped or tongue-
aril 76
76. Testa bearing endocarp remnants *Sophora*, 2.45
Testa rugose, veined, or wrinkled 77
77. Testa minutely pubescent; funiculus thick
..... *Callerya*, *Millettieae*
Testa glabrous; funiculus flattened 78
78. Testa mottled; hilum within rim
..... *Amphicarpaea*, 10.44
Testa bichrome or monochrome; hilum not within rim
or within corona or halo 79
79. Rim-aril entire, not 2-lipped *Derris*, *Millettieae*
Rim-aril 2-lipped *Baphia*, 2.18
80. Hilum visible 81
Hilum partially concealed or fully concealed 89
81. Hilum within corona or halo 82
Hilum not within corona or halo or within rim 85
82. Cotyledons with lobes *Sophora*, 2.45
Cotyledons without lobes 83
83. Aril tan; seed asymmetrical; lens flush, tan, triangular
..... *Ptycholibium*, *Millettieae*
Aril cream or white; seed symmetrical; lens mounded
or recessed, brown, hourglass or linear 84
84. Hilum with the lips of the faboid split the same color
as the rest of the hilum; lens recessed, within halo
..... *Tephrosia*, *Millettieae*
Hilum with the lips of the faboid split lighter colored
than the rest of the hilum and therefore conspicu-
ous; lens mounded, not within halo
..... *Pyranthus*, *Millettieae*
85. Testa minutely pubescent *Callerya*, *Millettieae*
Testa glabrous 86
86. Seed asymmetrical; radicle lobe tip curved 87
Seed symmetrical; radicle lobe tip straight 88

87. Seed ca. 4 mm long; aril fimbriate, tan; seed irregular; testa brown; lens linear; cotyledons tan *Rhodopis*, 10.09
Seed 7.2–12.5 mm long; aril entire, white; seed reniform; testa tan; lens diamond-shaped; cotyledons white *Maackia*, 2.40
88. Seed circular, elliptic, ovate, or rhombic; cotyledons with lobes *Sophora*, 2.45
Seed reniform; cotyledons without lobes *Sakoanala*, 2.35
89. Cotyledons inner face wavy or wrinkled 90
Cotyledons inner face flat or concave 92
90. Seed 24.5–26 mm long; aril brown; hilum within rim; lens oblong; cotyledons with lobes, brown *Dewevrea*, Millettieae
Seed 3–12 mm long; aril cream or ivory; hilum not within rim or within corona; lens linear; cotyledons without lobes, green, tan, white, or yellow 91
91. Aril entire; hilum within corona; cotyledons green, white, or yellow, inner face wrinkled; radicle bulbose or linear *Tephrosia*, Millettieae
Aril fimbriate; hilum not within corona; cotyledons tan, inner face wavy; radicle triangular *Airyantha*, 2.19
92. Hilum raised or flush 93
Hilum recessed 97
93. Testa minutely pubescent *Callerya*, Millettieae
Testa glabrous 94
94. Cotyledons white *Spathionema*, 10.55
Cotyledons brown or tan 95
95. Seed terete or quadrangular; hilum apical at apex of radicle tip *Neorudolphia*, 10.10
Seed compressed or flattened; hilum apical according to radicle tip but marginal according to seed length 96
96. Hilum concealed by funicular remnant; fruit wings absent; fruit with all layers dehiscent; epicarp not veined *Fordia*, Millettieae
Hilum concealed by aril or funiculus; fruit wings present; fruit indehiscent; epicarp veined *Derris*, Millettieae
97. Testa minutely pubescent *Callerya*, Millettieae
Testa glabrous 98
98. Aril fimbriate *Amphimas*, 2.11
Aril entire 99
99. Rim-aril 2-lipped *Baphia*, 2.18
Rim-aril not 2-lipped 100
100. Testa glaucous; lens diamond-shaped *Pericopsis*, 2.17
Testa dull or glossy; lens linear, oblong, or triangular 101
101. Testa mottled, glossy; hilum circular; lens oblong *Behaimia*, Millettieae
Testa monochrome, dull; hilum elliptic or oval; lens linear or triangular 102
102. Testa not bearing endocarp remnants; hilum concealed by aril or funiculus *Derris*, Millettieae
Testa bearing endocarp remnants; hilum concealed by funicular remnant *Sophora*, 2.45

Seed Key 8: Aril present; dry. Cotyledons split over radicle. Hilum raised or flush.

1. Cotyledons without lobes 2
Cotyledons with lobes 15
2. Testa chartaceous 3
Testa osseous or coriaceous 10
3. Radicle lobe tip curved 4
Radicle lobe tip straight 6
4. Rim-aril 2-lipped; hilum visible, raised, within rim *Galactia*, 10.27
Rim-aril hippocrepiform or rim-aril; hilum partially concealed or fully concealed, flush or recessed, within halo or not within rim 5
5. Rim-aril hippocrepiform; cotyledons white or yellow; radicle deflexed and parallel to cotyledon length *Pseudoeriosema*, 10.12
Rim-aril; cotyledons brown or tan; radicle oblique to cotyledons or with 90-degree turn *Derris*, Millettieae
6. Cotyledons 1 thicker than the other; lens elliptic *Clitoria*, 10.16
Cotyledons both the same thickness; lens linear, oblong, or triangular 7
7. Radicle linear or triangular 8
Radicle bulbose 9

8. Testa mottled; hilum visible, with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, with straight outline *Collaea*, 10.26
 Testa monochrome; hilum partially or fully concealed, with the lips of the faboid split the same color as the rest of the hilum, with curved outline *Derris*, Millettiae
9. Rim-aril hippocrepiform, 2-lipped rim-aril, partial rim-aril, or tongue-aril; fruit with all layers dehiscent; epicarp not veined, epicarp lenticular, rugose, or verrucose-rugose *Millettia*, Millettiae
 Rim-aril; fruit indehiscent; epicarp veined, epicarp dotted *Derris*, Millettiae
10. Plumule rudimentary 11
 Plumule moderately or well developed 12
11. Seed 5–48 mm long; rim-aril 2-lipped; hilum larger than punctiform; cotyledons yellow; radicle centered between cotyledons, less than 1/2 length of cotyledons *Physostigma*, 10.52
 Seed 3–4 mm long; tongue-aril; hilum punctiform; cotyledons tan; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different), 1/2 to nearly length of cotyledons *Cyamopsis*, 9.06
12. Hilum with straight outline 13
 Hilum with curved outline 14
13. Aril entire or fimbriate; testa dull; fracture lines absent; cotyledons margin not entire 180 degrees from base of radicle; radicle bulbose or linear *Canavalia*, 10.21
 Aril crenate; testa glossy; fracture lines present; cotyledons margin entire 180 degrees from base of radicle; radicle triangular *Cymbosema*, 10.19
14. Cotyledons 1 thicker than the other; embryonic axis deflexed, right angled, or straight; mesocarp 3-layered; endocarp white, scurfy *Clitoria*, 10.16
 Cotyledons both the same thickness; embryonic axis oblique; mesocarp 1-layered or 2-layered; endocarp brown or tan, smooth *Erythrina*, 10.01
15. Testa chartaceous 16
 Testa osseous or coriaceous 22
16. Radicle bulbose 17
 Radicle linear or triangular 18
17. Seed D-shaped; hilum punctiform; lens circular; cotyledons not concealing radicle, with lobes not touching *Fiebrigiella*, 14.06
 Seed elliptic, ovate, or reniform; hilum larger than punctiform; lens linear or triangular; cotyledons partially concealing radicle, with lobes touching (auriculate) *Derris*, Millettiae
18. Hilum within rim; cotyledons margin not entire 180 degrees from base of radicle, with lobes not touching, inner face wrinkled *Dewevrea*, Millettiae
 Hilum within corona or halo or not within rim; cotyledons margin entire 180 degrees from base of radicle, with lobes touching (auriculate), inner face flat, concave, or glandular dotted (with yellow latex-like substance inside) 19
19. Testa mottled 20
 Testa monochrome 21
20. Seed 6–8 mm long; aril ivory; testa not smooth; hilum within corona; radicle linear; plumule moderately developed *Vatovaea*, 10.53
 Seed 15–20 mm long; aril tan; testa smooth; hilum within halo; radicle triangular; plumule rudimentary *Antheroporum*, Millettiae
21. Hilum flush or recessed; fruit not inflated, chartaceous or coriaceous, indehiscent; fruit wings present *Derris*, Millettiae
 Hilum raised; fruit inflated, ligneous, with all layers dehiscent; fruit wings absent *Antheroporum*, Millettiae
22. Radicle bulbose 23
 Radicle linear 28
23. Cotyledons margin not entire 180 degrees from base of radicle; plumule well developed *Canavalia*, 10.21
 Cotyledons margin entire 180 degrees from base of radicle; plumule rudimentary or moderately developed 24
24. Endosperm thick 25
 Endosperm thin 26
25. Lens not discernible; seed with visible radicle and cotyledon lobes; fruit with the raised seed chambers not torulose, indehiscent *Nissolia*, 14.08
 Lens discernible; seed without visible radicle and cotyledon lobes; fruit with the raised seed chambers torulose, with all layers dehiscent *Sesbania*, 8.01

26. Hilum with straight outline; cotyledons completely concealing or not concealing radicle, brown, green, or tan; lens rhombic *Gliricidia*, 8.06
Hilum with curved outline; cotyledons partially concealing radicle, red or yellow; lens circular, irregular, linear, or wedge-shaped 27
27. Seed elliptic or oblong; hilum elliptic; cotyledons with lobes touching (auriculate), cotyledons yellow; plumule moderately developed *Hovea*, 23.04
Seed circular, D-shaped, quadrangular, or reniform; hilum circular; cotyledons with lobes not touching, cotyledons red; plumule rudimentary *Humularia*, 14.15
28. Plumule moderately or well developed 29
Plumule rudimentary 31
29. Seed elliptic, oblong, or ovate; testa brown or ivory; hilum larger than punctiform; cotyledons margin not entire 180 degrees from base of radicle; lens linear *Canavalia*, 10.21
Seed C-shaped or rhombic; testa tan; hilum punctiform; cotyledons margin entire 180 degrees from base of radicle; lens oblong or wedge-shaped 30
30. Seed 3–3.5 mm long, rhombic; hilum visible; endosperm absent; cotyledons with lobes overlapping; lens wedge-shaped *Pachecoa*, 14.23
Seed 5–5.3 mm long, C-shaped; hilum fully concealed; endosperm present; cotyledons with lobes not touching; lens oblong *Pictetia*, 14.05
31. Tongue-aril; cotyledons with both folded, differing at apex (1 concealed by overarched radicle and other auriculate and concealing radicle); radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different), 1/2 to nearly length of cotyledons *Cyamopsis*, 9.06
Rim-aril; cotyledons not folded, similar at apex; radicle centered between cotyledons, less than 1/2 length of cotyledons 32
32. Seed 1.2–1.8 mm long; aril tan; cotyledons yellow *Sphaerolobium*, 24.02
Seed 2–4.7 mm long; aril white or yellow; cotyledons brown, green, red, or tan 33
33. Aril white; hilum partially concealed or fully concealed; endosperm present; cotyledons brown, green, or tan; lens circular *Isotropis*, 24.06
Aril yellow; hilum visible; endosperm absent; cotyledons red; lens linear *Kotschya*, 14.11

Seed Key 9: Aril present; dry. Cotyledons split over radicle. Hilum recessed.

1. Cotyledons completely or partially concealing radicle 2
Cotyledons not concealing radicle 36
2. Testa osseous or coriaceous 3
Testa chartaceous 17
3. Hilum punctiform 4
Hilum larger than punctiform 8
4. Seed symmetrical; cotyledons white; embryonic axis straight, parallel to length of seed 5
Seed asymmetrical; cotyledons brown, green, tan, or yellow; embryonic axis deflexed, oblique to length of seed 6
5. Seed 12–13 mm long, with umbo on seed faces; testa brown; hilum visible, not within rim; endosperm present *Ramorinoa*, 4.11
Seed 8.5–9.5 mm long, without umbo on seed faces; testa black or tan; hilum partially or fully concealed, within rim; endosperm absent *Pterodon*, 3.03
6. Radicle lobe tip straight; lens irregular, linear, or oblong 80
Radicle lobe tip curved or hooked; lens circular or elliptic 7
7. Tongue-aril; hilum partially concealed, not within rim; radicle lobe tip hooked; radicle deflexed and parallel to cotyledon length *Jacksonia*, 24.08
Rim-aril; hilum visible, within rim; radicle lobe tip curved; radicle deflexed and parallel to cotyledon width *Amorpha*, 6.04
8. Testa color modified by a bloom 9
Testa color not modified by a bloom 10
9. Aril cream; testa dull; plumule moderately or well developed; lens oblong or ovate *Vigna*, 10.66
Aril brown; testa glaucous; plumule rudimentary; lens linear *Dumasia*, 10.42
10. Cotyledons white 11
Cotyledons brown, green, tan, or yellow 12
11. Lens brown or red *Vigna*, 10.66
Lens black *Erythrina*, 10.01
12. Rim-aril 2-lipped; hilum without faboid split *Baphia*, 2.18
Rim-aril partial (not 2-lipped) or tongue-aril; hilum with faboid split 13

13. Hilum with straight outline; endocarp spongy *Gliricidia*, 8.06
Hilum with curved outline; endocarp scurfy or smooth 14
14. Hilum elliptic or oval; embryonic axis oblique or right angled; seeds with length parallel with fruit length 15
Hilum circular; embryonic axis deflexed or straight; seeds with length transverse to fruit length 16
15. Cotyledons without lobes *Erythrina*, 10.01
Cotyledons with lobes *Sophora*, 2.45
16. Seed ca. 6.3 mm long; aril fimbriate; endosperm absent; embryonic axis straight; radicle lobe tip curved *Mastersia*, 10.38
Seed 3–5 mm long; aril entire; endosperm present; embryonic axis deflexed; radicle lobe tip straight *Poitea*, 8.05
17. Hilum apical at apex of radicle tip or subapical to radicle tip 18
Hilum apical according to radicle tip but marginal according to seed length or marginal according to radicle tip 22
18. Testa glaucous; hilum within halo; lens diamond-shaped *Pericopsis*, 2.17
Testa dull or glossy; hilum not within halo or within corona or rim; lens linear, oblong, or triangular . 19
19. Radicle bulbose *Millettia*, Millettieae
Radicle linear 20
20. Hilum visible; cotyledons green or yellow *Ammodendron*, 2.46
Hilum partially or fully concealed; cotyledons tan .. 21
21. Seed 10–25 mm long; rim-aril 2-lipped; hilum not within rim or within corona *Baphia*, 2.18
Seed 5–9.5 mm long; rim-aril not 2-lipped or tongue-aril; hilum within rim *Cadia*, 2.36
22. Radicle deflexed and parallel to cotyledon length or width 23
Radicle oblique to cotyledons or with 90- or 180-degree turn 27
23. Cotyledons orange; plumule well developed *Meizotropis*, 10.06
Cotyledons tan, white, or yellow; plumule rudimentary or moderately developed 24
24. Rim-aril hippocrepiform *Pseudoeriosema*, 10.12
Rim-aril 2-lipped or tongue-aril 25
25. Seed 10–25 mm long, circular, elliptic, or irregular; endocarp brown, gray, or purple *Baphia*, 2.18
Seed 4.6–8.3 mm long, obovate, ovate, rectangular, or reniform; endocarp tan or white 26
26. Seed 4.6–5.6 mm long; aril white; hilum within halo; endosperm present; cotyledons not smooth *Neonotonia*, 10.40
Seed 6.4–8.3 mm long; aril brown or tan; hilum not within halo or within rim; endosperm absent; cotyledons smooth *Apios*, 10.07
27. Cotyledons white 28
Cotyledons brown, green, orange, tan, or yellow 29
28. Aril without tongue (or flaplike) on lips of 2-lipped rim-aril; lens mounded *Vigna*, 10.66
Aril with tongues (or flaplike) on lips of 2-lipped rim-aril; lens flush *Millettia*, Millettieae
29. Testa mottled *Diphylarium*, 10.37
Testa bichrome or monochrome 30
30. Rim-aril hippocrepiform, rim-aril 2-lipped, or tongue-aril 31
Rim-aril not 2-lipped or rim-aril partial 33
31. Radicle bulbose *Millettia*, Millettieae
Radicle linear or triangular 32
32. Seed 6.4–8.3 mm long, obovate, ovate, rectangular, or reniform; fruit terete; endocarp white, septate *Apios*, 10.07
Seed 10–25 mm long, circular, elliptic, or irregular; fruit compressed or flattened; endocarp brown, gray, or purple, nonseptate *Baphia*, 2.18
33. Testa bearing endocarp remnants; fruit long tapered at base *Sophora*, 2.45
Testa wrinkled; fruit rounded, tapered, or short tapered at base 34
34. Lens circular; seed length parallel with fruit length *Pongamia*, Millettieae
Lens linear, oblong, or triangular; seed length oblique or transverse to fruit length 35
35. Rim-aril partial; fruit with all layers dehiscing; epicarp not veined, lenticular, rugose, or verrucose-rugose *Millettia*, Millettieae
Rim-aril entire; fruit indehiscent; epicarp veined, dotted *Derris*, Millettieae
36. Hilum punctiform 37
Hilum larger than punctiform 54

37. Endosperm absent *Amicia*, 14.19
Endosperm present 38
38. Endosperm thin 39
Endosperm thick 45
39. Seed rim present 40
Seed rim absent 41
40. Testa glossy; hilum between cotyledon and radicle lobe; cotyledons brown; embryonic axis with a joint evident between the radicle and the cotyledons *Gonocytisus*, 30.20
Testa dull; hilum apical at apex of or subapical to radicle tip; cotyledons tan; embryonic axis without a joint evident between the radicle and the cotyledons *Coursetia*, 8.08
41. Hilum not within corona, halo, or rim 42
Hilum within rim 43
42. Seed 3–5 mm long; testa coriaceous; plumule rudimentary or moderately developed *Poitea*, 8.05
Seed 17–20 mm long; testa osseous; plumule well developed *Hebestigma*, 8.02
43. Seed 5–10 mm long; testa dull; cotyledons brown; radicle less than 1/2 length of cotyledons; plumule moderately developed *Hybosema*, 8.04
Seed 1.5–4.2 mm long; testa glossy; cotyledons tan, white, or yellow; radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons; plumule rudimentary 44
44. Seed overgrown, mitaform, mounded on one side and straight on the other; outer face of one cotyledon flat and convex, one thicker than the other *Adesmia*, 15.01
Seed not overgrown, with shape variable but not mitaform, terete, or compressed; cotyledons both outer faces convex, both the same thickness 45
45. Fruit 2–9 times longer than wide, with persistent calyx *Genista*, 30.22
Fruit more than 9 times longer than wide, with deciduous calyx *Spartium*, 30.19
46. Hilum partially concealed or fully concealed 47
Hilum visible 50
47. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons; fruit rounded, tapered, or short tapered at apex 48
Radicle less than 1/2 length of cotyledons; fruit long tapered at apex 49
48. Hilum concealed by funiculus or funicular remnant; lens elliptic or oblong *Genista*, 30.22
Hilum concealed by aril; lens circular or triangular *Adenocarpus*, 30.05
49. Testa color modified by a bloom, black; hilum concealed by funicular remnant, within rim; embryonic axis parallel to length of seed *Pickeringia*, 29.06
Testa color not modified by a bloom, brown; hilum concealed by radicle lobe or wing, not within rim; embryonic axis oblique to length of seed *Jacksonia*, 24.08
50. Cuticle wrinkled; plumule moderately developed *Echinospartum*, 30.23
Cuticle not wrinkled; plumule rudimentary 51
51. Hilum within halo; cotyledons brown; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) *Erinacea*, 30.18
Hilum within rim; cotyledons tan, white, or yellow; radicle centered between cotyledons 52
52. Cotyledons not smooth *Argyrolobium*, 30.03
Cotyledons smooth 53
53. Fruit without beak, coriaceous; mesocarp coriaceous *Genista*, 30.22
Fruit with beak, ligneous; mesocarp ligneous *Calicotome*, 30.17
54. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons 55
Radicle less than 1/2 length of cotyledons 68
55. Endosperm thin 56
Endosperm thick 59
56. Hilum not within halo or rim 57
Hilum within halo or rim 58
57. Rim-aril; lens circular or elliptic *Lupinus*, 30.08
Tongue-aril; lens irregular, linear, or oblong *Poitea*, 8.05
58. Endocarp scurfy or smooth; seeds in 1 series *Genista*, 30.22
Endocarp spongy; seeds in 2 or more series *Lupinus*, 30.08
59. Seed symmetrical; hilum with straight outline *Petteria*, 30.13
Seed asymmetrical; hilum with curved outline 60
60. Hilum partially or fully concealed 61
Hilum visible 64

61. Hilum elliptic or oval; hilum rim color lighter than testa or darker than testa 62
Hilum circular; hilum rim color of testa 64
62. Seed 2–3 mm long; aril brown, cream, ivory, or tan; lens key-hole shaped or oblong, same or similar color as testa, brown; cotyledons tan *Ulex*, 30.25
Seed 3.5–4 mm long; aril white; lens linear, dissimilar color from testa, tan; cotyledons yellow *Argyrocytisus*, 30.14
63. Hilum concealed by funiculus or funicular remnant; lens elliptic or oblong *Genista*, 30.22
Hilum concealed by aril; lens circular or triangular *Adenocarpus*, 30.05
64. Cotyledons not smooth *Argyrolobium*, 30.03
Cotyledons smooth 65
65. Testa glossy 66
Testa dull 67
66. Fruit without beak, coriaceous; mesocarp coriaceous *Genista*, 30.22
Fruit with beak, ligneous; mesocarp ligneous *Calicotome*, 30.17
67. Fruit with beak, ligneous; mesocarp ligneous; funiculus filiform *Calicotome*, 30.17
Fruit without beak, chartaceous or coriaceous; mesocarp coriaceous; funiculus triangular *Cytisus*, 30.15
68. Embryonic axis oblique, parallel, right angled, or straight 69
Embryonic axis deflexed 73
69. Cotyledons white *Vigna*, 10.66
Cotyledons brown, green, tan, or yellow 70
70. Rim-aril 2-lipped or tongue-aril; cotyledons without lobes 71
Rim-aril not 2-lipped; cotyledons with lobes 72
71. Aril without tongue (or flaplike) on lips of 2-lipped rim-aril, cream; testa coriaceous; hilum with straight outline *Physostigma*, 10.52
Aril with tongues (or flaplike) on lips of 2-lipped rim-aril, brown or tan; testa chartaceous; hilum with curved outline *Apios*, 10.07
72. Seed 3–17 mm long; aril entire; seed terete or compressed; testa brown, red, or tan; cotyledons with basal groin formed by lobes; embryonic axis without a joint evident between the radicle and the cotyledons *Sophora*, 2.45
Seed ca. 20 mm long; aril crenate; seed flattened; testa black; cotyledons without basal groin formed by lobes; embryonic axis with a joint evident between the radicle and the cotyledons *Panurea*, 2.30
73. Tongue-aril; lens irregular, linear, oblong, or rhombic 74
Rim-aril; lens circular or elliptic 75
74. Seed 5.5–12 mm long; hilum with straight outline; lens rhombic *Gliricidia*, 8.06
Seed 3–5 mm long; hilum with curved outline; lens irregular, linear, or oblong *Poitea*, 8.05
75. Radicle bulbous 76
Radicle linear or triangular 77
76. Seed 1.6–3 mm long; hilum oval, within rim; lens less than 0.5 mm in length, confluent with hilum *Gompholobium*, 24.01
Seed 4–6 mm long; hilum circular, within halo; lens equal to or greater than 0.5 mm in length, adjacent to hilum *Robinia*, 8.07
77. Aril white; endosperm thin *Lupinus*, 30.08
Aril brown or tan; endosperm thick 78
78. Hilum partially or fully concealed, oval, within rim; cotyledons orange or yellow *Chorizema*, 24.10
Hilum visible, circular, within halo or not within rim; cotyledons tan 79
79. Testa monochrome; seed rim present; hilum not within halo; radicle deflexed and parallel to cotyledon width *Viminaria*, 24.03
Testa mottled or streaked; seed rim absent; hilum within halo; radicle deflexed and parallel to cotyledon length *Callistachys*, 24.12
80. Seed 3–5 mm long; endosperm thin; cotyledons margin entire 180 degrees from radicle base, brown, green, or tan; fruit a legume *Poitea*, 8.05
Seed 1 mm long; endosperm thick; cotyledons margin not entire 180 degrees from radicle base, yellow; fruit a loment (or a loment segment) *Soemmeringia*, 14.10

**Seed Key 10: Aril absent. Cotyledons entire over radicle.
Endosperm absent.**

1. Seed symmetrical 2
Seed asymmetrical 10
2. Seed with surface wrinkled 3
Seed with surface smooth 4
3. Seed 8.9–16 mm long, circular, terete; testa free from endocarp; cotyledons completely concealing radicle, brown or yellow *Holocalyx*, 1.12
Seed ca. 23 mm long, elliptic, compressed; testa fused to endocarp, at most a transparent brown tissue; cotyledons not concealing radicle, tan *Myrocarpus*, 2.05
4. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous 5
Hilum with the lips of the faboid split the same color as the rest of the hilum 7
5. Cotyledons not concealing radicle; radicle deflexed and parallel to cotyledon width; plumule well developed *Lathyrus*, 19.02
Cotyledons completely or partially concealing radicle; radicle deflexed and parallel to cotyledon length or straight with embryonic axis; plumule rudimentary 6
6. Seed 4–5 mm long, compressed; cotyledons partially concealing radicle; embryonic axis perpendicular to length of seed; radicle triangular *Vavilovia*, 19.05
Seed 20–80 mm long, terete; cotyledons completely concealing radicle; embryonic axis oblique or parallel to length of seed; radicle linear *Andira*, 4.04
7. Seed elliptic, ovate, or rhombic 8
Seed circular or oblong 9
8. Cotyledons without margins recessed; fruit linear, with epicarp and mesocarp dehiscent and endocarp not dehiscent; endocarp separating into 1-seeded winged segments *Endosamara*, *Millettieae*
Cotyledons with margins recessed; fruit coiled or moniliform, with all layers dehiscent, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscent along suture; endocarp entire *Sophora*, 2.45
9. Seed 20–80 mm long; testa not bearing endocarp remnants; cotyledons without lobes; embryonic axis deflexed or straight; radicle deflexed and parallel to cotyledon length or straight with embryonic axis *Andira*, 4.04
Seed 3–17 mm long; testa bearing endocarp remnants; cotyledons with lobes; embryonic axis oblique or right angled; radicle oblique to cotyledons or with 90-degree turn *Sophora*, 2.45
10. Seed with visible radicle and cotyledon lobes 11
Seed without visible radicle and cotyledon lobes 17
11. Hilum punctiform; raphe visible 12
Hilum larger than punctiform; raphe not visible 14
12. Seed ca. 8 mm long, with surface grooved; testa chartaceous; raphe raised; hilum flush, within rim *Tipuana*, 4.13
Seed 5–6 or ca. 17 mm long, with surface smooth; testa coriaceous; raphe recessed; hilum recessed, not within rim 13
13. Seed 5–6 mm long; testa smooth; raphe from hilum through lens to base of seed and terminating; hilum visible; lens discernible *Cascaronia*, 4.16
Seed ca. 17 mm long; testa not smooth; raphe from hilum to near base of seed and terminating; hilum fully concealed; lens not discernible *Platypodium*, 4.14
14. Testa chartaceous 15
Testa coriaceous 16
15. Seed ca. 8 mm long, flattened; cotyledons not concealing radicle, red; radicle bulbous; radicle lobe tip curved *Discolobium*, 14.17
Seed ca. 1.4 mm long, compressed; cotyledons partially concealing radicle, brown; radicle linear; radicle lobe tip straight *Paramachaerium*, 4.10
16. Seed mitaform, oblong, rhombic, or triangular; testa dull; seed rim absent; lens within rim *Medicago*, 21.05
Seed ovate or reniform; testa glossy; seed rim present; lens not within rim *Desmodiastrum*, 11.18A
17. Cotyledons not smooth 18
Cotyledons smooth 24
18. Cotyledons not concealing radicle 19
Cotyledons completely or partially concealing radicle 20

19. Lens mounded or recessed; radicle deflexed and parallel to cotyledon width *Lathyrus*, 19.02
 Lens flush; radicle deflexed and parallel to cotyledon length *Desmodium*, 11.09
20. Plumule moderately or well developed; endocarp coriaceous 21
 Plumule rudimentary; endocarp chartaceous 22
21. Seed irregular; testa present; cotyledons margin not entire 180 degrees from base of radicle; embryonic axis with a joint evident between the radicle and the cotyledons; radicle linear *Spatholobus*, 10.05
 Seed ovate or reniform; testa absent; cotyledons margin entire 180 degrees from base of radicle; embryonic axis without a joint evident between the radicle and the cotyledons; radicle triangular *Cordyla*, 1.06
22. Seed flattened, with surface grooved; embryonic axis straight, perpendicular to length of seed; radicle linear *Etaballia*, 2.09
 Seed terete or compressed, with surface smooth; embryonic axis deflexed or parallel, oblique or parallel to length of seed; radicle triangular or truncate 23
23. Seed with umbo on seed faces; testa coriaceous; hilum flush; radicle truncate, deflexed and parallel to cotyledon width *Phylloxylon*, 9.01
 Seed without umbo on seed faces; testa chartaceous; hilum recessed; radicle triangular, straight with embryonic axis *Swartzia*, 1.01
24. Hilum punctiform 25
 Hilum larger than punctiform 32
25. Hilum recessed 26
 Hilum flush 29
26. Lens not discernible; cotyledons completely or partially concealing radicle; embryonic axis parallel to length of seed; radicle triangular, straight with embryonic axis *Swartzia*, 1.01
 Lens discernible; cotyledons not concealing radicle; embryonic axis oblique to length of seed; radicle linear, deflexed and parallel to cotyledon length or oblique to cotyledons 27
27. Lens adjacent to hilum, same color as testa; cotyledons brown; embryonic axis straight; radicle oblique to cotyledons *Rhynchotropis*, 9.03
 Lens confluent with hilum, dissimilar color from testa; cotyledons green, tan, or yellow; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length 28
28. Lens mounded; embryonic axis with a joint evident between the radicle and the cotyledons *Hymenocarpus*, 13.04
 Lens flush; embryonic axis without a joint evident between the radicle and the cotyledons *Desmodium*, 11.09
29. Seed reniform; hilum fully concealed; radicle bulbous or linear; radicle deflexed and parallel to cotyledon length; plumule moderately or well developed ... 30
 Seed D-shaped, oblong, or ovate; hilum visible; radicle triangular, deflexed and parallel to cotyledon width; plumule rudimentary 31
30. Hilum within rim; lens circular; cotyledons yellow; radicle linear; plumule moderately developed *Arthroclianthus*, 11.03
 Hilum not within rim; lens oblong; cotyledons brown or tan; radicle bulbous; plumule well developed *Platymiscium*, 4.08
31. Seed D-shaped; testa chartaceous; hilum marginal according to radicle tip; embryonic axis without a joint evident between the radicle and the cotyledons *Baphiopsis*, 1.05
 Seed oblong or ovate; testa coriaceous; hilum subapical to radicle tip; embryonic axis with a joint evident between the radicle and the cotyledons *Bocoa*, 1.02
32. Testa chartaceous 33
 Testa osseous or coriaceous 41
33. Seed with shallow hilar sinus; testa fused to endocarp, at most a transparent brown tissue; cotyledons with only 1 folded *Ostryocarpus*, Millettieae
 Seed without hilar sinus; testa free from endocarp; cotyledons with both folded or not folded 34
34. Seed terete 35
 Seed compressed or flattened 36
35. Testa streaked; hilum flush; cotyledons tan *Harleyodendron*, 1.09
 Testa monochrome or mottled; hilum recessed; cotyledons brown or green *Swartzia*, 1.01
36. Lens discernible 37
 Lens not discernible 38

37. Fruit wings present, stipitate or substipitate; fruit apex aligned or oblique with longitudinal axis of fruit; epicarp glabrous or glabrate, eglandular *Desmodium*, 11.09
Fruit wings absent, nonstipitate; fruit apex right-angled with longitudinal axis of fruit; epicarp pubescent and indurate, glandular *Cranocarpus*, 11.02
38. Hilum apical according to radicle tip but marginal according to seed length 39
Hilum apical at apex of radicle tip, subapical to radicle tip, marginal according to radicle tip, or between cotyledon and radicle lobe 40
39. Seed flattened; fruit a loment (or a loment segment), irregular or reniform, without beak, membranous; epicarp monochrome *Cranocarpus*, 11.02
Seed compressed; fruit a legume, elliptic, falcate, fusiform, moniliform, or oblong, with beak, chartaceous; epicarp multicolored *Austrosteenisia*, Millettieae
40. Seed flattened; fruit a loment (or a loment segment), irregular or reniform, membranous, nonstipitate *Cranocarpus*, 11.02
Seed compressed; fruit a legume, circular, elliptic, moniliform, oblong, or ovate, fleshy, leathery, or ligneous, stipitate or substipitate *Swartzia*, 1.01
41. Hilum within corona, halo, or rim 42
Hilum not within corona, halo, or rim 44
42. Testa red; hilum within corona; lens wedge-shaped, within corona; embryonic axis parallel to length of seed *Rupertia*, 12.05
Testa brown, green, olive, or tan; hilum within halo or rim; lens circular, elliptic, 2 circular mounds separated by groove, or oblong, not within corona; embryonic axis oblique to length of seed 43
43. Hilum flush; cotyledons brown *Campylotropis*, 11.23
Hilum recessed; cotyledons green, tan, or yellow *Desmodium*, 11.09
44. Seed flattened 45
Seed compressed 46
45. Fruit apex aligned or oblique with longitudinal axis of fruit, stipitate or substipitate; fruit wings present; epicarp glabrous or glabrate *Desmodium*, 11.09
Fruit apex right-angled with longitudinal axis of fruit, nonstipitate; fruit wings absent; epicarp pubescent and indurate *Cranocarpus*, 11.02
46. Radicle 1/2 to nearly length of, equaling length of, or exceeding length of cotyledons 47
Radicle less than 1/2 length of cotyledons 48
47. Seed 1.2–7 mm long; testa papillate, transversely ridged, rugose, or wrinkled; fruit 2–9 times or more than 9 times longer than wide, with orifice formed by curving of fruit or fruit segments; mesocarp absent *Medicago*, 21.05
Seed 8–30 mm long; testa shagreen or veined; fruit length less than twice as long as width, without orifice formed by curving of fruit or fruit segments; mesocarp present *Lecointea*, 1.08
48. Hilum with curved or straight outline, marginal according to radicle tip or between cotyledon and radicle lobe, recessed; lens discernible *Desmodium*, 11.09
Hilum with angular outline, subapical to radicle tip, flush; lens not discernible *Lecointea*, 1.08
- Seed Key 11: Aril absent. Cotyledons entire over radicle. Hilum raised or flush. Endosperm present.**
1. Seed with visible radicle and cotyledon lobes 2
Seed without visible radicle and cotyledon lobes 20
2. Seed with external groove between radicle and cotyledon lobes 3
Seed without external groove between radicle and cotyledon lobes 8
3. Hilum partially concealed 4
Hilum visible 6
4. Seed mitaform or ovate, terete *Ebenus*, 18.07
Seed oblong or reniform, compressed 5
5. Seed without hilar sinus; hilum within halo; cotyledons tan *Onobrychis*, 18.06
Seed with shallow hilar sinus; hilum within rim; cotyledons white or yellow *Hedysarum*, 18.02
6. Seed 1.2–1.3 mm long; hilum within rim; endosperm adnate to embryo; cotyledons white *Melliniella*, 11.19
Seed 1.5–6 mm long; hilum not within rim or within halo; endosperm adnate to testa; cotyledons green or tan 7
7. Seed ca. 6 mm long, mitaform; hilum not within halo; cotyledons green; radicle less than 1/2 length of cotyledons; plumule rudimentary *Oreophysa*, 16.06
Seed 1.5–2.3 mm long, elliptic, oblong, or ovate; hilum within halo; cotyledons tan; radicle 1/2 to nearly length of cotyledons; plumule moderately developed *Kummerowia*, 11.25

8. Cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) 9
Cotyledons similar at apex; radicle centered between cotyledons 10
9. Seed 1.5–1.8 mm long, reniform; endosperm thin, adnate to testa; cotyledons not folded, yellow; plumule moderately developed *Smithia*, 14.12
Seed 3–4 mm long, circular, elliptic, or rectangular; endosperm thick, adnate to embryo; cotyledons with both folded, tan; plumule rudimentary *Cyamopsis*, 9.06
10. Hilum within halo or rim 11
Hilum not within halo or rim 15
11. Radicle linear; plumule moderately developed 12
Radicle bulbous; plumule rudimentary 13
12. Seed compressed; hilum punctiform, within rim; lens circular or elliptic, black *Christia*, 11.17
Seed flattened; hilum larger than punctiform, within halo; lens irregular, linear, or wedge-shaped, brown *Droogmansia*, 11.14
13. Seed terete; lens circular, similar color as testa; endosperm thick; radicle deflexed and parallel to cotyledon width *Chaetocalyx*, 14.07
Seed compressed; lens linear or oblong, dissimilar color from testa; endosperm thin; radicle deflexed and parallel to cotyledon length 14
14. Seed 2–2.5 mm long; testa coriaceous; hilum within rim; lens not within halo; cotyledons not concealing radicle, yellow *Pearsonia*, 27.01
Seed 1–1.5 mm long; testa chartaceous; hilum within halo; lens within halo; cotyledons partially concealing radicle, tan or white *Gueldenstaedtia*, 16.19
15. Seed with deep or shallow hilar sinus 16
Seed without hilar sinus 17
16. Seed circular, with umbo on seed faces; cotyledons yellow; radicle linear; plumule moderately developed *Bolusia*, 27.08
Seed oblong or reniform, without umbo on seed faces; cotyledons brown; radicle bulbous; plumule rudimentary *Calophaca*, 16.12
17. Seed rim present; fruit a loment (or a loment segment), moniliform, with beak *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet, circular, coiled, dolabriform, elliptic, falcate, fusiform, lanceolate, linear, oblong, obovate, or ovate, without beak 18
18. Hilum partially concealed *Melilotus*, 21.03
Hilum visible 19
19. Hilum punctiform; lens not within rim *Trifolium*, 21.06
Hilum larger than punctiform; lens within rim *Medicago*, 21.05
20. Hilum larger than punctiform 21
Hilum punctiform 32
21. Plumule moderately or well developed 22
Plumule rudimentary 27
22. Cotyledons not smooth 23
Cotyledons smooth 24
23. Cotyledons completely concealing radicle; lens lighter than testa; cotyledons yellow; radicle 1/2 to nearly length of cotyledons; plumule moderately developed *Dichilus*, 30.02
Cotyledons not concealing radicle; lens darker than testa; cotyledons tan; radicle less than 1/2 length of cotyledons; plumule well developed *Lathyrus*, 19.02
24. Hilum within halo; fruit C-shaped or moniliform ... 25
Hilum not within halo; fruit circular, elliptic, irregular, oblong, or reniform 26
25. Seed compressed; hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, with straight outline; lens circular; cotyledons completely concealing radicle, brown *Eleiotis*, 11.21
Seed flattened; hilum with the lips of the faboid split the same color as the rest of the hilum, with curved outline; lens irregular, linear, or wedge-shaped; cotyledons not concealing radicle, tan *Droogmansia*, 11.14
26. Seed circular, irregular, or oblong; testa green or red; cotyledons outer face of 1 cotyledon flat and other cotyledon concave, 1 thicker than the other, with only 1 or both folded *Psoralidium*, 12.04
Seed reniform; testa brown; cotyledons both outer faces convex, both the same thickness, not folded *Cranocarpus*, 11.02

27. Seed flattened 28
Seed terete or compressed 29
28. Seed reniform, without umbo on seed faces; testa dull, smooth *Cranocarpus*, 11.02
Seed C-shaped, with umbo on seed faces; testa glossy, not smooth *Riedeliella*, 2.08
29. Cotyledons not smooth, completely concealing radicle, cotyledons yellow *Dichilus*, 30.02
Cotyledons smooth, not concealing radicle, brown or tan 30
30. Seed with deep hilar sinus; hilum partially or fully concealed *Calophaca*, 16.12
Seed without hilar sinus; hilum visible 31
31. Seed mitaform, oblong, rhombic, or triangular; embryonic axis oblique to length of seed; radicle 1/2 to nearly length of or equaling length of cotyledons *Medicago*, 21.05
Seed ovate or reniform; embryonic axis parallel to length of seed; radicle less than 1/2 length of cotyledons *Orbexilum*, 12.07
32. Endosperm thick 33
Endosperm thin 41
33. Embryonic axis parallel to length of seed 34
Embryonic axis oblique to length of seed 35
34. Seed circular, oblong, ovate, or reniform; testa orange, red, or yellow; hilum within halo; lens circular; radicle bulbous *Ornithopus*, 13.15
Seed rhombic; testa brown or tan; hilum not within halo; lens wedge-shaped; radicle linear *Coronilla*, 13.11
35. Seed terete 36
Seed quadrangular, compressed, or flattened 38
36. Testa orange or red; cotyledons with both folded *Scorpiurus*, 13.14
Testa brown, green, purple, tan, or yellow; cotyledons not folded 37
37. Lens key-hole shaped; embryonic axis with a joint evident between the radicle and the cotyledons; radicle less than 1/2 length of cotyledons *Dorycnium*, 13.06
Lens circular, elliptic, or linear; embryonic axis without a joint evident between the radicle and the cotyledons; radicle 1/2 to nearly length of cotyledons *Lotus*, 13.07
38. Testa chartaceous; cotyledons partially concealing radicle, brown *Chesneya*, 16.14
Testa coriaceous; cotyledons not concealing radicle, green, tan, or yellow 39
39. Hilum visible; radicle oblique to cotyledons *Antopetitia*, 13.16
Hilum partially or fully concealed; radicle deflexed and parallel to cotyledon length 40
40. Hilum without faboid split; fruit with beak; fruit margin with sulcus; mesocarp absent; endocarp with septa thicker than paper, firm *Securigera*, 13.12
Hilum with faboid split; fruit without beak; fruit margin without sulcus; mesocarp present; endocarp with septa thin (like tissue paper), flexible *Lotus*, 13.07
41. Hilum not within halo or rim 42
Hilum within halo or rim 44
42. Seed with deep hilar sinus; radicle lobe tip curved or hooked *Calophaca*, 16.12
Seed without hilar sinus; radicle lobe tip straight 43
43. Testa black, green, red, tan, or yellow; hilum visible, between cotyledon and radicle lobe; embryonic axis without a joint evident between the radicle and the cotyledons *Trifolium*, 21.06
Testa brown; hilum fully concealed, apical at apex of radicle tip; embryonic axis with a joint evident between the radicle and the cotyledons *Cytisopsis*, 13.01
44. Cotyledons brown, green, or tan 45
Cotyledons white or yellow 48
45. Seed reniform; cotyledons not smooth; plumule moderately developed *Christia*, 11.17
Seed C-shaped, circular, irregular, mitaform, oblong, quadrangular, or triangular; cotyledons smooth; plumule rudimentary 46
46. Seed C-shaped; cotyledons brown; embryonic axis with a joint evident between the radicle and the cotyledons *Vermifruix*, 13.10
Seed circular, irregular, mitaform, oblong, quadrangular, or triangular; cotyledons green or tan; embryonic axis without a joint evident between the radicle and the cotyledons 47
47. Hilum partially or fully concealed; lens black *Lotus*, 13.07
Hilum visible; lens brown *Anthyllis*, 13.02

48. Radicle bulbose 49
 Radicle linear 50
49. Seed asymmetrical; testa brown or tan; hilum within rim; lens linear or oblong; endosperm adnate to embryo *Pearsonia*, 27.01
 Seed symmetrical; testa orange, red, or yellow; hilum within halo; lens circular; endosperm adnate to testa *Ornithopus*, 13.15
50. Lens oblong; radicle less than 1/2 length of cotyledons *Dorycniopsis*, 13.05
 Lens circular, elliptic, or linear; radicle 1/2 to nearly length of cotyledons 51
51. Lens less than 0.5 mm in length, mounded, black; cotyledons smooth; plumule rudimentary *Lotus*, 13.07
 Lens equal to or greater than 0.5 mm in length, flush, brown; cotyledons not smooth; plumule moderately developed *Alysicarpus*, 11.18
- Seed Key 12: Aril absent. Cotyledons entire over radicle. Hilum recessed. Endosperm present.**
1. Seed without visible radicle and cotyledon lobes 2
 Seed with visible radicle and cotyledon lobes 36
2. Hilum larger than punctiform 3
 Hilum punctiform 20
3. Hilum within corona, halo, or rim 4
 Hilum not within corona, halo, or rim 8
4. Hilum within corona; fruit oblong; cotyledons with the interface division terminating in radicle tissue *Pediomelum*, 12.03
 Hilum within halo or rim; fruit circular, coiled, dolabriform, irregular, linear, moniliform, or samaroid; cotyledons with the interface division terminating at base of radicle 5
5. Seed D-shaped, linear, oblong, quadrangular, rectangular, or reniform; hilum marginal according to radicle tip or between cotyledon and radicle lobe 6
 Seed circular, elliptic, ovate, or rhombic; hilum apical according to radicle tip but marginal according to seed length 7
6. Lens flush; radicle linear, deflexed and parallel to cotyledon length, less than 1/2 length of cotyledons *Desmodium*, 11.09
 Lens mounded; radicle bulbous, deflexed and parallel to cotyledon width, 1/2 to nearly length of cotyledons *Bobgunnia*, 1.01A
7. Cotyledons without margins recessed; fruit linear, with epicarp and mesocarp dehiscent and endocarp not dehiscent; endocarp separating into 1-seeded winged segments, with wings not extending into epicarp *Endosamara*, Millettieae
 Cotyledons with margins recessed; fruit coiled or moniliform, with all layers dehiscent, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscent along suture; endocarp entire, without or with wings extending into epicarp *Sophora*, 2.45
8. Testa partially adhering to endocarp; cotyledons with the interface division terminating in radicle tissue *Pediomelum*, 12.03
 Testa not adhering to endocarp; cotyledons with the interface division terminating at base of radicle ... 9
9. Seed with surface grooved 10
 Seed with surface smooth 11
10. Seed with grooves longitudinal or oblique; lens circular, elliptic, or 2 circular mounds separated by groove or oblong; embryonic axis oblique to length of seed *Desmodium*, 11.09
 Seed with grooves transverse; lens hourglass shaped, irregular, or wedge-shaped; embryonic axis perpendicular to length of seed *Indigofera*, 9.07
11. Cotyledons not smooth 12
 Cotyledons smooth 13
12. Lens mounded or recessed; radicle deflexed and parallel to cotyledon width *Lathyrus*, 19.02
 Lens flush; radicle deflexed and parallel to cotyledon length *Desmodium*, 11.09
13. Seed flattened 14
 Seed compressed 15
14. Fruit apex aligned or oblique with longitudinal axis of fruit, stipitate or substipitate; fruit wings present; epicarp glabrous or glabrate, eglandular *Desmodium*, 11.09
 Fruit apex right-angled with longitudinal axis of fruit, nonstipitate; fruit wings absent; epicarp pubescent and indurate; epicarp glandular *Cranocarpus*, 11.02
15. Testa chartaceous 16
 Testa coriaceous 17
16. Hilum marginal according to radicle tip or between cotyledon and radicle lobe; lens discernible *Desmodium*, 11.09
 Hilum apical according to radicle tip but marginal according to seed length; lens not discernible *Austrosteenisia*, Millettieae

17. Radicle 1/2 to nearly length of or equaling length of cotyledons 18
Radicle less than 1/2 length of cotyledons 19
18. Fruit with orifice formed by curving of fruit or fruit segments, circular, coiled, or falcate; fruit base right angled with longitudinal axis of fruit; fruit seed chambers externally invisible; mesocarp absent *Medicago*, 21.05
Fruit without orifice formed by curving of fruit or fruit segments, linear or oblong; fruit base aligned or oblique with longitudinal axis of fruit; fruit seed chambers externally visible; mesocarp present *Poitea*, 8.05
19. Aril cupshaped or rim-aril; fruit wings present; endocarp spongy, septate *Desmodium*, 11.09
Aril tongue-aril; fruit wings absent; endocarp scurfy or smooth, subseptate or nonseptate *Poitea*, 8.05
20. Embryonic axis parallel to length of seed 21
Embryonic axis oblique to length of seed 26
21. Seed circular, elliptic, hippocrepiform, linear, oblong, or ovate; plumule moderately developed 22
Seed rectangular, reniform, or rhombic; plumule rudimentary 24
22. Seed hippocrepiform or linear, terete; endosperm adnate to embryo; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different), less than 1/2 length of cotyledons *Hippocrepis*, 13.13
Seed circular, elliptic, oblong, or ovate, compressed; endosperm adnate to testa; radicle centered between cotyledons, 1/2 to nearly length of cotyledons or exceeding length of cotyledons 23
23. Seed 2.5–5 mm long, circular, oblong, or ovate; hilum not within rim; lens discernible; cotyledons tan; radicle exceeding length of cotyledons *Anarthrophyllum*, 30.06
Seed 5.5–6.7 mm long, elliptic; hilum within rim; lens not discernible; cotyledons yellow; radicle 1/2 to nearly length of cotyledons *Hoita*, 12.06
24. Hilum not within corona or rim; seed rhombic *Coronilla*, 13.11
Hilum within corona or rim; seed rectangular or reniform 25
25. Testa black; hilum within rim; endosperm thick; cotyledons tan; radicle less than 1/2 length of cotyledons *Pickeringia*, 29.06
Testa brown or green; hilum within corona; endosperm thin; cotyledons yellow; radicle 1/2 to nearly length of cotyledons *Cullen*, 12.01
26. Hilum within halo or rim 27
Hilum not within halo or rim 30
27. Lens flush; fruit wings present; endocarp spongy *Desmodium*, 11.09
Lens mounded; fruit wings absent; endocarp smooth 28
28. Seed 3–3.6 mm long; hilum marginal according to radicle tip; testa glossy; lens confluent with hilum *Dendrolobium*, 11.06
Seed 1–2.7 mm long; hilum between cotyledon and radicle lobe; testa dull; lens adjacent to hilum 29
29. Hilum partially concealed, within rim; lens irregular or key-hole shaped, black *Melolobium*, 30.01
Hilum visible, within halo; lens elliptic or 2 circular mounds separated by groove, brown *Acmispon*, 13.07A
30. Radicle 1/2 to nearly length of or equaling length of cotyledons 31
Radicle less than 1/2 length of cotyledons 33
31. Radicle oblique to cotyledons *Hammatolobium*, 13.17
Radicle deflexed and parallel to cotyledon length or width 32
32. Testa black, green, red, tan, or yellow *Trifolium*, 21.06
Testa brown *Poitea*, 8.05
33. Testa not smooth 34
Testa smooth 35
34. Hilum partially concealed; fruit oblong, terete; fruit wings absent; endocarp with septa thin (like tissue paper), flexible *Tripodion*, 13.03
Hilum visible or fully concealed; fruit circular, dolabriform, irregular, linear, or samaroid, compressed or flattened; fruit wings present; endocarp with septa thicker than paper, firm *Desmodium*, 11.09
35. Aril cupshaped or rim-aril; fruit wings present; seed length parallel with fruit length *Desmodium*, 11.09
Aril tongue-aril; fruit wings absent; seed length transverse to fruit length *Poitea*, 8.05

36. Hilum not within corona, halo, or rim 37
Hilum within corona, halo or rim 61
37. Seed with surface grooved *Indigofera*, 9.07
Seed with surface smooth 38
38. Radicle not centered between cotyledons (radicle
outside 1 cotyledon and inside other, therefore
junctions for each cotyledon different) 39
Radicle centered between cotyledons 40
39. Testa black, brown, tan, or white; lens oblong;
endosperm thin; radicle bulbous, less than 1/2 to
nearly length of cotyledons *Aspalathus*, 27.06
Testa red; lens punctiform; endosperm thick; radicle
linear, exceeding length of cotyledons
..... *Notospartium*, 17.02
40. Hilum larger than punctiform 41
Hilum punctiform 47
41. Seed rim present; fruit a loment (or a loment seg-
ment),
moniliform *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet, circular,
coiled, elliptic, falcate, linear, oblong, or samaroid
..... 42
42. Radicle lobe tip curved or hooked 43
Radicle lobe tip straight 44
43. Seed 1–8 mm long; hilum elliptic; lens discernible;
radicle deflexed and parallel to cotyledon length
..... *Crotalaria*, 27.07
Seed 20–25 mm long; hilum oval; lens not discern-
ible; radicle deflexed and parallel to cotyledon
width *Vataireopsis*, 4.01
44. Endosperm thin or trace 45
Endosperm thick 46
45. Fruit with orifice formed by curving of fruit or fruit
segments; fruit base right angled with longitudinal
axis of fruit; fruit seed chambers externally
invisible; mesocarp absent; seed length parallel
with fruit length *Medicago*, 21.05
Fruit without orifice formed by curving of fruit or
fruit segments; fruit base aligned or oblique with
longitudinal axis of fruit; fruit seed chambers
externally visible; mesocarp present; seed length
transverse to fruit length *Poitea*, 8.05
46. Lens not within rim; fruit without orifice formed by
curving of fruit or fruit segments, inflated; fruit
base aligned or oblique with longitudinal axis of
fruit; epicarp not veined *Crotalaria*, 27.07
Lens within rim; fruit with orifice formed by curving
of fruit or fruit segments, not inflated; fruit base
right angled with longitudinal axis of fruit; epicarp
veined *Medicago*, 21.05
47. Endosperm thick 48
Endosperm thin or trace 54
48. Radicle lobe tip curved or hooked 49
Radicle lobe tip straight 51
49. Lens equal to or greater than 0.5 mm in length; fruit
inflated, rounded at base *Crotalaria*, 27.07
Lens less than 0.5 mm in length; fruit not inflated,
long or short tapered at base 50
50. Seed 2–3.5 mm long; testa not smooth; hilum partially
concealed; lens not in groove of raphe, same color
as testa *Jacksonia*, 24.08
Seed 5–6 mm long; testa smooth; hilum visible; lens
in groove of raphe, similar color as testa
..... *Cascaronia*, 4.16
51. Seed cordate or reniform 52
Seed circular, elliptic, linear, mitaform, oblong, ovate,
quadrangular, rectangular, or rhombic 53
52. Lens equal to or greater than 0.5 mm in length, not in
groove of raphe, tan *Crotalaria*, 27.07
Lens less than 0.5 mm in length, in groove of raphe,
brown *Cascaronia*, 4.16
53. Fruit not plicate, rounded at base; fruit seed chambers
externally invisible; epicarp not veined, shagreen
..... *Crotalaria*, 27.07
Fruit plicate, tapered or short tapered at base; fruit
seed chambers externally visible; epicarp veined,
warty *Trigonella*, 21.04
54. Plumule moderately developed or well developed .. 55
Plumule rudimentary 58
55. Seed reniform 56
Seed circular, elliptic, linear, mitaform, oblong,
obovate, ovate, quadrangular, rectangular, or
rhombic 57
56. Lens irregular, linear, or oblong; fruit coriaceous, with
all layers dehiscent; fruit seed chambers externally
visible; seed length transverse to fruit length
..... *Poitea*, 8.05
Lens circular; fruit membranous, indehiscent; fruit
seed chambers externally invisible; seed length
parallel with fruit length *Cascaronia*, 4.16

57. Fruit plicate; epicarp tan, warty; funiculus filiform, curved *Trigonella*, 21.04
Fruit not plicate; epicarp brown, wrinkled; funiculus flattened or triangular, straight *Poitea*, 8.05
58. Testa black, green, red, tan, or yellow; mesocarp absent *Trifolium*, 21.06
Testa brown; mesocarp present 59
59. Hilum with faboid split; lens irregular, linear, or oblong; fruit seed chambers externally visible; fruit with all layers dehiscing; seed length transverse to fruit length *Poitea*, 8.05
Hilum without faboid split; lens circular; fruit seed chambers externally invisible; fruit indehiscent; seed length parallel with fruit length 60
60. Seed 2–2.7 mm long; testa not smooth; raphe from hilum to lens, black, flush; hilum fully concealed *Stracheya*, 18.04
Seed 5–6 mm long; testa smooth; raphe from hilum through lens to base of seed and terminating, brown, recessed; hilum visible *Cascaronia*, 4.16
61. Radicle bulbous 62
Radicle linear 70
62. Endosperm thick 63
Endosperm thin 65
63. Fracture lines present; lens same color as testa; cotyledons partially concealing radicle *Glycyrrhiza*, 16.22
Fracture lines absent; lens similar color as or dissimilar color from testa; cotyledons not concealing radicle 64
64. Lens tan; endosperm adnate to testa *Crotalaria*, 27.07
Lens brown; endosperm adnate to embryo *Lebeckia*, 27.10
65. Lens oblong 66
Lens circular or triangular 68
66. Seed reniform; hilum larger than punctiform; cotyledons red; radicle deflexed and parallel to cotyledon width *Rafnia*, 27.05
Seed circular, mitaform, ovate, quadrangular, rectangular, or rhombic; hilum punctiform; cotyledons tan or yellow; radicle deflexed and parallel to cotyledon length 67
67. Seed circular, mitaform, quadrangular, or rhombic; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) *Aspalathus*, 27.06
Seed ovate or rectangular; radicle centered between cotyledons *Wiborgia*, 27.11
68. Testa purple, red, or yellow; endosperm adnate to embryo; cotyledons yellow *Lotononis*, 27.09
Testa brown or tan; endosperm adnate to testa; cotyledons tan or white 69
69. Hilum partially concealed; lens dissimilar color from testa; cotyledons tan; embryonic axis oblique to length of seed; plumule moderately developed *Piptanthus*, 29.02
Hilum visible or fully concealed; lens similar color as testa; cotyledons white; embryonic axis parallel to length of seed; plumule rudimentary *Astracantha*, 16.16
70. Hilum marginal according to radicle tip 71
Hilum between cotyledon and radicle lobe 73
71. Seed 10–15 mm long, elliptic or oblong; hilum larger than punctiform; endosperm thick; radicle less than 1/2 length of cotyledons; plumule moderately developed *Anagyris*, 29.03
Seed 1.9–5 mm long, circular or reniform; hilum punctiform; endosperm thin; radicle 1/2 to nearly length of or exceeding length of cotyledons; plumule rudimentary 72
72. Seed 1.9–2.1 mm long; circular, terete; hilum visible, within rim; cotyledons tan *Corallospartium*, 17.04
Seed 2.5–5 mm long; reniform, compressed; hilum fully concealed, within corona; cotyledons yellow *Cullen*, 12.01
73. Radicle deflexed and parallel to cotyledon width 74
Radicle deflexed and parallel to cotyledon length ... 75
74. Seed D-shaped, compressed; raphe from lens to base of seed and terminating; hilum within halo or rim; cotyledons margin entire 180 degrees from base of radicle *Baptisia*, 29.05
Seed elliptic, terete; raphe from hilum to near base of seed and terminating; hilum within corona; cotyledons margin not entire 180 degrees from base of radicle *Parryella*, 6.03
75. Embryonic axis straight; raphe visible ... *Ononis*, 12.01
Embryonic axis deflexed; raphe not visible 76

76. Cotyledons white; seeds in 2 or more series *Parochetus*, 21.02
Cotyledons green, tan, or yellow; seeds in 1 series . 77
77. Lens elliptic or 2 circular mounds separated by groove *Acmispon*, 13.07A
Lens circular, oblong, rectangular, or wedge-shaped 78
78. Endosperm thick; fruit inflated *Crotalaria*, 27.07
Endosperm thin; fruit not inflated 79
79. Radicle 1/2 to nearly length of cotyledons 80
Radicle less than 1/2 length of cotyledons 81
80. Seed 1–1.2 mm long; hilum visible, within rim; lens wedge-shaped; cotyledons yellow; plumule moderately developed *Robynsiophyton*, 27.03
Seed 3–3.7 mm long; hilum fully concealed, within halo; lens circular; cotyledons tan; plumule rudimentary *Eversmannia*, 18.01
81. Seed 1–1.4 mm long; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); hilum visible; cotyledons tan or yellow *Rothia*, 27.02
Seed 1.5–2.5 mm long; radicle centered between cotyledons; hilum partially concealed; cotyledons green *Taverniera*, 18.03

Seed Key 13: Aril absent. One (1) cotyledon scooped out to accommodate plicate radicle and other cotyledon entire.

1. Seed with visible radicle and cotyledon lobes 2
Seed without visible radicle and cotyledon lobes 5
2. Hilum larger than punctiform 3
Hilum punctiform 4
3. Seed ca. 6 mm long, rim absent; lens in groove of raphe; cotyledons not smooth, 1 longer than other, with only 1 folded *Streblorrhiza*, 17.01
Seed 1.2–2 mm long, rim present; lens not in groove of raphe; cotyledons smooth, both more or less of equal length, not folded ... *Desmodiastrum*, 11.18A
4. Seed 2.5–3 mm long; testa red; raphe from hilum to lens; lens punctiform, red; cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle) *Chordospartium*, 17.03
Seed 5–6 mm long; testa brown; raphe from hilum through lens to base of seed and terminating; lens circular, brown; cotyledons similar at apex *Cascaronia*, 4.16

5. Seed terete; fruit with all layers dehiscent or with epicarp and mesocarp dehiscent and endocarp not dehiscent 6
Seed compressed or flattened; fruit indehiscent 7
6. Seed ca. 10 mm long, elliptic; testa monochrome; hilum apical according to radicle tip but marginal according to seed length, recessed, within rim *Endosamara*, Millettieae
Seed 35–50 mm long, irregular or ovate; testa streaked; hilum apical at apex of radicle tip, flush, not within rim *Harleyodendron*, 1.09
7. Testa not smooth *Lecointea*, 1.08
Testa smooth 8
8. Seed flattened; fruit a loment (or a loment segment) *Cranocarpus*, 11.02
Seed compressed; fruit a legume *Austrosteenisia*, Millettieae

Seed Key 14: Aril absent. Cotyledons notched at radicle.

1. Testa absent 2
Testa present 6
2. Seed irregular, ovate, or reniform, with surface smooth 3
Seed circular, elliptic, oblong, obovate, or triangular, with surface ridged, grooved, or wrinkled 4
3. Seed ca. 35 mm long, ovate, flattened; cotyledons not smooth, with lobes; embryonic axis straight *Monopteryx*, 2.31
Seed 11–16 mm long, irregular or reniform, terete; cotyledons smooth, without lobes; embryonic axis oblique, parallel, or right angled ... *Myroxylon*, 2.07
4. Testa partially adhering to endocarp; cotyledons with 5–7-branched grooves (from veins of testa) on each face; embryonic axis straight; radicle oblique to cotyledons *Aldina*, 1.04
Testa not adhering to endocarp; cotyledons pitted or wrinkled; embryonic axis deflexed or right angled; radicle deflexed and parallel to cotyledon width or straight with embryonic axis 5
5. Seed circular, oblong, or obovate, compressed, with surface ridged; cotyledons not concealing radicle; radicle bulbous or linear *Vatairea*, 4.02
Seed elliptic, terete, with surface wrinkled; cotyledons partially concealing radicle; radicle triangular *Angylocalyx*, 2.13
6. Testa osseous or coriaceous 7
Testa chartaceous 36

7. Hilum punctiform 8
Hilum larger than punctiform 14
8. Seed without visible radicle and cotyledon lobes 9
Seed with visible radicle and cotyledon lobes 11
9. Testa purple; cotyledons differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); radicle bulbose *Hymenolobium*, 4.03
Testa brown; cotyledons similar at apex; radicle linear or truncate 10
10. Seed with umbo on seed faces; testa wrinkled; hilum fully concealed; cotyledons not concealing radicle; radicle linear *Poecilanthus*, Millettieae
Seed without umbo on seed faces; testa shagreen; hilum visible; cotyledons partially concealing radicle; radicle truncate *Zollernia*, 1.11
11. Seed D-shaped; testa red *Psorothamnus*, 6.06
Seed circular, elliptic, mitaform, or reniform; testa brown, green, olive, tan, or yellow 12
12. Hilum partially concealed, flush; lens confluent with hilum, dissimilar color from testa *Melilotus*, 21.03
Hilum visible, recessed; lens adjacent to hilum, similar color as testa 13
13. Seed 1.2–2.5 mm long; testa olive or tan; hilum within rim; lens not in groove of raphe, tan, oblong *Marina*, 6.07
Seed 5–6 mm long; testa brown; hilum not within rim; lens in groove of raphe, brown, circular *Cascaronia*, 4.16
14. Seed asymmetrical 15
Seed symmetrical 25
15. Seed with visible radicle and cotyledon lobes 16
Seed without visible radicle and cotyledon lobes 19
16. Seed rim present; fruit a loment (or a loment segment) *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet 17
17. Lens black; endosperm absent; embryonic axis oblique; radicle oblique to cotyledons or with 180-degree turn *Erythrina*, 10.01
Lens brown; endosperm present; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length or width 18
18. Seed 5–8 mm long; endosperm thin; cotyledons partially concealing radicle, yellow; radicle linear, less than 1/2 length of cotyledons *Ammopiptanthus*, 29.01
Seed 1.5–4.5 mm long; endosperm thick; cotyledons not concealing radicle, tan; radicle bulbous, 1/2 to nearly length of cotyledons *Melilotus*, 21.03
19. Endosperm present 20
Endosperm absent 22
20. Seed angular, compressed; testa glossy; hilum within rim *Centrolobium*, 4.12
Seed not angular, flattened; testa dull; hilum not within rim 21
21. Fruit a loment (or a loment segment), irregular or reniform, rounded at apex; fruit wings absent *Cranocarpus*, 11.02
Fruit a legume, lanceolate or oblong, long tapered at apex; fruit wings present .. *Dalbergiella*, Millettieae
22. Seed flattened; fruit a loment (or a loment segment), membranous *Cranocarpus*, 11.02
Seed terete or compressed; fruit a legume or nutlet, coriaceous, fleshy, or fragile, thinner than chartaceous like *Trifolium* (21.06), leathery, or ligneous 23
23. Hilum with angular outline, subapical to radicle tip *Lecointea*, 1.08
Hilum with curved outline or straight outline, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip 24
24. Embryonic axis right angled or straight; seed length transverse to fruit length *Mucuna*, 10.03
Embryonic axis oblique; seed length parallel with fruit length *Erythrina*, 10.01
25. Hilum recessed 26
Hilum raised or flush 29
26. Cotyledons with lobes *Sophora*, 2.45
Cotyledons without lobes 27
27. Seed irregular or mitaform; cotyledons not smooth, completely concealing radicle, inner face wrinkled; plumule rudimentary *Dussia*, 2.24
Seed circular, elliptic, oblong, ovate, or reniform; cotyledons smooth, partially concealing radicle, inner face flat or concave; plumule moderately or well developed 28
28. Lens brown *Amphicarpaea*, 10.44
Lens black *Erythrina*, 10.01

29. Radicle linear 30	42. Testa fused to endocarp, at most a transparent brown tissue, clear <i>Myroxylon</i> , 2.07
Radicle bulbose or triangular 31	Testa free from endocarp, colored 43
30. Seed 3.4–9 mm long, terete; hilum within rim; cotyledons smooth, tan or white; embryonic axis oblique <i>Cajanus</i> , 10.73	43. Hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, apical at apex of radicle tip, subapical to radicle tip, or marginal according to radicle tip, raised <i>Centrosema</i> , 10.14
Seed 23–50 mm long, compressed; hilum not within rim; cotyledons not smooth, red or yellow; embryonic axis straight <i>Dipteryx</i> , 3.01	Hilum with the lips of the faboid split the same color as the rest of the hilum, apical according to radicle tip but marginal according to seed length or between cotyledon and radicle lobes, recessed ... 44
31. Plumule rudimentary 32	44. Cotyledons without margins recessed; fruit circular, elliptic, linear, or oblong, emarginate, rounded, or short tapered at base 76
Plumule moderately or well developed 33	Cotyledons with margins recessed; fruit coiled or moniliform, long tapered at base <i>Sophora</i> , 2.45
32. Embryonic axis oblique; radicle lobe tip straight; radicle oblique to cotyledons <i>Oxyrhynchus</i> , 10.68	45. Seed samaroid; testa color modified by a bloom <i>Amburana</i> , 1.15
Embryonic axis right angled or straight; radicle lobe tip curved; radicle with 90- or with 180-degree turn <i>Mucuna</i> , 10.03	Seed circular, D-shaped, elliptic, irregular, oblong, ovate, reniform, rhombic, or trapezoid; testa color not modified by a bloom 46
33. Radicle lobe tip curved 34	46. Seed with deep or shallow hilar sinus 47
Radicle lobe tip straight 35	Seed without hilar sinus 49
34. Embryonic axis right angled or straight; seed length transverse to fruit length <i>Mucuna</i> , 10.03	47. Lens mounded; endocarp monochrome 77
Embryonic axis oblique; seed length parallel with fruit length <i>Erythrina</i> , 10.01	Lens flush or recessed; endocarp mottled 48
35. Fruit quadrangular, rounded or truncate at base <i>Psophocarpus</i> , 10.51	48. Seed compressed or flattened; hilum recessed; lens circular; cotyledons partially concealing radicle; radicle linear <i>Pongamia</i> , Millettieae
Fruit compressed or terete, long tapered or tapered at base <i>Erythrina</i> , 10.01	Seed terete; hilum raised; lens linear; cotyledons not concealing radicle; radicle triangular <i>Muelleria</i> , Millettieae
36. Hilum within halo or rim 37	49. Cotyledons with lobes 50
Hilum not within halo or rim 57	Cotyledons without lobes 52
37. Hilum visible 38	50. Testa glaucous; hilum subapical to radicle tip; lens diamond-shaped <i>Pericopsis</i> , 2.17
Hilum partially or fully concealed 45	Testa dull; hilum apical according to radicle tip but marginal according to seed length or between cotyledon and radicle lobe; lens linear, triangular, or not discernible 51
38. Seed with visible radicle and cotyledon lobes 39	51. Testa wrinkled or smooth; cotyledons without basal groin formed by lobes 78
Seed without visible radicle and cotyledon lobes 41	Testa bearing endocarp remnants; cotyledons with basal groin formed by lobes <i>Sophora</i> , 2.45
39. Seed with surface wrinkled; hilum within halo; endosperm absent <i>Aganope</i> , Millettieae	52. Testa fused to endocarp, at most a transparent brown tissue <i>Myroxylon</i> , 2.07
Seed with surface smooth; hilum within rim; endosperm present 40	Testa free from endocarp 53
40. Hilum rim color darker than testa; lens circular, embryo adnate to testa; cotyledons both outer faces convex, brown or tan 75	
Hilum rim color of or lighter than testa; lens ovate; endosperm adnate to embryo; cotyledons both outer faces flat, green <i>Styphnolobium</i> , 2.44	
41. Seed flattened, with surface wrinkled; testa mottled <i>Butea</i> , 10.04	
Seed terete or compressed, with surface smooth; testa monochrome 42	

53. Cotyledons yellow 54
Cotyledons brown, tan, or white 55
54. Testa rugose or wrinkled; hilum fully concealed
..... *Phaseolus*, 10.72
Testa with 1 longitudinal ridge on each face; hilum
partially concealed *Psophocarpus*, 10.51
55. Hilum not within rim or within halo; fruit wings
present *Derris*, Millettieae
Hilum within rim; fruit wings absent 56
56. Lens circular or triangular, mounded; radicle bulbose
or linear *Phaseolus*, 10.72
Lens linear, flush; radicle triangular
..... *Amphicarpaea*, 10.44
57. Hilum visible 58
Hilum partially or fully concealed 64
58. Testa not smooth 59
Testa smooth 60
59. Seed reniform; testa fused to endocarp, at most a
transparent brown tissue; cotyledons not conceal-
ing radicle, inner face flat; radicle linear
..... *Kunstleria*, Millettieae
Seed elliptic or irregular; testa free from endocarp;
cotyledons partially concealing radicle, inner face
with central ridge on 1 and central groove on other;
radicle bulbose *Diploptropis*, 2.27
60. Seed flattened; fruit membranous; epicarp veined... 61
Seed terete or compressed; fruit chartaceous, coria-
ceous, or fleshy; epicarp not veined 62
61. Fruit a loment (or a loment segment), irregular or
reniform, rounded at apex, nonstipitate; fruit wings
absent *Cranocarpus*, 11.02
Fruit a legume, lanceolate or oblong, long tapered at
apex, substipitate; fruit wings present
..... *Dalbergiella*, Millettieae
62. Seed ca. 4.5 mm long; hilum apical according to
radicle tip but marginal according to seed length,
recessed *Austrostenisia*, Millettieae
Seed 4.7–50 mm long; hilum apical at apex of radicle
tip, subapical to radicle tip, or marginal according
to radicle tip, raised or flush 63
63. Seed 4.7–11.6 mm long, symmetrical; testa mono-
chrome; hilum raised; endosperm present; plumule
moderately or well developed ... *Centrosema*, 10.14
Seed 35–50 mm long, asymmetrical; testa streaked;
hilum flush; endosperm absent; plumule
rudimentary *Harleyodendron*, 1.09
64. Cotyledons not concealing radicle 65
Cotyledons completely or partially concealing radicle
..... 69
65. Seed terete 66
Seed compressed or flattened 67
66. Seed ovate or reniform, with deep hilar sinus; hilum
raised; endosperm present; radicle triangular
..... *Muelleria*, Millettieae
Seed linear, without hilar sinus; hilum flush; en-
dosperm absent; radicle linear *Fissicalyx*, 4.07
67. Seed irregular, compressed, with surface wrinkled;
cotyledons not smooth *Luetzelburgia*, 2.03
Seed reniform, flattened, with surface smooth;
cotyledons smooth 68
68. Seed with visible radicle and cotyledon lobes; testa
not smooth *Discolobium*, 14.17
Seed without visible radicle and cotyledon lobes; testa
smooth *Cranocarpus*, 11.02
69. Seed with visible radicle and cotyledon lobes; testa
orange *Cyclolobium*, Millettieae
Seed without visible radicle and cotyledon lobes; testa
black, brown, cream, white, or yellow 70
70. Cotyledons margin not entire 180 degrees from base
of radicle *Clathrotropis*, 2.26
Cotyledons margin entire 180 degrees from base of
radicle 71
71. Seed symmetrical 72
Seed asymmetrical 73
72. Testa with 1 longitudinal ridge on each face; cotyle-
dons yellow *Psophocarpus*, 10.51
Testa wrinkled; cotyledons brown or tan
..... *Derris*, Millettieae
73. Seed terete; testa mottled, minutely pubescent
..... *Myrospermum*, 2.06
Seed compressed or flattened; testa monochrome,
glabrous 74
74. Fruit a loment (or a loment segment), membranous;
fruit apex right-angled with longitudinal axis of
fruit; fruit wings absent; seed length parallel with
fruit length *Cranocarpus*, 11.02
Fruit a legume, chartaceous or coriaceous; fruit apex
aligned or oblique with longitudinal axis of fruit;
fruit wings present; seed length oblique or trans-
verse to fruit length *Derris*, Millettieae

75. Seed 2–9 mm wide; lens mounded; endosperm thin; radicle bulbous; plumule moderately developed *Pterocarpus*, 4.17
Seed 12–21 mm wide; lens recessed; endosperm trace; radicle linear; plumule rudimentary *Pongamia*, Millettieae
76. Seeds D-shaped, irregular, or reniform; fruit 2–11 cm wide, indehiscent; epicarp with spines; endocarp entire *Pterocarpus*, 4.17
Seeds elliptic; fruit 1–1.6 cm wide, with epicarp and mesocarp dehiscent and endocarp not dehiscent; epicarp without spines; endocarp separating into 1-seed winged segments *Endosamara*, Millettieae
77. Endosperm present; fruit margin with a wing; fruit stipitate or substipitate, indehiscent *Pterocarpus*, 4.17
Endosperm absent; fruit margin with thickened sutural areas; fruit nonstipitate, with all layers dehiscent *Phaseolus*, 10.72
78. Seed without visible radicle and cotyledon lobes, without umbo on seed faces; hilum with faboid split, 1.4 mm long; cotyledons with lobes touching (auriculate) *Derris*, Millettieae
Seed with visible radicle and cotyledon lobes, with umbo on seed faces; hilum without faboid split, 0.2–0.5 mm long; cotyledons with lobes not touching *Brya*, 11.01

Seed Key 15: Aril absent. Cotyledons split over radicle. Hilum raised or flush.

1. Seed with visible radicle and cotyledon lobes 2
Seed without visible radicle and cotyledon lobes 21
2. Seed terete 3
Seed compressed or flattened 7
3. Seed D-shaped; embryonic axis deflexed; plumule rudimentary *Bryaspis*, 14.14
Seed circular, elliptic, oblong, ovate, or reniform; embryonic axis oblique or straight; plumule moderately or well developed 4
4. Embryonic axis straight; radicle deflexed and parallel to cotyledon width or straight with embryonic axis; endocarp cobwebby or scurfy 5
Embryonic axis oblique; radicle oblique to cotyledons or with 180 degree turn; endocarp smooth 6
5. Hilum flush; cotyledons smooth, tan; embryonic axis parallel to length of seed; radicle bulbous *Arachis*, 14.26
Hilum raised; cotyledons not smooth, brown or red; embryonic axis oblique to length of seed; radicle linear *Geoffroea*, 4.15
6. Seed 3.5–4 mm long; testa chartaceous; hilum punctiform, between cotyledon and radicle lobe; cotyledons completely concealing radicle, with lobes *Chapmannia*, 14.24
Seed 5–45 mm long; testa osseous or coriaceous; hilum larger than punctiform, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; cotyledons partially concealing radicle, without lobes *Erythrina*, 10.01
7. Hilum larger than punctiform 8
Hilum punctiform 15
8. Cotyledons not concealing radicle 9
Cotyledons completely or partially concealing radicle 12
9. Seed rim present *Desmodiastrum*, 11.18A
Seed rim absent 10
10. Hilum fully concealed, with curved outline; embryonic axis perpendicular to length of seed; radicle bulbous, 1/2 to nearly length of cotyledons *Aeschynomene*, 14.09
Hilum visible, with straight outline; embryonic axis oblique to length of seed; radicle linear, less than 1/2 length of cotyledons 11
11. Seed 4.5–5 mm long, circular, oblong, or reniform; lens circular, lighter than testa, tan; cotyledons tan *Podocytisus*, 30.11
Seed ca. 4 mm long, D-shaped or rectangular; lens linear, darker than testa, brown; cotyledons green *Euchilopsis*, 24.20
12. Seed with external groove between radicle and cotyledon lobes; testa chartaceous *Ormocarpum*, 14.01
Seed without external groove between radicle and cotyledon lobes; testa osseous or coriaceous 13
13. Seed 1.2–2 mm long, rim present *Desmodiastrum*, 11.18A
Seed 2.2–45 mm long, rim absent 14
14. Seed 2.2–2.4 mm long, D-shaped; hilum circular; endosperm present *Apoplansia*, 6.01
Seed 5–45 mm long, circular, elliptic, oblong, ovate, or reniform; hilum elliptic or oval; endosperm absent 51
15. Testa chartaceous 16
Testa coriaceous 18

16. Seed 3.5–3.7 mm long, circular; hilum fully concealed; cotyledons not concealing radicle; radicle lobe tip straight; plumule well developed *Belairia*, 14.04
Seed 1.9–3.4 mm long, falcate, oblong, ovate, or reniform; hilum visible; cotyledons partially concealing radicle; radicle lobe tip curved; plumule rudimentary or moderately developed 17
17. Seed 1.9–3 mm long, rim absent; hilum not within rim; lens circular; cotyledons margin not entire 180 degrees from base of radicle, yellow *Stylosanthes*, 14.25
Seed 3.2–3.4 mm long, rim present; hilum within rim; lens elliptic; cotyledons margin entire 180 degrees from base of radicle, tan..... *Eysenhardtia*, 6.02
18. Hilum within halo or rim; cotyledons yellow 19
Hilum not within halo or rim; cotyledons tan 20
19. Seed compressed; testa smooth; hilum visible; lens 2 circular mounds separated by groove *Zornia*, 14.21
Seed flattened; testa not smooth; hilum partially concealed; lens circular *Poiretia*, 14.20
20. Seed 0.7–1.2 mm long, mitaform; cotyledons not folded, similar at apex, completely concealing radicle; radicle bulbose *Cyclocarpa*, 14.16
Seed 3–4 mm long, circular, elliptic, or rectangular; cotyledons with both folded, differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle), partially concealing or not concealing radicle; radicle linear *Cyamopsis*, 9.06
21. Endosperm present 22
Endosperm absent 37
22. Radicle 1/2 to nearly length, equaling length, or exceeding length of cotyledons 23
Radicle less than 1/2 length of cotyledons 25
23. Seed reniform, flattened *Cranocarpus*, 11.02
Seed circular, irregular, or oblong, terete 24
24. Seed circular or irregular; hilum elliptic; cotyledons tan or white; radicle bulbose; plumule well developed *Pisum*, 19.04
Seed oblong; hilum circular; cotyledons yellow; radicle linear; plumule rudimentary *Otholobium*, 12.08
25. Endosperm thick 26
Endosperm thin or trace 27
26. Seed reniform, flattened; lens dissimilar color from testa *Cranocarpus*, 11.02
Seed mitaform, oblong, quadrangular, or rectangular, terete or compressed; lens similar color as testa *Sesbania*, 8.01
27. Seed circular, D-shaped, irregular, oblong, quadrangular, or triangular 28
Seed elliptic, ovate, or reniform 31
28. Cotyledons orange, white, or yellow 29
Cotyledons brown, green, or tan 30
29. Seed without umbo on seed faces; endosperm restricted to region of embryo; radicle linear *Lens*, 19.03
Seed with umbo on seed faces; endosperm covering entire embryo; radicle triangular *Vicia*, 19.01
30. Seed terete; lens linear; cotyledons without lobes; radicle linear or triangular *Strongylodon*, 10.02
Seed compressed or flattened; lens rhombic or wedge-shaped; cotyledons with lobes; radicle bulbose *Gliricidia*, 8.06
31. Testa chartaceous 32
Testa osseous or coriaceous 33
32. Fruit a loment (or a loment segment), membranous; fruit apex right-angled with longitudinal axis of fruit; fruit wings absent; seed length parallel with fruit length *Cranocarpus*, 11.02
Fruit a legume, chartaceous or coriaceous; fruit apex aligned or oblique with longitudinal axis of fruit; fruit wings present; seed length oblique or transverse to fruit length *Derris*, *Millettieae*
33. Seed reniform 34
Seed ovate 35
34. Seed terete or compressed; fruit a legume, circular or obovate, coriaceous; fruit seed chambers externally invisible *Orbexilum*, 12.07
Seed flattened; fruit a loment (or a loment segment), irregular or reniform, membranous; fruit seed chambers externally visible *Cranocarpus*, 11.02
35. Radicle bulbose; hilum apical at apex of radicle tip *Gliricidia*, 8.06
Radicle linear or triangular; hilum marginal according to radicle tip 36

36. Seed with umbo on seed faces; cotyledons white or yellow; embryonic axis oblique to length of seed; radicle triangular; plumule well developed *Vicia*, 19.01
Seed without umbo on seed faces; cotyledons tan; embryonic axis parallel to length of seed; radicle linear; plumule rudimentary *Orbexilum*, 12.07
37. Seed terete 38
Seed compressed or flattened 41
38. Testa streaked; hilum apical at apex of radicle tip; plumule rudimentary *Harleyodendron*, 1.09
Testa bichrome, monochrome, or mottled; hilum apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; plumule moderately or well developed 39
39. Lens oblong; cotyledons with lobes, brown; embryonic axis with a joint evident between the radicle and the cotyledons; plumule pubescent *Ormocarpopsis*, 14.02
Lens circular, elliptic, linear, ovate, punctiform, rhombic, or wedge-shaped; cotyledons without lobes, tan, white, or yellow; embryonic axis without a joint evident between the radicle and the cotyledons; plumule glabrous 40
40. Hilum without faboid split; epicarp rugose, exfoliating in part; funiculus partially filiform and partially thick *Strongylodon*, 10.02
Hilum with faboid split; epicarp muricate or wrinkled, not exfoliating; funiculus flattened or thick *Erythrina*, 10.01
41. Testa osseous or coriaceous 42
Testa chartaceous 46
42. Testa smooth 43
Testa not smooth 44
43. Seed compressed; fruit a legume or nutlet, compressed or terete, long tapered, tapered, or short tapered at apex, coriaceous, fleshy, leathery, or ligneous *Erythrina*, 10.01
Seed flattened; fruit a loment (or a loment segment), flattened, rounded at apex, membranous *Cranocarpus*, 11.02
44. Seed with surface grooved; cotyledons not smooth *Dipteryx*, 3.01
Seed with surface ridged or smooth; cotyledons smooth 45
45. Hilum with curved outline, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; lens discernible *Erythrina*, 10.01
Hilum with angular outline, subapical to radicle tip; lens not discernible *Lecointea*, 1.08
46. Testa tan; seed oblong; hilum punctiform *Euchresta*, 28.01
Testa brown; seed D-shaped, elliptic, irregular, ovate, samaroid, or reniform; hilum larger than punctiform 47
47. Cotyledons margin not entire 180 degrees from base of radicle; fruit with all layers dehiscent *Clathrotropis*, 2.26
Cotyledons margin entire 180 degrees from base of radicle; fruit indehiscent 48
48. Seed with deep hilar sinus; fruit with deciduous calyx *Leptoderris*, Millettieae
Seed without hilar sinus; fruit with persistent calyx 49
49. Seed angular, irregular or samaroid *Sweetia*, 2.02
Seed not angular, elliptic, ovate, or reniform 50
50. Fruit a loment (or a loment segment); fruit apex right-angled with longitudinal axis of fruit, membranous; fruit wings absent; seed length parallel with fruit length *Cranocarpus*, 11.02
Fruit a legume; fruit apex aligned or oblique with longitudinal axis of fruit, chartaceous or coriaceous; fruit wings present; seed length oblique or transverse to fruit length *Derris*, Millettieae
51. Seed flattened; hilum without faboid split, 0.5 mm long; cotyledons with lobes; plumule rudimentary *Grazilodendron*, 4.09
Seed terete or compressed; hilum with faboid split, 2–10.5 mm long; cotyledons without lobes; plumule moderately or well developed *Erythrina*, 10.01

Seed Key 16: Aril absent. Cotyledons split over radicle. Hilum recessed.

1. Seed with umbo on seed faces 2
Seed without umbo on seed faces 3
2. Seed 2.7–5 mm long; hilum partially concealed, larger than punctiform, within halo or rim; cotyledons tan; radicle equaling or exceeding length of cotyledons *Chamaecytisus*, 30.15A
Seed 12–13 mm long; hilum visible, punctiform, not within halo or rim; cotyledons white; radicle less than 1/2 length of cotyledons *Ramorinoa*, 4.11

3. Seed with visible radicle and cotyledon lobes 4
Seed without visible radicle and cotyledon lobes 33
4. Hilum larger than punctiform 5
Hilum punctiform 18
5. Cotyledons completely or partially concealing radicle 6
Cotyledons not concealing radicle 11
6. Seed rim present; fruit a loment (or a loment segment) *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume or nutlet 7
7. Endosperm absent *Erythrina*, 10.01
Endosperm present 8
8. Seed with surface grooved; cotyledons white *Cicer*, 20.01
Seed with surface smooth; cotyledons brown, green, tan, or yellow 9
9. Seed 12–35 mm long, with shallow hilar sinus; testa not smooth, chartaceous; hilum elliptic; endosperm trace *Pongamia*, *Millettieae*
Seed 3–7 mm long, without hilar sinus; testa smooth, coriaceous; hilum circular; endosperm thick or thin 10
10. Testa color modified by a bloom; embryonic axis right angled, perpendicular to length of seed *Diphysa*, 14.03
Testa color not modified by a bloom; embryonic axis deflexed, oblique to length of seed *Poitea*, 8.05
11. Seed rim present; fruit a loment (or a loment segment), moniliform, indehiscent; endocarp septate *Desmodiastrum*, 11.18A
Seed rim absent; fruit a legume, circular, elliptic, linear, oblong, obovate, or ovate, with all layers dehiscent or epicarp and mesocarp dehiscent and endocarp not dehiscent; endocarp subseptate or nonseptate 12
12. Endosperm thick 13
Endosperm thin 14
13. Seed without external groove between radicle and cotyledon lobes; hilum circular, within rim; radicle 1/2 to nearly length of cotyledons or equaling length of cotyledons; lens oblong or wedge-shaped *Calicotome*, 30.17
Seed with external groove between radicle and cotyledon lobes; hilum elliptic, not within rim or within halo; radicle less than 1/2 length of cotyledons; lens circular or triangular *Aotus*, 24.21
14. Seed terete; testa osseous; hilum with straight outline *Glottidium*, 8.01A
Seed compressed; testa coriaceous; hilum with curved outline 15
15. Hilum elliptic or oval 16
Hilum circular 17
16. Hilum partially concealed, within rim; lens similar color as testa; cotyledons brown or tan; radicle linear *Gastrolobium*, 24.13
Hilum visible, within halo; lens dissimilar color from testa; cotyledons green; radicle bulbose *Phyllota*, 24.19
17. Hilum within rim; lens elliptic or wedge-shaped; cotyledons red *Laburnum*, 30.09
Hilum not within rim; lens irregular, linear, or oblong; cotyledons brown, green, or tan *Poitea*, 8.05
18. Seed with external groove between radicle and cotyledon lobes 19
Seed without external groove between radicle and cotyledon lobes 21
19. Testa color modified by a bloom; embryonic axis right angled, perpendicular to length of seed *Diphysa*, 14.03
Testa color not modified by a bloom; embryonic axis deflexed, oblique to length of seed 20
20. Testa not smooth; hilum elliptic; lens circular or triangular; endosperm thick *Aotus*, 24.21
Testa smooth; hilum circular; lens irregular, linear, or oblong; endosperm thin *Poitea*, 8.05
21. Endosperm thick 22
Endosperm thin or trace 26
22. Hilum partially or fully concealed 23
Hilum visible 24
23. Seed 5.5–6 mm long, ovate; hilum within rim; lens equal to or greater than 0.5 mm in length, oblong; radicle lobe tip straight *Hesperolaburnum*, 30.10
Seed 2–3.5 mm long, oblong or reniform; hilum not within rim; lens less than 0.5 mm in length, circular; radicle lobe tip hooked *Jacksonia*, 24.08
24. Seed reniform; hilum not within rim *Cascaronia*, 4.16
Seed circular, D-shaped, elliptic, oblong, or rectangular; hilum within rim 25

25. Lens oblong or wedge-shaped; cotyledons not concealing radicle; radicle lobe tip straight, deflexed and parallel to cotyledon length, 1/2 to nearly length of or equaling length of cotyledons *Calicotome*, 30.17
 Lens circular or elliptic; cotyledons partially concealing radicle; radicle lobe tip curved, deflexed and parallel to cotyledon width, less than 1/2 length of cotyledons *Amorpha*, 6.04
26. Hilum within halo or rim 27
 Hilum not within halo or rim 30
27. Seed terete; lens oblong *Spartidium*, 27.04
 Seed compressed; lens circular, elliptic, linear, triangular, or wedge-shaped 28
28. Seed circular, D-shaped, ovate, quadrangular, or rectangular; seed rim present; radicle deflexed and parallel to cotyledon length *Coursetia*, 8.08
 Seed elliptic, mitaform, or reniform; seed rim absent; radicle deflexed and parallel to cotyledon width or oblique to cotyledons 29
29. Testa osseous; hilum rim color of testa; cotyledons with lobes touching (auriculate), yellow; radicle oblique to cotyledons *Geissaspis*, 14.13
 Testa coriaceous; hilum rim color lighter than testa; cotyledons with lobes not touching, tan; radicle deflexed and parallel to cotyledon width *Dalea*, 6.08
30. Seed D-shaped; testa red *Psorothamnus*, 6.06
 Seed circular, oblong, obovate, ovate, rectangular, or reniform; testa brown 31
31. Lens irregular, linear, or oblong *Poitea*, 8.05
 Lens circular 32
32. Seed 2.2–2.8 mm long; testa osseous; lens equal to or greater than 0.5 mm in length, not in groove of raphe, dissimilar color from testa, black *Geissaspis*, 14.13
 Seed 5–6 mm long; testa coriaceous; lens less than 0.5 mm in length, in groove of raphe, similar color as testa, brown *Cascaronia*, 4.16
33. Seed rim present 34
 Seed rim absent 37
34. Cotyledons not concealing radicle; radicle deflexed and parallel to cotyledon length 35
 Cotyledons completely or partially concealing radicle; radicle deflexed and parallel to cotyledon width, oblique to cotyledons, or straight with embryonic axis 36
35. Testa osseous; hilum larger than punctiform, marginal according to radicle tip; endosperm thick *Retama*, 30.21
 Testa coriaceous; hilum punctiform, apical at apex of or subapical to radicle tip; endosperm thin *Coursetia*, 8.08
36. Seed 4–4.5 mm long, terete; testa coriaceous; rim winglike along 1 side of seed; wings present; hilum not within halo *Inocarpus*, 2.10
 Seed 9–16.5 mm long, compressed; testa chartaceous; rim winglike around seed; wings absent; hilum within halo *Pericopsis*, 2.17
37. Testa chartaceous 38
 Testa osseous or coriaceous 50
38. Hilum apical at apex of radicle tip, subapical to radicle tip, or between cotyledon and radicle lobe 39
 Hilum apical according to radicle tip but marginal according to seed length or marginal according to radicle tip 42
39. Seed reniform, flattened; hilum not within halo or rim *Cranocarpus*, 11.02
 Seed elliptic, irregular, oblong, or ovate, terete or compressed; hilum within halo or rim 40
40. Seed ca. 38 mm long; hilum fusiform; cotyledons pubescent around base of radicle; radicle triangular; plumule well developed, pubescent *Haplormosia*, 2.16
 Seed 3.5–16.5 mm long; hilum circular or elliptic; cotyledons glabrous around base of radicle; radicle bulbous or linear; plumule rudimentary, glabrous 41
41. Seed 3.5–8.2 mm long; hilum with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous, within rim; lens linear, flush; cotyledons without basal groin formed by lobes *Ammodendron*, 2.46
 Seed 9–16.5 mm long; hilum with the lips of the faboid split the same color as the rest of the hilum, within halo; lens diamond-shaped, mounded; cotyledons with basal groin formed by lobes *Pericopsis*, 2.17
42. Seed terete 43
 Seed compressed or flattened 45
43. Seed asymmetrical; raphe not visible; hilum fully concealed *Strongylodon*, 10.02
 Seed symmetrical; raphe visible; hilum visible or partially concealed 44

44. Cotyledons without margins recessed; fruit linear, rounded at base, with epicarp and mesocarp dehiscent and endocarp not dehiscent; endocarp separating into 1-seeded winged segments *Endosamara*, Millettieae
Cotyledons with margins recessed; fruit coiled or moniliform, long tapered at base, with all layers dehiscent, indehiscent, or with epicarp and mesocarp breaking near center of valve and endocarp dehiscent along suture; endocarp entire *Sophora*, 2.45
45. Seed circular, elliptic, ovate, or rhombic 46
Seed reniform 47
46. Testa wrinkled; cotyledons without margins recessed *Derris*, Millettieae
Testa bearing endocarp remnants; cotyledons with margins recessed *Sophora*, 2.45
47. Hilum elliptic, fusiform, heart-shaped, or oval 48
Hilum circular 49
48. Fruit a loment (or a loment segment), apex right-angled with longitudinal axis of fruit, membranous; fruit wings absent; seed length parallel with fruit length *Cranocarpus*, 11.02
Fruit a legume, apex aligned or oblique with longitudinal axis of fruit, chartaceous or coriaceous; fruit wings present; seed length oblique or transverse to fruit length *Derris*, Millettieae
49. Seed flattened; fruit a loment (or a loment segment), without beak; fruit apex right-angled with longitudinal axis of fruit; epicarp villous, glandular *Cranocarpus*, 11.02
Seed compressed; fruit a legume, with beak; fruit apex aligned or oblique with longitudinal axis of fruit; epicarp sericeous, eglandular *Austrostenisia*, Millettieae
50. Cotyledons without lobes 51
Cotyledons with lobes 55
51. Seed terete 52
Seed compressed or flattened 53
52. Hilum without faboid split; epicarp rugose, exfoliating in part; funiculus partially filiform and partially thick *Strongylodon*, 10.02
Hilum with faboid split; epicarp muricate or wrinkled, not exfoliating; funiculus flattened or thick *Erythrina*, 10.01
53. Seed flattened; fruit a loment (or a loment segment), rounded at apex, membranous; epicarp glandular *Cranocarpus*, 11.02
Seed compressed; fruit a legume or nutlet, long tapered, tapered, or short tapered at apex, coriaceous, fleshy, leathery, or ligneous; epicarp eglandular 54
54. Hilum elliptic or oval; endosperm absent; embryonic axis oblique; radicle oblique to cotyledons or with 180-degree turn *Erythrina*, 10.01
Hilum circular; endosperm present; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length or width *Poitea*, 8.05
55. Seed symmetrical 56
Seed asymmetrical 59
56. Hilum punctiform; radicle not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) *Errazurizia*, 6.05
Hilum larger than punctiform; radicle centered between cotyledons... 57
57. Hilum with straight outline, apical at apex of radicle tip; radicle deflexed and parallel to cotyledon width *Gliricidia*, 8.06
Hilum with curved outline, apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; radicle deflexed and parallel to cotyledon length, oblique to cotyledons, or with 90-degree turn 58
58. Testa glossy; hilum oval, marginal according to radicle tip; embryonic axis deflexed; radicle deflexed and parallel to cotyledon length *Gastrolobium*, 24.13
Testa dull; hilum elliptic, apical according to radicle tip but marginal according to seed length; embryonic axis oblique or right angled; radicle oblique to cotyledons or with 90-degree turn *Sophora*, 2.45
59. Endosperm absent 60
Endosperm present 63
60. Hilum larger than punctiform 61
Hilum punctiform 62
61. Fruit a loment (or a loment segment), irregular or reniform, short tapered at base, membranous, nonstipitate *Cranocarpus*, 11.02
Fruit a legume, C-shaped, circular, coiled, falcate, or samaroid, rounded at base, coriaceous or ligneous, stipitate or substipitate *Machaerium*, 4.06

62. Hilum partially or fully concealed, between cotyledon and radicle lobe; embryonic axis deflexed; radicle deflexed and parallel to cotyledon width *Machaerium*, 4.06
Hilum visible, subapical or marginal according to radicle tip; embryonic axis straight; radicle oblique to cotyledons *Taralea*, 3.02
63. Seed with surface grooved *Cicer*, 20.01
Seed with surface smooth 64
64. Testa color modified by a bloom 65
Testa color not modified by a bloom 66
65. Seed oblong, terete or compressed; raphe visible *Diphysa*, 14.03
Seed reniform, flattened; raphe not visible *Cranocarpus*, 11.02
66. Hilum within halo or rim 67
Hilum not within halo or rim 70
67. Radicle linear or triangular 68
Radicle bulbous 69
68. Fruit 2–9 times longer than wide, short tapered at apex; dehiscence of valves active; endocarp spongy; funiculus less than 0.5 mm long *Lupinus*, 30.08
Fruit length less than twice as long as width, rounded at apex; dehiscence of valves passive; endocarp scurfy or smooth; funiculus measured *Gastrolobium*, 24.13
69. Seed 1.6–3 mm long; hilum with curved outline, marginal according to radicle tip; radicle deflexed and parallel to cotyledon length; lens circular *Gompholobium*, 24.01
Seed 5.5–12 mm long; hilum with straight outline, apical at apex of radicle tip; radicle deflexed and parallel to cotyledon width; lens rhombic *Gliricidia*, 8.06
70. Seed reniform 71
Seed circular, oblong, obovate, ovate, quadrangular, or rectangular 72
71. Seed flattened; fruit a loment (or a loment segment), irregular or reniform, rounded at apex, indehiscent; fruit apex right-angled with longitudinal axis of fruit *Cranocarpus*, 11.02
Seed compressed; fruit a legume, linear or oblong, short tapered at apex, with all layers dehiscing; fruit apex aligned with longitudinal axis of fruit *Poitea*, 8.05
72. Lens circular or elliptic; seeds in 2 or more series *Lupinus*, 30.08
Lens irregular, linear, oblong, or rhombic; seeds in 1 series 73
73. Seed 5.5–12 mm long; lens rhombic; mesocarp thick, 2-layered, ligneous; endocarp spongy *Gliricidia*, 8.06
Seed 3–5 mm long; lens irregular, linear, or oblong; mesocarp thin, 1-layered, coriaceous; endocarp scurfy or smooth *Poitea*, 8.05

Synopses of Fruit and Seed Characters

Swartzieae (1.01–1.15)

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

Phylogenetic Number: 1.01.

Tribe: Swartzieae.

Group: *Swartzia*.

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

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

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

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

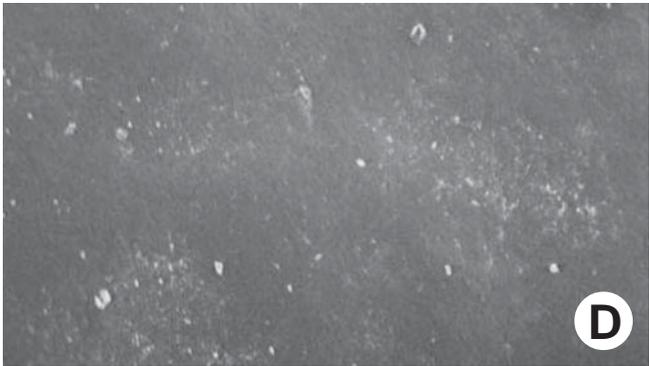
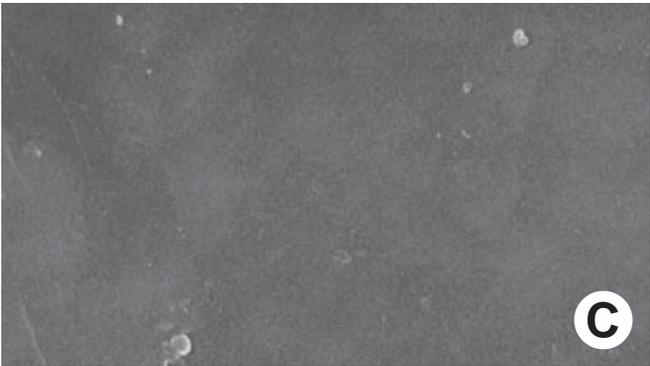
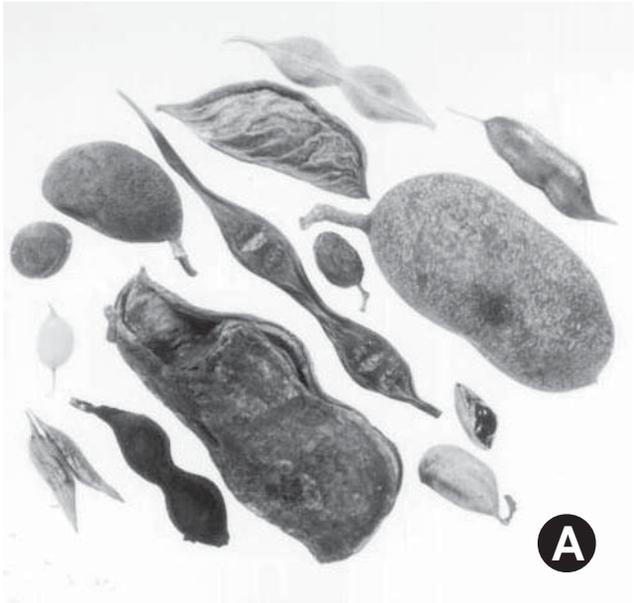
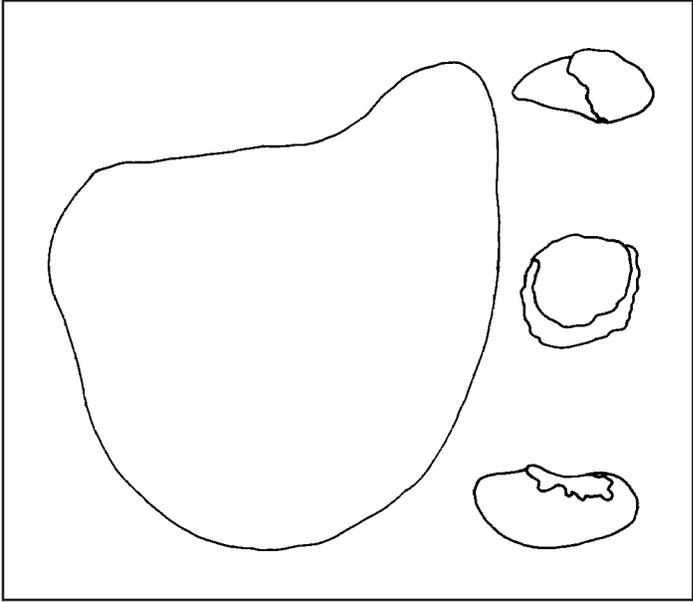
at apex; partially or completely concealing radicle (if radicle differentiated); entire over radicle; without lobes; with the interface division terminating at base of radicle or in radicle tissue; without margins recessed; dark reddish to dark greenish brown or green (dark brownish); inner face flat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

Distribution: Neotropics.

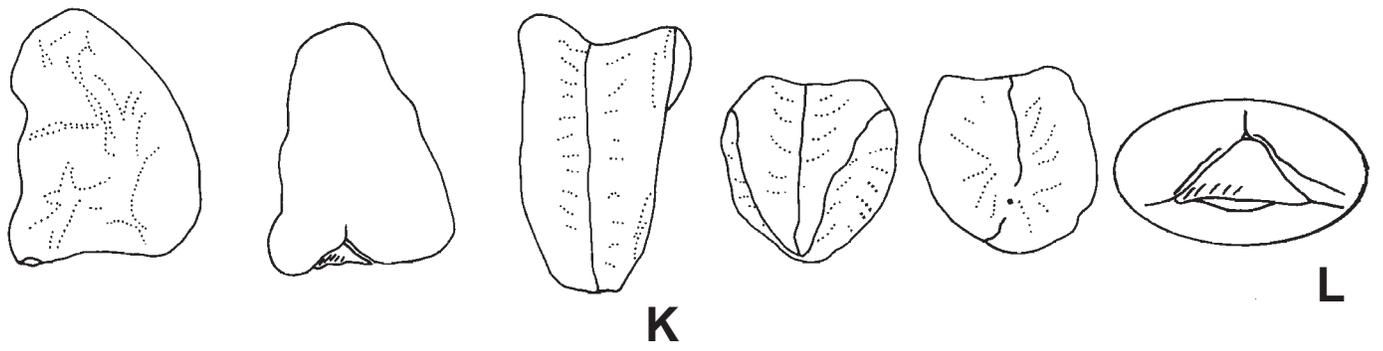
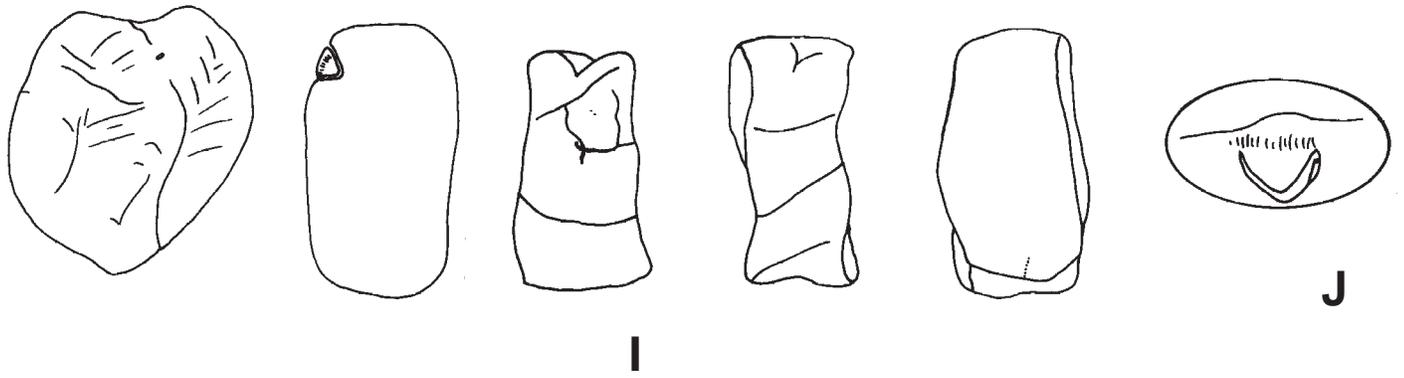
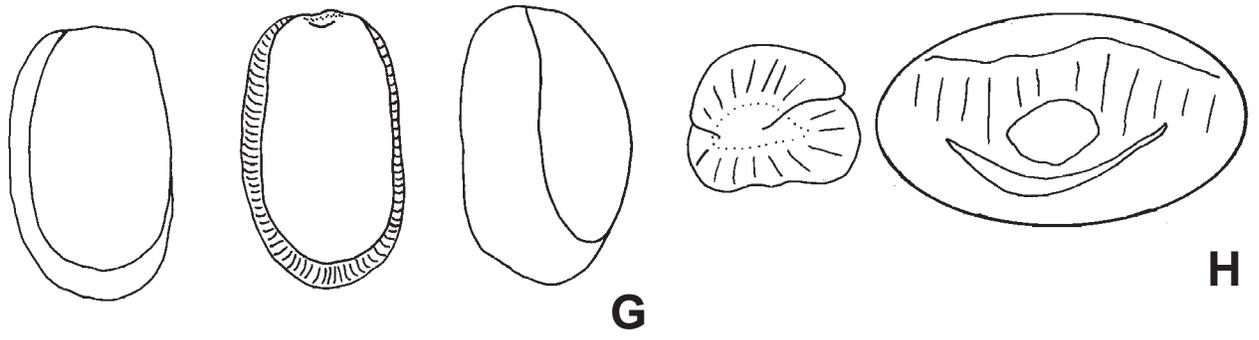
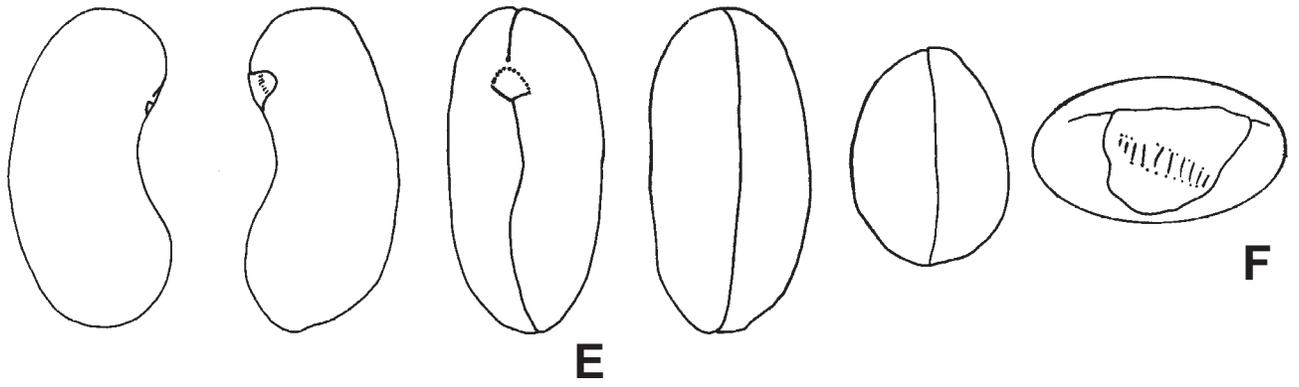
Notes: Swartzieae has been assigned to Caesalpinioideae (Cowan 1968), Swartzioideae (Candolle 1825a,b; Corner 1976), and Faboideae (Bentham 1865, Hutchinson 1964, Cowan 1981a). In 1968, Cowan (1968) was unable “finally to resolve the sub-familial relationship of *Swartzia*,” but in 1981 he (Cowan 1981a)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

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

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



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



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

Phylogenetic Number: 1.01A.

Tribe: Swartzieae.

Group: Swartzia.

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

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

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

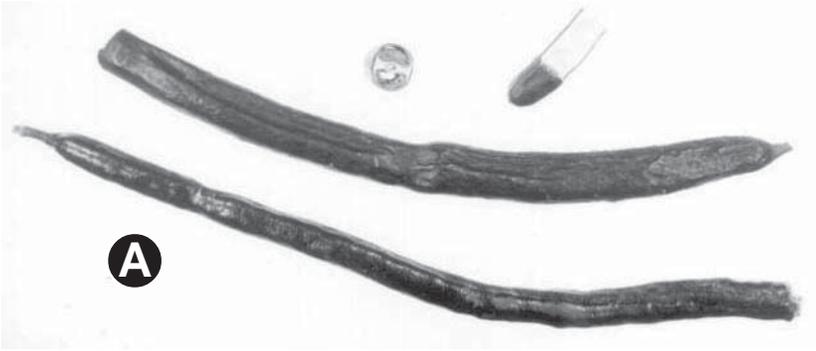
bifurcating; darker than testa; reddish brown; flush. Hilum partially or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5 mm long; with curved outline; circular; between cotyledon and radicle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

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

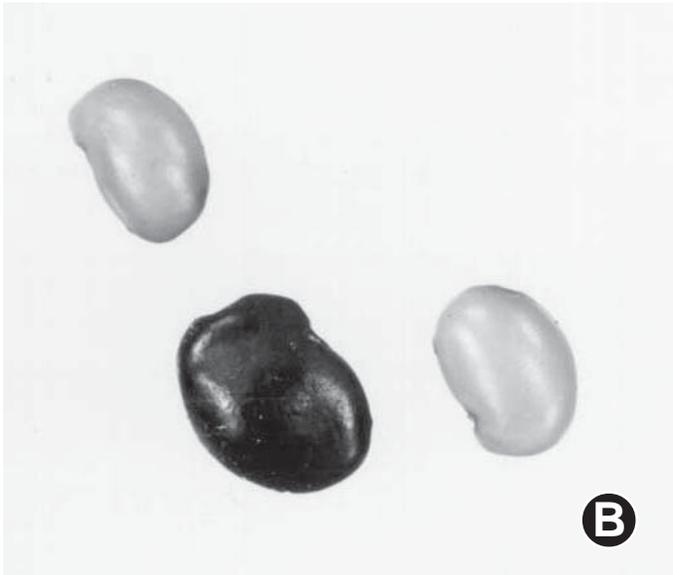
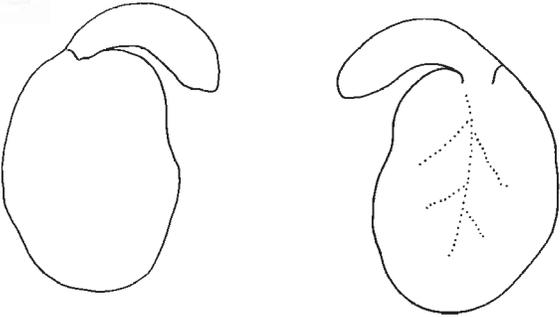
Notes: *Bobgunnia fistuloides* (H.A.T. Harms) J.H. Kirkbride & J.H. Wiersema and *B. madagascariensis* were once placed in *Swartzia*, but their seeds and fruits are so incompatible with *Swartzia* that they were moved to a new genus by Kirkbride and Wiersema (1997). These species are clearly members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

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

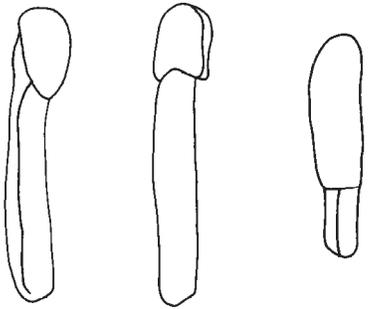
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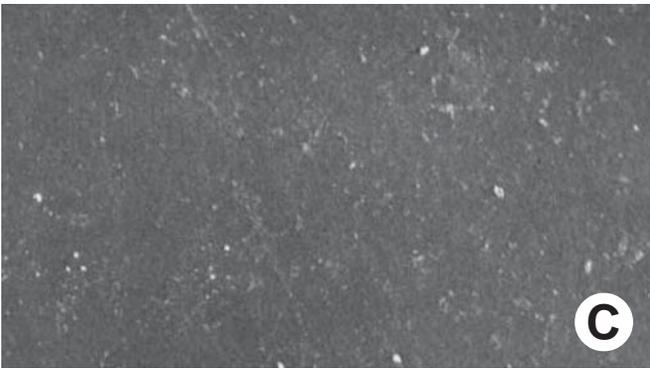
A



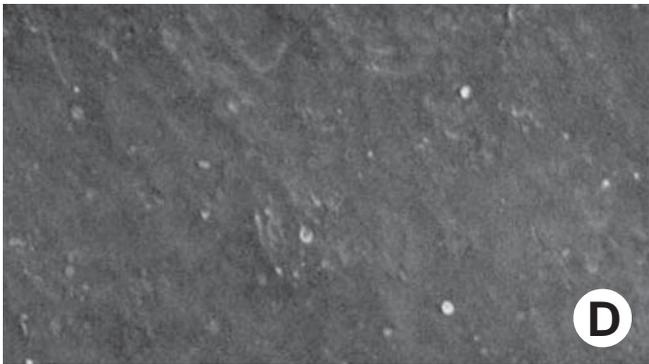
B



E



C



D

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

Phylogenetic Number: 1.02.

Tribe: Swartzieae.

Group: Swartzia.

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

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

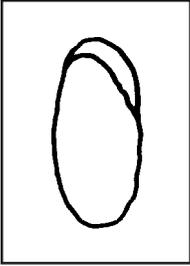
Seed $8-27 \times 3.5-13 \times 2.7-13$ mm; not overgrown; not angular; asymmetrical; oblong or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus;

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

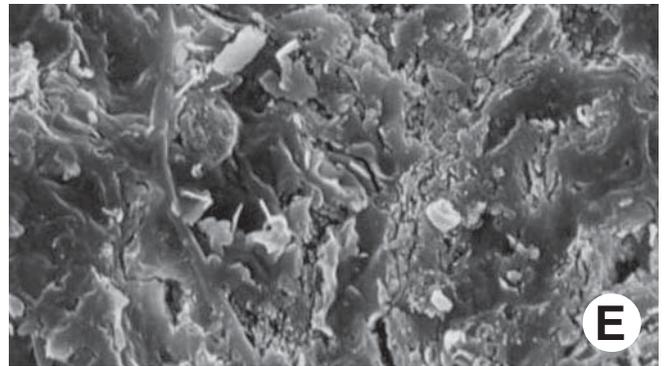
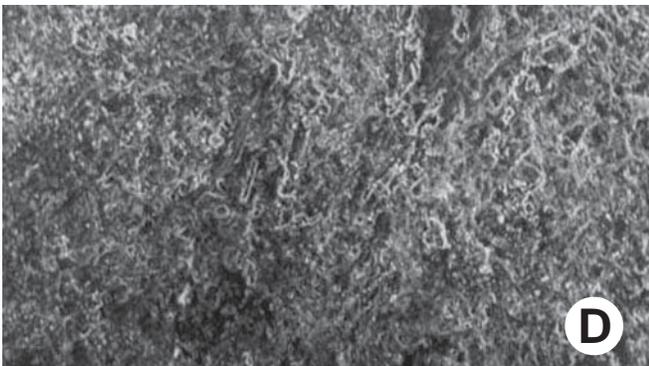
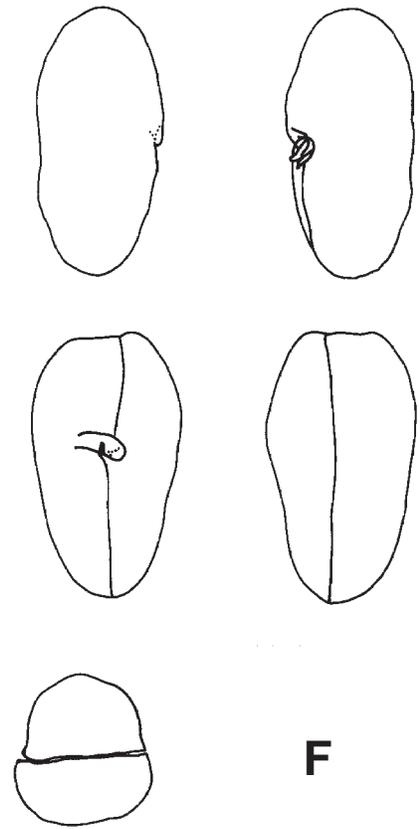
Distribution: Eastern Peru, eastern coastal and Amazonian Brazil, Guyana, and French Guiana.

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

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



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



Genus: *Candolleodendron* R.S. Cowan

Phylogenetic Number: 1.03.

Tribe: Swartzieae.

Group: Swartzia.

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

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

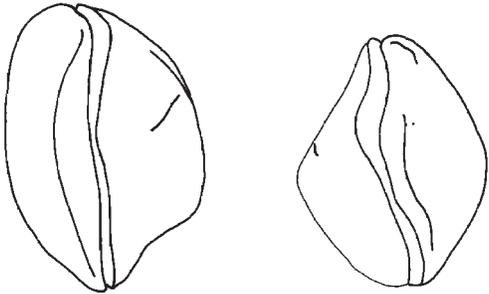
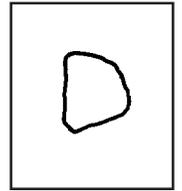
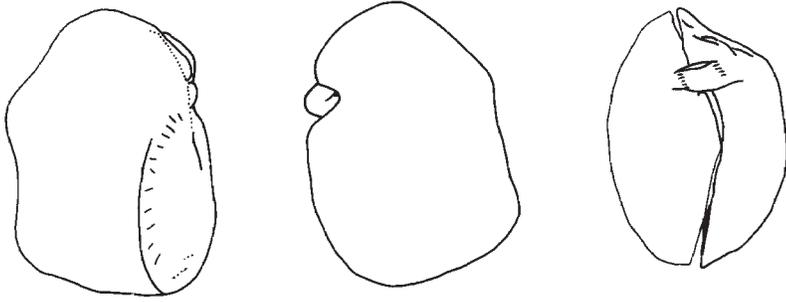
Seed 10–18 × 9–12 × 6–10 mm; not overgrown; angular; asymmetrical; irregular, rectangular, or triangular; quadrangular or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a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

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

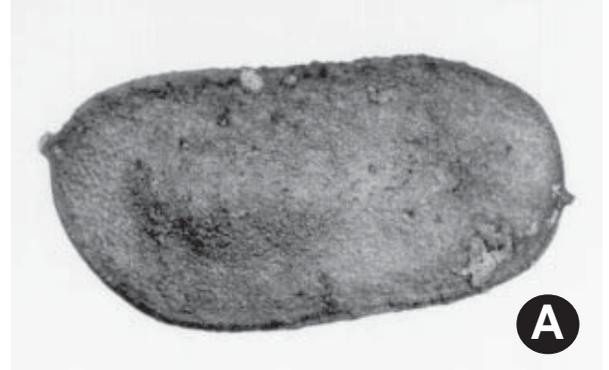
Distribution: French Guiana.

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

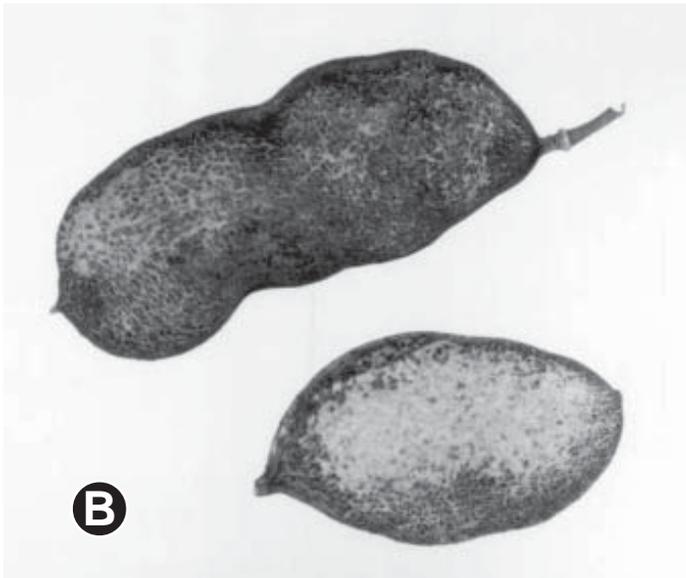
Candolleodendron: *C. brachystachyum* (A.-P. de Candolle) R.S. Cowan (A–F). A–B, Fruit ($\times 1.8$, $\times 1.2$); C, seeds ($\times 2.9$); D–E, testa ($\times 50$, $\times 1000$); F, embryos ($\times 2$).



F



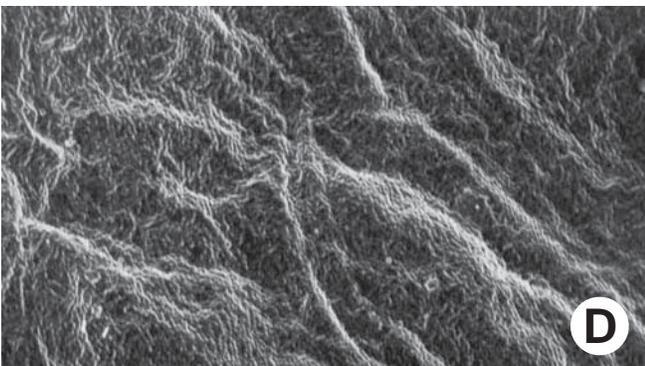
A



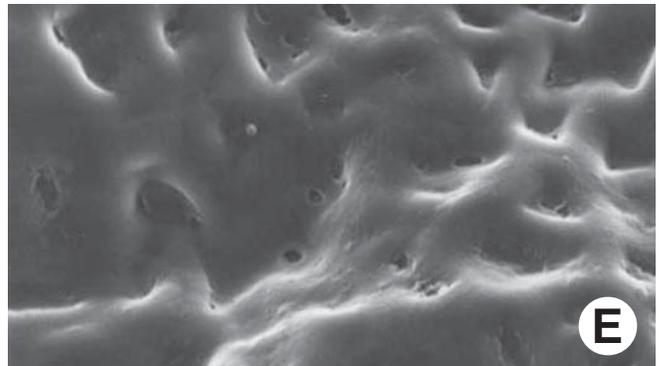
B



C



D



E

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

Phylogenetic Number: 1.04.

Tribe: Swartzieae.

Group: *Aldina*.

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

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

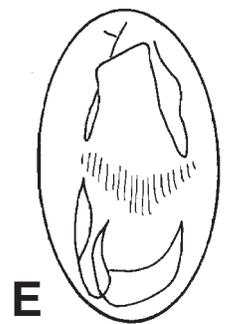
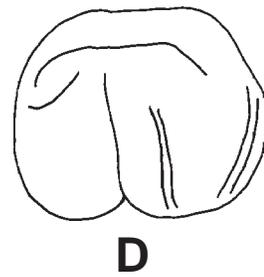
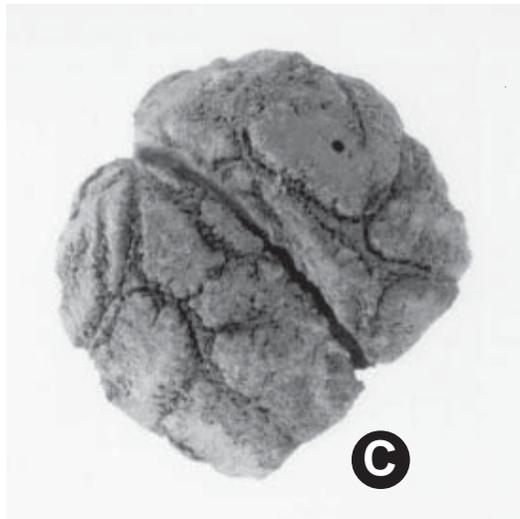
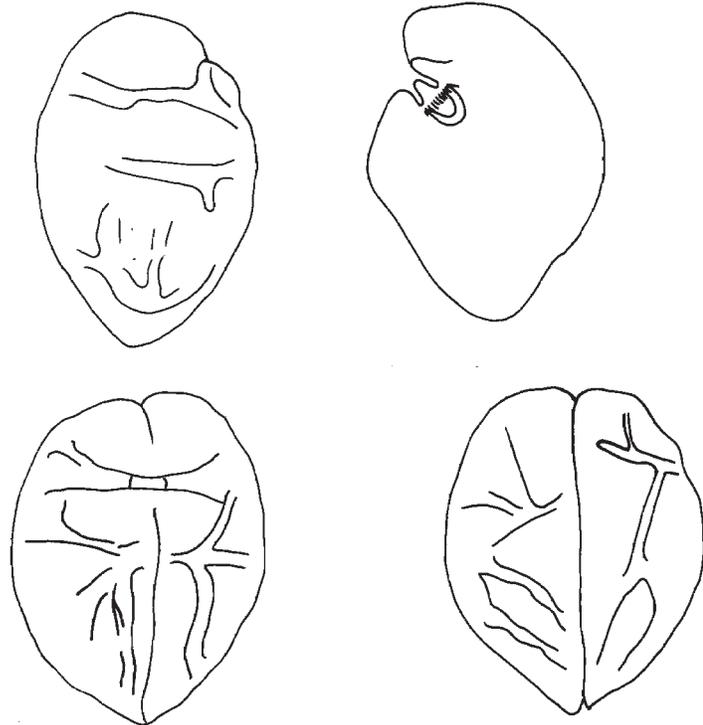
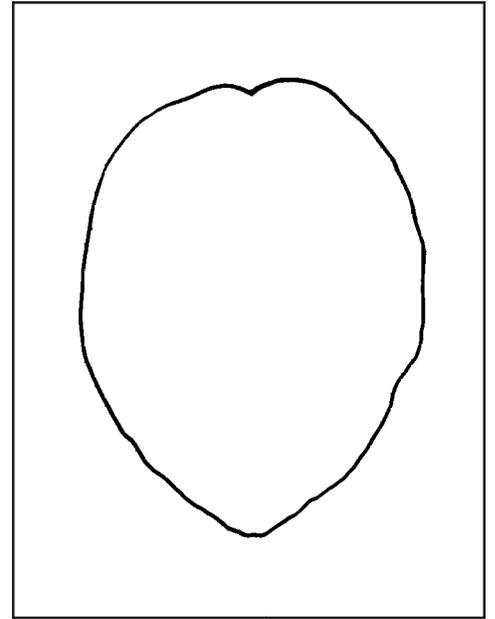
Seed $35\text{--}60 \times 30\text{--}50 \times 22\text{--}40$ mm; overgrown, 1 seed filling entire fruit cavity (including more than 1 seed per fruit); not angular or angular; symmetrical; sub circular, elliptic, or triangular; terete or compressed; with surface ridged or grooved; with grooves oblique;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

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

Distribution: Venezuela, Guyana, and upper Amazon basin.

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

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



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

Phylogenetic Number: 1.05.

Tribe: Swartzieae.

Group: Aldina.

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

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

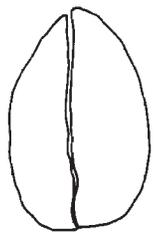
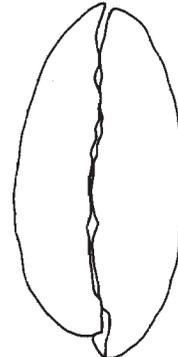
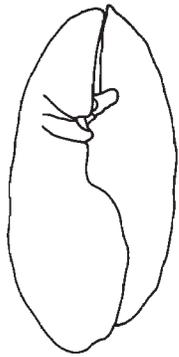
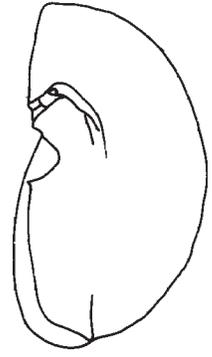
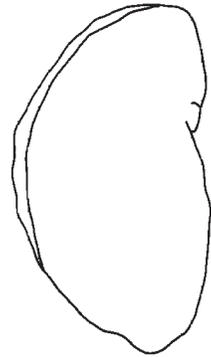
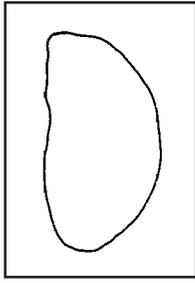
Seed $22\text{--}35 \times 13\text{--}17 \times 7.5\text{--}15$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; asymmetrical; D-shaped; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to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

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

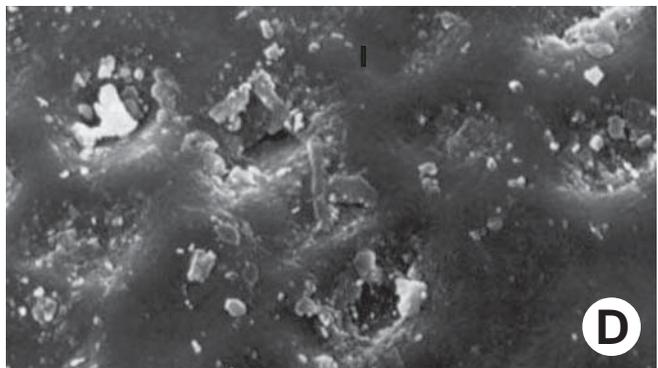
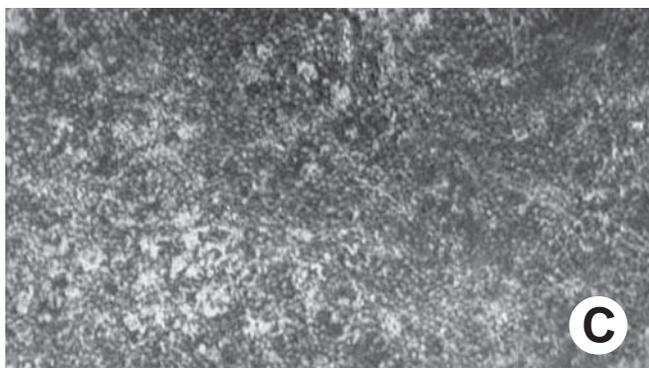
Distribution: Tropical Africa.

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

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



E



Genus: *Cordyla* J. de Loureiro

Phylogenetic Number: 1.06.

Tribe: Swartzieae.

Group: Aldina.

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

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

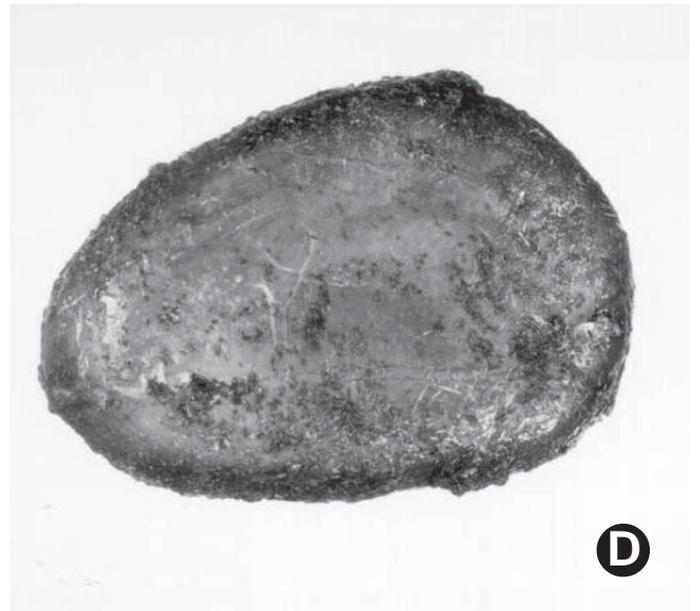
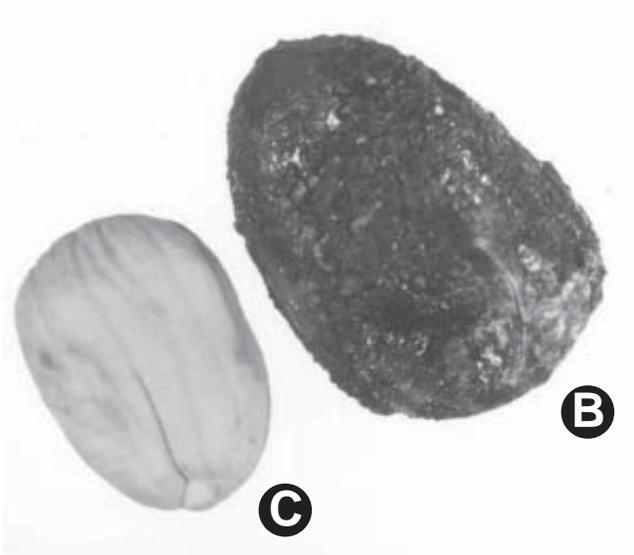
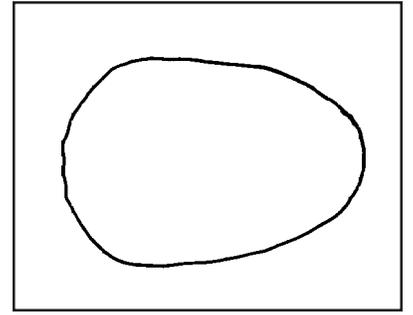
Seed 20–30 × 15–22 × 9–16 mm; not overgrown; angular; asymmetrical; ovate or reniform; compressed or terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent; partially adhering to endocarp. Endosperm absent. Cotyledons not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

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

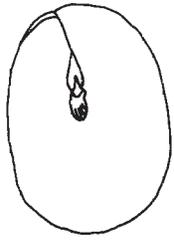
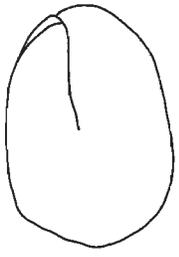
Distribution: Tropical Africa and Madagascar.

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

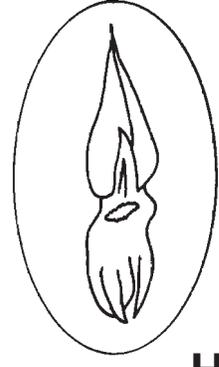
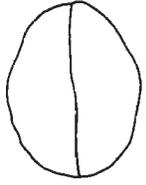
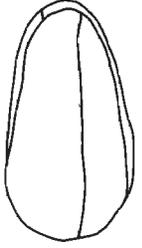
Cordyla: *C. africana* J. de Loureiro (B–F), *C. spp.* (A). A, Fruits (× 1.1); B, D, seed with endocarp functioning as testa (× 1.5, × 2.2); C, seed without endocarp (× 1.5); E–F, endocarp (× 50, × 1000).



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



G



H

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

Phylogenetic Number: 1.07.

Tribe: Swartzieae.

Group: Aldina.

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

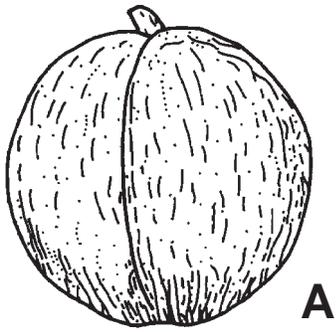
Fruit a legume; unilocular; $10 \times 10 \times 10$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; circular; not inflated; terete; without beak; rounded at apex; apex aligned with longitudinal axis of fruit; rounded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

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

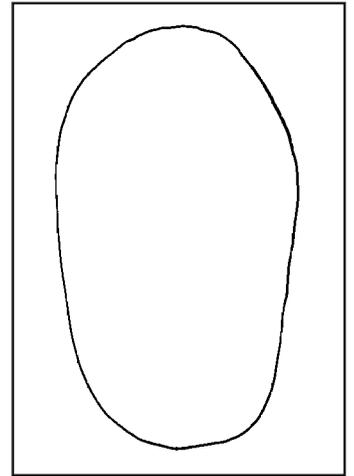
Distribution: Tropical Africa.

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

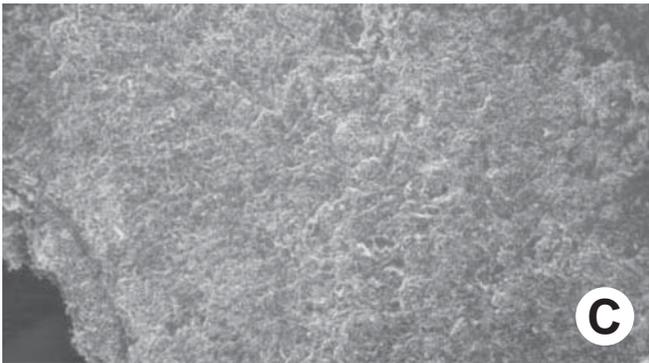
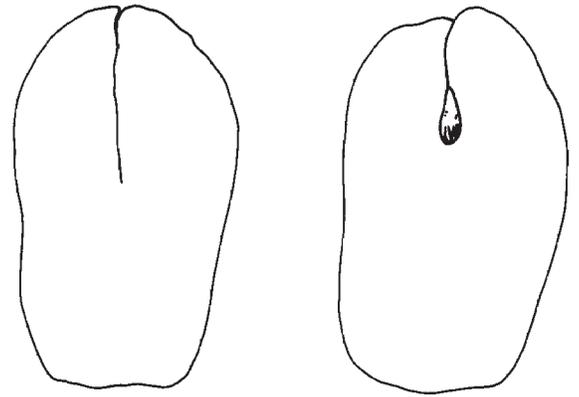
Mildbraediodendron: M. excelsum H.A.T. Harms (A–F). A, Fruit ($\times 2$, after Aubréville 1970: 305, t. 74); B, seed with endocarp functioning as testa ($\times 1.8$); C–D, endocarp ($\times 50$, $\times 1000$); E, embryos ($\times 1$); F, embryo magnified ($\times 3$).



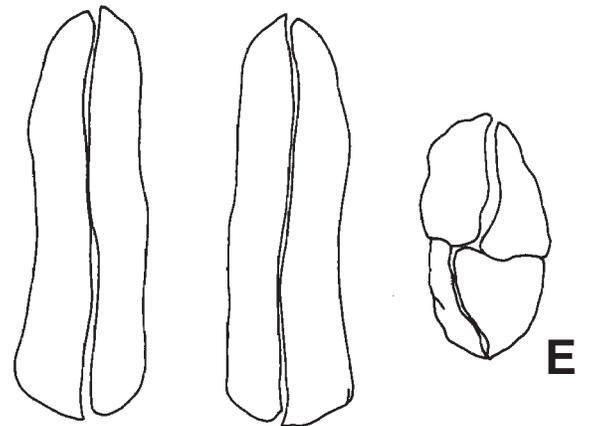
A



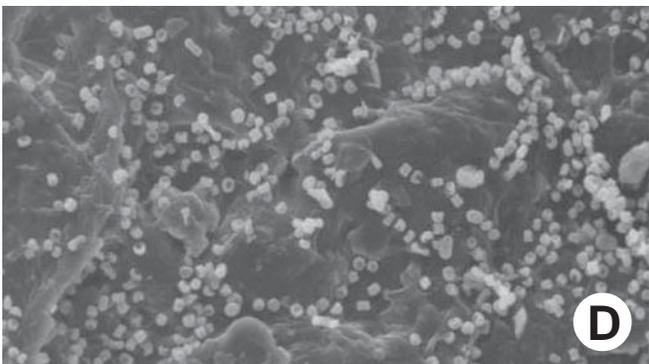
B



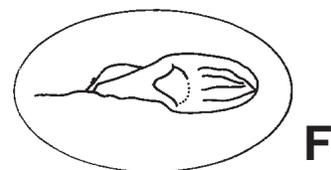
C



E



D



F

Genus: *Lecointea* A. Ducke

Phylogenetic Number: 1.08.

Tribe: Swartzieae.

Group: *Lecointea*.

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

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

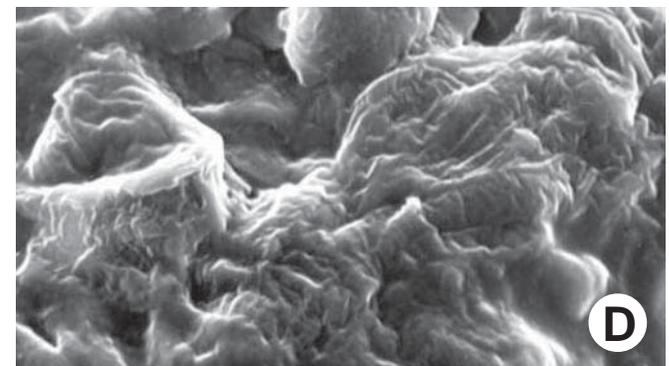
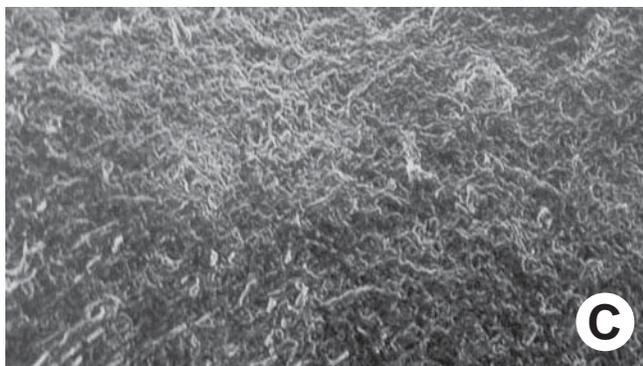
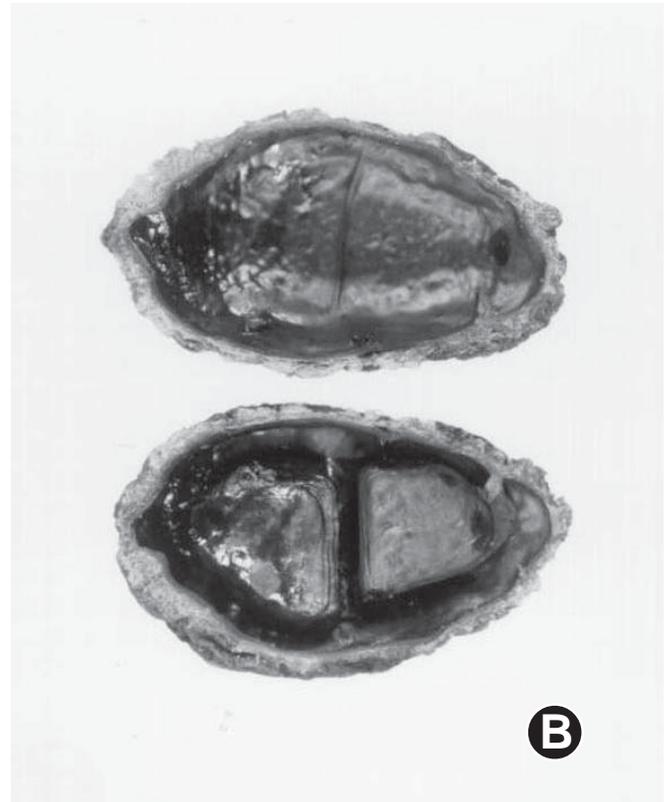
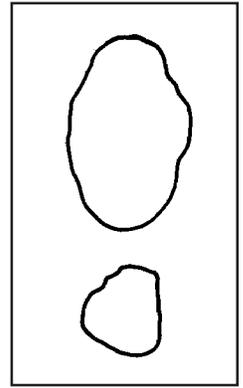
Seed $8\text{--}30 \times 4\text{--}15 \times 3.5\text{--}8$ mm; overgrown, 1 seed filling entire fruit cavity; angular or not angular; asymmetrical; circular, D-shaped, elliptic, oblong, ovate, or reniform (rarely); compressed; with surface smooth; without visible radicle and cotyledon lobes; without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

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

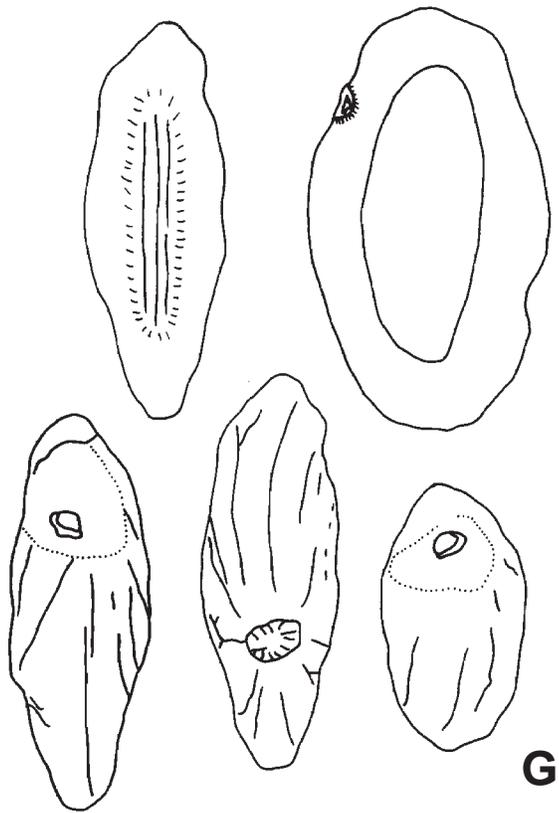
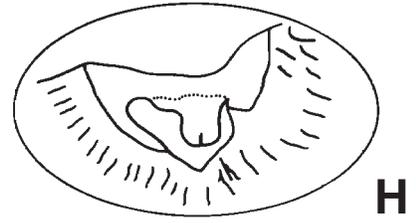
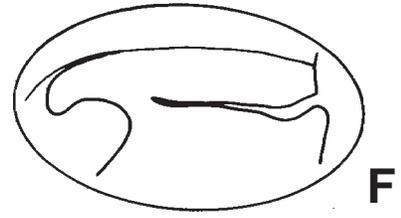
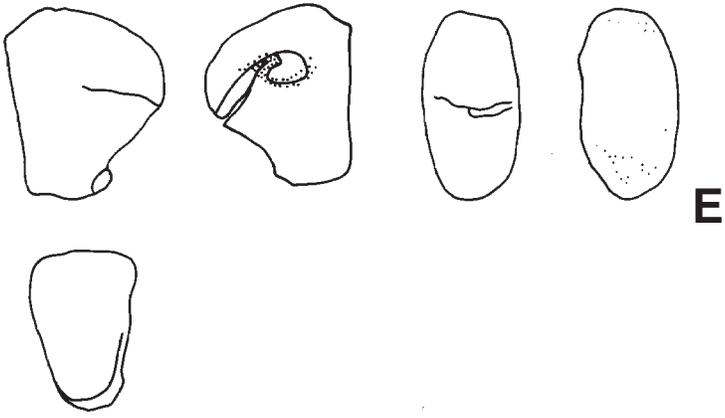
Distribution: Honduras (1 sp.) and Brazil (Amazonia, 3 spp.).

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

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



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



Genus: *Harleyodendron* R.S. Cowan

Phylogenetic Number: 1.09.

Tribe: Swartzieae.

Group: Lecointea.

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

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

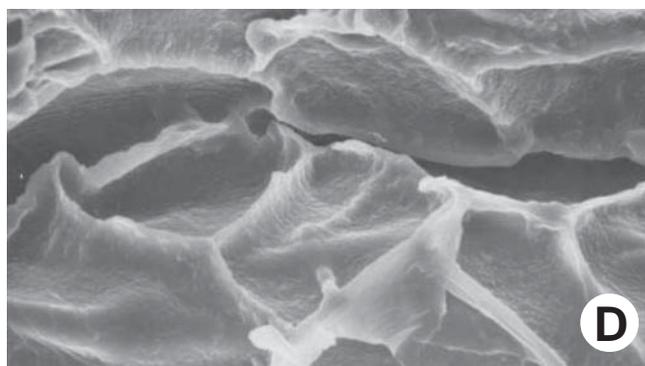
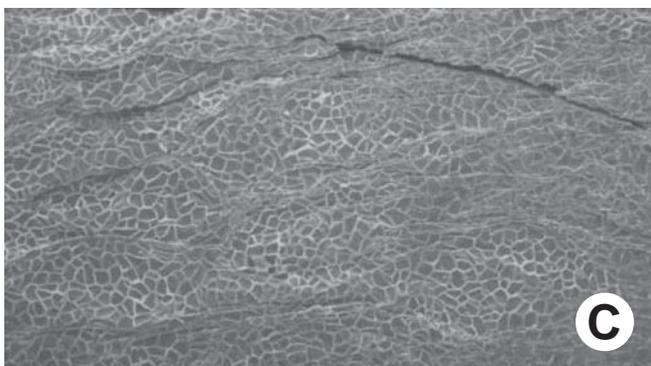
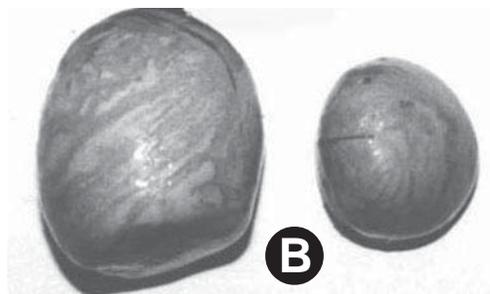
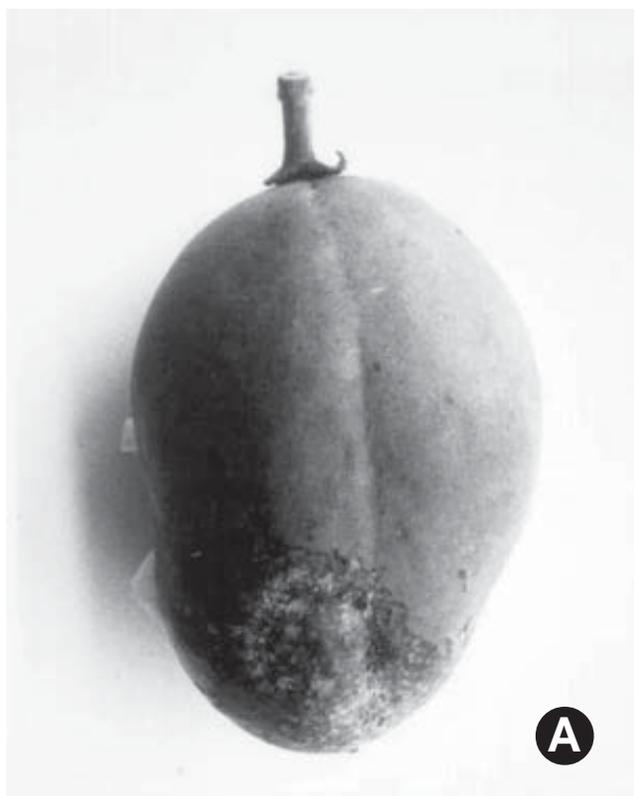
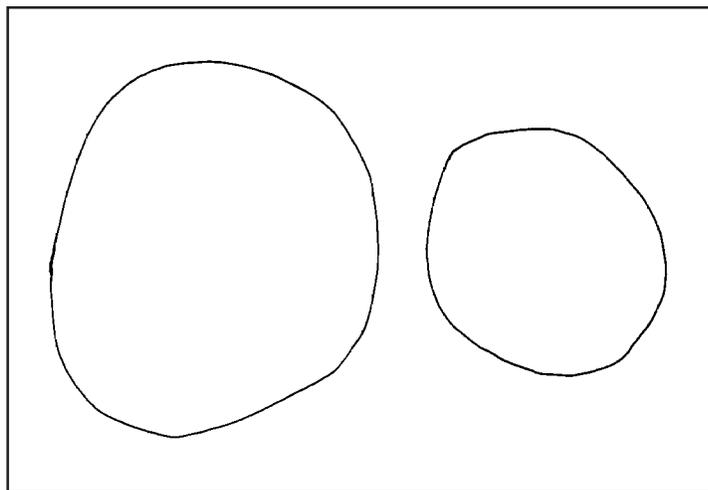
Seed $35\text{--}50 \times 25\text{--}35 \times 25\text{--}35$ mm; overgrown, 1 seed filling entire fruit cavity; not angular or angular; asymmetrical; ovate or irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa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

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

Distribution: Brazil (Bahia: Atlantic coast).

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

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



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

Phylogenetic Number: 1.11.

Tribe: Swartzieae.

Group: Lecointea.

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

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

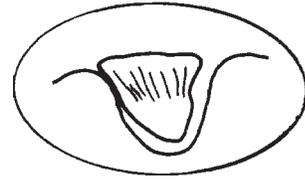
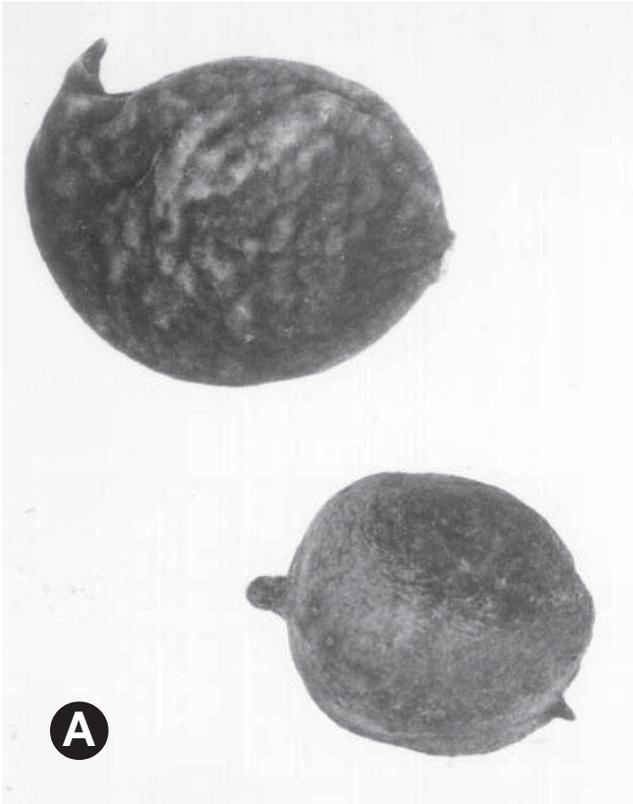
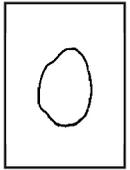
Seed 10–11 or 36 × 7 or 22 × 5.5–6 or 16 mm; angular; asymmetrical or symmetrical; ovate or elliptic (terminal seeds at each end of *Z. magnifica* fruit obtusely conical); compressed; with surface smooth; without

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

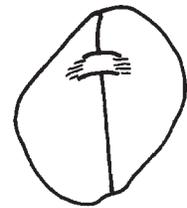
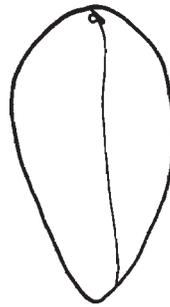
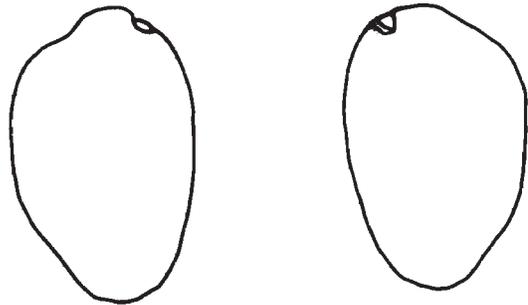
Distribution: Central America, Guianas, and Brazil.

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

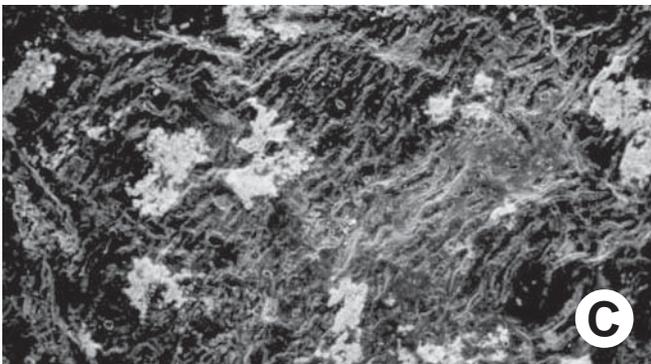
Zollernia: *Z. ilicifolia* (A.T. Brongniart) J.R.T. Vogel (B, E, F), *Z. kanukuensis* R.S. Cowan (C–D), *Z. spp.* (A). A, Fruits (× 3.5); B, seed (× 5.7); C–D, testa (× 50, × 1000); E, embryos (× 4); F, embryo magnified (× 18).



F



E



Genus: *Holocalyx* M. Micheli

Phylogenetic Number: 1.12.

Tribe: Swartzieae.

Group: Lecointea.

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

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

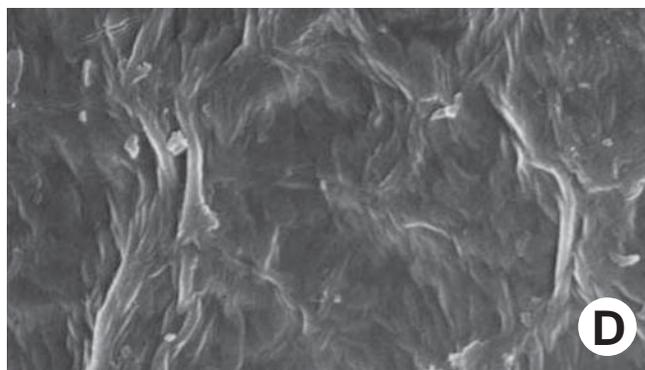
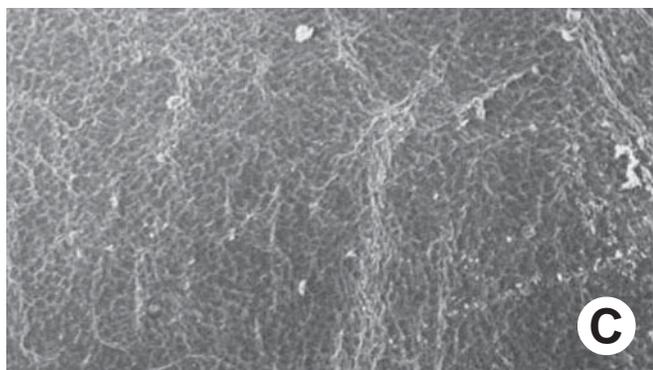
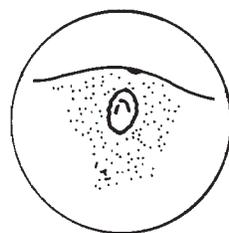
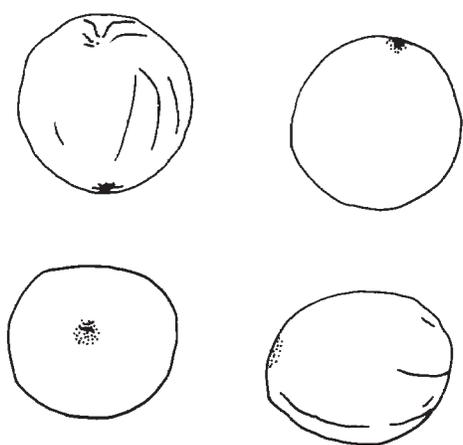
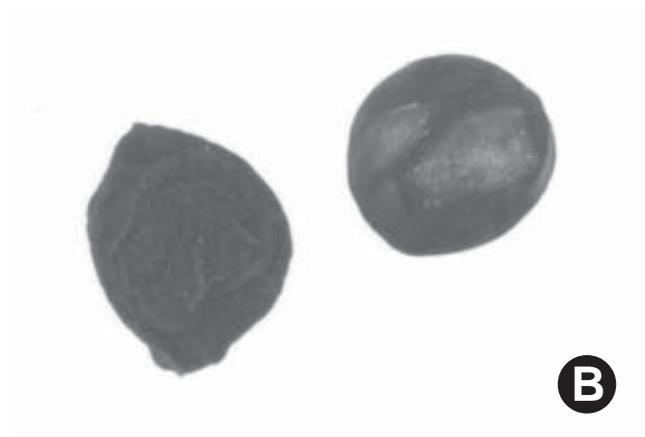
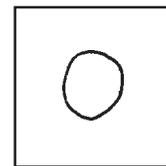
Seed $8.9\text{--}16 \times 8\text{--}15 \times 7\text{--}13$ mm; not overgrown; not angular; symmetrical; circular; terete; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Cuticle absent. Testa not adhering or partially adhering to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

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

Distribution: Southeastern Brazil, Paraguay, and northeastern Argentina.

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

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



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

Phylogenetic Number: 1.13.

Tribe: Sophoreae.

Group: *Ateleia*.

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

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

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

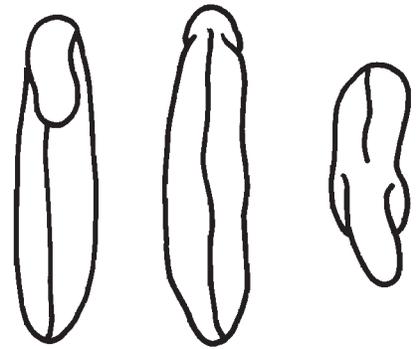
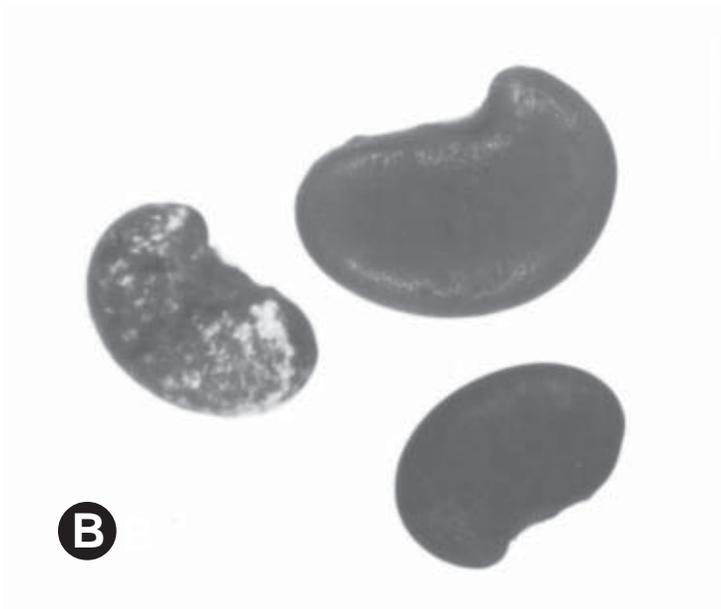
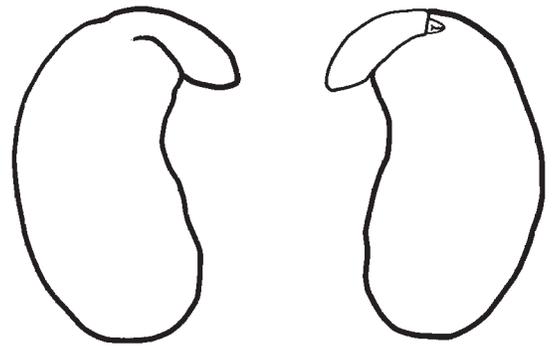
chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.6–1.3 mm long; with curved outline; elliptic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

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

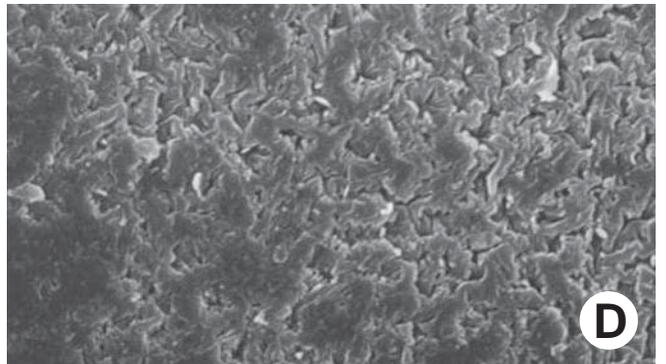
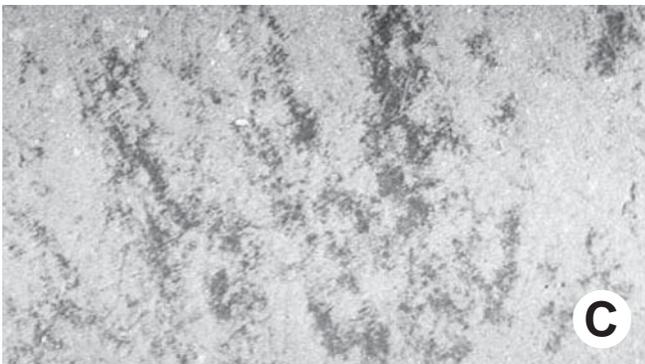
Notes: Polhill (1994a,b) transferred this genus from the Sophoreae (2) following Herendeen's (1995) cladistic analysis.

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

3



E



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

Phylogenetic Number: 1.14.

Tribe: Sophoreae.

Group: Ateleia.

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

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

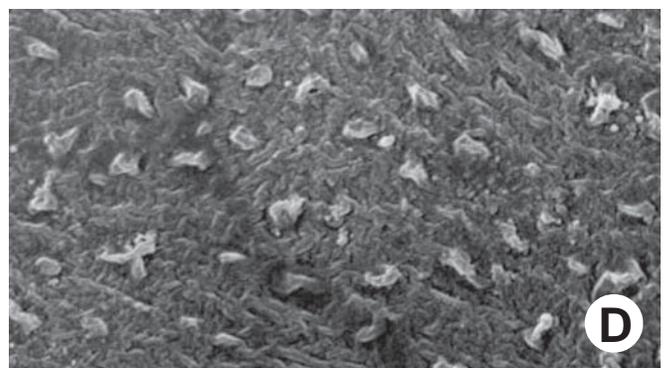
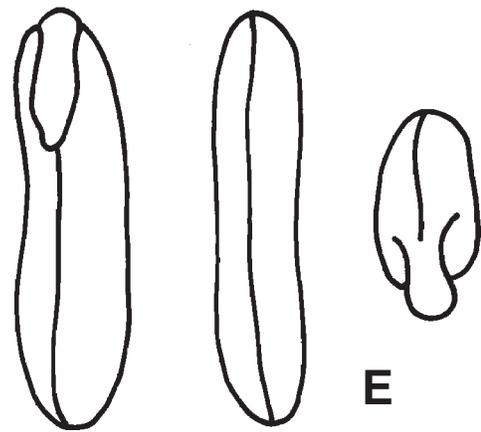
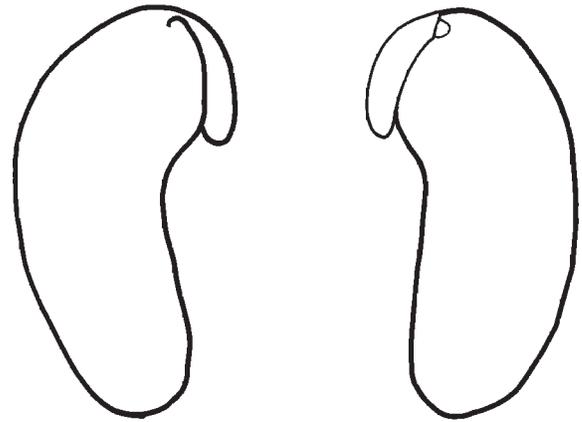
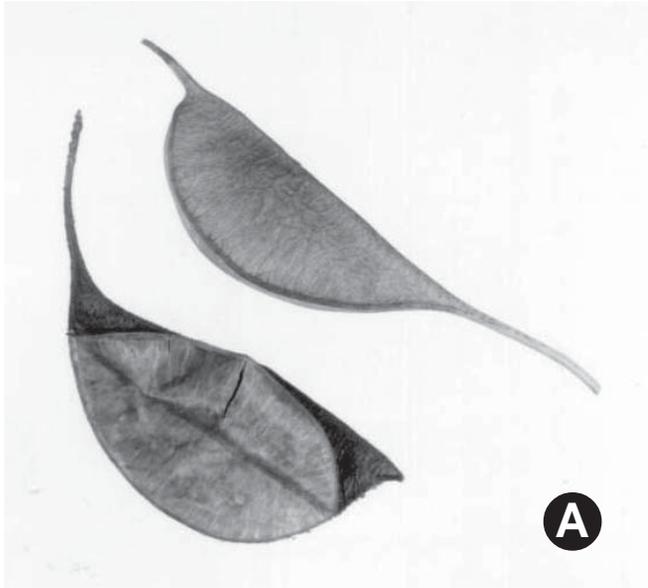
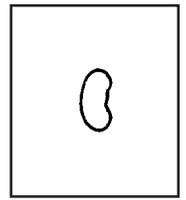
Seed $7.5\text{--}11 \times 4\text{--}7 \times 2.2\text{--}3.2$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by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

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

Distribution: Peru and Ecuador.

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

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



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

Phylogenetic Number: 1.15.

Tribe: Sophoreae.

Group: Ateleia.

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

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

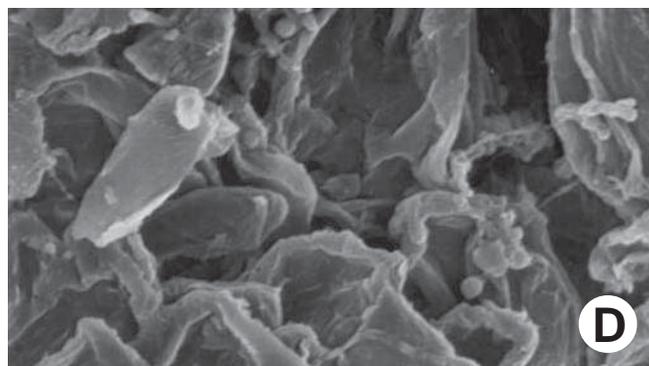
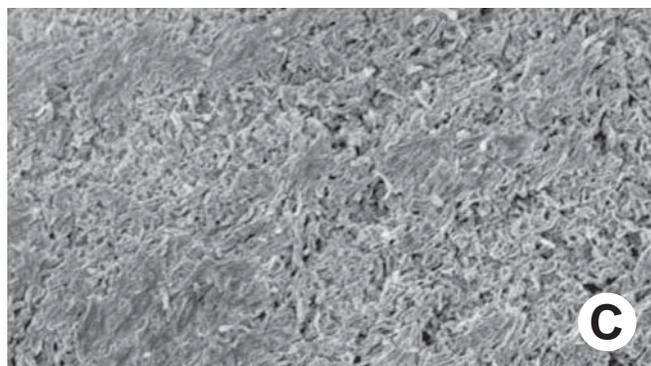
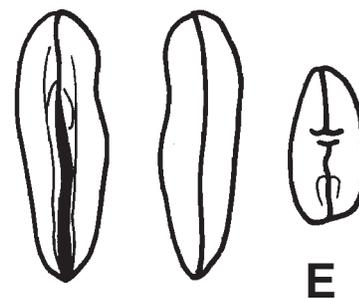
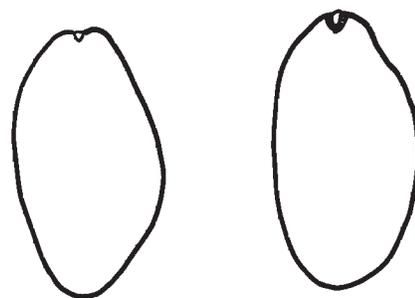
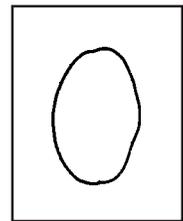
Seed $45\text{--}66 \times 11\text{--}20 \times 4\text{--}6.5$ mm; not overgrown; not angular; asymmetrical; samaroid; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp (in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

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

Distribution: Northeastern Brazil to southeastern Peru and northern Argentina.

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

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



Sophoreae (2.01–2.46)

Genus: *Acosmium* H.W. Schott

Phylogenetic Number: 2.01.

Tribe: Sophoreae.

Group: Myroxyton.

Species Studied—Species in Genus: 6 spp.—16 spp.

Fruit a legume or nutlet; unilocular; $1.7\text{--}9.2 \times 1.4\text{--}2.4 \times 0.2\text{--}0.7$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; elliptic, moniliform, or irregular; when asymmetrical with both sutures unequally curved; not inflated; flattened or compressed; without beak; short tapered or rounded at apex; apex aligned with longitudinal axis of fruit; tapered to rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain or embellished; with ridges (slight). Fruit wings absent. Fruit nonstipitate, substipitate, or stipitate; with the stipe 2–7 mm long. Fruit indehiscent. Replum invisible. Epicarp dull to semiglossy; monochrome or multicolored; bichrome; brown; with brown overlay; glabrous, glabrate, or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain or swollen; eglandular or glandular; with glandular hairs; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; papillose; not exfoliating; with or without cracks; cracking irregular. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with spongy layer over solid layer; subligneous, coriaceous, or chartaceous. Endocarp dull; monochrome; brown to yellow; scurfy to smooth or fibrous; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–3; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Aril dry; rim-aril; fimbriate; ivory.

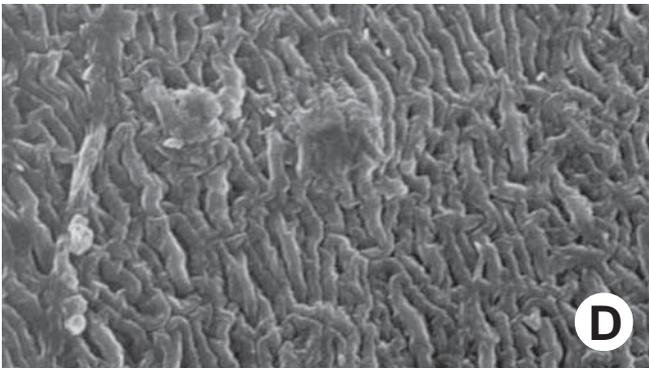
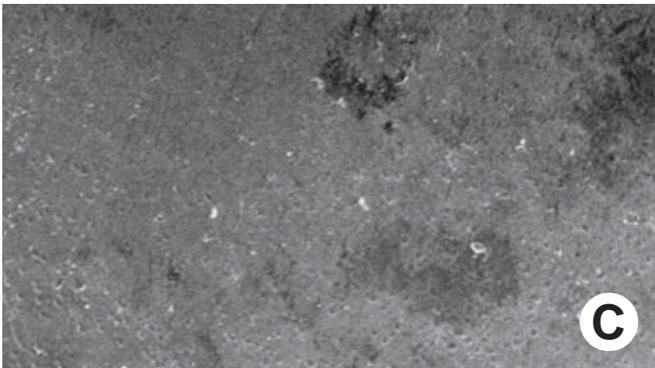
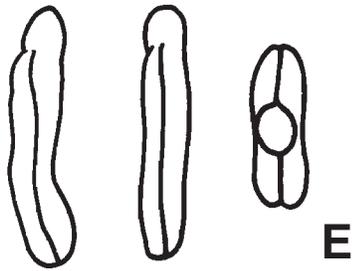
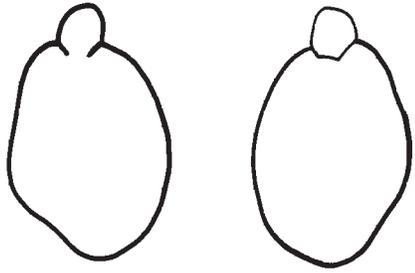
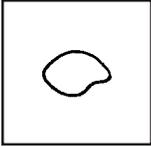
Seed 7–11.3 $3.5\text{--}8.3 \times 2.5\text{--}5.2$ mm; not overgrown; not angular; symmetrical or nearly symmetrical; ovate, circular, oblong, or reniform; compressed to terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; reddish brown to brown; with brown overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens and base of seed to point opposite hilum; not bifurcating; darker than testa; brown; flush. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.8–2 mm long; with curved outline; elliptic; subapical to radicle tip; flush or recessed; within rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 2–3 mm long; with margins straight; linear or wedge-shaped; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm thick or trace; covering entire embryo or restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face with central ridge on 1 and central groove on other; glabrous around base of radicle. Embryonic axis straight or deflexed (slightly); parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis or deflexed (slightly) and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southern Mexico to northern Argentina.

Notes: Polhill (1981b) stated that “the Sophoreae s.l. is a tribe of convenience between the Caesalpinioideae and the bulk of the Papilionoideae, sharply defined from neither.” He transferred four genera from Sophoreae into the Swartzieae (1), *Amburana* (1.15), *Ateleia* (1.13), *Cyathostegia* (1.14), and *Holocalyx* (1.12), following Herendeen’s (1995) cladistic analyses.

Herendeen performed cladistic analyses for all Swartzieae (1) genera, sensu Cowan (1981a), 19 Sophoreae genera, and 3 Caesalpinioideae genera. He concluded that Swartzieae is polyphyletic and that it should be disbanded and its genera transferred to Sophoreae. Preliminary *rbcL* data (Doyle et al. 1997) supported his conclusions. Polhill (1981b) noted that *Lovanafia* M. Peltier (2.33) was closely related to *Acosmium*, but Yakovlev (1977) and Polhill (1994a,b) included *Lovanafia* in *Dicraeopetalum* (2.33). Bridgewater and Striton (1997) studied the infraspecific variation of *A. dasycarpum* (J.R.T. Vogel) G.P. Yakovlev, and concluded that it cannot be segregated infraspecifically.

Acosmium: *A. nitens* (J.R.T. Vogel) G. Bentham (*C–E*), *A.*
spp. (*A–B*). *A*, Fruits ($\times 1.2$); *B*, seeds ($\times 4.9$); *C–D*,
testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 3$).



Genus: *Sweetia* C.P.J. Sprengel

Phylogenetic Number: 2.02.

Tribe: Sophoreae.

Group: Myroxyton.

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

Fruit a legume; unilocular; $4.5\text{--}6 \times 1\text{--}1.3 \times 0.2\text{--}0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; compressed; without beak; rounded at apex; apex aligned or oblique (slightly) with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain or embellished; with wing. Fruit wing 1; 30–35 mm wide; samaroid; apical. Fruit substipitate; with the stipe 3–4 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; brown to tan; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; irregularly veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; mottled; white; with mottling (dark); with tan overlay; scurfy; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; ca. 0.5 mm long; flattened; straight. Aril absent.

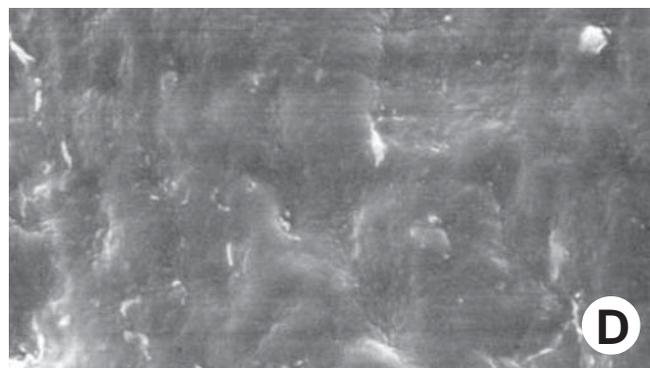
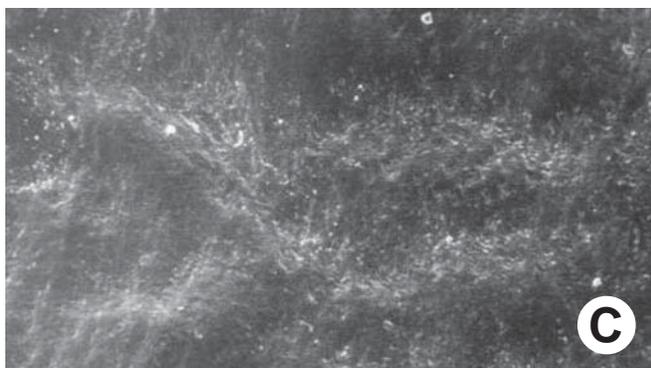
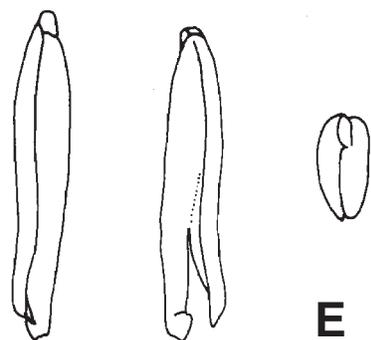
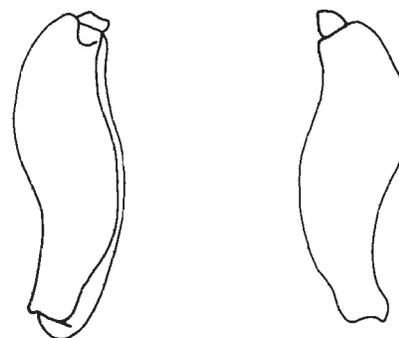
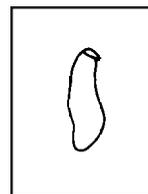
Seed $13\text{--}15 \times 4\text{--}5 \times 1.5\text{--}2$ mm; not overgrown; angular; asymmetrical; irregular to samaroid; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa with or without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; larger than punctiform; 0.8–1.4 mm long; with

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

Distribution: Brazil, Bolivia, and Paraguay.

Notes: Following Yakovlev (1969), we recognize *Sweetia* with only one species. The remaining species belong in *Acosmium* (2.01).

Sweetia: *S. fruticosa* C.P.J. Sprengel (A–E). A, Fruits ($\times 1.5$); B, seeds ($\times 4.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



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

Phylogenetic Number: 2.03.

Tribe: Sophoreae.

Group: Myroxyton.

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

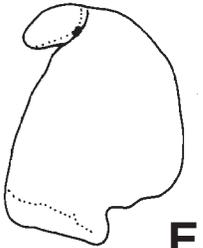
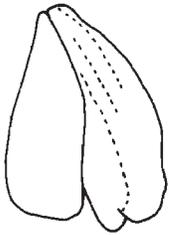
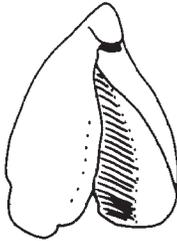
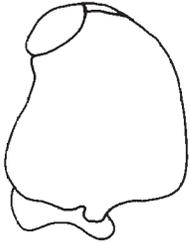
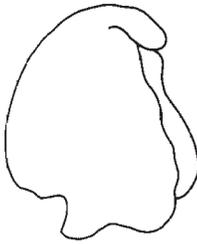
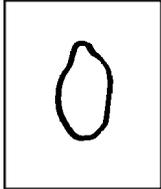
Fruit a legume; unilocular; $7-9 \times 2.5-2.9 \times 0.5-0.9$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; flattened; without beak; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded to short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain or embellished; with wing. Fruit wing 1; 45–60 mm wide; samaroid; apical. Fruit substipitate. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; brown; with tan overlay; with surface texture uniform; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; sericeous to villous; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; reticulately veined; not tuberculate; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; mealy; chartaceous. Endocarp dull; opaque; monochrome or bichrome; tan, tan and brown, white (creamy), or brown; smooth or smooth and scurfy; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; filiform; straight. Aril absent.

Seed $10-22 \times 7.5-12.5 \times 3.5-4.5$ mm; not overgrown; not angular; asymmetrical; irregular; compressed; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown or orange; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings

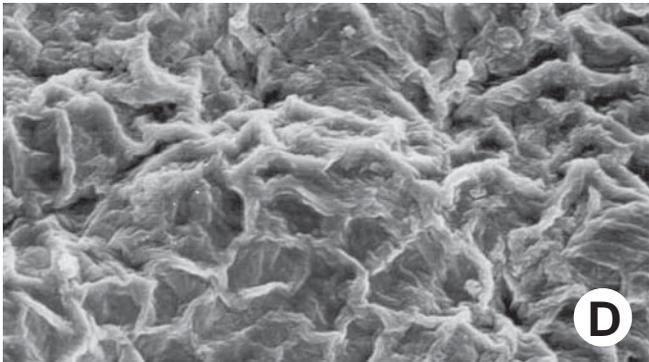
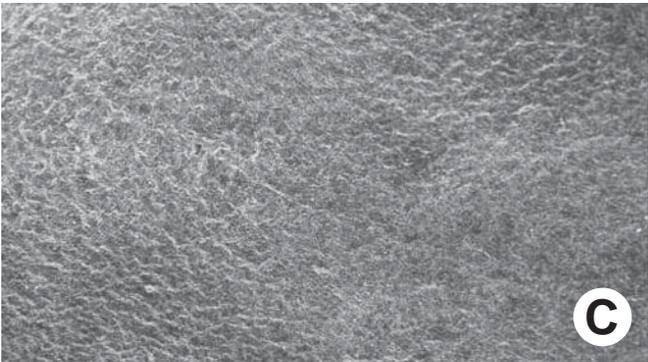
absent. Raphe visible or not visible; from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; brown; raised. Hilum partially or fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 0.5–1 mm long; with curved or straight outline; elliptic or oblong; apical according to radicle tip but marginal according to seed length; flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–2 mm long; with margins straight; triangular; not in groove of raphe; confluent with hilum; flush; same or similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Brazil.

Luetzelburgia: *L. praecox* (H.A.T. Harms) H.A.T. Harms (*B-E*), *L. spp.* (*A*). *A*, Fruits ($\times 1$); *B*, seed ($\times 3.8$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 4$).



E



Genus: *Uribea* A. Dugand & R.C. Romero-Castañeda

Phylogenetic Number: 2.04.

Tribe: Sophoreae.

Group: Myroxylon.

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

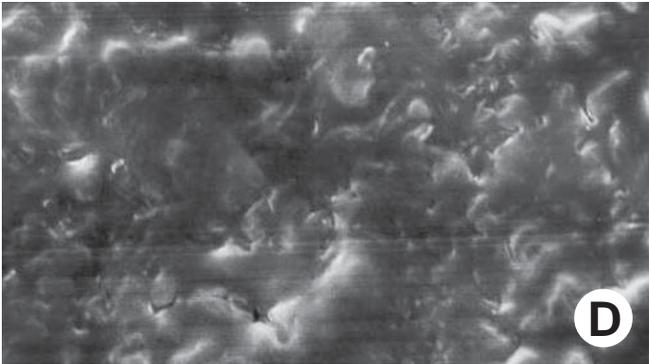
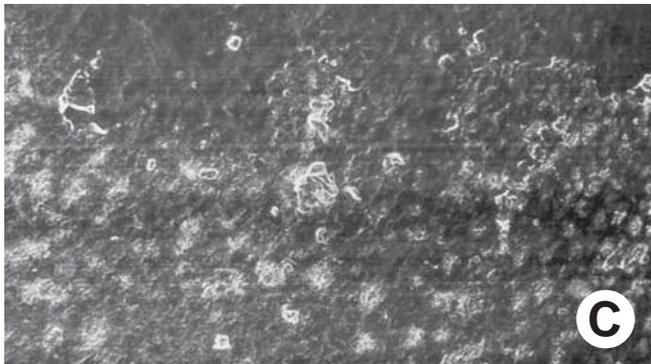
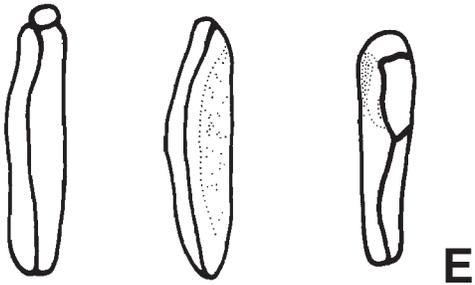
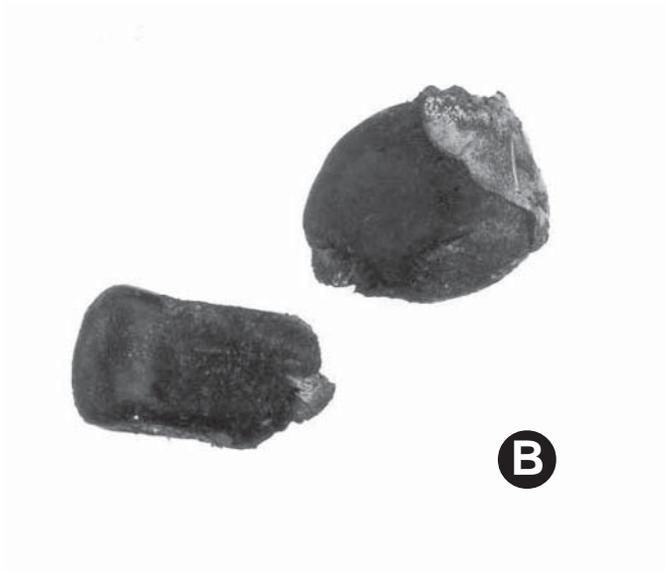
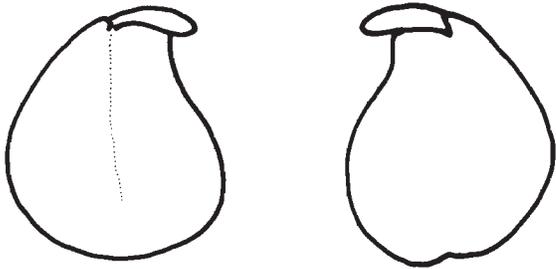
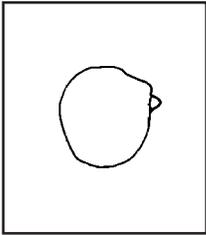
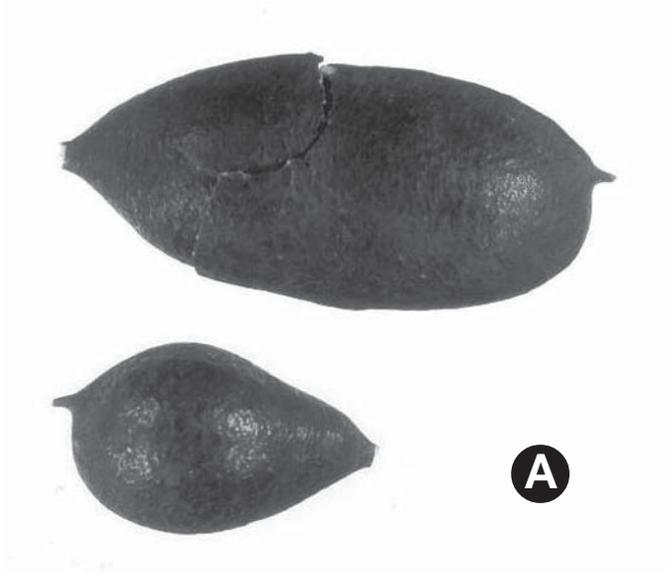
Fruit a legume; unilocular; $3-7 \times 2-2.7 \times 1.4-1.8$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; elliptic, obovate, obliquely obovate, or reniform; when asymmetrical with both sutures parallelly or unequally curved; somewhat inflated or not inflated; terete; with beak; straight or declined; with solid beak the same color and texture as fruit; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded, tapered, or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate or substipitate; with the stipe 2–10 mm long. Fruit indehiscent. Epicarp dull; monochrome; reddish brown or brown; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated or recessed features; not veined; not tuberculate; papillose; pitted; not exfoliating; with or without cracks; cracking transverse to fruit length. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; fleshy. Endocarp concealed by fleshy mesocarp. Seeds 1–4; length transverse to fruit length; neither overlapping nor touching; in 1 series. Aril fleshy; topknotlike; entire; covering less than 1/2 of seed; brown.

Seed 14–19 × 8–12 × 7–10 mm; not overgrown; angular or not angular; asymmetrical; oblong, obovate, quadrangular, or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa with pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; black to brown (dark); glabrous; smooth and not smooth; with elevated features; bearing endocarp remnants; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril; larger than punctiform; 3–3.5 mm

long; with curved outline; elliptic; subapical to radicle tip; recessed; not within corona, halo, or rim. Lens not discernible. Endosperm thick; covering entire embryo; adnate to testa. Cotyledons smooth or not smooth; convoluted; outer face of 1 cotyledon concave and other cotyledon convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes overlapping; with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face wavy; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Costa Rica and Colombia.

Uribea: U. tamarinoides A. Dugand & R.C. Romero-Castañeda (A–E). A, Fruits (× 1.3); B, seeds (× 2.3); C–D, testa (× 50, × 1000); E, embryos (× 3).



Genus: *Myrocarpus* F.F. Allemão e Cysneiro

Phylogenetic Number: 2.05.

Tribe: Sophoreae.

Group: Myroxylon.

Species Studied—Species in Genus: 1 sp.—4 spp.

Fruit a legume; unilocular; $2.5\text{--}19 \times 0.7\text{--}2 \times 0.1\text{--}0.3$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic to fusiform to falcate (slightly); when asymmetrical with both sutures nearly straight; not inflated; flattened; without or with beak (short); declined; with solid beak the same color and texture as fruit; rounded or tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with wings. Fruit wings 2; 2–6 mm wide; sutural; on both sutures. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; multicolored; bichrome or mottled; orangish or greenish brown; with brown (darker) overlay; with surface texture uniform; glabrous or glabrate (from literature); eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length (with some reticulation); not tuberculate; not exfoliating; without cracks. Mesocarp trace; 1-layered; with balsamic vesicles; without fibers; mealy; chartaceous. Endocarp concealed by adnate testa. Seeds 3–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Aril absent.

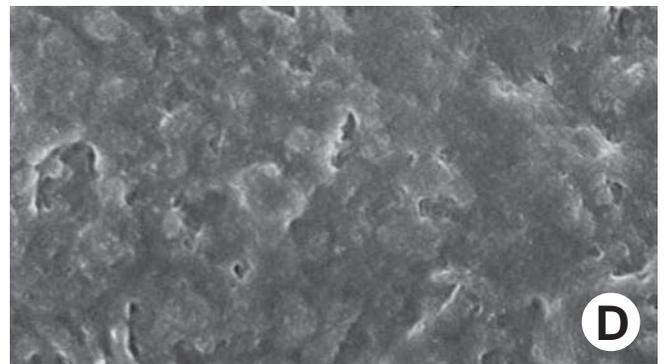
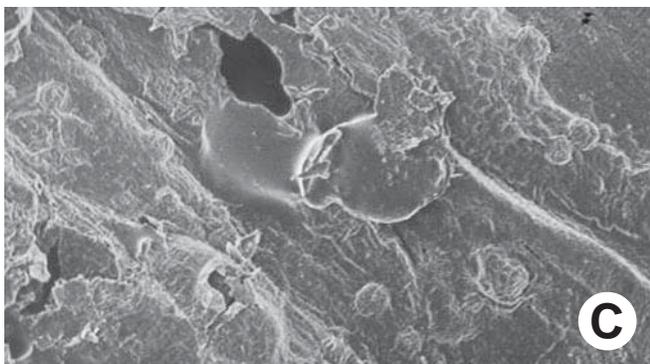
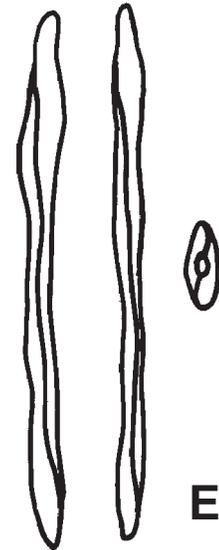
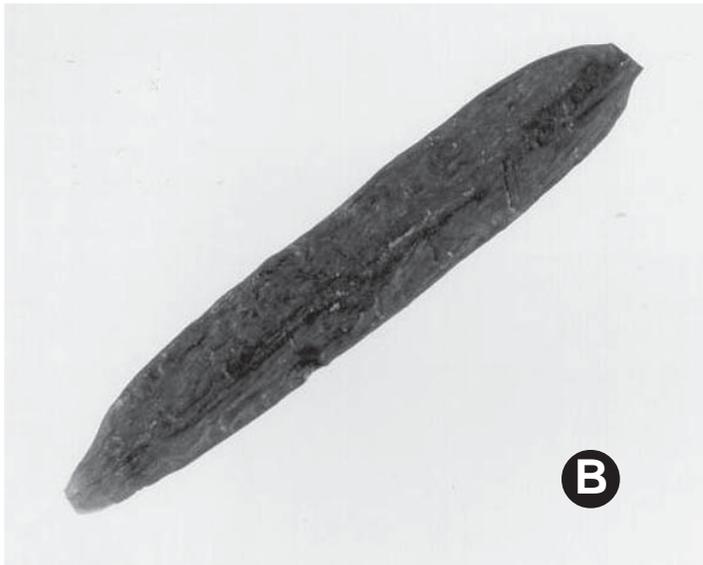
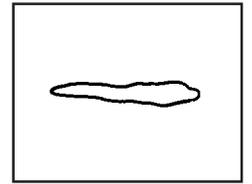
Seed ca. $2.3 \times 5.5\text{--}6 \times$ ca. 2 mm; not overgrown; not angular; symmetrical; elliptic; compressed; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Testa with pieces of adhering epicarp; fused to endocarp, at most a transparent brown tissue. Rim absent. Wings absent. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; 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 straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Venezuela, Brazil, Paraguay, and Argentina.

Notes: Rudd (1972a) revised *Myrocarpus*.

Myrocarpus: *M. frondosus* F.F. Allemão e Cysneiro (A–E). A, Fruits ($\times 1.9$); B, seed ($\times 4.1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Myrospermum* N. von Jacquin

Phylogenetic Number: 2.06.

Tribe: Sophoreae.

Group: Myroxylon.

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

Fruit a legume; unilocular; $7-12 \times 1.7-2.5 \times 0.7-1$ cm; with deciduous or persistent (rarely) calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; compressed; with or without beak; declined; with papery fragile beak up to 1 cm long; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas or wing. Fruit wing 1; 45–65 mm wide; samaroid; basal. Fruit substipitate or stipitate (rarely); with the stipe 1–12 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; tan; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length (with some reticulate veins); not tuberculate; irregularly papillose; not exfoliating; without cracks. Mesocarp thin; 1-layered; with balsamic vesicles; without fibers; mealy; coriaceous. Endocarp dull; opaque; monochrome; tan; rugose; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–3); length parallel with fruit length. Funiculus measured; ca. 1 mm long; thick; convoluted. Aril absent.

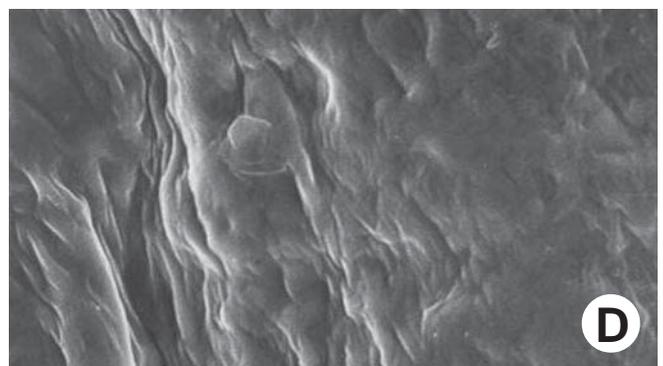
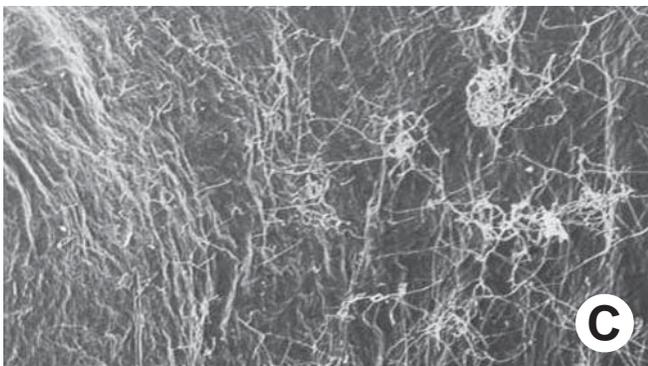
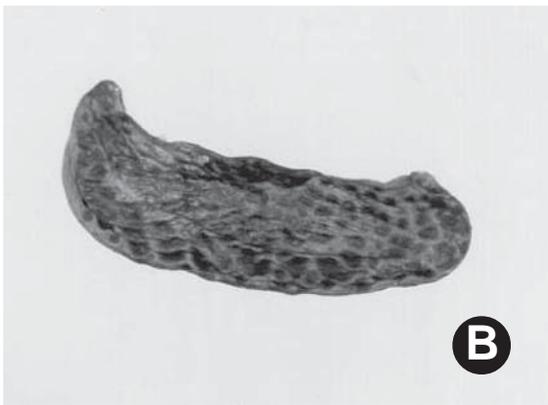
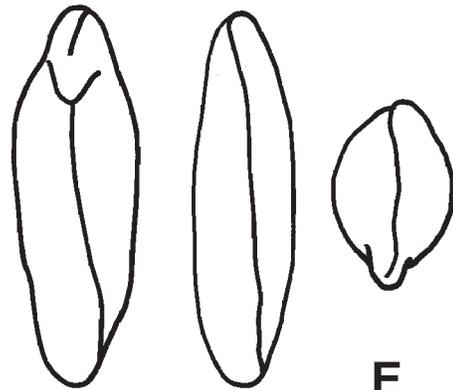
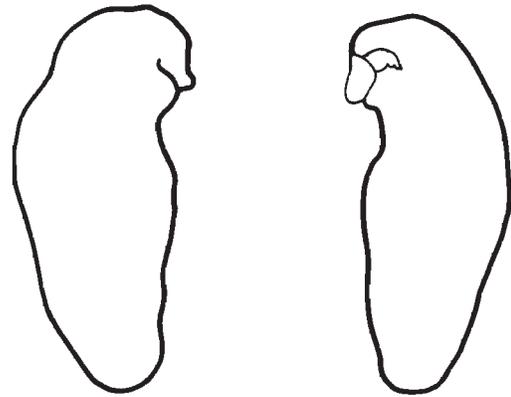
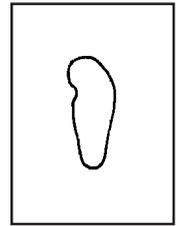
Seed (10–)15–17 \times (4–)5.6–7.2 \times 4.5–5.5 mm; not overgrown; not angular; asymmetrical; reniform; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; brown; with tan overlay; minutely pubescent (only along hilum); not smooth; with elevated features; rugose; chartaceous. Fracture lines absent. Rim absent. Wings

absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; color of testa; flush. Hilum fully concealed; concealed by funicular remnant; larger than punctiform; 0.7–1.5 mm long; with curved outline; oval; apical according to radicle tip but marginal according to seed length; raised; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–1.5 mm long; with margins straight; linear or triangular; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; rugose; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique or parallel; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Southern Texas to northern South America.

Notes: Delgado Salinas and Johnston (1984) definitively added a second species, *M. sousanum* A. Delgado Salinas & M.C. Johnston, to this genus, which extended its range into southern Texas.

Myrospermum: *M. frutescens* N. von Jacquin (A–E). A, Fruits ($\times 1.1$); B, seed ($\times 3.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Myroxylon* C. Linnaeus f.

Phylogenetic Number: 2.07.

Tribe: Sophoreae.

Group: *Myroxylon*.

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

Fruit a legume; unilocular; 4–9 × 1–3 × 1–1.5 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; curved elliptic or samaroid; when asymmetrical with both sutures parallelly or unequally curved; not inflated; compressed and flattened; without beak; rounded at apex; apex oblique with longitudinal axis of fruit; rounded or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with wing. Fruit wing 1; 40–65 mm wide; samaroid; basal. Fruit stipitate; with the stipe 5–10 mm long. Fruit indehiscent. Epicarp dull; multi-colored; mottled; tan; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; dotted or lenticular; without cracks. Mesocarp thick and thin; 1-layered; with balsamic vesicles; without fibers; fleshy; coriaceous. Endocarp dull; opaque; monochrome; creamy yellow; veined; with or without adhering pieces of testa; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; mostly remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; convoluted. Aril absent.

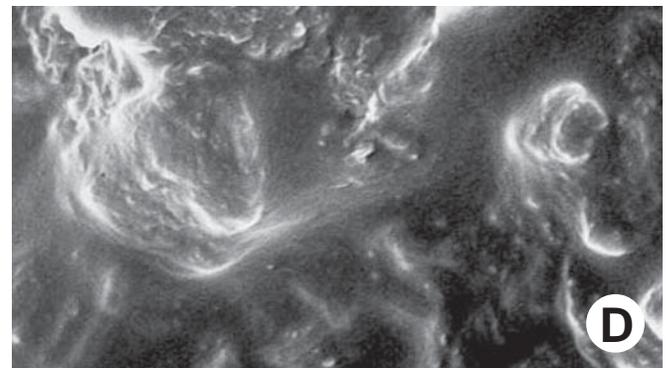
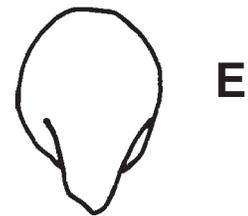
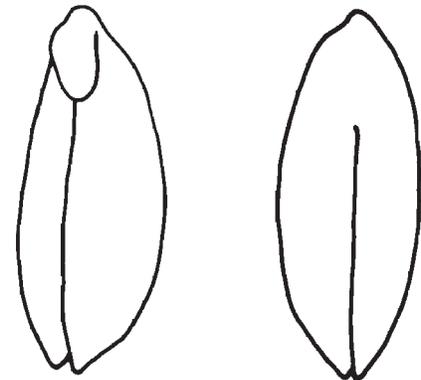
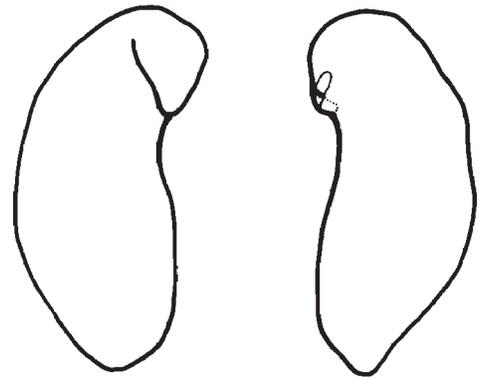
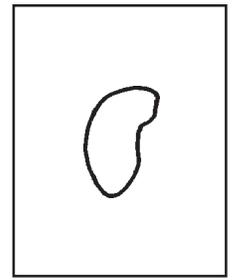
Seed 11–16 × 7–8 × 7–8.5 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; irregular or reniform; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Testa present or absent; without pieces of adhering epicarp; partially adhering to endocarp; fused to endocarp, at most a transparent brown tissue; dull; not modified by a bloom; clear; monochrome; transparent, light brown; glabrous; smooth; chartaceous.

Fracture lines absent. Rim absent. Wings absent. Hilum present, even when concealed (or unknown). Endosperm absent. Cotyledons smooth; both outer faces convex; 1 thicker than the other or both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat or wavy; glabrous around base of radicle. Embryonic axis oblique, parallel, or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Mexico, Central and South America.

Notes: The specific nomenclature follows Rudd (1968).

Myroxylon: *M. balsamum* (C. Linnaeus) H.A.T. Harms var. *pereirae* (J.F. Royle) H.A.T. Harms (C–E), *M. spp.* (A–B). A, Fruits (× 0.8); B, seeds (× 3.7); C–D, testa (× 50, × 1000); E, embryos (× 4).



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

Phylogenetic Number: 2.08.

Tribe: Sophoreae.

Group: Myroxyton.

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

Fruit a legume; unilocular; $2.5-4 \times 2-3 \times 0.15-0.3$ cm; with deciduous corolla; with persistent or deciduous 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; rounded at apex; apex exceeding (crossing) longitudinal axis of fruit; emarginate 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; embellished; with wing. Fruit wing 1; 5–10 mm wide; samaroid; on 1 suture. Fruit stipitate or substipitate; with the stipe up to 5 mm long. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; reddish to greenish brown; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; subcoriaceous. Endocarp dull; streaked; reddish to greenish brown; with streaking above and below seed chambers; with brown (reddish) overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; flattened; straight. Aril absent.

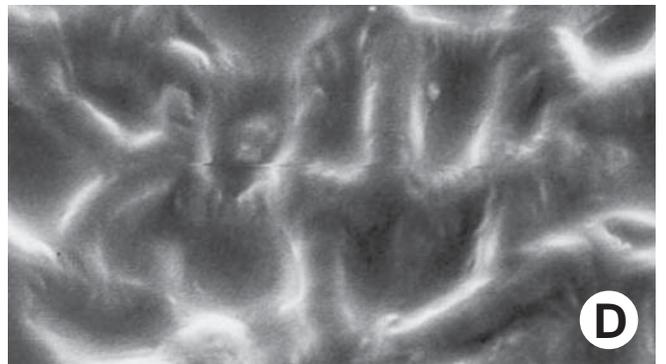
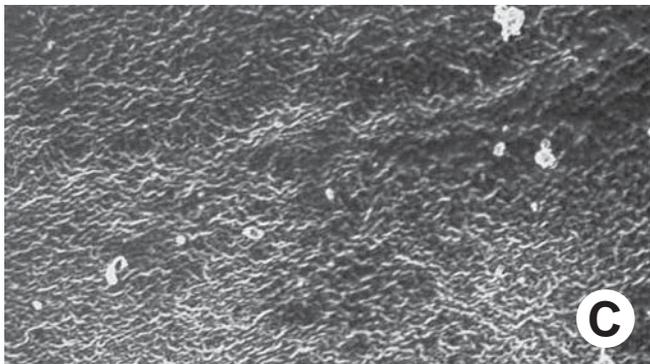
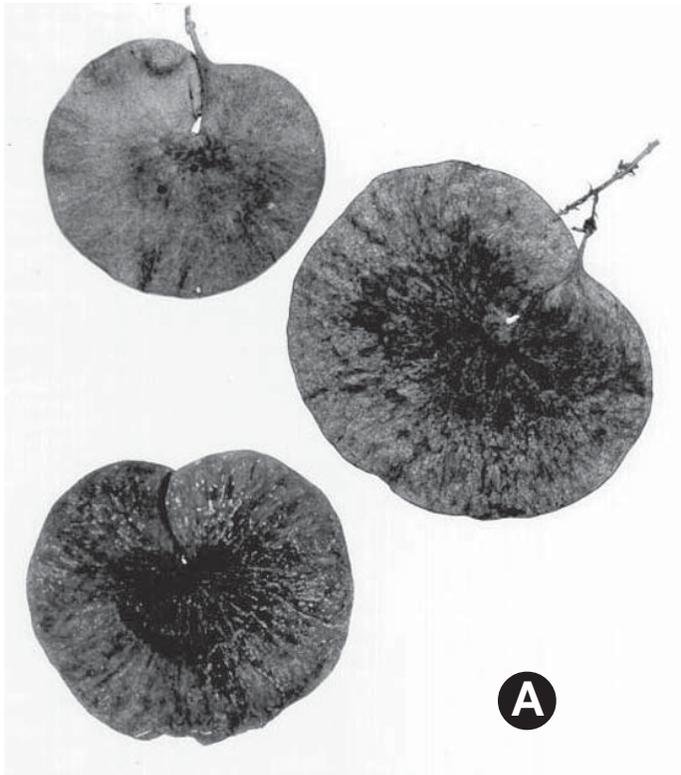
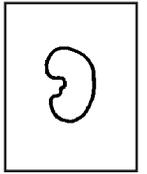
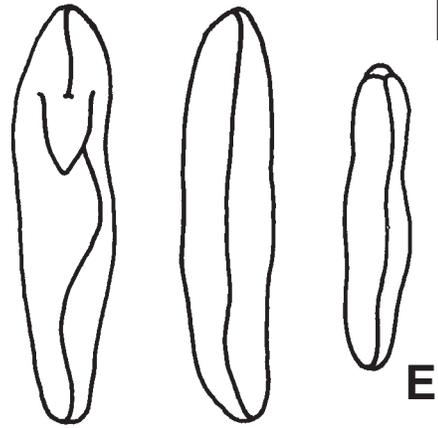
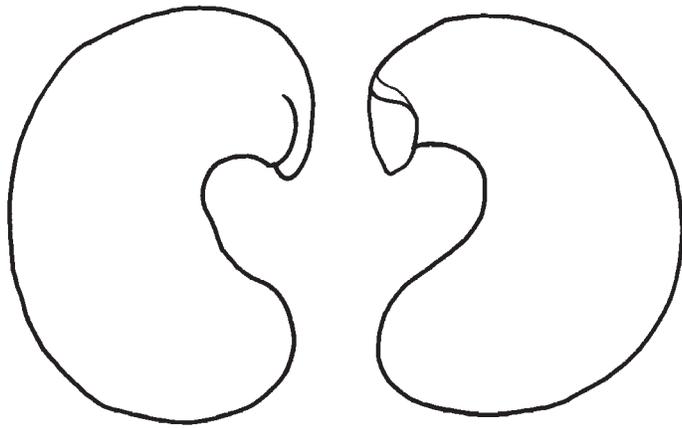
Seed $9-15 \times 5-7 \times 0.5-0.6$ mm; not overgrown; not angular; asymmetrical; C-shaped; flattened; with surface smooth; without visible radicle and cotyledon lobes; with umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform;

0.8 mm long; with straight outline; linear; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. 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; greenish 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: Brazil and Paraguay.

Notes: Mohlenbrock (1962b) monographed the genus, and Lima and Fonseca Vaz (1984) revised it. The recent papers of Rizzini (1977, 1979) and Mattos filho (1980) provided fruit and seed data.

Riedeliella: *R. magalhaesii* (C.T. Rizzini) H.C. de Lima & A.M.S. de Fonseca Vaz (C–E), *R. spp.* (A–B). A, Fruits ($\times 1.4$); B, seeds ($\times 4.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Etaballia* G. Bentham

Phylogenetic Number: 2.09.

Tribe: Sophoreae.

Group: Myroxyton.

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

Fruit a legume; unilocular; $3.5-4 \times 2-3 \times 0.3-0.5$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved; not plicate; not twisted; asymmetrical; C-shaped, irregular, or reniform; when asymmetrical with both sutures unequally or parallelly curved; not inflated; flattened; without beak; short tapered or emarginate at apex; apex oblique or right-angled with longitudinal axis of fruit; rounded at base; base aligned or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with wing. Fruit wing present or absent (while not winged, whole fruit is winglike); continuous wing around fruit; on both sutures. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; brown; pubescent and indurate or glabrate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined or reticulately veined; not tuberculate; longitudinally rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; with fibers; fibrous throughout; coriaceous. Endocarp dull; monochrome; reddish brown; hairy; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed usually 1; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril absent.

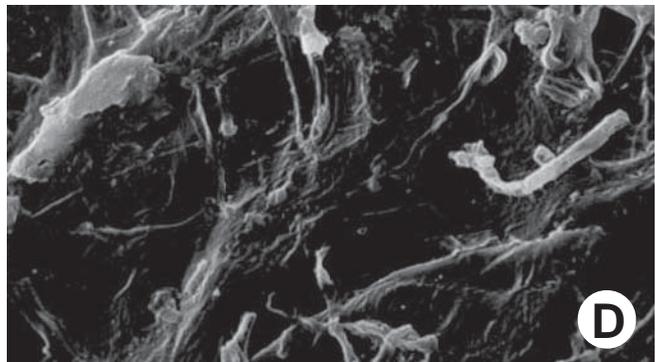
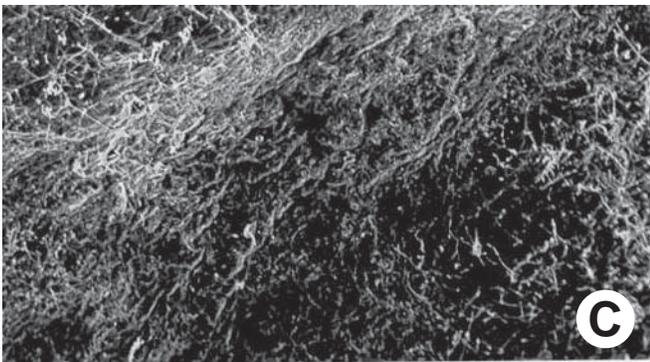
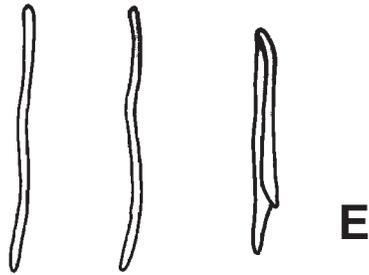
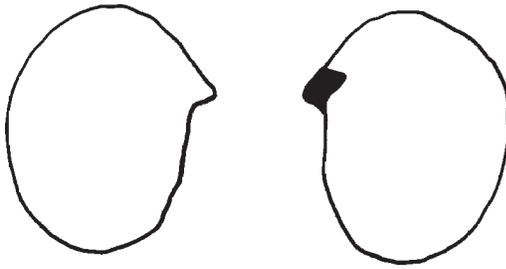
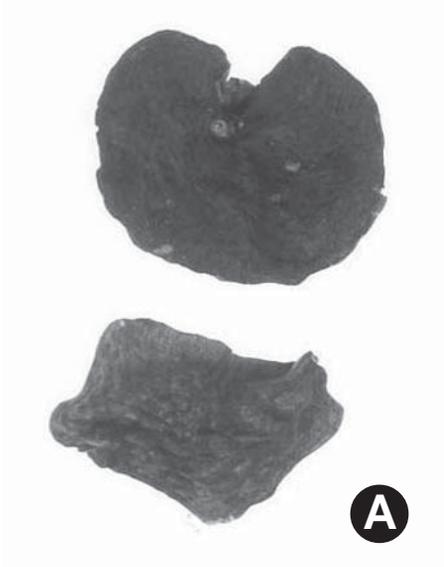
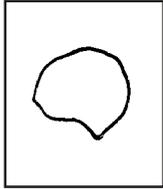
Seed $12 \times 11 \times 0.4$ mm; overgrown, 1 seed filling entire fruit cavity; angular; asymmetrical; irregular; flattened; with surface grooved; with grooves oblique; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated or recessed features; reticulate; grooved; chartaceous. Fracture lines absent. Rim absent. Wings

absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split (probably absent); larger than punctiform; 0.5 mm long; with curved outline; elliptic; between cotyledon and radicle lobe; flush; within halo. Hilum halo color darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth (obliquely grooved); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Guyana, Venezuela, and Brazil.

Notes: Bentham (1862) reported on the confusion caused by seeing *Etaballia* and *Inocarpus* (2.10) for the first time.

Etaballia: *E. dubia* (K.S. Kunth) V.E. Rudd (*A-E*). *A*, Fruits ($\times 1$); *B*, seed ($\times 4$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 3$).



Genus: *Inocarpus* J.R. Forster & J.G. Forster

Phylogenetic Number: 2.10.

Tribe: Sophoreae.

Group: Myroxyton.

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

Fruit a legume or nutlet; unilocular; $5-8 \times 4-7 \times 1.9-4.5$ 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 circular; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; terete; with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; when fresh drupaceous and ligneous (when dry); seed chambers externally invisible. Fruit margin constricted (if 2-seeded) or not constricted; constricted only on 1 margin; without sulcus; plain. Fruit substipitate. Fruit indehiscent or with all layers dehiscing (but opening, thus permitting entry of water); splitting along suture. Dehiscence of valves along 1 suture; medial and up and down; passive. Replum invisible. Epicarp dull; monochrome; brown; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface uniformly veined; 2-layered; without balsamic vesicles; with fibers; with fibers over solid layer; ligneous. Endocarp nearly glossy; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

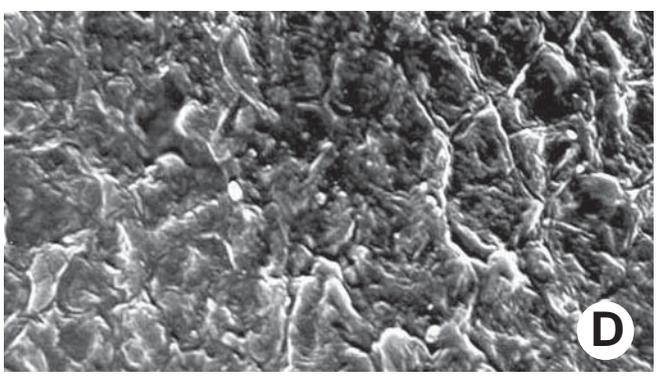
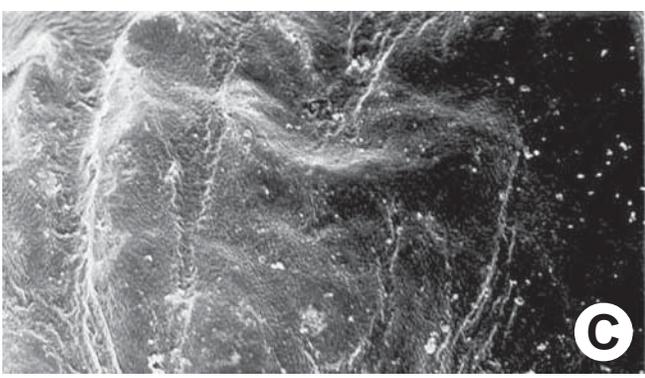
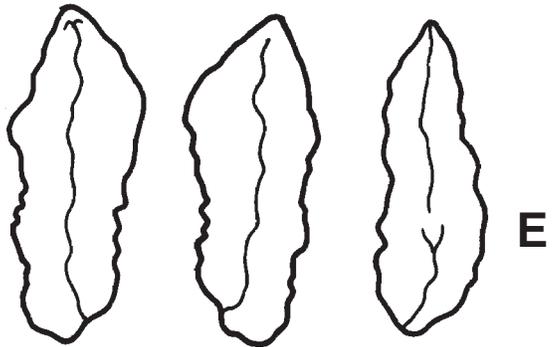
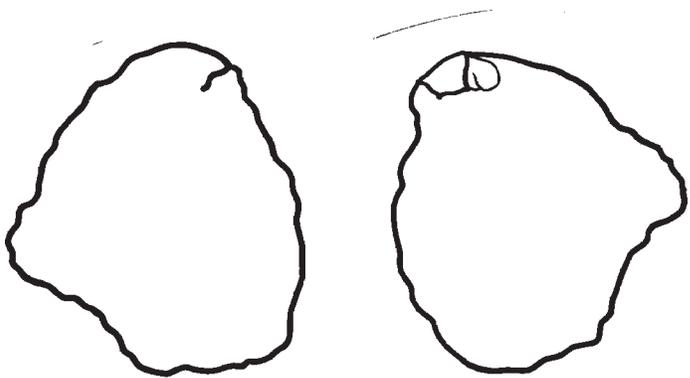
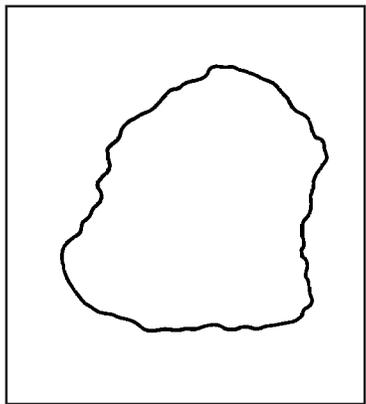
Seed $4-4.5 \times 4 \times 2.5$ mm; overgrown, 1 seed filling entire fruit cavity; angular; asymmetrical; oblong; terete; with surface smooth; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; not smooth; with elevated features; veined and wrinkled; coriaceous. Fracture lines absent. Rim wing-like along 1 side of seed. Wing present. Raphe visible (if the wing

is considered the raphe); from hilum to near base of seed and terminating; not bifurcating; color of testa; brown; raised. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 0.5 mm long; with curved or straight outline; circular or oblong; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons not smooth (wrinkled); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; split over radicle; with lobes; with the interface division terminating at base of radicle; without margins recessed; dirty 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 width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Malesia, New Guinea, and Pacific Islands.

Notes: Bentham (1862) reported on the confusion caused by seeing *Inocarpus* and *Etaballia* (2.09) for the first time. He also recorded some of the uses of *I. fagifer*.

Inocarpus: *I. fagifer* (S. Parkinson) F.R. Fosberg (B-E), *I.* spp (A). A, Fruits ($\times 0.8$); B, seeds ($\times 0.5$); C-D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 1$).



Genus: *Amphimas* J.B.L. Pierre ex H.A.T. Harms

Phylogenetic Number: 2.11.

Tribe: Sophoreae.

Group: Myroxyton.

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

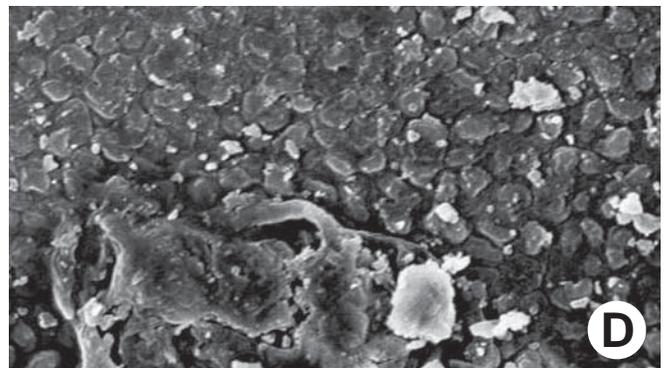
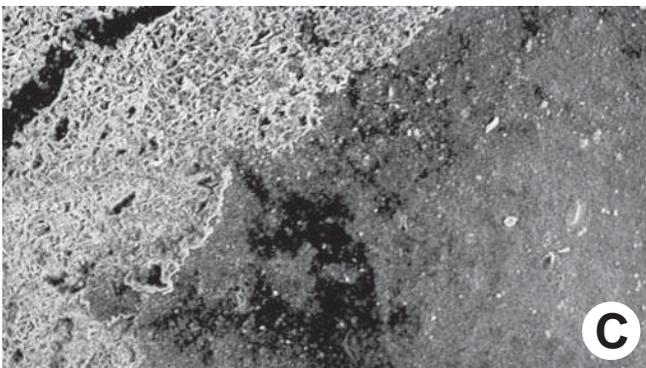
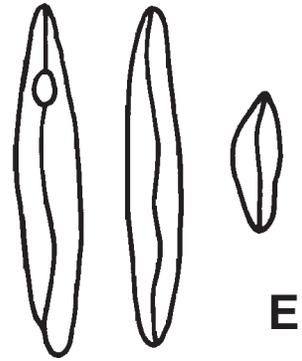
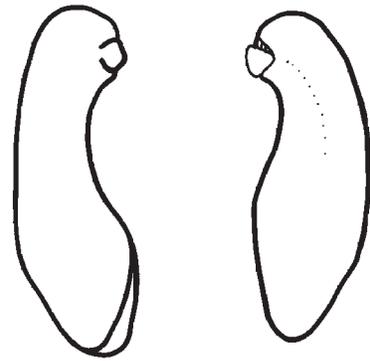
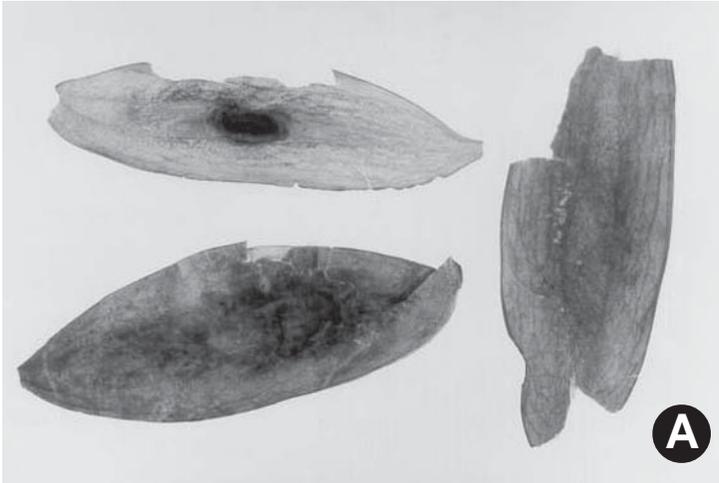
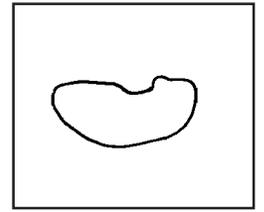
Fruit a legume; unilocular; 10–24 × 4–5.7 × 0.4–0.8 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic to ovate; not inflated; flattened; without beak; rounded to emarginate at apex; apex aligned with longitudinal axis of fruit; tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain or embellished; with wings. Fruit wings 2; 13–24 mm wide; sutural; on both sutures. Fruit stipitate to substipitate; with the stipe 4–6 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves reflexing. Replum invisible. Epicarp dull; multicolored; mottled; brown to tan; with brown overlay; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; papillose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; spongy; chartaceous. Endocarp dull; bichrome; tan and brown (around seed); smooth and pulpy (around seed); nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2–4 mm long; of 1 length only; flattened; straight or triangular. Aril dry; rim-aril; fimbriate; brown.

Seed 18–34 × 8.5–16 × 3–7.2 mm; not overgrown; not angular; symmetrical or asymmetrical; elliptic to reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp (like a powdery coating); dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with elevated features; rugose and bearing endocarp remnants; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed;

concealed by funicular remnant and aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 3–7.5 mm long; with curved or straight outline; elliptic; linear; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 1–2.5 mm long; with margins curved; circular; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length or 1 longer than other; not folded; margin entire 180 degrees from base of radicle; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; green to tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical Africa.

Amphimas: *A. pterocarpoides* H.A.T. Harms (C–E), *A.* spp. (A–B). A, Fruits (× 0.4); B, seeds (× 3.1); C–D, testa (× 50, × 1000); E, embryos (× 2).



Genus: *Castanospermum* A. Cunningham ex W.J. Hooker

Phylogenetic Number: 2.12.

Tribe: Sophoreae.

Group: Angylocalyx.

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

Fruit a legume; unilocular; 13–22 × 3.5–5.5 × 2.6–5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical (slightly); fusiform or falcate (slightly); when asymmetrical with both sutures nearly straight; not inflated; terete; without beak; short tapered at apex; apex aligned or oblique (slightly) with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 5–10 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; brown; with black or brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; papillose; not exfoliating; without or with cracks; cracking transverse to fruit length. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; ligneous. Endocarp dull; opaque; mottled; brown; with mottling (dark); with brown overlay; smooth; without adhering pieces of testa; septate; with septa thin (tissue paper-like), flexible to thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–6; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 3 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; without tongue (or flap-like) on lips of 2-lipped rim-aril; cream.

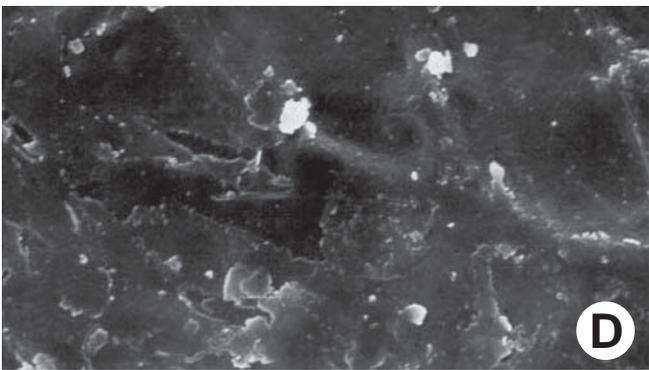
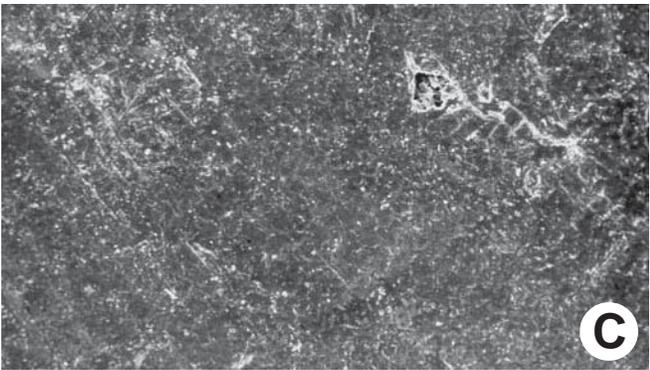
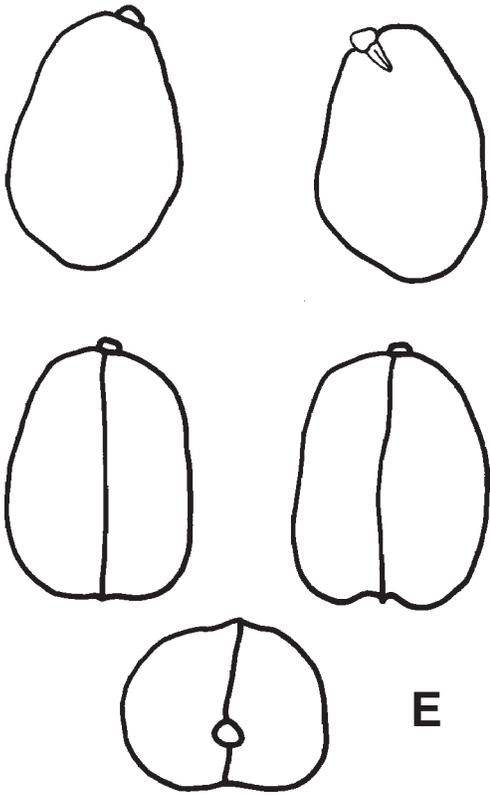
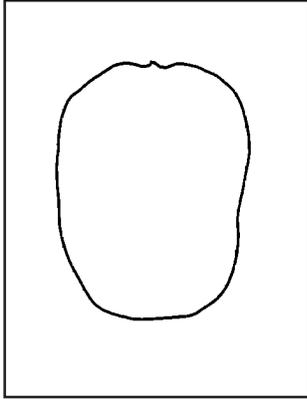
Seed 35–39 × 34–36 × 20–25 mm; not overgrown; not angular; symmetrical; bilobed, cicerlike, or circular (nearly); mounded on 1 side and straight on other side; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle

not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 38–40 mm long; with straight outline; linear; apical at apex of radicle tip; flush; within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 2.2 mm long; with margins curved; elliptic; not in groove of raphe; confluent with hilum; flush; similar color as testa; lighter than testa; within corona. Lens corona color darker than testa. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire or not entire 180 degrees from base of radicle; notched; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 or both margins recessed; recessed on same side as hilum (terminal radicle); brown; inner face flat or concave; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Northern Australia, New Caledonia, and New Hebrides.

Notes: *Castanospermum* is grown as an ornamental tree in California, Australia, and South Africa. It is also the source of a potential anti-AIDS drug (Duke 1988).

Castanospermum: *C. australe* A. Cunningham & C. Fraser ex W.J. Hooker (A–E). A, Fruits (× 0.5); B, seed (× 1.6); C–D, testa (× 50, × 1000); E, embryos (× 1).



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

Phylogenetic Number: 2.12A.

Tribe: Sophoreae.

Group: Angylocalyx.

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

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

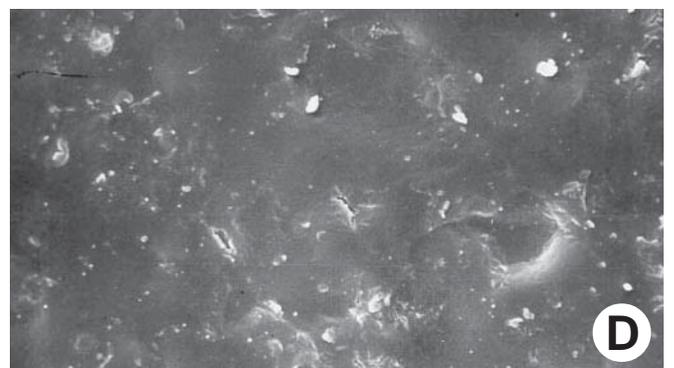
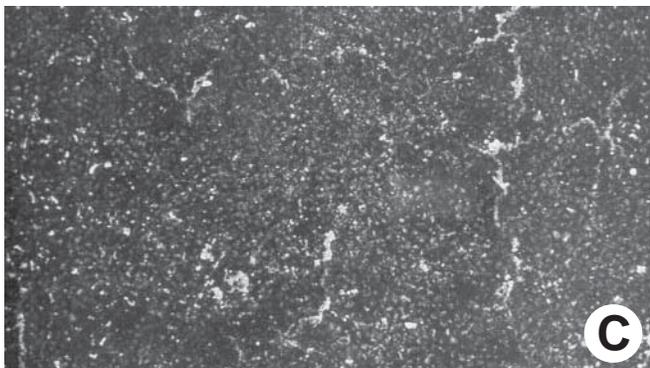
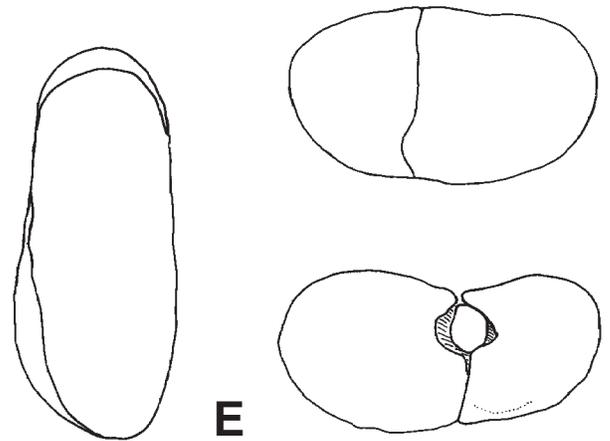
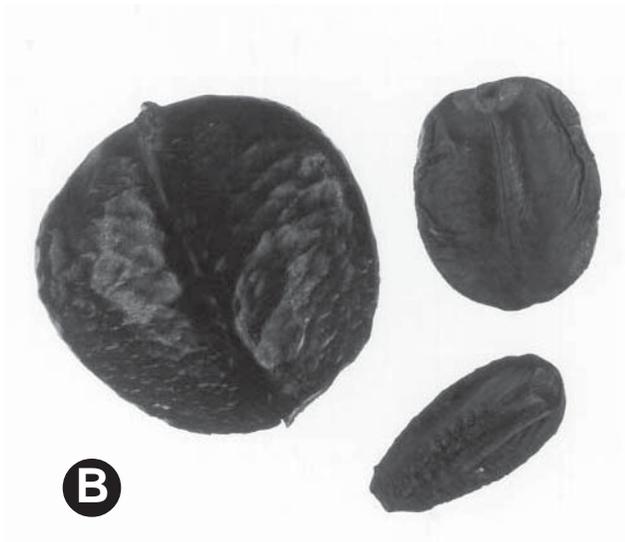
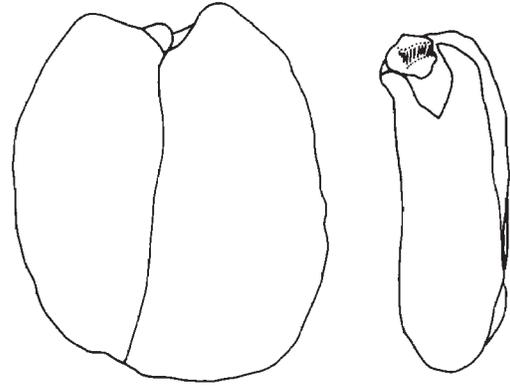
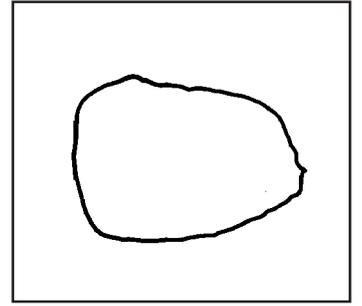
Seed $20-38 \times 12-38 \times 10.5-16$ mm; not overgrown; not angular; symmetrical; circular, oblong, or ovate; compressed to terete; with surface smooth; without

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

Distribution: Tropical South America.

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

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



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

Phylogenetic Number: 2.13.

Tribe: Sophoreae.

Group: *Angylocalyx*.

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

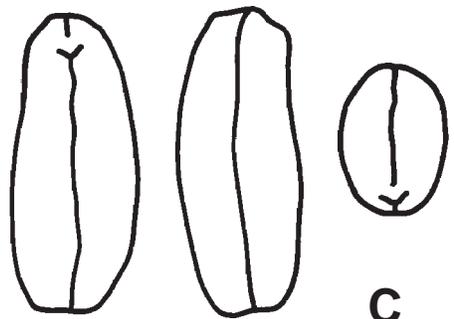
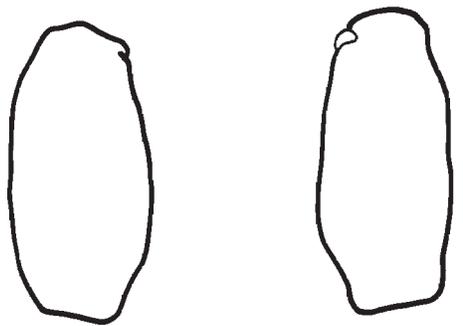
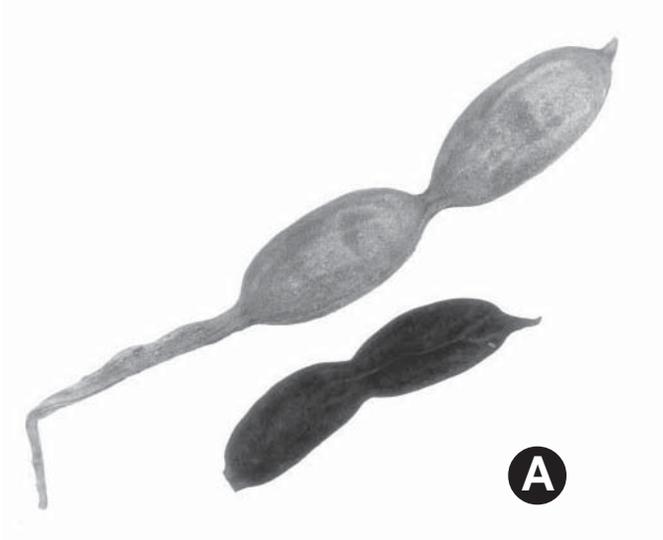
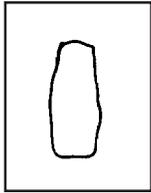
Fruit a legume (superficially resembling a loment); unilocular; $5-20 \times 0.8-2.6 \times 0.7-2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (to slightly curved); not plicate; not twisted or twisted; asymmetrical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

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

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

Distribution: Tropical Africa.

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



Genus: *Xanthocercis* H.E. Baillon

Phylogenetic Number: 2.14.

Tribe: Sophoreae.

Group: Angylocalyx.

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

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

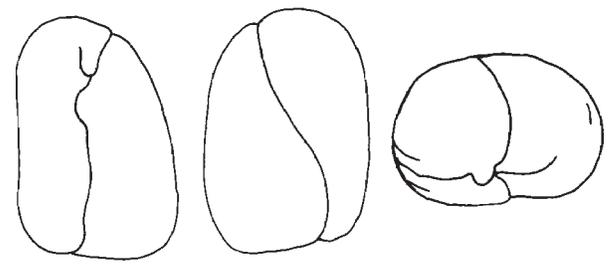
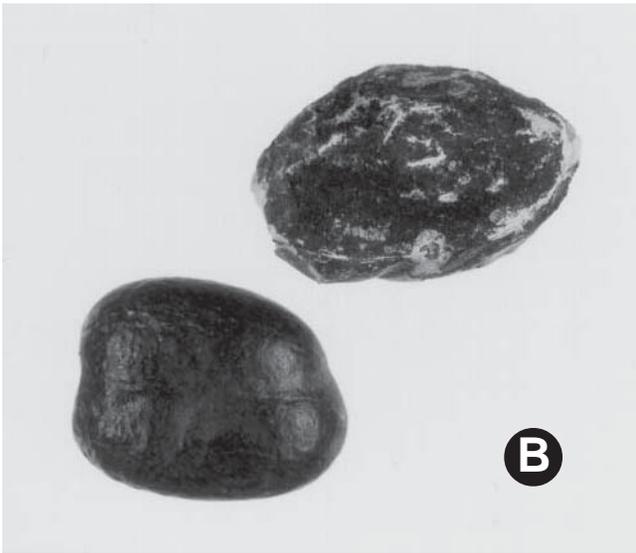
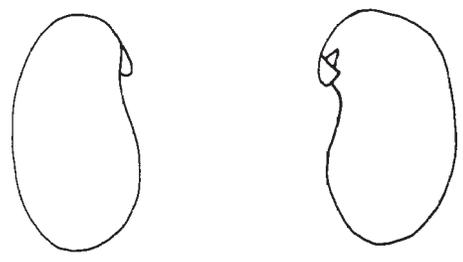
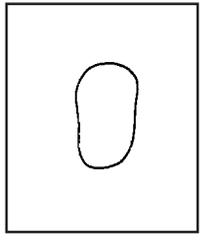
Seed $14\text{--}21 \times 10\text{--}15 \times 8\text{--}12$ mm; not overgrown; not angular; symmetrical or asymmetrical; oblong to ovate or irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each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

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

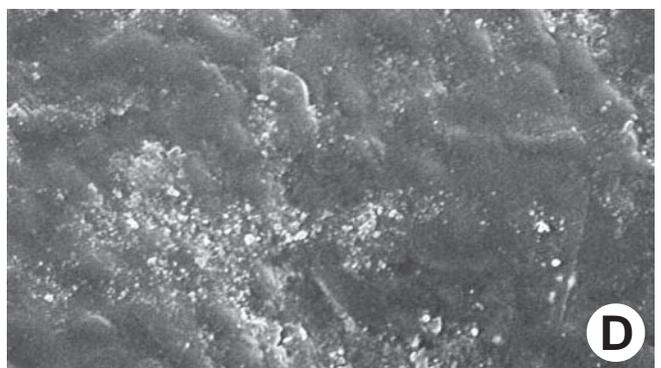
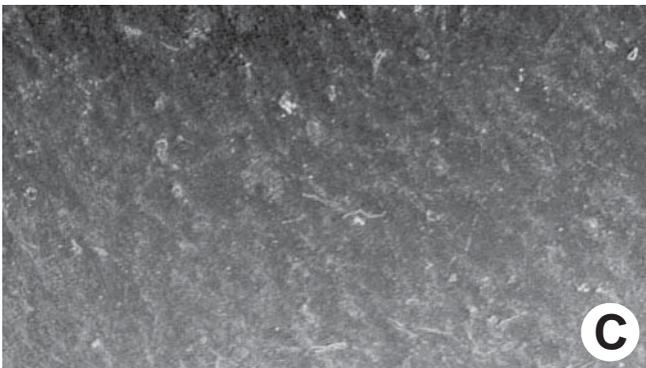
Distribution: Northern Madagascar (1 sp.) and south-central to southern Africa (1 sp.).

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

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



E



Genus: *Ormosia* G. Jackson

Phylogenetic Number: 2.15.

Tribe: Sophoreae.

Group: *Ormosia*.

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

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

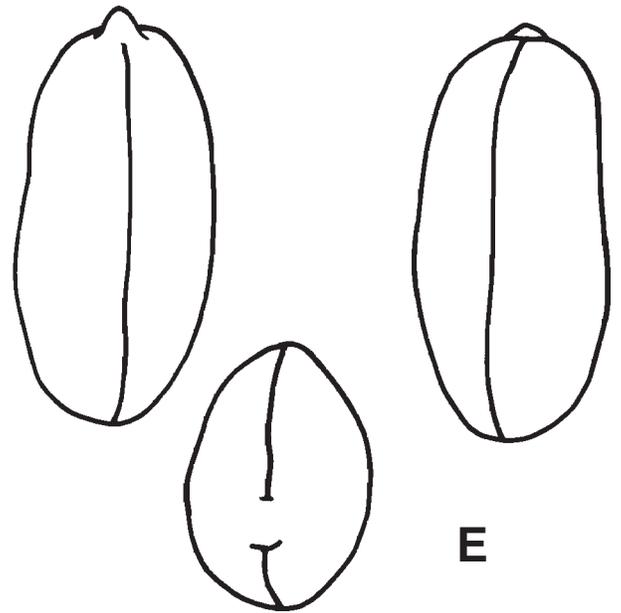
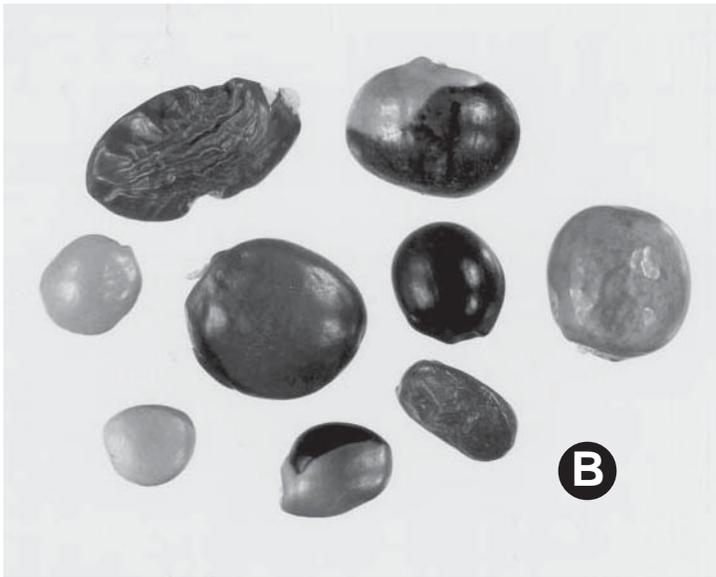
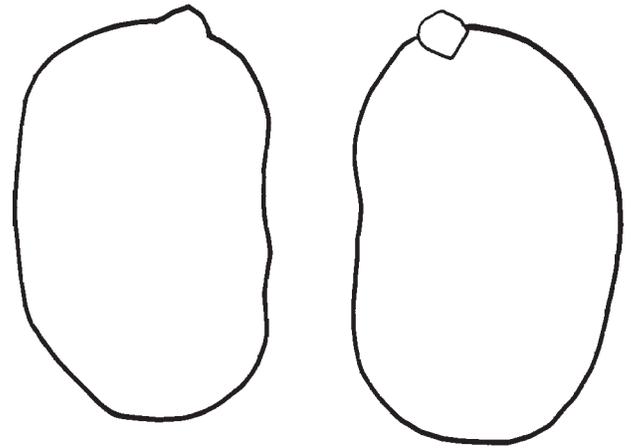
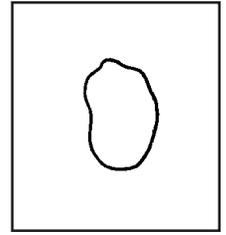
length parallel with, oblique to, or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5–2.5 mm long; of 1 length only; thick; curved. Aril dry; rim-aril; cream or tan.

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

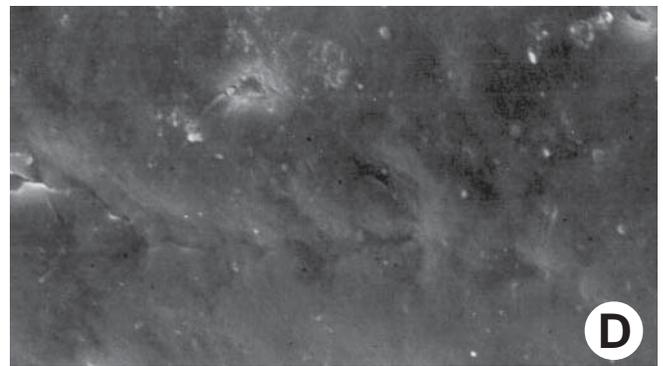
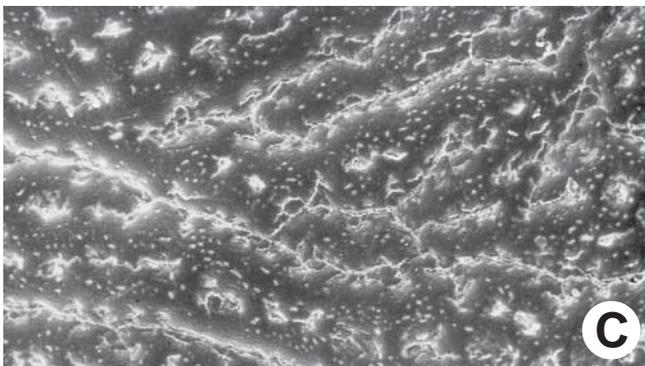
Distribution: Tropical and eastern South America and eastern Asia to northeastern Australia.

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

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



E



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

Phylogenetic Number: 2.16.

Tribe: Sophoreae.

Group: Ormosia.

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

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

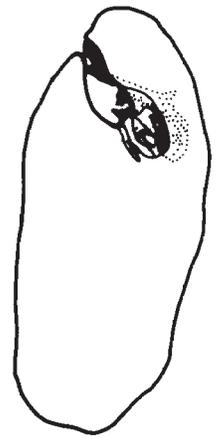
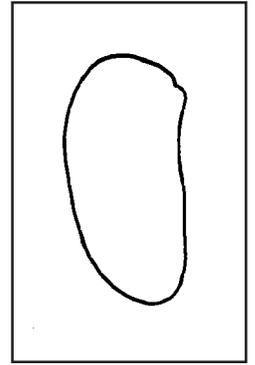
Seed 38 × 18 × 7 mm; not overgrown; not angular; symmetrical; elliptic; compressed; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; transparently colored; monochrome; brown;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

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

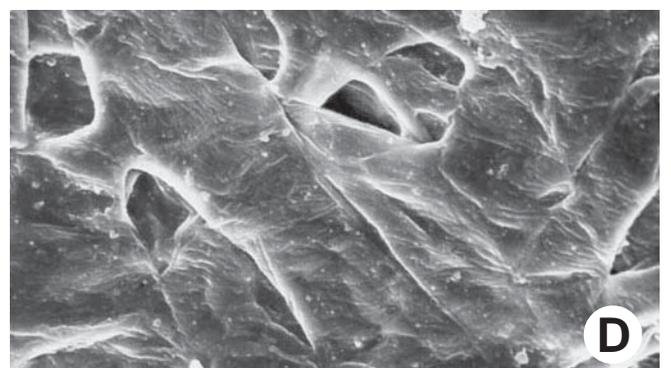
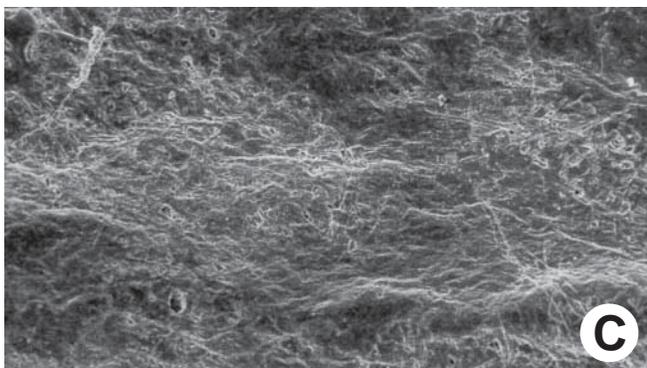
Distribution: Sierra Leone to Gabon.

Notes: More fruits and seeds should be studied.

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



E



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

Phylogenetic Number: 2.17.

Tribe: Sophoreae.

Group: Ormosia.

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

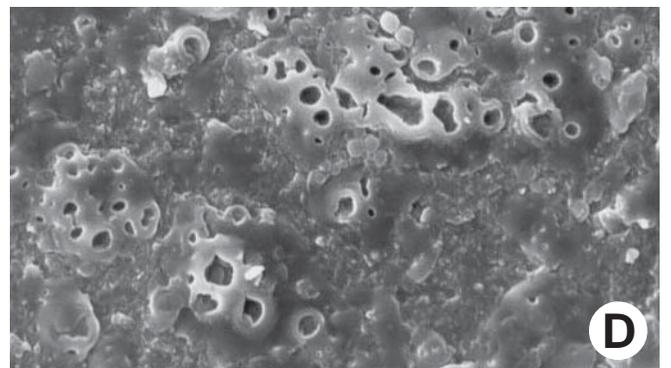
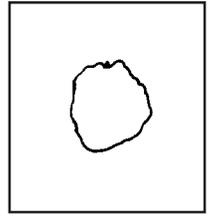
Fruit a legume; unilocular; $7-24 \times 2-4 \times 0.4-0.7$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; circular, elliptic, fusiform, or linear; not inflated; compressed or flattened; with or without beak; straight;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

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

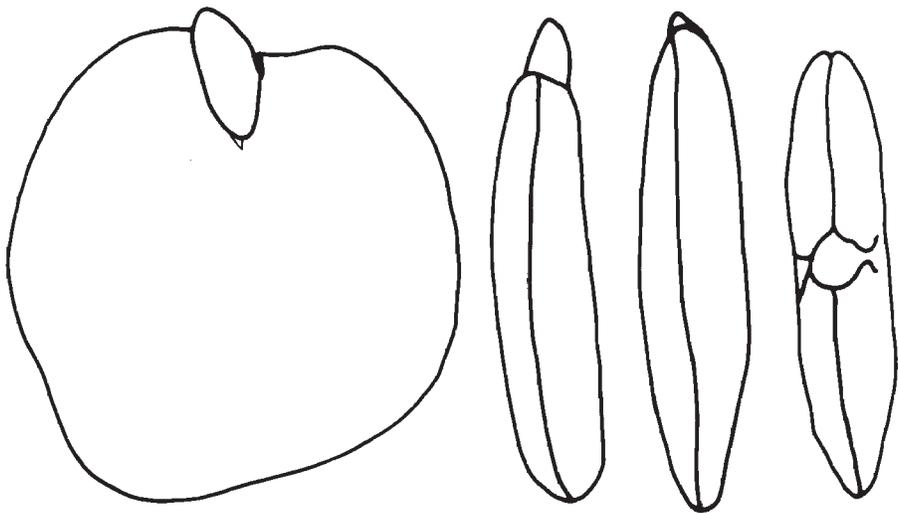
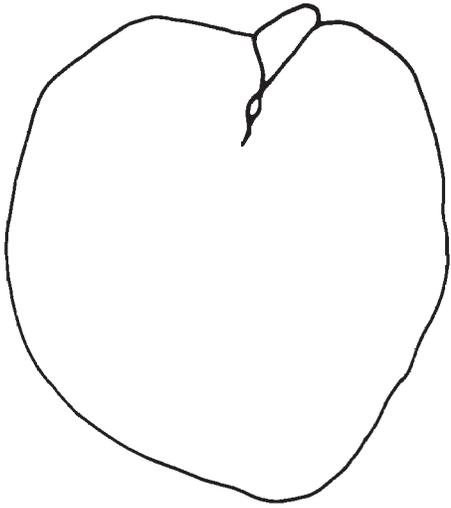
elliptic, irregular, oblong, or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering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

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

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



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



E

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

Phylogenetic Number: 2.18.

Tribe: Sophoreae.

Group: *Baphia*.

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

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

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

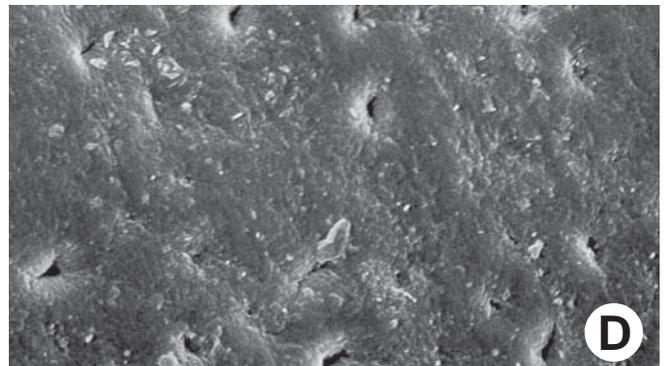
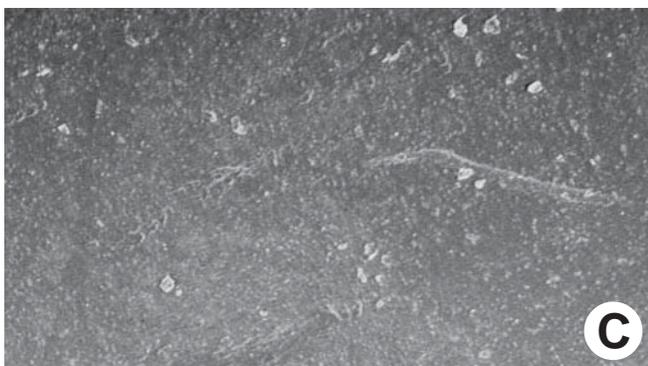
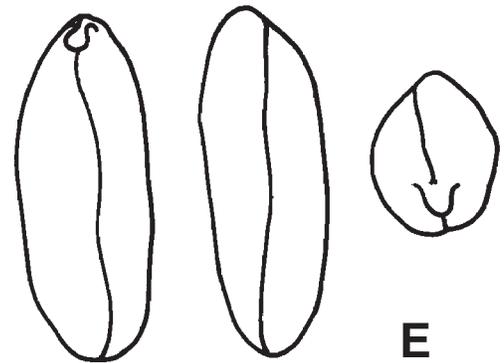
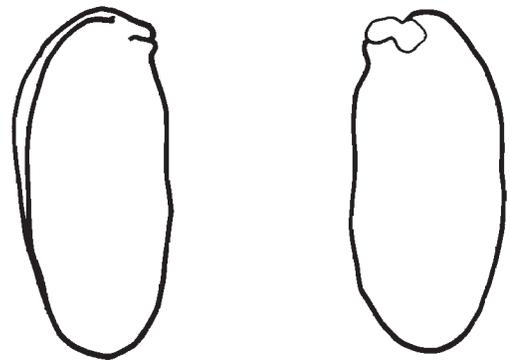
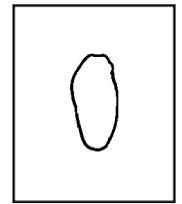
Seed $10\text{--}25 \times 6\text{--}20 \times 2\text{--}5$ mm; not overgrown; not angular; symmetrical or asymmetrical; circular, elliptic, or irregular; compressed or flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa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

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

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

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

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



Genus: *Airyantha* R.K. Brummitt

Phylogenetic Number: 2.19.

Tribe: Sophoreae.

Group: Baphia.

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

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

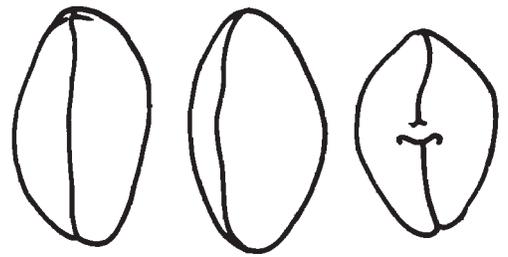
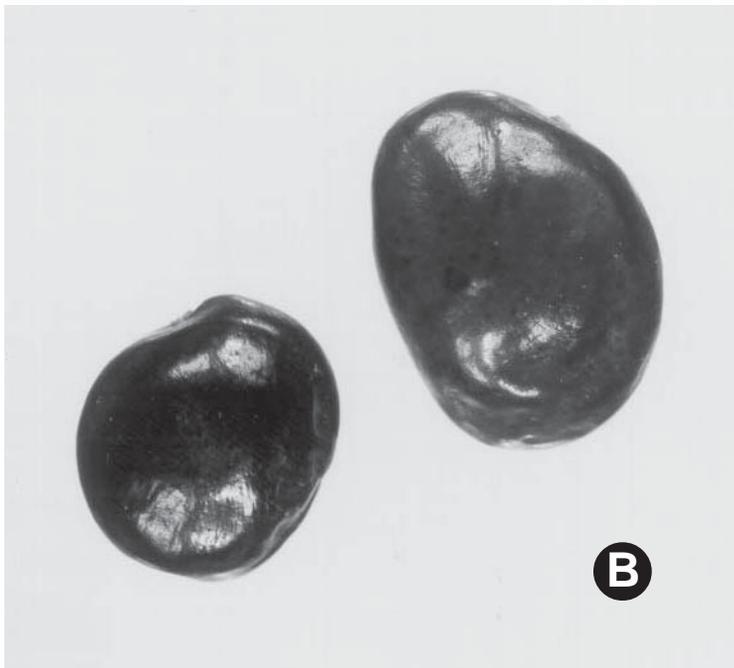
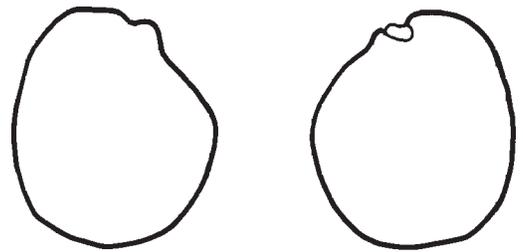
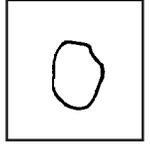
Seed 8–12 × 6–9.5 × 5–7.5 mm; not overgrown; not angular; symmetrical or asymmetrical (slightly); circular to ovate; compressed to terete (sub); with

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

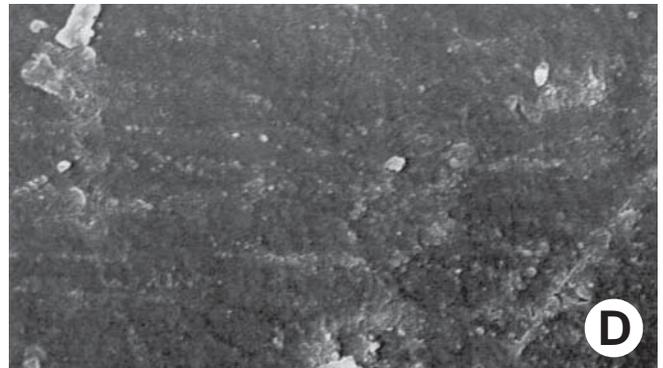
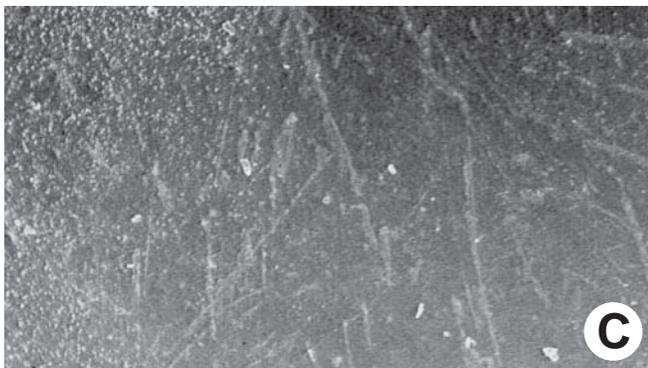
Distribution: Guinea-Congo (1 sp.) and Borneo (1 sp.).

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

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



E



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

Phylogenetic Number: 2.20.

Tribe: Sophoreae.

Group: Baphia.

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

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

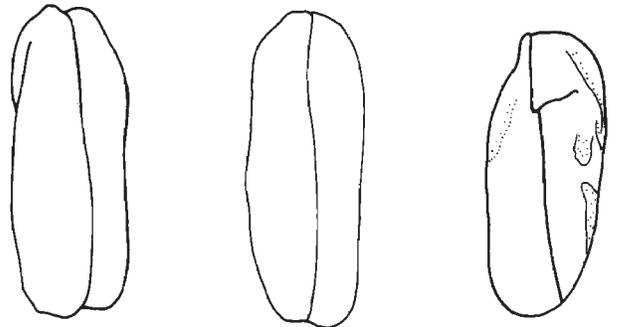
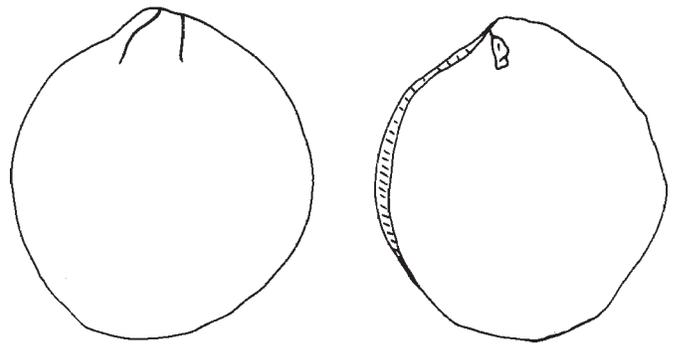
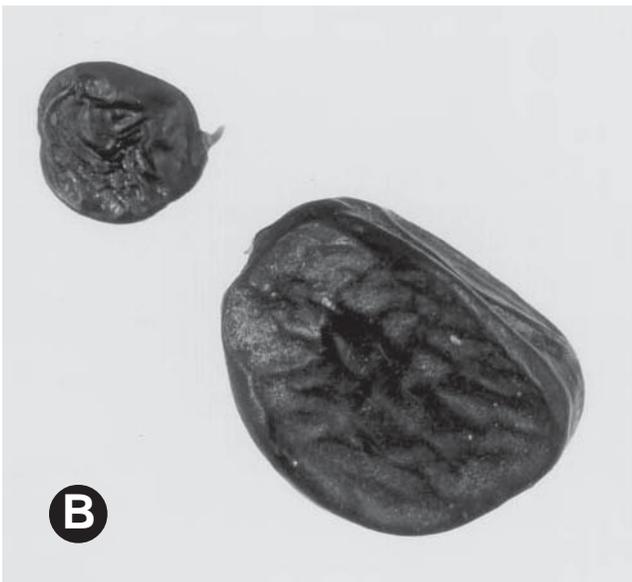
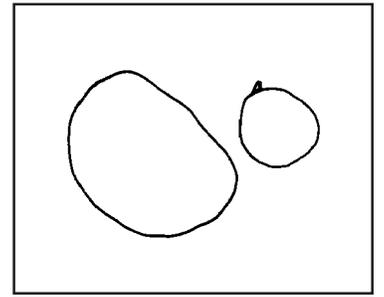
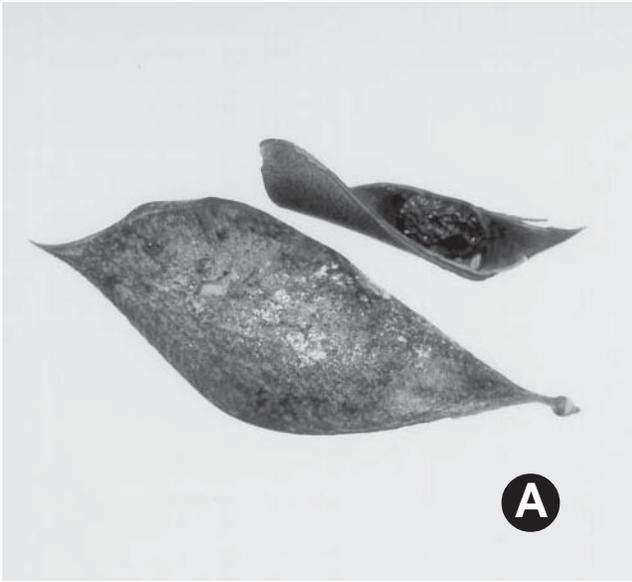
Seed 12–25 × 10–24 × 2.5–11 mm; not overgrown; not angular; symmetrical or asymmetrical; ovate or irregular; compressed or flattened; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or dull and glossy;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

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

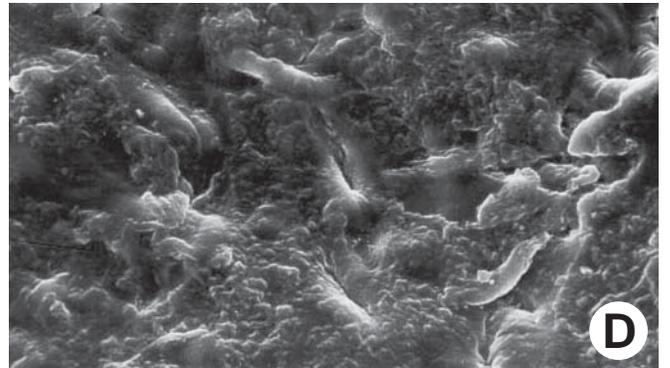
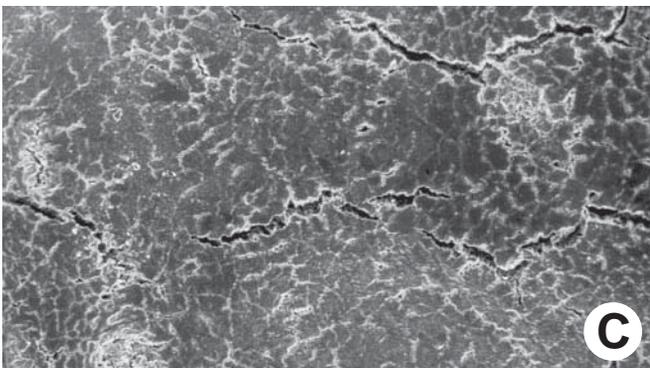
Distribution: Western tropical Africa (1 sp., around the Gulf of Guinea) and northeastern India and Bangladesh (2 spp.).

Notes: Only one seed was studied internally.

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



E



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

Phylogenetic Number: 2.21.

Tribe: Sophoreae.

Group: Baphia.

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

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

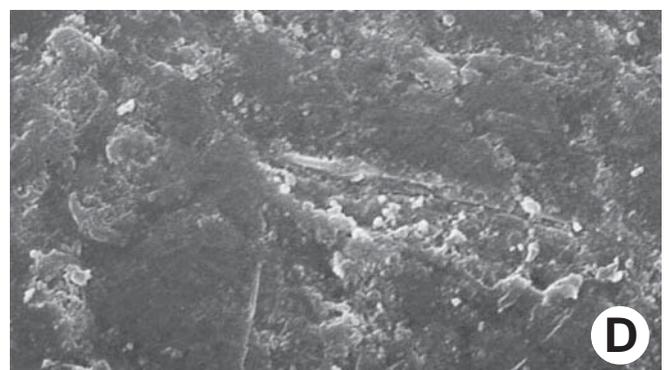
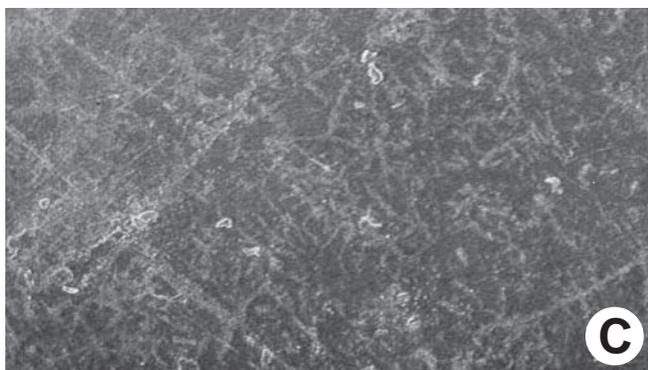
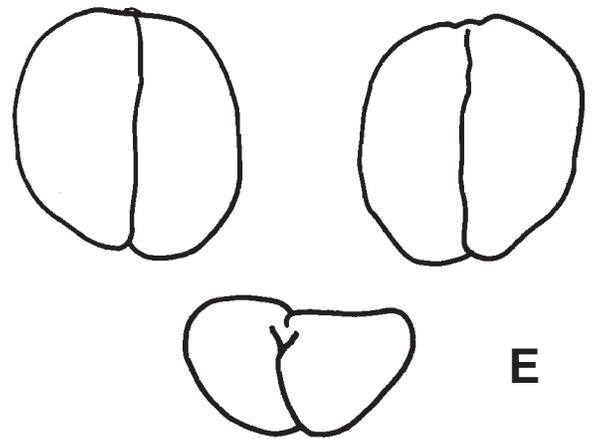
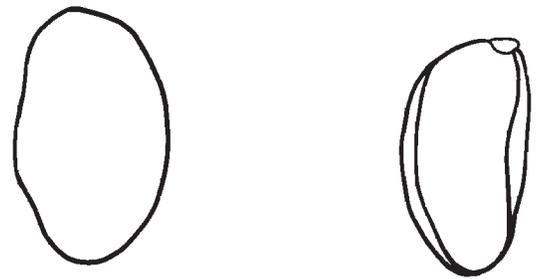
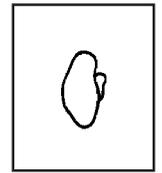
Seed $11\text{--}17.5 \times 8\text{--}12 \times 5\text{--}9$ mm; not overgrown; not angular; symmetrical; elliptic to circular to bilobed, cicerlike (slightly); terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering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

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

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

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

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



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

Phylogenetic Number: 2.22.

Tribe: Sophoreae.

Group: Baphia.

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

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

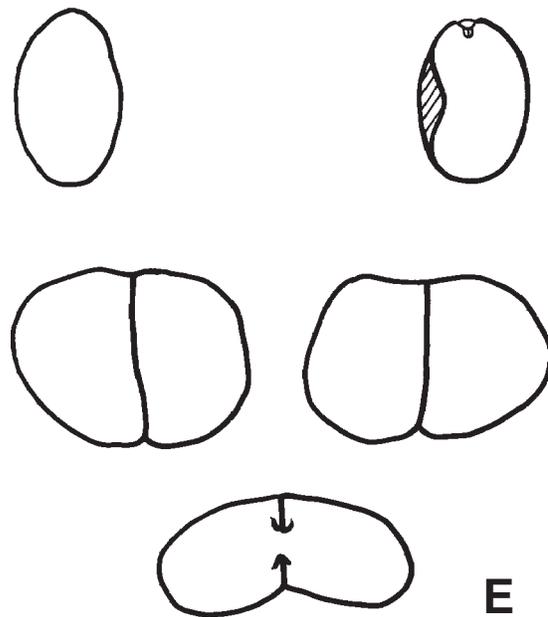
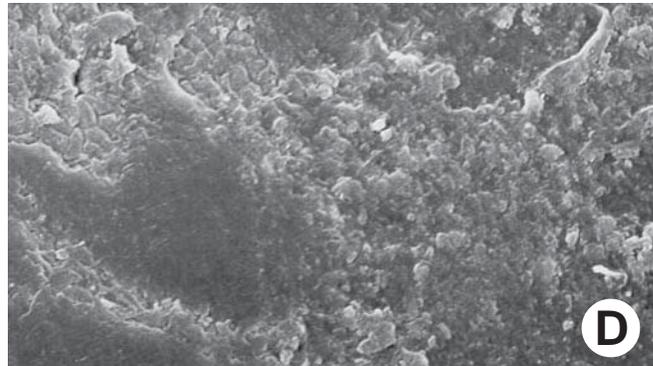
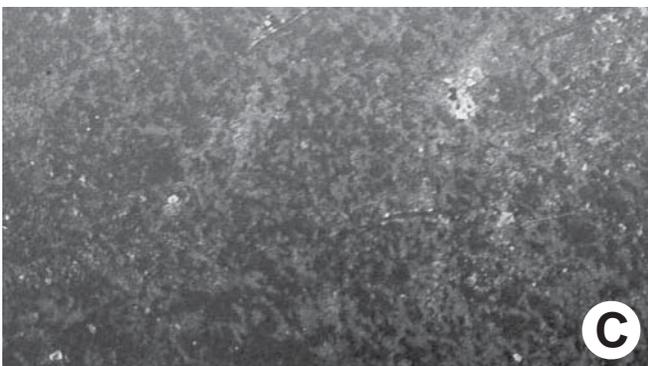
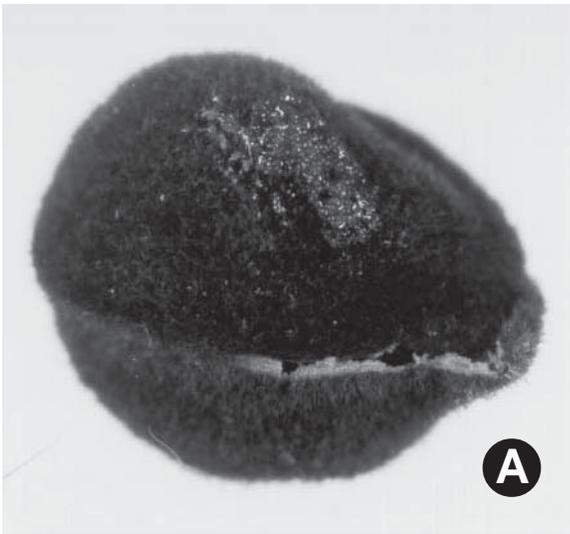
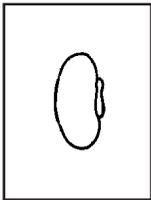
Seed 11–12 × 8–9 × 6–7 mm; not overgrown; not angular; symmetrical; elliptic; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; dark red; glabrous;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

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

Distribution: Cameroon, Gabon, and Zaire.

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

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



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

Phylogenetic Number: 2.23.

Tribe: Sophoreae.

Group: Baphia.

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

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

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

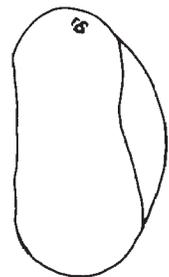
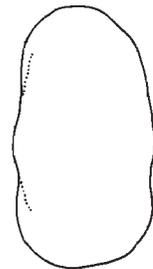
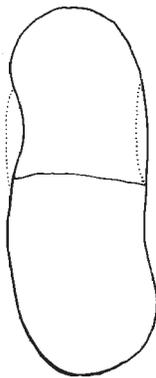
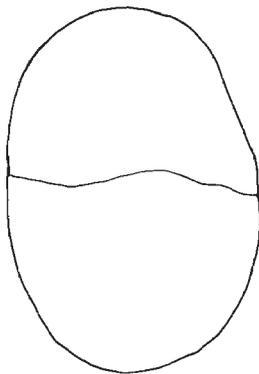
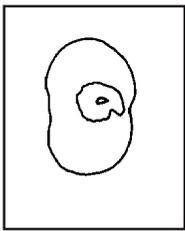
without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or bichrome; reddish to purplish black or red and black (reddish to purplish); glabrous; not smooth; with elevated features;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

Distribution: Gulf of Guinea to Ivory Coast.

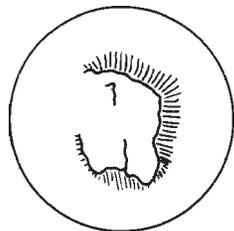
Notes: Polhill (1981b) noted that *Leucomphalos* radicles resemble those of *Bowringia* (2.21). Brummitt (1968) also commented on *Leucomphalos*. Only one seed was studied internally.

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

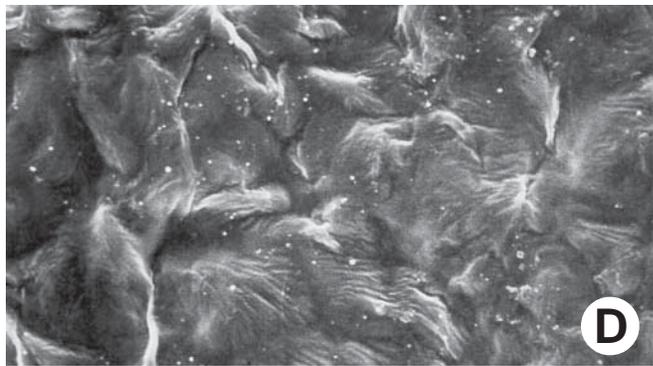
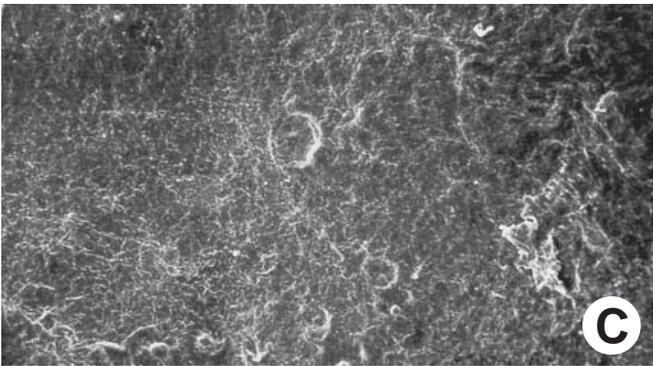
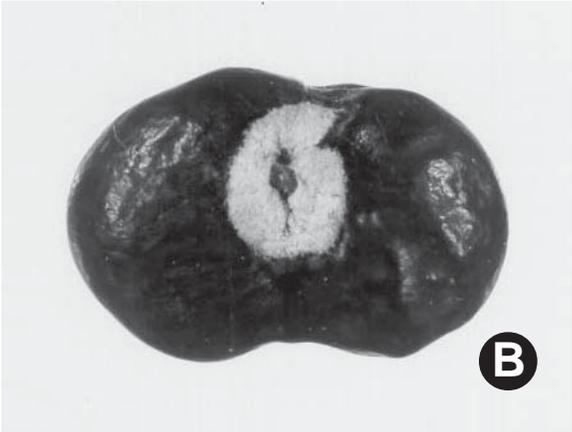
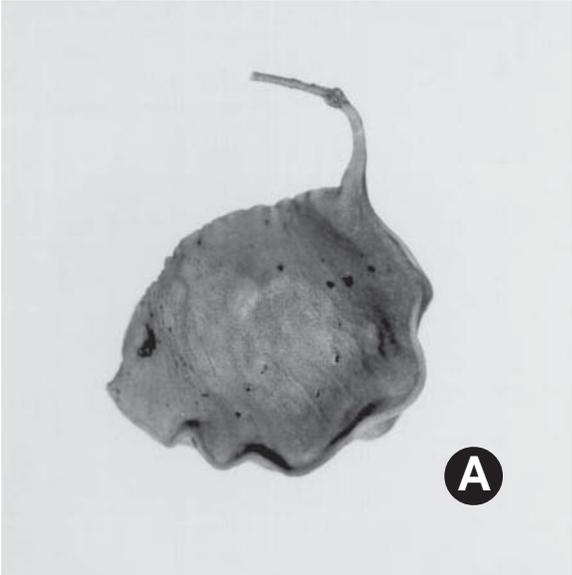
Planchon (A–F). A, Fruits ($\times 2.1$); B, seed ($\times 3.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$); F, embryo magnified ($\times 24$).



E



F



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

Phylogenetic Number: 2.24.

Tribe: Sophoreae.

Group: *Dussia*.

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

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

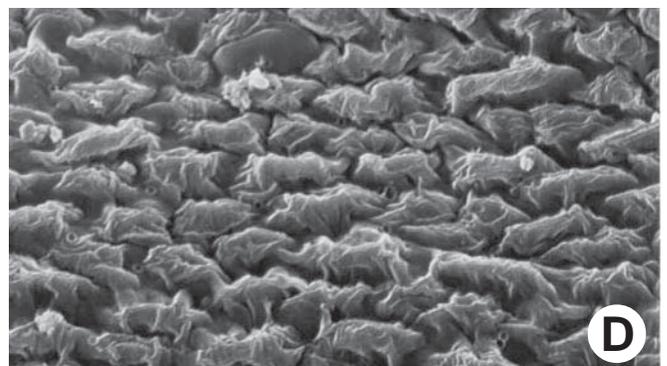
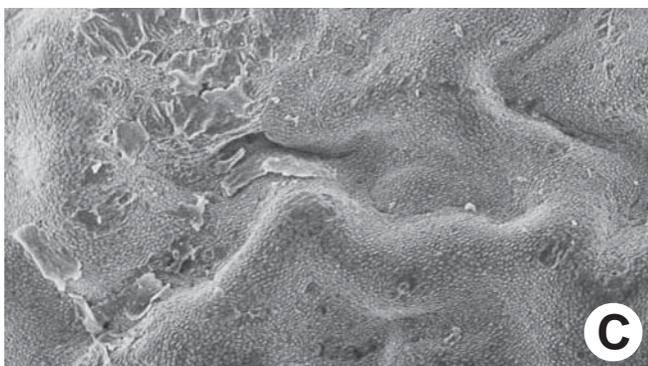
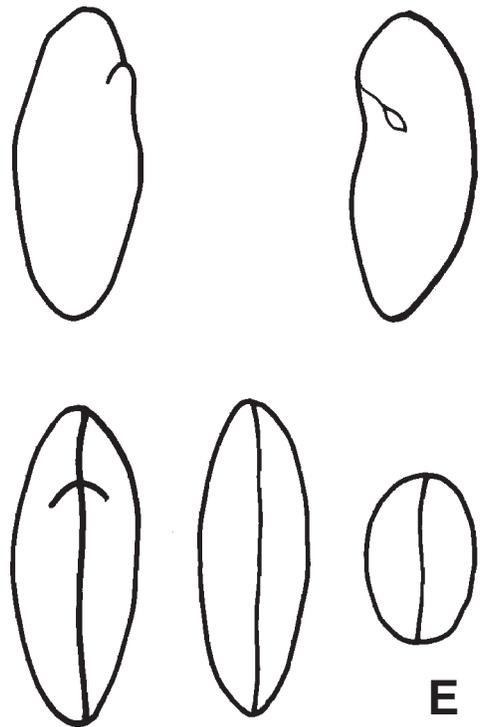
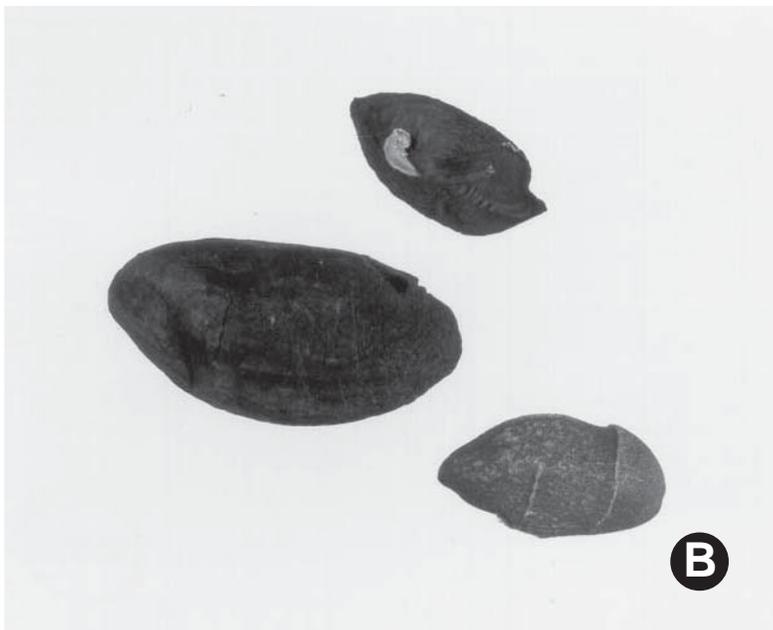
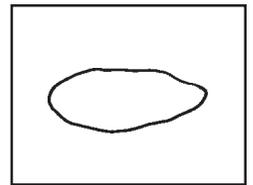
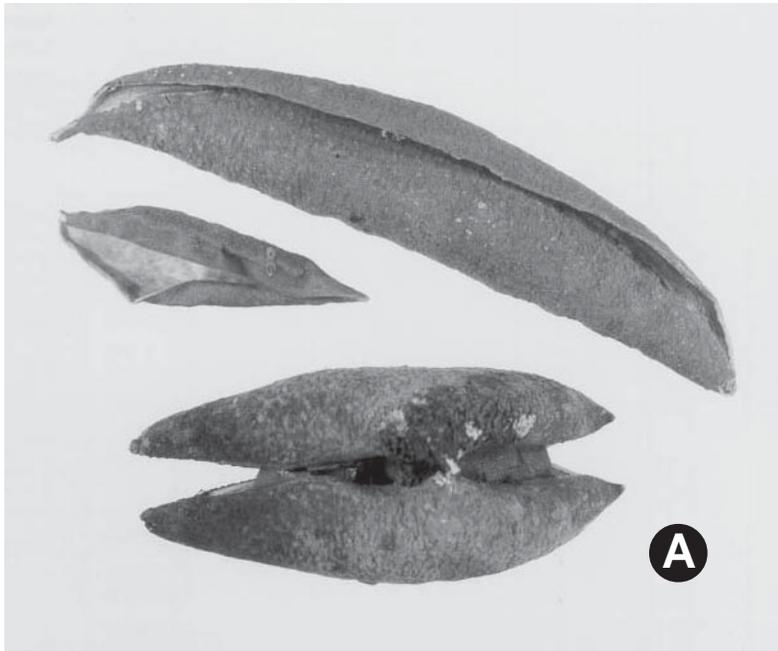
Seed 20–45 × 10–20 × 10–20 mm; not overgrown; angular; symmetrical; mitaform to irregular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled;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

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

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

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

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



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

Phylogenetic Number: 2.26.

Tribe: Sophoreae.

Group: Dussia.

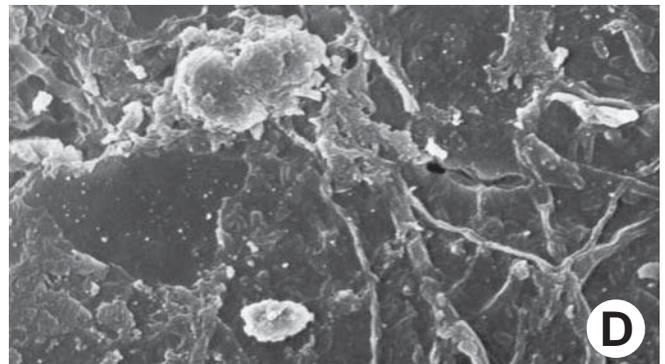
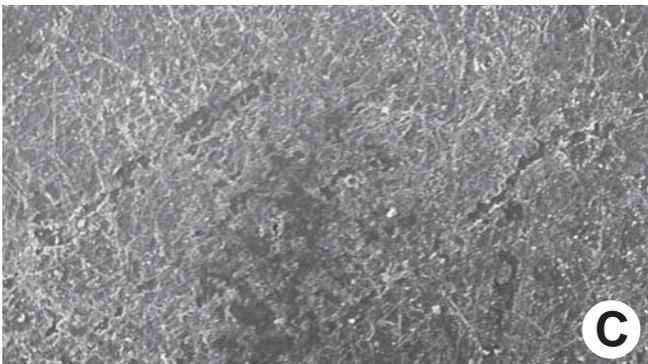
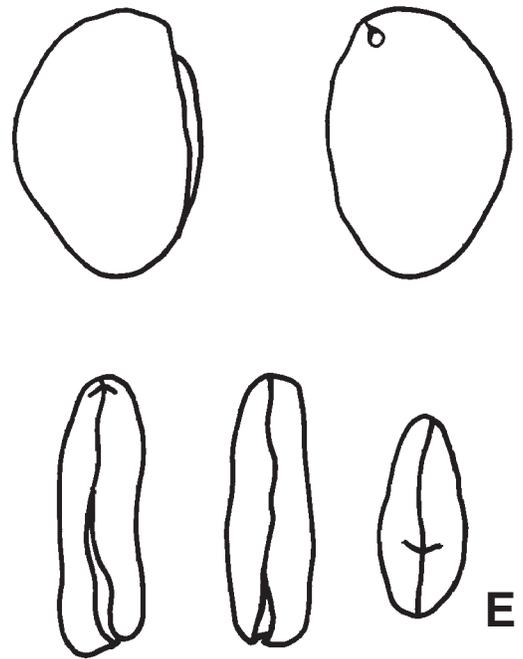
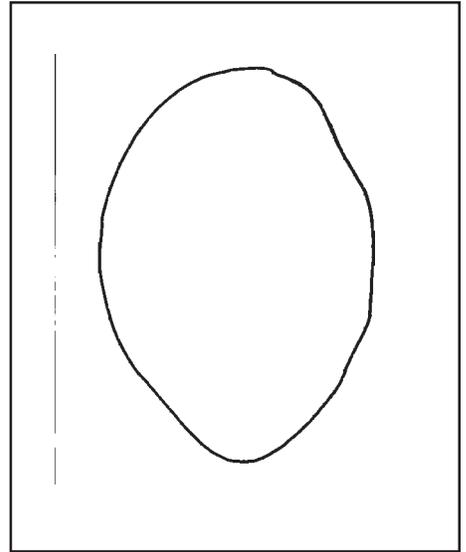
Species Studied—Species in Genus: 3 spp.—6 spp.

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

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

Distribution: Tropical South America.

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



Genus: *Diploptropis* G. Bentham

Phylogenetic Number: 2.27.

Tribe: Sophoreae.

Group: Dussia.

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

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

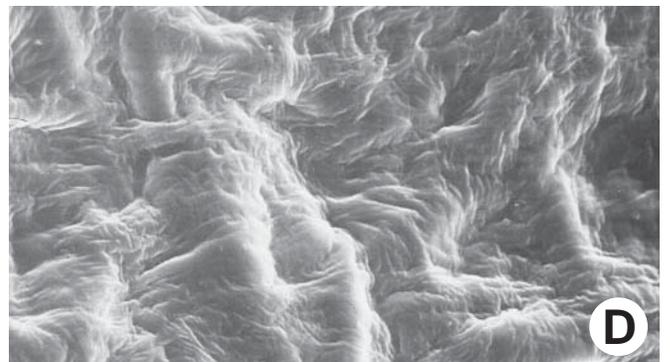
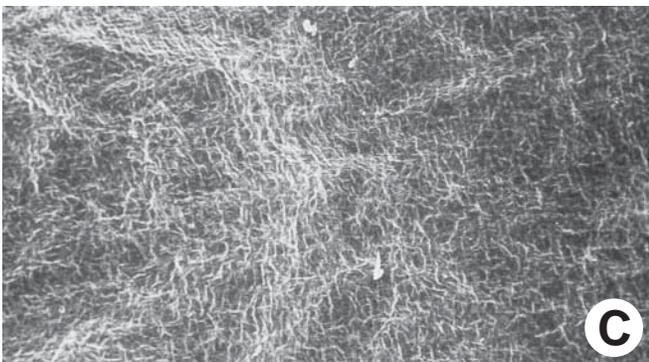
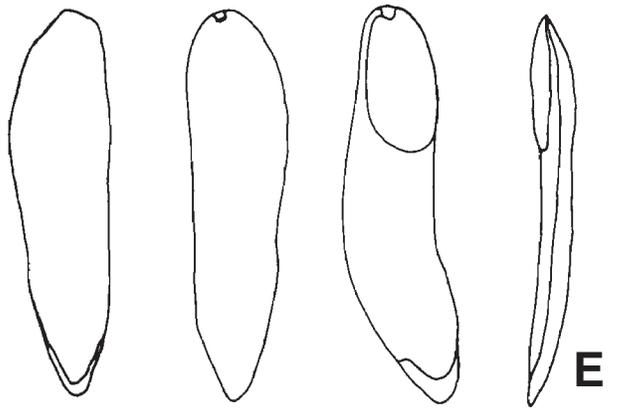
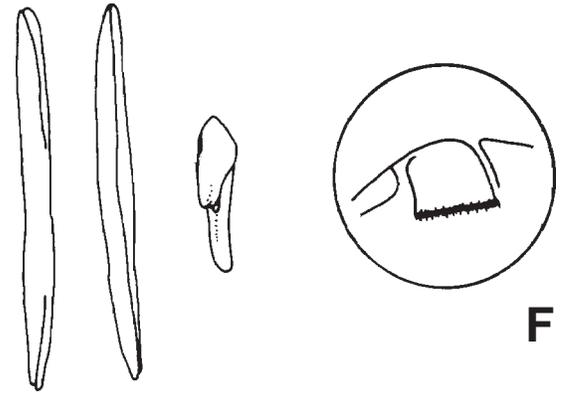
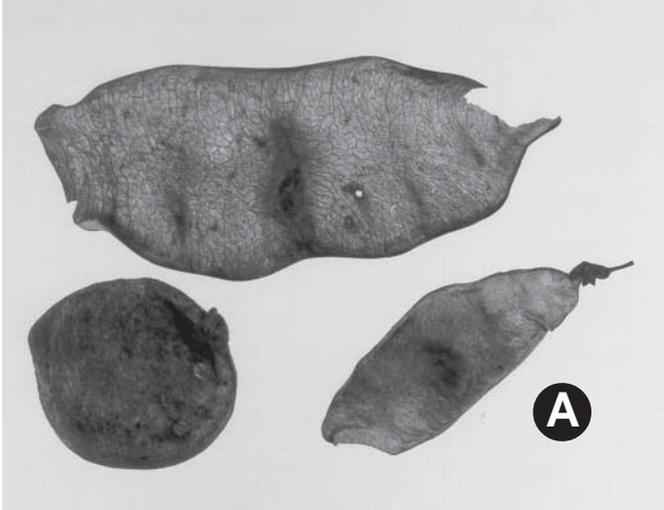
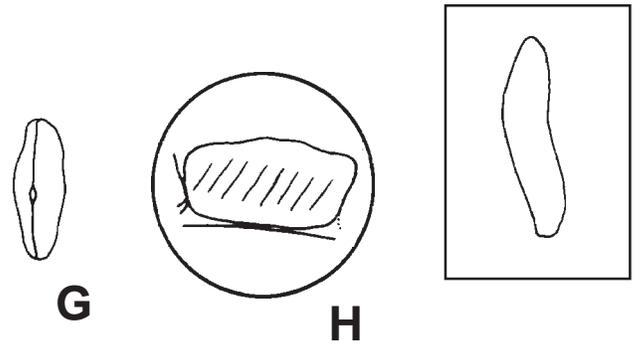
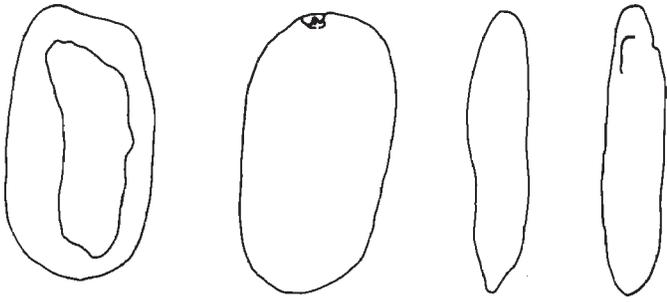
Seed $13-27 \times 6-8 \times 2.3-3$ mm; not overgrown; angular or not angular; asymmetrical; irregularly elliptic or

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

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

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

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



Genus: *Bowdichia* K.S. Kunth

Phylogenetic Number: 2.28.

Tribe: Sophoreae.

Group: Dussia.

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

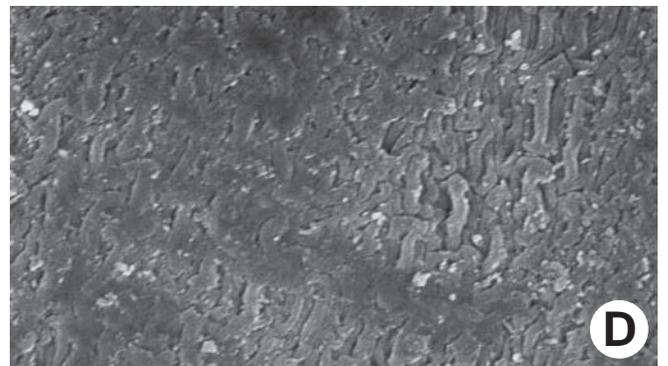
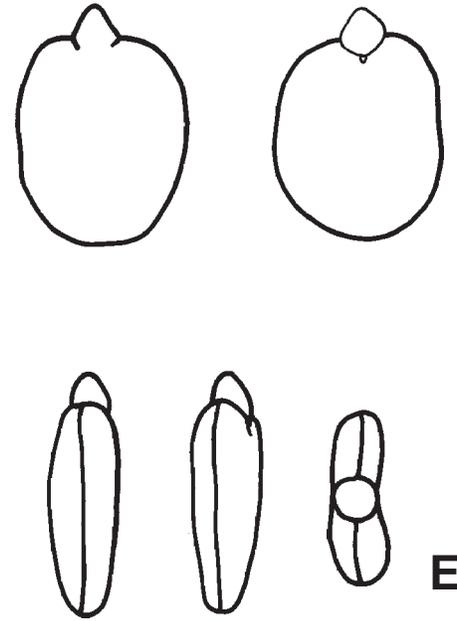
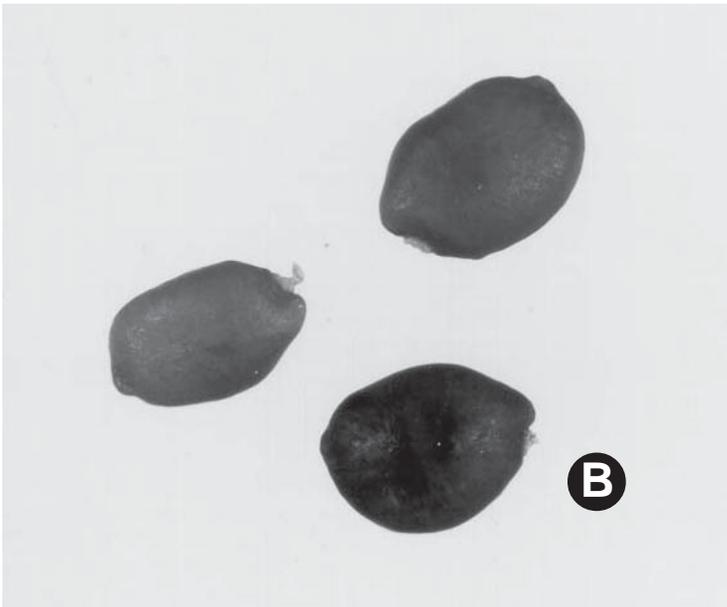
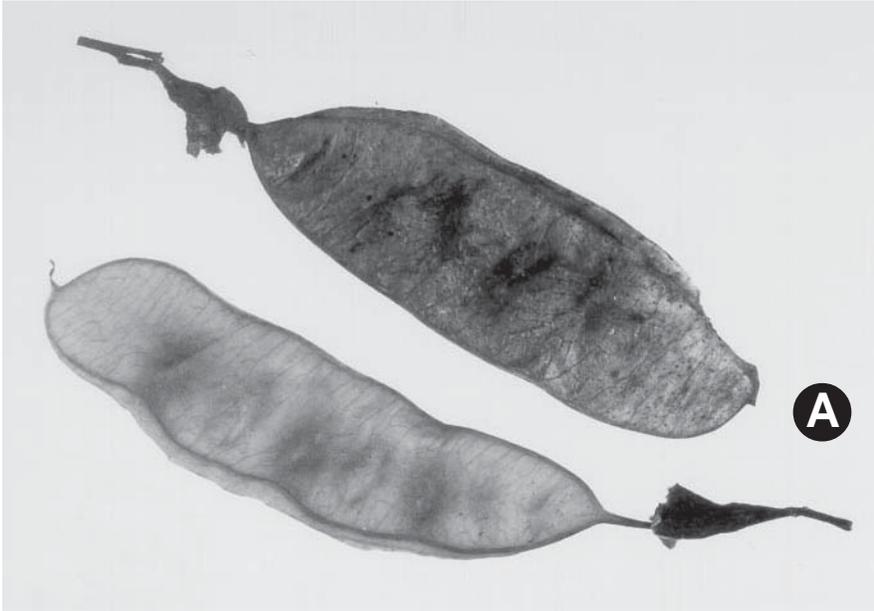
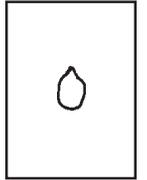
Fruit a legume; unilocular; $3.8-6 \times 1-1.5 \times 0.2-0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical to nearly symmetrical; elliptic to oblong; not inflated;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

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

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

Distribution: Venezuela to central Brazil.

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



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

Phylogenetic Number: 2.29.

Tribe: Sophoreae.

Group: Dussia.

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

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

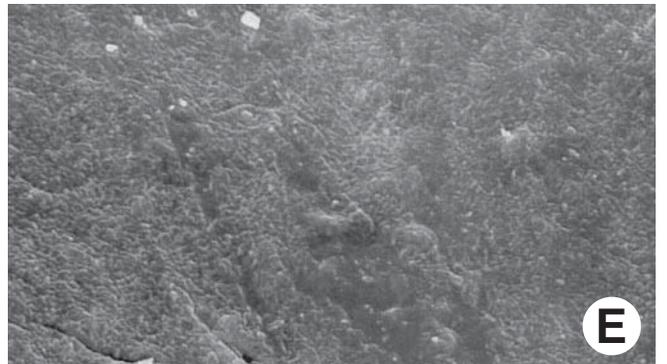
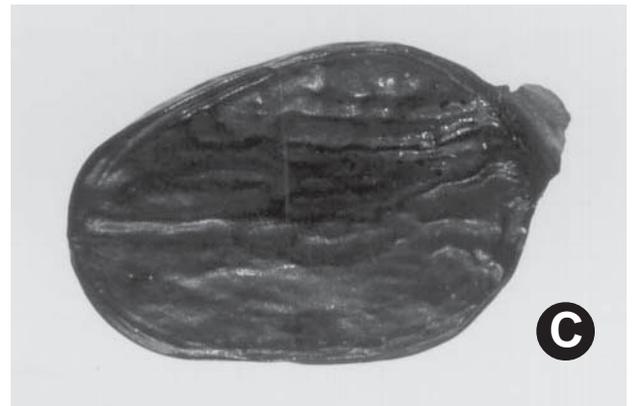
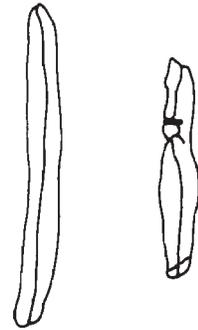
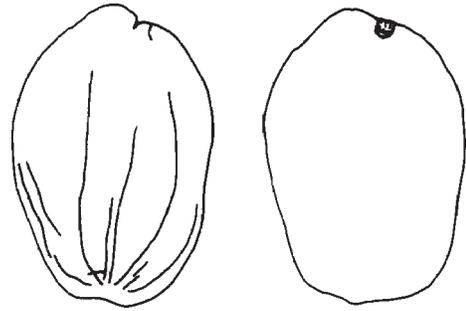
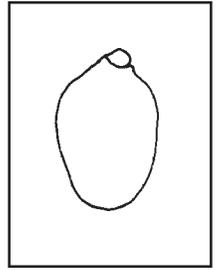
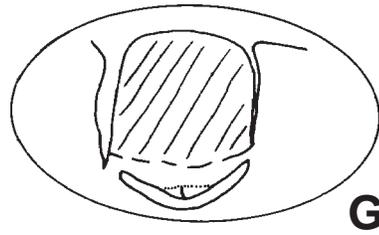
Seed ca. 20 × ca. 14 × ca. 3.5 mm; not overgrown; not angular; symmetrical; ovate; flattened; with surface wrinkled; with grooves longitudinal; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not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

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

Distribution: Amazon basin.

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

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



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

Phylogenetic Number: 2.30.

Tribe: Sophoreae.

Group: Dussia.

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

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

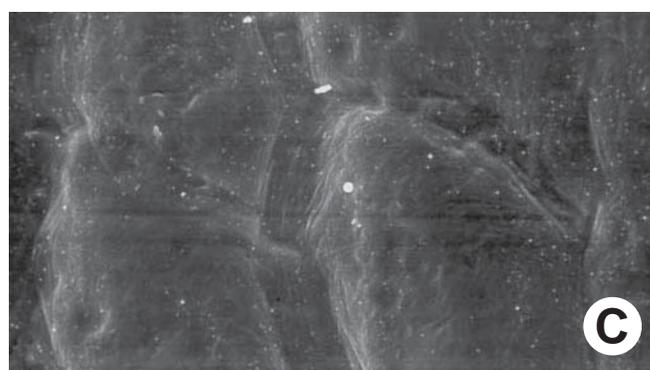
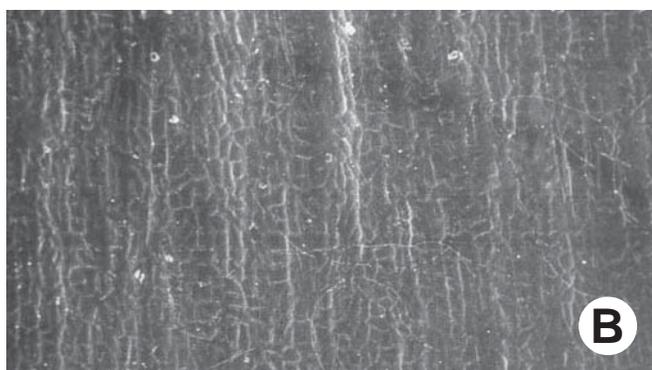
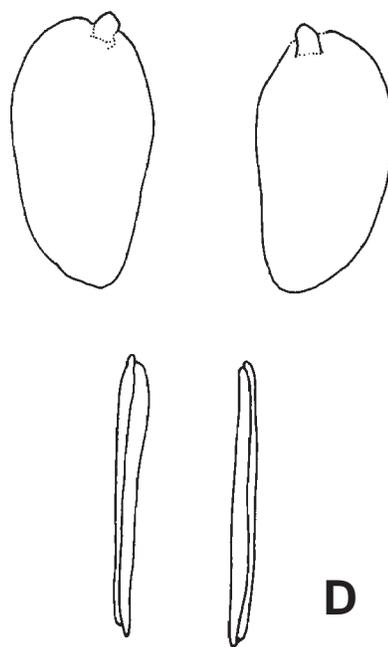
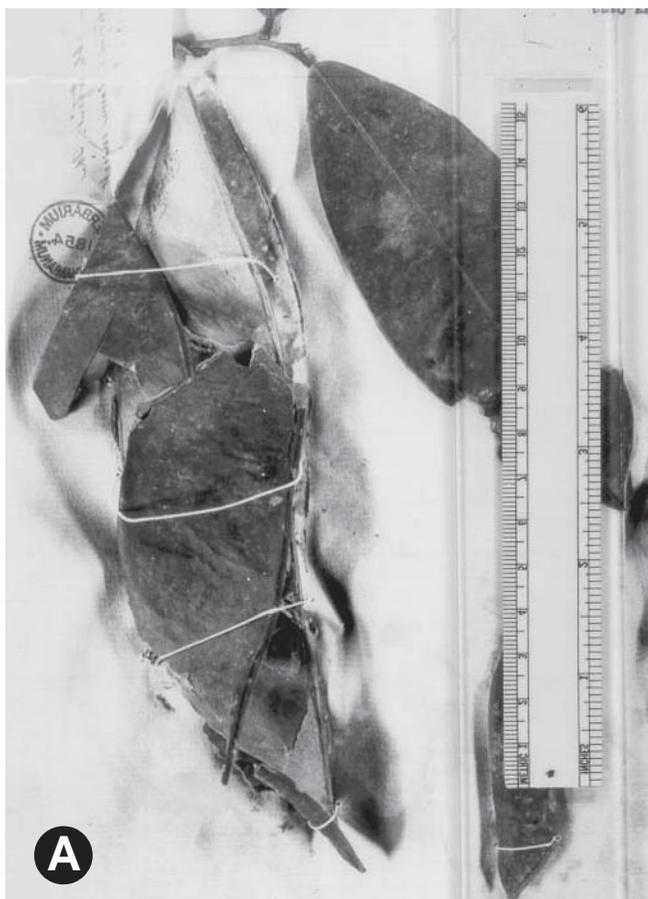
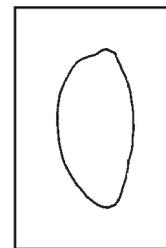
Seed ca. 20 × ca. 12 × ca. 2 mm; not overgrown; not angular; symmetrical; elliptic; flattened; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; black;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

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

Distribution: Colombia and Brazil.

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

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



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

Phylogenetic Number: 2.31.

Tribe: Sophoreae.

Group: Dussia.

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

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

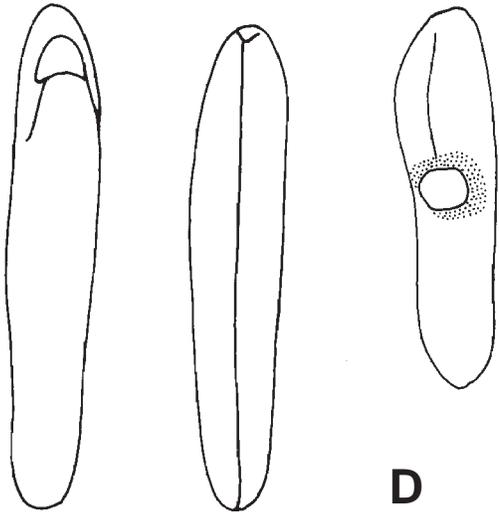
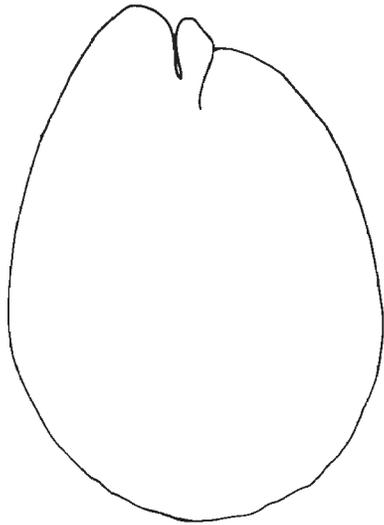
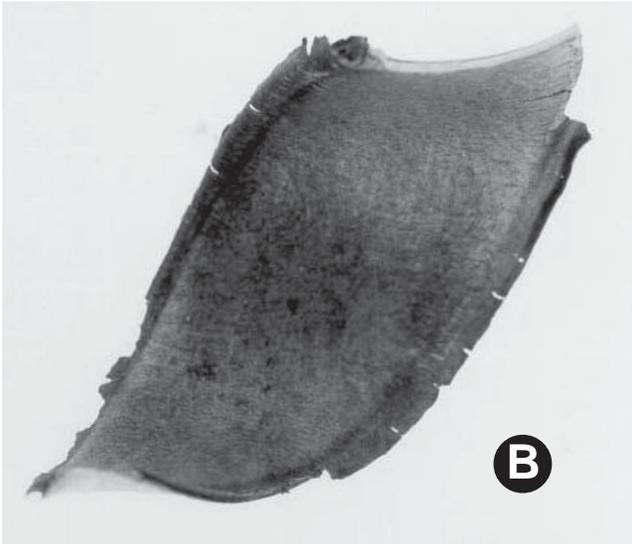
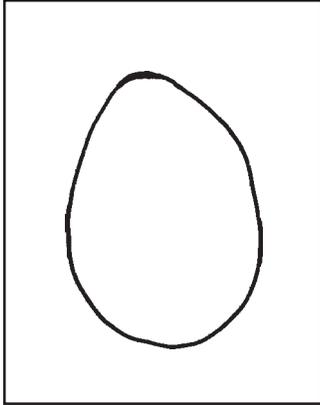
Seed ca. 35 × ca. 25.5 × ca. 5.5 mm; not overgrown; not angular; symmetrical; ovate; flattened; without umbo on seed faces; without medial ridge on each face. Testa absent (probably fused to endocarp). Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less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

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

Distribution: Brazil and Venezuela.

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

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



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

Phylogenetic Number: 2.32.

Tribe: Sophoreae.

Group: Dussia.

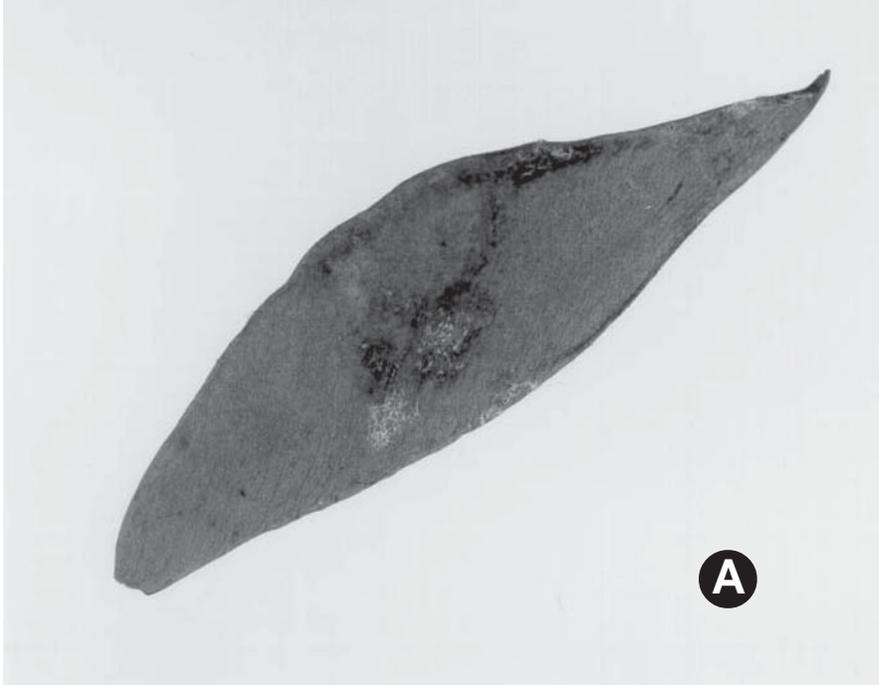
Species Studied—Species in Genus: 1 sp.—1 sp.

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

Distribution: Northeastern South America.

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

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



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

Phylogenetic Number: 2.33.

Tribe: Sophoreae.

Group: Sophora.

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

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

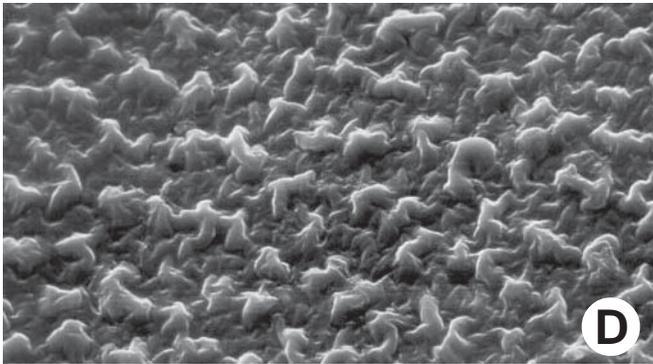
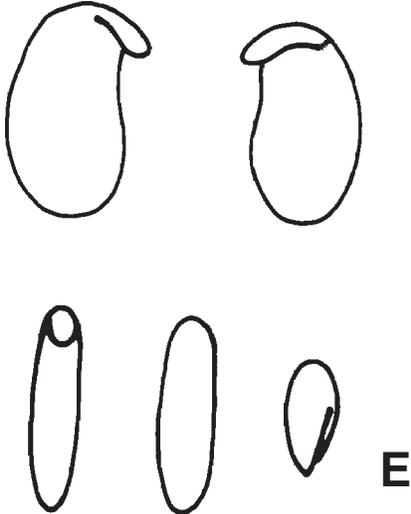
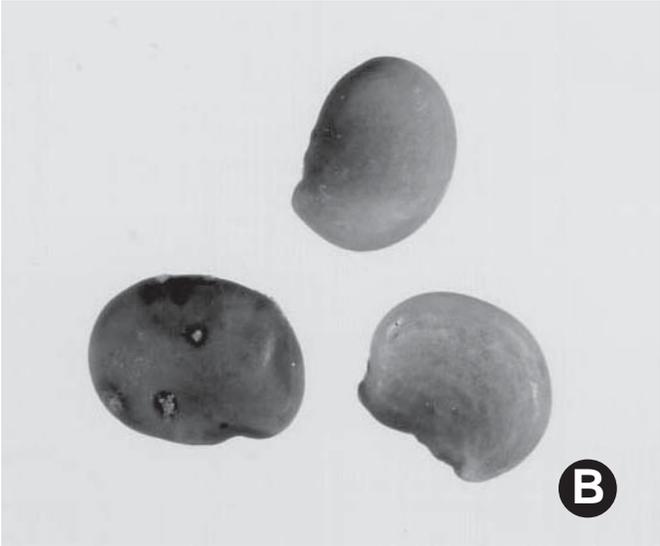
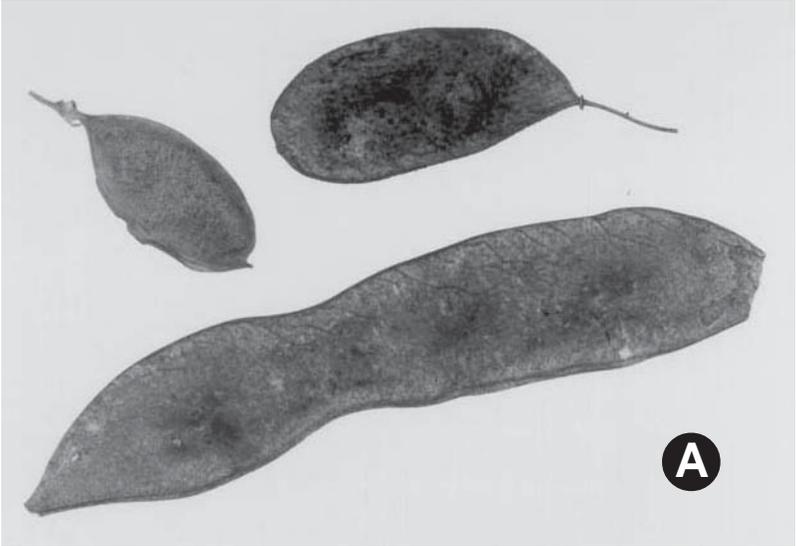
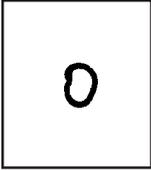
Seed $5-6 \times 3.5-4 \times 1.8-2.2$ mm; not overgrown; not angular; symmetrical; elliptic or reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on

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

Distribution: Ethiopia to northern Kenya and southern Madagascar.

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

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



Genus: *Neoharmsia* R. Viguier

Phylogenetic Number: 2.34.

Tribe: Sophoreae.

Group: Sophora.

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

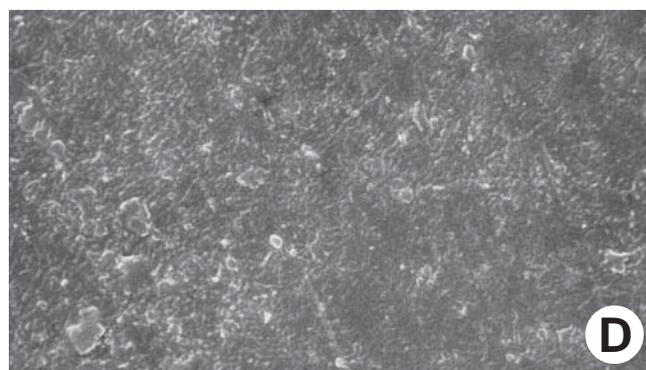
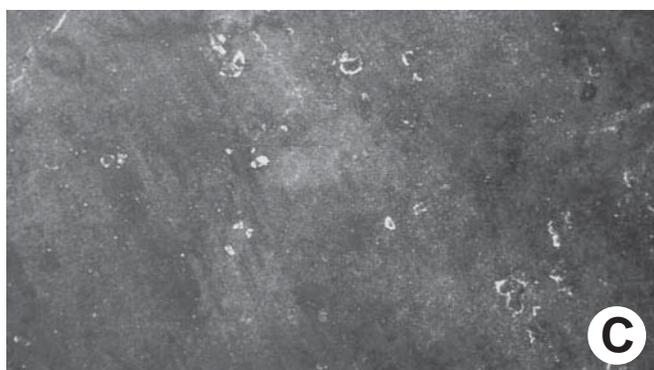
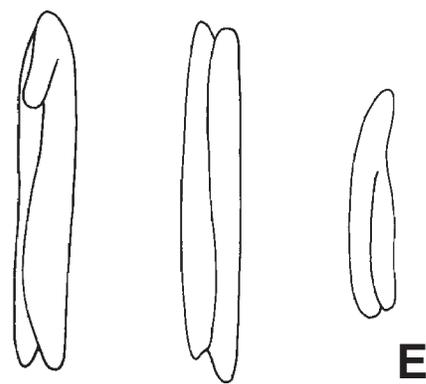
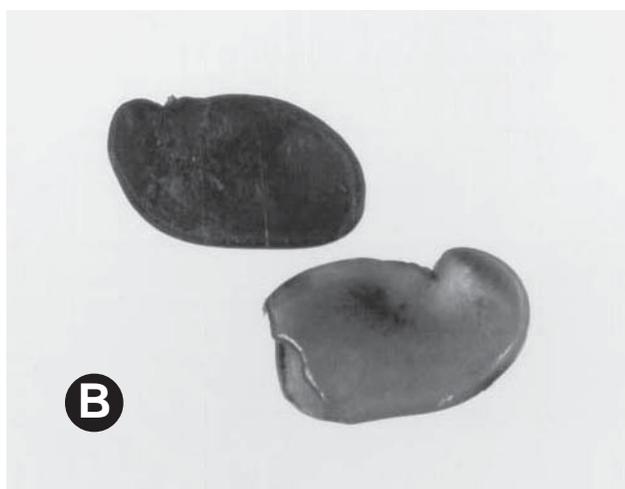
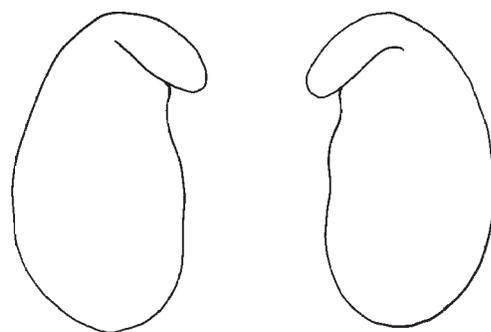
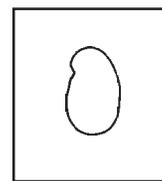
Fruit a legume; unilocular; $7.5\text{--}20 \times 1.4\text{--}1.6 \times 2\text{--}3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; slightly asymmetrical; fusiform or linear (nearly);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

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

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

Distribution: Northwestern and western Madagascar.

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



Genus: *Sakoanala* R. Viguier

Phylogenetic Number: 2.35.

Tribe: Sophoreae.

Group: Sophora.

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

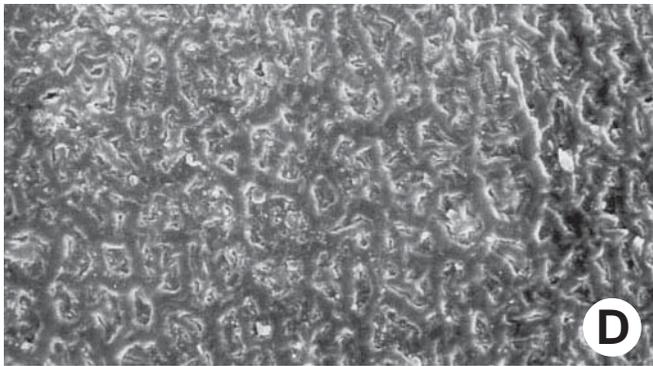
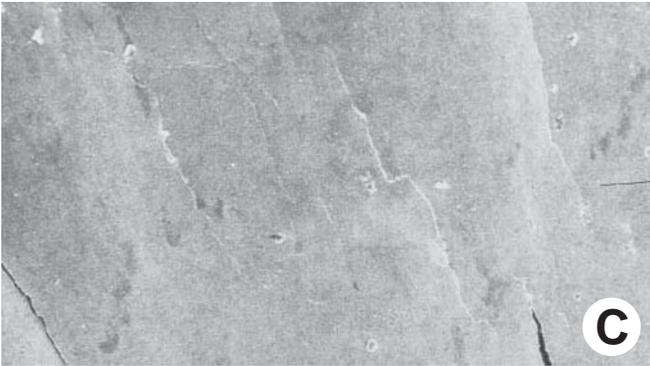
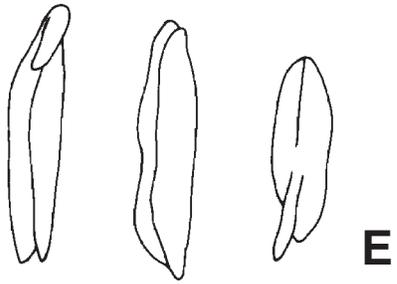
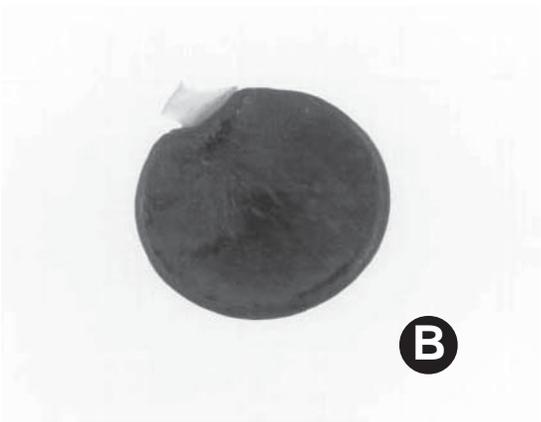
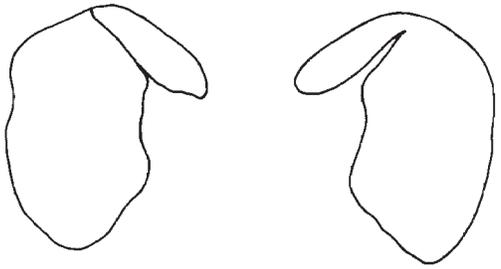
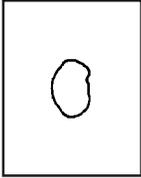
Fruit a legume; unilocular; $5-15 \times 1.3-2.6 \times 0.1-0.2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical (slightly); fusiform, falcate, or linear (or nearly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

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

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

Distribution: Eastern and northeastern Madagascar.

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



Genus: *Cadia* P. Forsskål

Phylogenetic Number: 2.36.

Tribe: Sophoreae.

Group: Sophora.

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

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

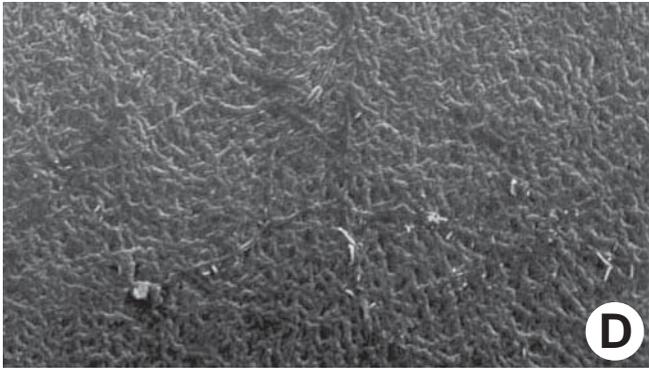
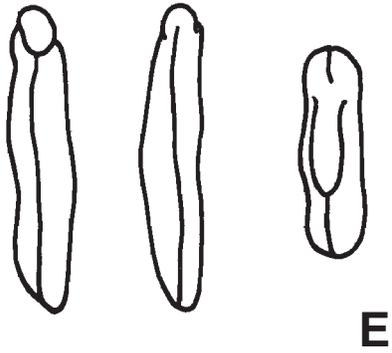
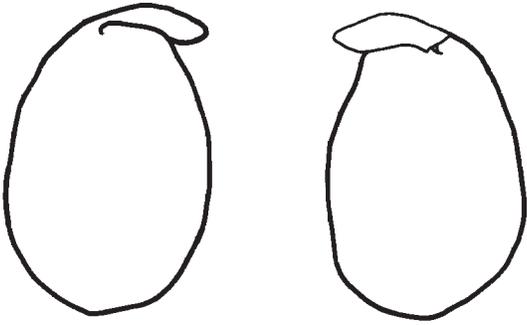
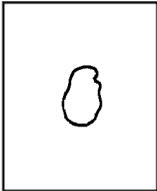
Seed 5–9.5 × 3–7 × 2–4 mm; not overgrown; not angular; symmetrical; elliptic to ovate to circular (sub) or D-shaped; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified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

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

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

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

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



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

Phylogenetic Number: 2.37.

Tribe: Sophoreae.

Group: Sophora.

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

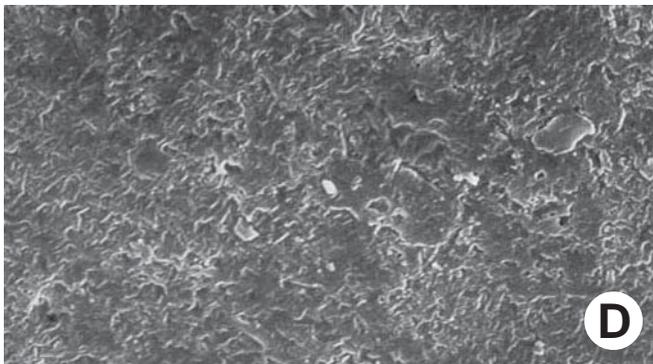
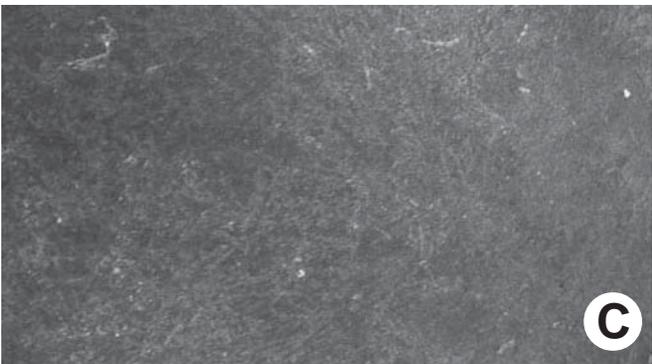
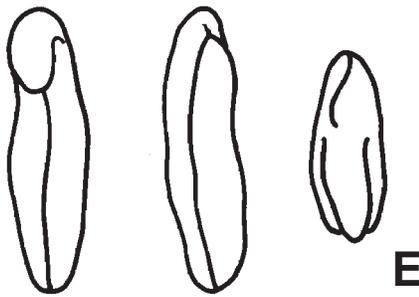
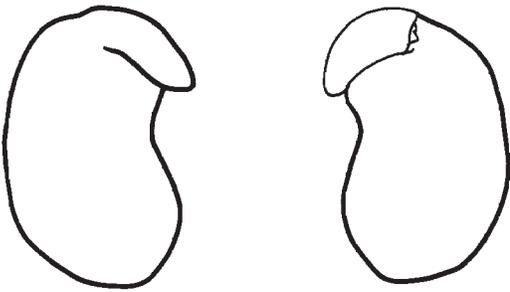
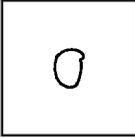
Fruit a legume; unilocular; $4.6-7.3 \times 0.8-1.3 \times 0.2-0.4$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical to nearly symmetrical; linear to fusiform or moniliform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

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

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

Distribution: Malawi to Natal.

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



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

Phylogenetic Number: 2.38.

Tribe: Sophoreae.

Group: Sophora.

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

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

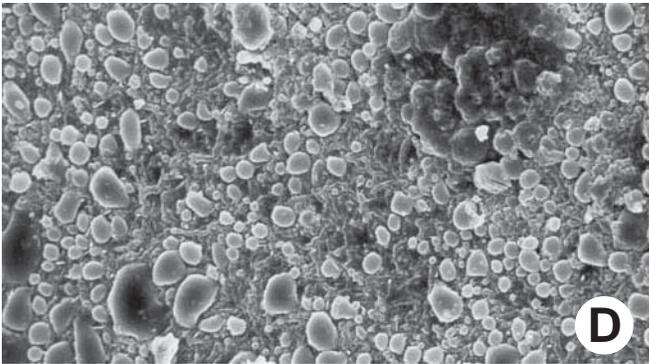
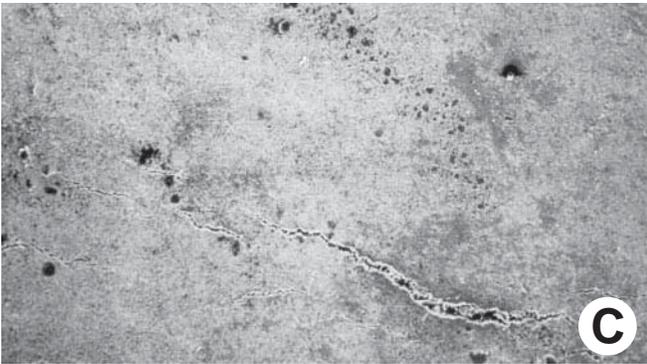
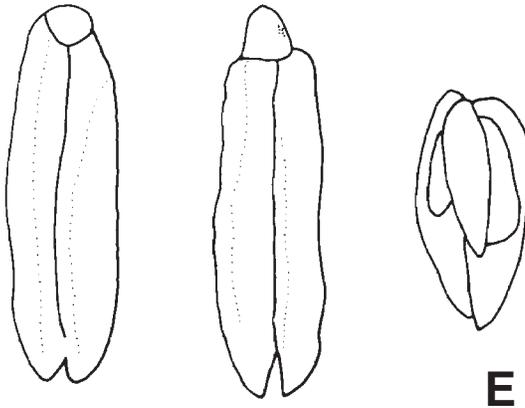
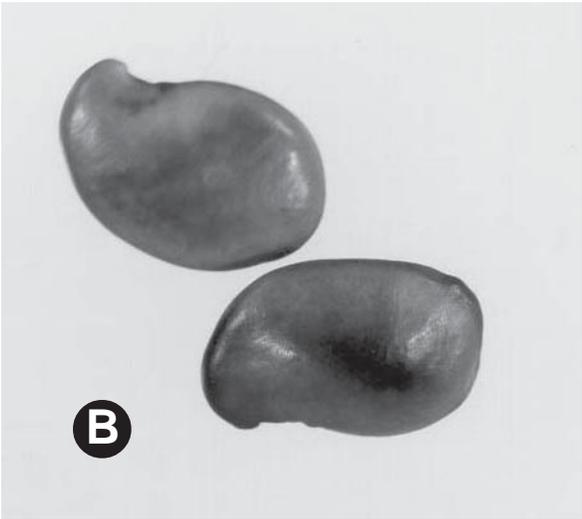
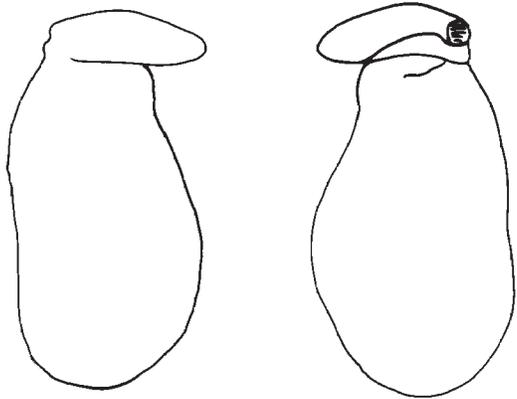
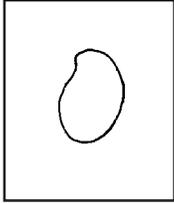
Seed 12–18 × 8–10.5 × 4–6.5 mm; not overgrown; not angular; asymmetrical; irregularly ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on both faces of seed; without medial ridge on each face. Cuticle not exfoliating; not inflated; not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

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

Distribution: Eastern and northeastern Africa.

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

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



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

Phylogenetic Number: 2.39.

Tribe: Sophoreae.

Group: Sophora.

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

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

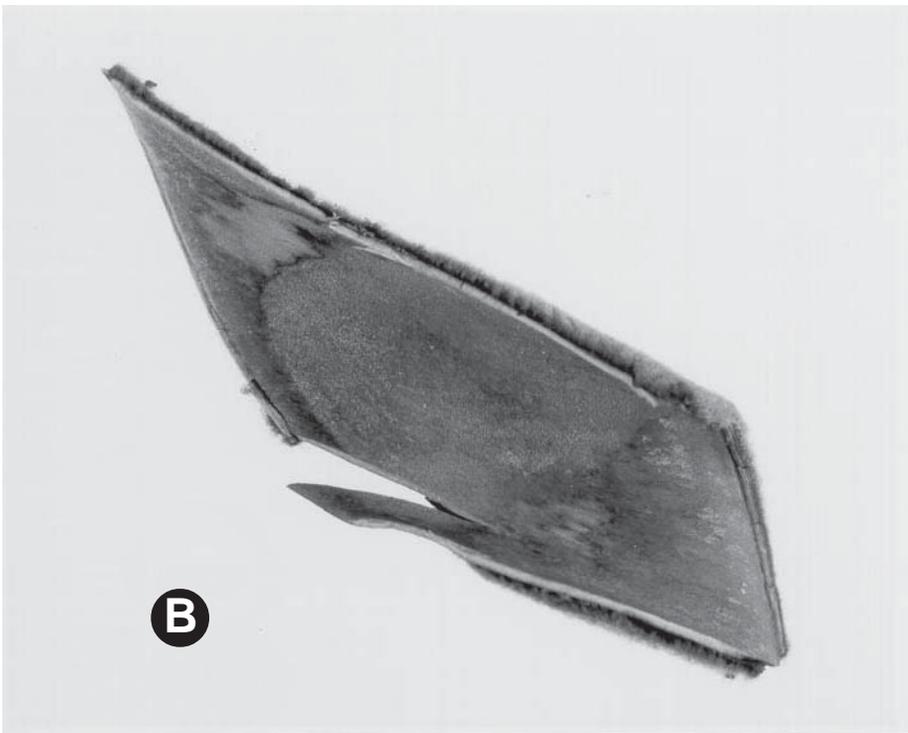
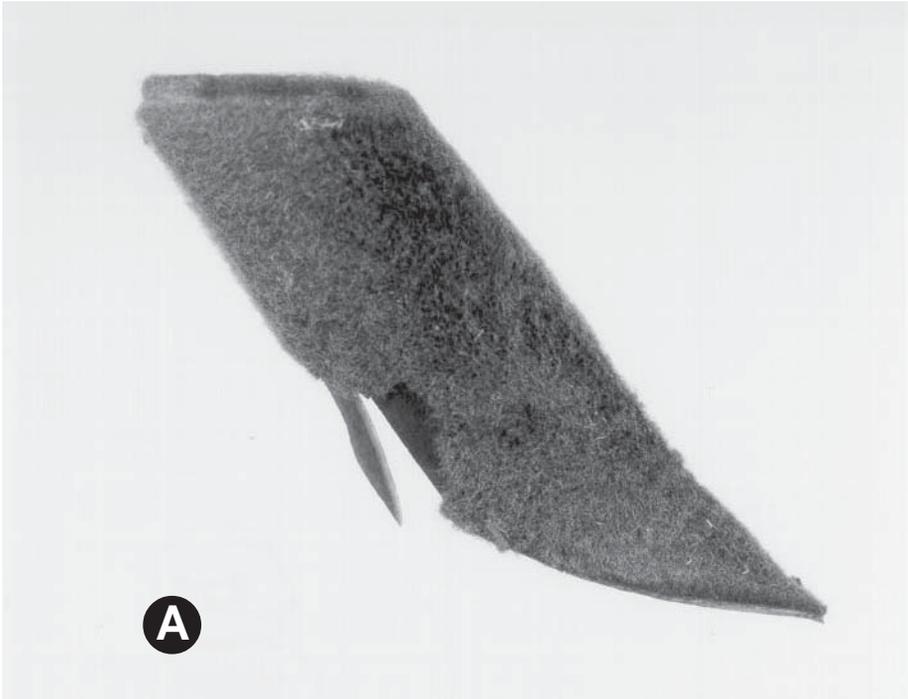
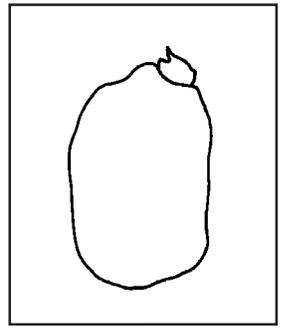
Seed 20–37 × 14–24 × 8–10.5 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; irregular, oblong, or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull;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

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

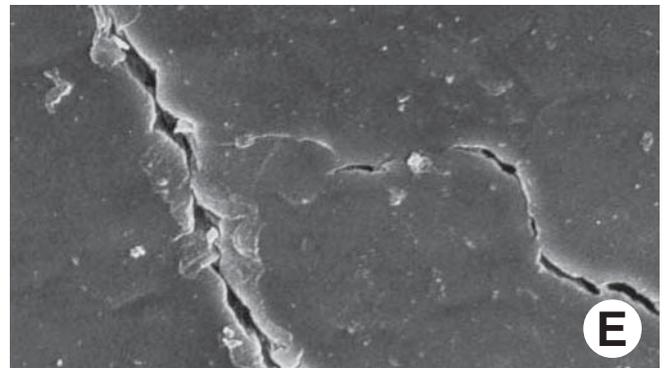
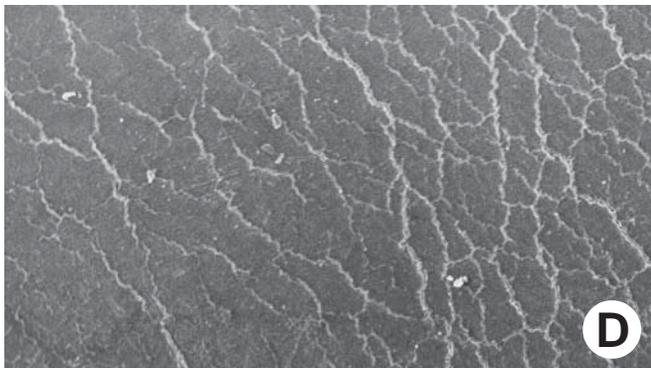
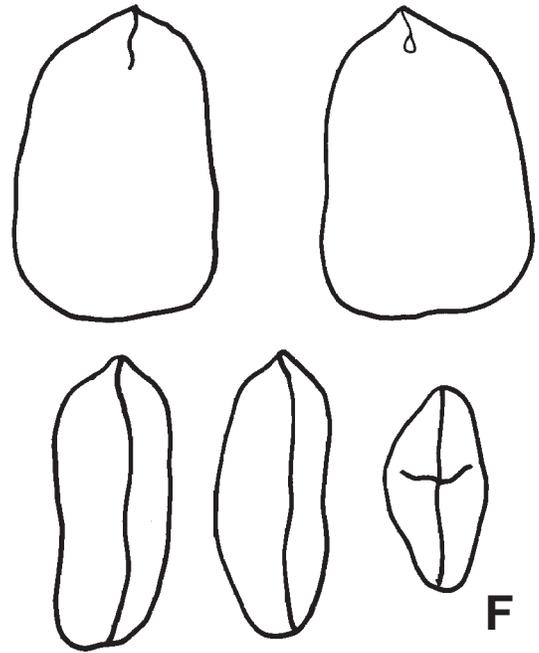
Distribution: Gulf of Guinea (Nigeria to Angola).

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

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



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



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

Phylogenetic Number: 2.40.

Tribe: Sophoreae.

Group: Sophora.

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

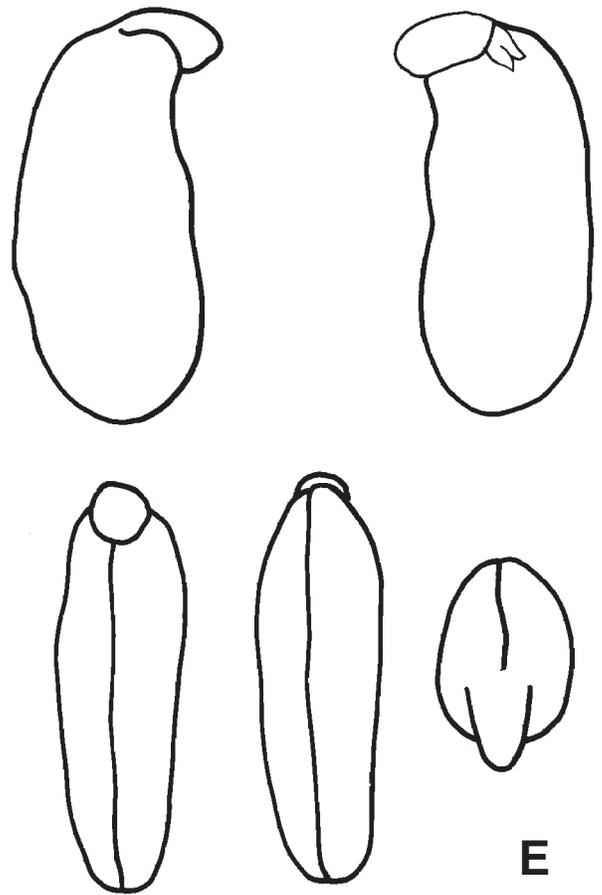
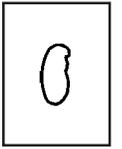
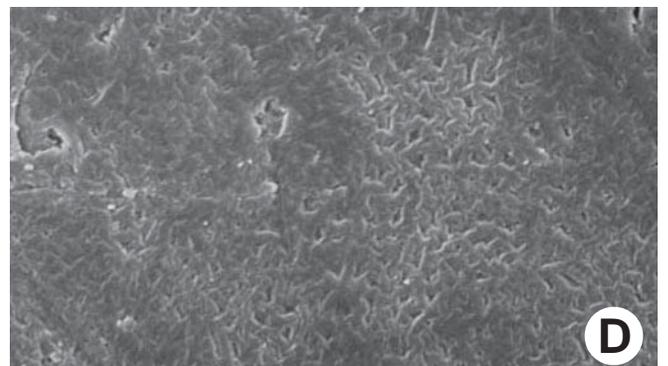
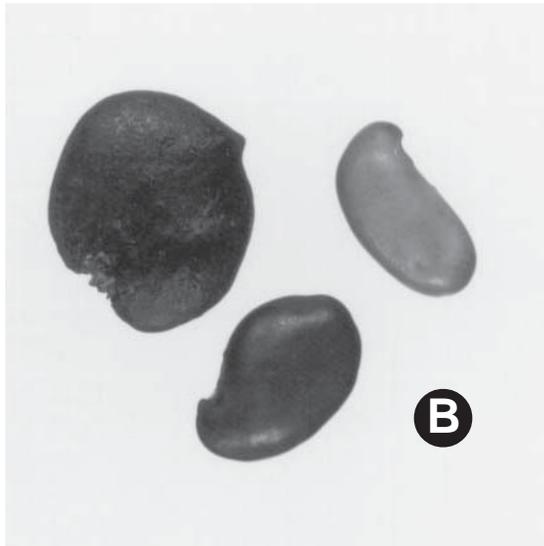
Fruit a legume; unilocular; $2.3-8 \times 1-1.7 \times 0.1-0.3$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic, fusiform, or ovate (narrowly); not inflated;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

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

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

Distribution: Eastern Asia and cultivated elsewhere.

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



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

Phylogenetic Number: 2.41.

Tribe: Sophoreae.

Group: Sophora.

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

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

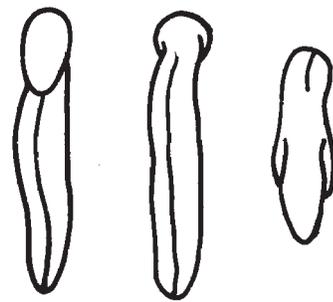
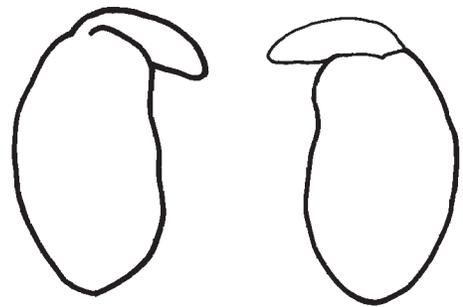
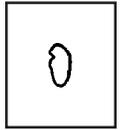
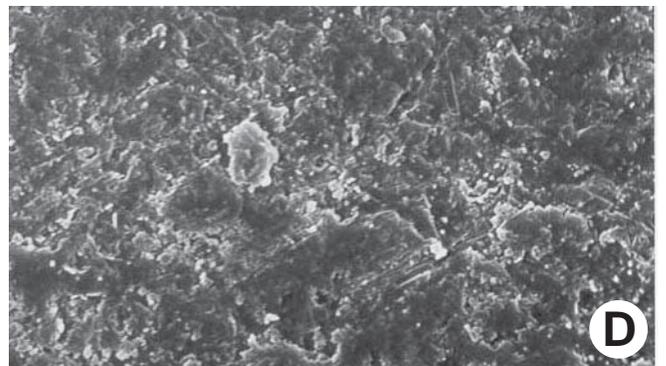
Seed $5\text{--}10 \times 3\text{--}5 \times 1.8\text{--}3$ mm; not overgrown; not angular; asymmetrical; elliptic to irregular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified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

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

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

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

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



E

Genus: *Salweenia* E.G. Baker

Phylogenetic Number: 2.42.

Tribe: Sophoreae.

Group: Sophora.

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

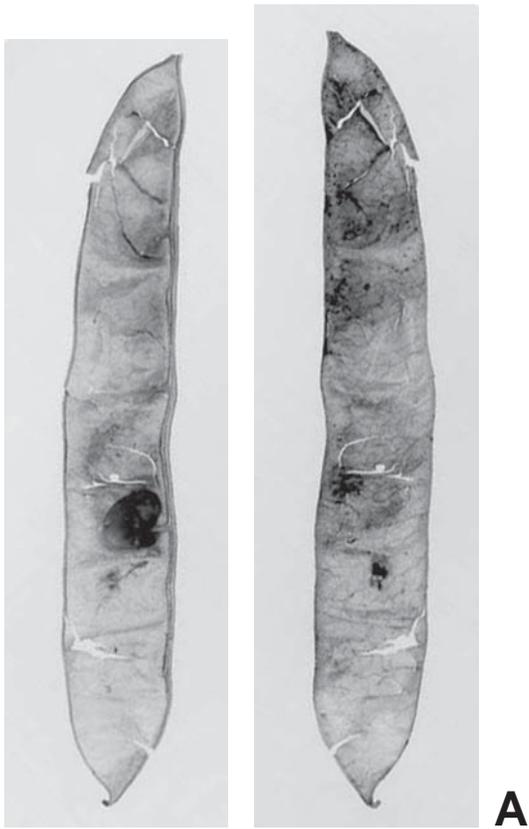
Fruit a legume; unilocular; $6-9 \times 0.8-1.2 \times$ ca. 0.4 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear to moniliform (slightly); not inflated; compressed; with beak;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

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

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

Distribution: Tibet.

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



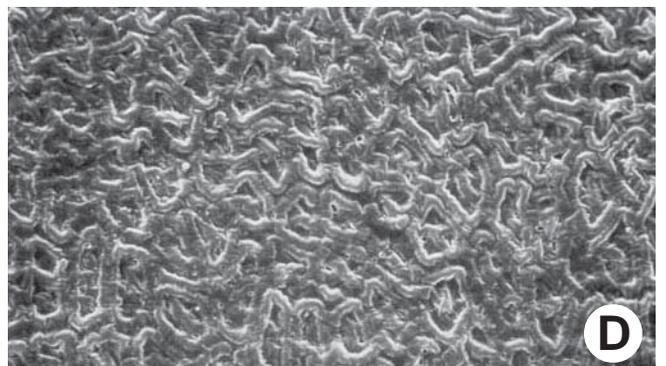
A



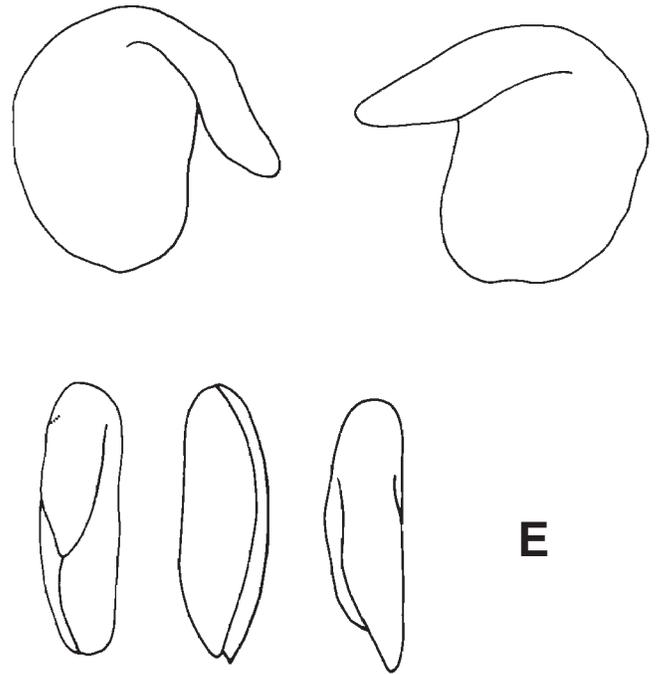
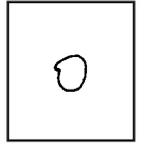
B



C



D



E

Genus: *Styphnolobium* H.W. Schott

Phylogenetic Number: 2.44.

Tribe: Sophoreae.

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

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

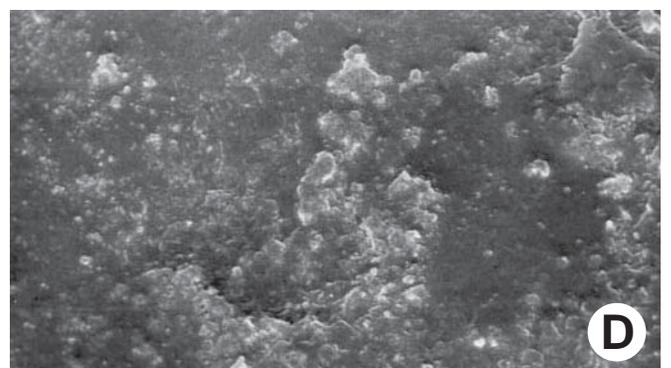
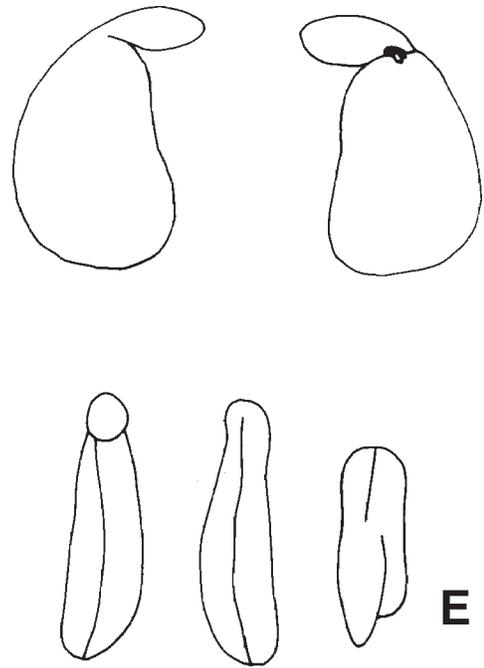
Seed $6-25 \times 4-15 \times 3-4$ (at least) mm; not overgrown; not angular; symmetrical or asymmetrical; ovate or reniform; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with

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

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

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

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



Genus: *Sophora* C. Linnaeus

Phylogenetic Number: 2.45.

Tribe: Sophoreae.

Group: *Sophora*.

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

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

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

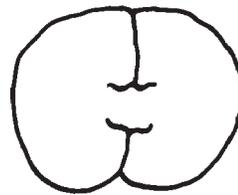
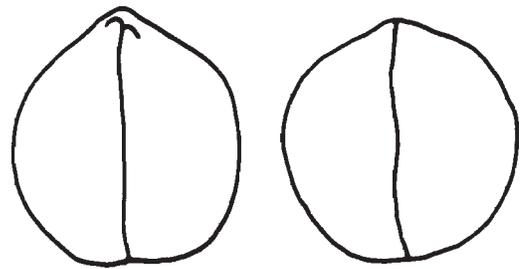
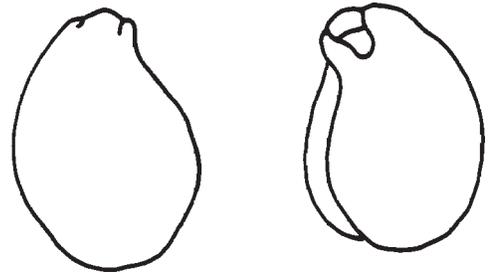
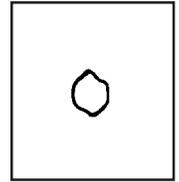
Seed 3–17 × 2–14 × 2–14 mm; not overgrown; not angular or angular; symmetrical; ovate, elliptic to circular (nearly), or rhombic; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face.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

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

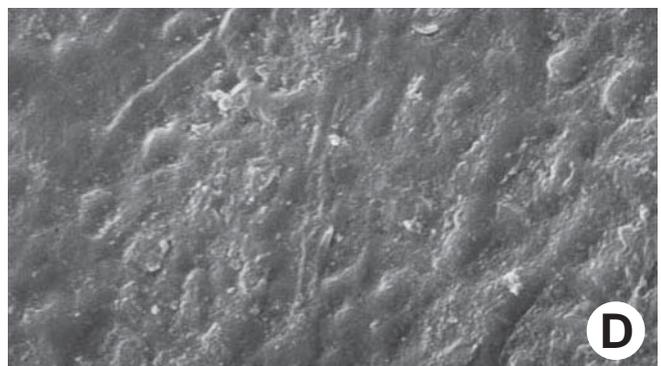
Distribution: North America and Eurasia.

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

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



E



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

Phylogenetic Number: 2.46.

Tribe: Sophoreae.

Group: Sophora.

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

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

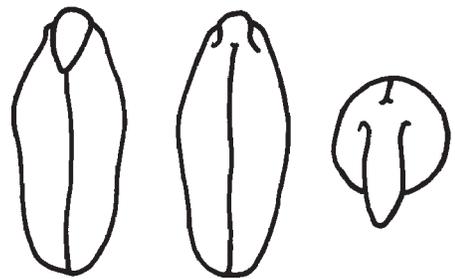
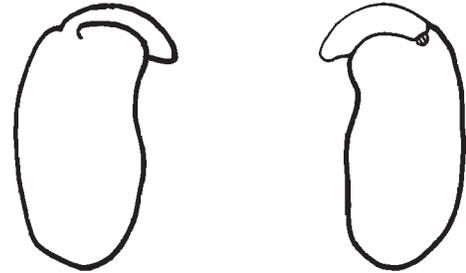
Seed $3.5-8.2 \times 2-4.5 \times 1.8-4.5$ mm; not overgrown; not angular; symmetrical; oblong or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom;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

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

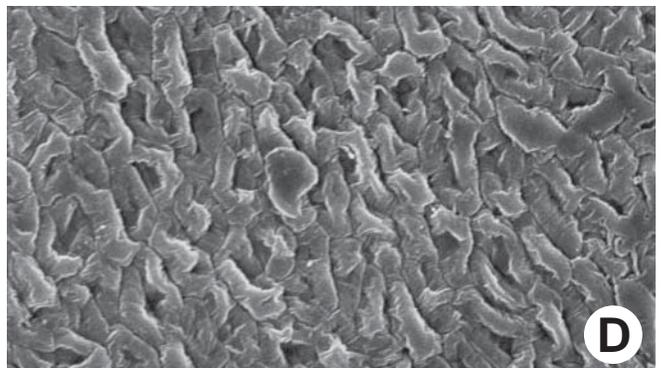
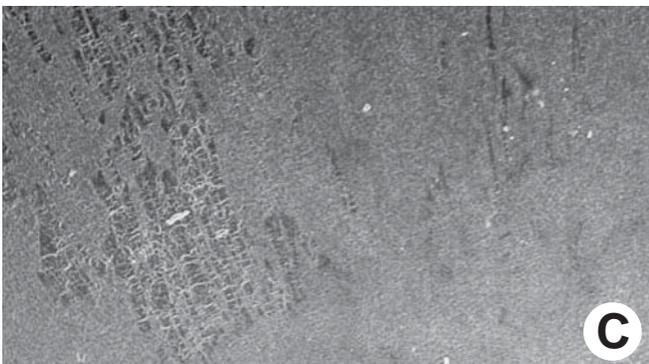
Distribution: Central Asia.

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

0



E



Dipteryx (3.01–3.03)

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

Phylogenetic Number: 3.01.

Tribe: Dipteryx.

Species Studied—Species in Genus: 9 spp.—ca. 10 spp.

Fruit a nutlet or legume; 4.2–6.3 × 2.4–3.5 × 1.6–3 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; circular to elliptic to ovate; not inflated; compressed; without beak; short tapered to 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; drupaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit stipitate; with the stipe 15 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown; glabrous (when dry) or pubescent but soon deciduous (when fresh); with pubescence uniformly distributed; with simple hairs; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; exfoliating; with cracks; cracking irregular. Mesocarp thick; surface not veined; 1- or 2-layered; with balsamic vesicles; with fibers; firm-walled open empty cells (with balsamic vesicle); with fibers over solid layer; ligneous. Endocarp dull; monochrome; red (dish); fibrous (white fibers over reddish surface in *D. trifoliolata* A. Ducke) or smooth; nonseptate; coriaceous; exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; up to 1 mm long; thick; straight. Aril absent.

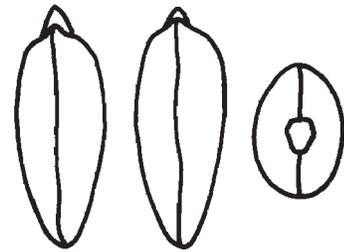
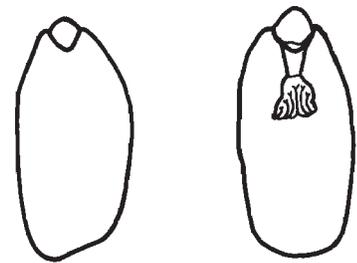
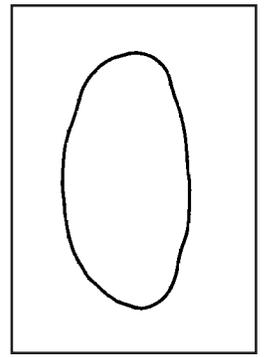
Seed 23–50 × 13–15 × 4–8 mm; not overgrown; not angular; symmetrical; elliptic, oblong, or ovate and linear; compressed; with surface grooved; with grooves reticulate; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; black; glabrous; not smooth; with elevated features; reticulately wrinkled; coriaceous. Fracture lines absent. Rim absent. Raphe not visible. Hilum 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; 5 mm long; with curved outline; elliptic; subapical or marginal according to radicle tip; flush; not

within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle (by radicle); notched at or split over radicle; without or with lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or red (dish); inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed. Radicle linear; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

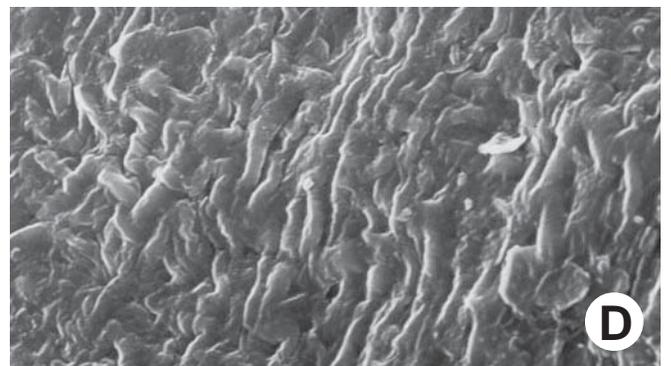
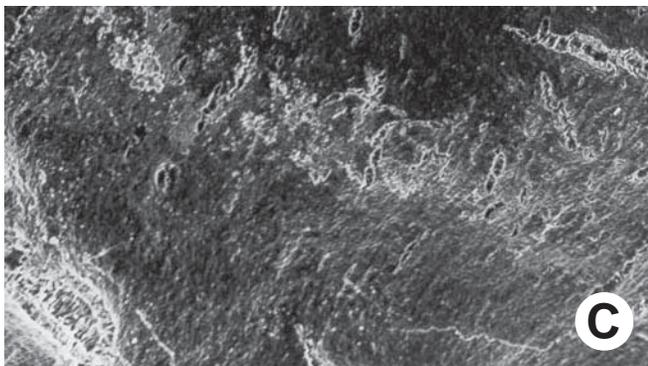
Distribution: Central and South America.

Notes: Polhill (1981c) noted that the tribe has “woody dehiscent valves, or with stony endocarp tardily opening on ground, or winged around the hard central seed-chamber with epicarp flaking.” Melhem (1974a,b, 1975) reported on the morphology, anatomy, and germination of seeds of *D. alata* (J.R.T. Vogel) P.H.W. Taubert.

Dipteryx: *D. punctata* (J. Blake) G.J.H. Amshoff (C–E), *D.* spp. (A–B). A, Fruits, valves, fruits in transection, and fruit without epicarp (× 0.8); B, seeds (× 1.8); C–D, testa (× 50, × 1000); E, embryos (× 1).



E



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

Phylogenetic Number: 3.02.

Tribe: Dipteryxae.

Species Studied—Species in Genus: 3 spp.—ca. 5 spp.

Fruit a legume; unilocular; $3\text{--}7.5 \times 1.5\text{--}4 \times 0.8\text{--}1.2$ cm; 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; flattened; without beak; short tapered at apex; apex oblique (or nearly so) with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligenous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate (based on loose fruits). Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; probably apical and down; active or passive; with valves enrolling. Replum invisible. Epicarp dull; monochrome; black or brown; glabrous; eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; solid; ligenous. Endocarp dull; monochrome; tan; smooth; nonseptate; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1 mm long; of 1 length only; thick; straight. Aril absent.

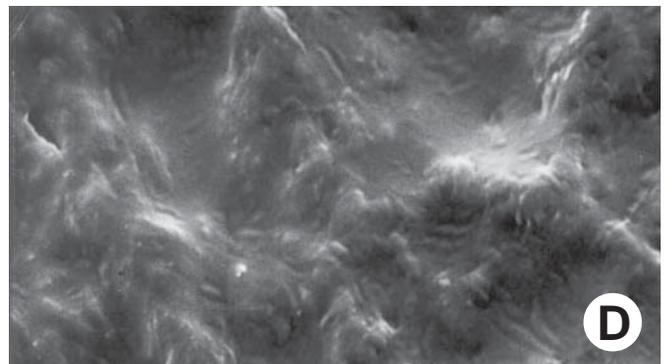
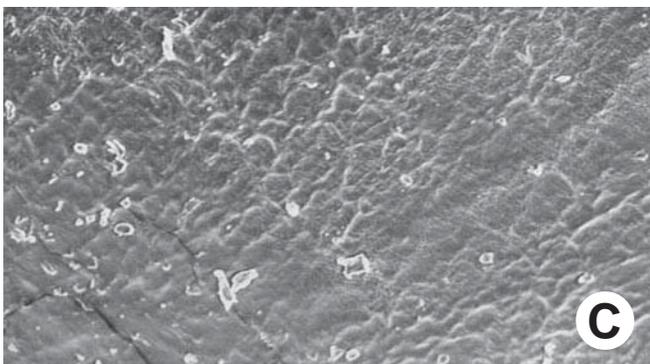
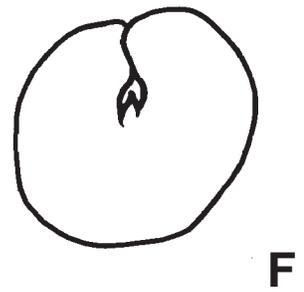
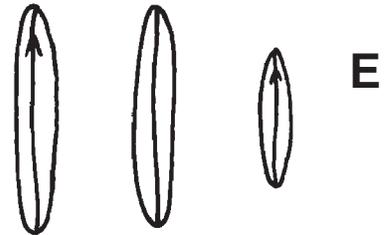
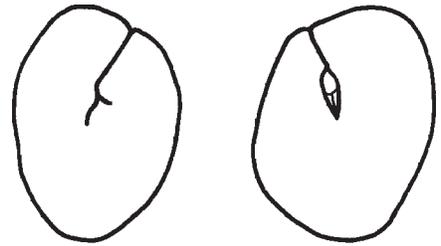
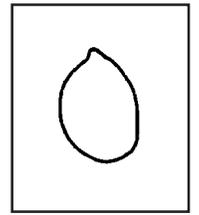
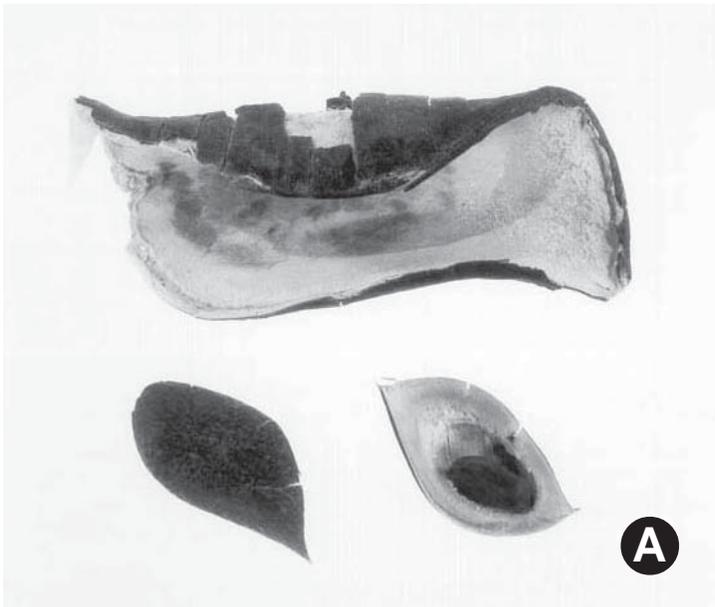
Seed $22\text{--}32 \times 18\text{--}27 \times 5$ mm; not overgrown; angular or not angular; asymmetrical; circular to ovate to rhombic; compressed to flattened; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with elevated or recessed features; somewhat wrinkled; faintly, longitudinally striate; coriaceous. Fracture lines absent. Rim absent. Raphe not visible. Hilum visible; without faboid split; punctiform; subapical or marginal according to radicle tip (depending on shape of seed); recessed; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth or not smooth; wrinkled (*T. oppositifolia* J.C.B.F. Aublet); both outer faces convex;

both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; split over radicle; with lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed. Radicle linear; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical South America.

Notes: Cowan (1958) included *Taralea* in *Dipteryx* (3.01) because only the fruit differ significantly. *Taralea* has dehiscent fruits and *Dipteryx* has indehiscent fruits. Polhill (1981c) also noted that the seeds are “quite different” and that there is a leaflet difference, thus he provisionally accepted *Taralea* as a genus. Our data supports Polhill’s treatment.

Taralea: T. crassifolia (G. Bentham) W.A. Ducke (C–E), *T.* spp. (A–B). A, Valves ($\times 1$); B, seeds ($\times 1.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 1$); F, external embryo ($\times 1$).



Genus: *Pterodon* J.R.T. Vogel

Phylogenetic Number: 3.03.

Tribe: Dipteryxae.

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

Fruit a nutlet or legume; $3-6 \times 2-3.5 \times 0.5-0.7$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; oblong to ovate; inflated; flattened; without beak; tapered or rounded at apex; apex aligned with longitudinal axis of fruit; short tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; drupaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished. Fruit wing present (readily visible when epicarp exfoliates); 1; 5–25 mm wide (most of our samples with damaged or nearly missing wings); continuous wing around fruit; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; black; glabrous; without spines; not smooth; not veined; not tuberculate; exfoliating; with cracks; cracking irregular. Mesocarp thick; surface veined over seed chamber and inconspicuously veined on wing; 1-layered; with balsamic vesicles; without fibers; firm-walled open empty cells (with balsamic vesicles); ligneous. Endocarp dull; monochrome; tan; fibrous or spongy; nonseptate; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; up to 1 mm long; thick; straight. Aril dry; rim-aril; brown.

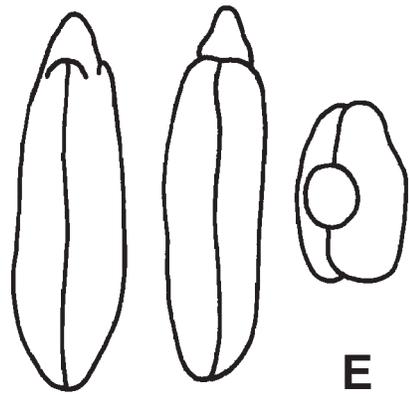
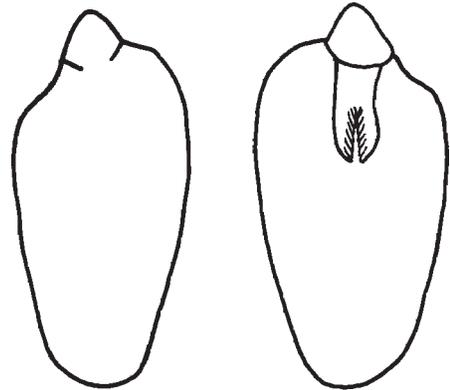
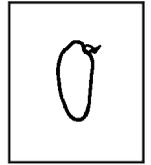
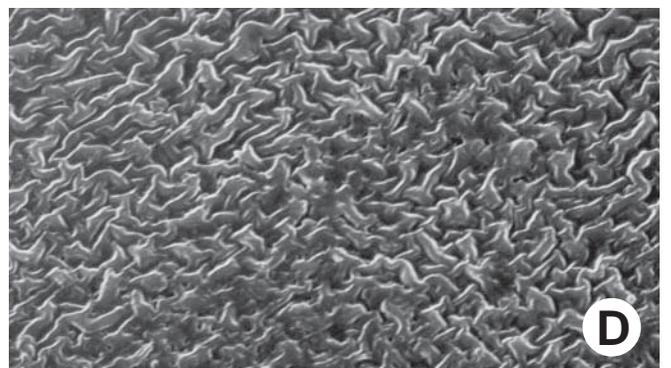
Seed $8.5-9.5 \times 4-5 \times 1.5-3.5$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; symmetrical (except for hilum); oblong or ovate; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; black or tan; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; black; flush. Hilum partially to fully concealed; concealed by aril; 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; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 1 mm long; with margins straight or curved; oblong; not

in groove of raphe; adjacent to hilum; mounded; dissimilar color from testa; darker than testa; dark brown; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with the interface division terminating at base of radicle; white; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed. Radicle linear; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Brazil and Bolivia.

Notes: Polhill (1981c) noted that a “critical reappraisal is needed” for *Pterodon*. Hutchinson (1964) noted that the seeds are “full of balsam oil.” The mature epicarp readily exfoliates, leaving the mesocarp with its fragile wing and woody seed chamber. Other legume fruits whose winged mesocarps “dehisce” from the epicarp include these diverse genera: *Amburana* (1.15), a faboid genus in tribe Sophoreae; *Schizolobium* (1.17), a caesalpinoid genus in tribe Caesalpinieae (Gunn 1991); and *Wallaceodendron* (5.16), a mimosoid genus in tribe Ingeae (Gunn 1984). The former two genera have winged mesocarps that are samaralike and the latter genus has winged mesocarp segments that have two marginal wings. *Pterodon* has a wing that encircles the mesocarp unit.

Pterodon: *P. polygalaeflorus* G. Bentham (C–E), *P.* spp. (A–B). A, Fruit with epicarp and two fruit without epicarp ($\times 1$); B, seeds ($\times 6.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Dalbergieae (4.01–4.17)

Genus: *Vataireopsis* W.A. Ducke

Phylogenetic Number: 4.01.

Tribe: Dalbergieae.

Group: Andira.

Species Studied—Species in Genus: 3 spp.—4 spp.

Fruit a legume; unilocular; $8\text{--}12 \times 2\text{--}3 \times 0.5\text{--}0.6$ cm (in our fruits the lateral wing was folded in to fruit body and was not included in width measurement); with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; seed chamber compressed to flattened (wing); without beak; rounded and emarginate 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. Fruit margin not constricted; without sulcus; embellished; with wings. Fruit wings 3 (1 major apical wing and 2 smaller lateral wings folded into seed chamber); major samaroid and valvular (minor); basal; minor wings on both valves; major wing on 1 suture. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome or multicolored; mottled; greenish to reddish brown; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; tan; with dark spotted mottling; with brown (reddish-brown) overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length oblique to fruit length. Funiculus less than 0.5 mm long; straight. Aril absent.

Seed $20\text{--}25 \times 0.8\text{--}1 \times 2.5\text{--}3$ mm; not overgrown; not angular; asymmetrical; oblong or reniform; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus;

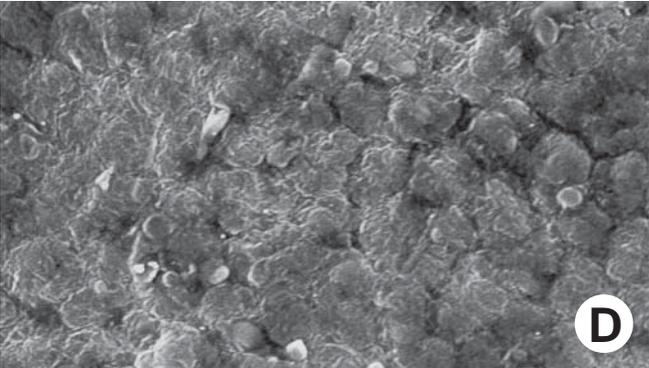
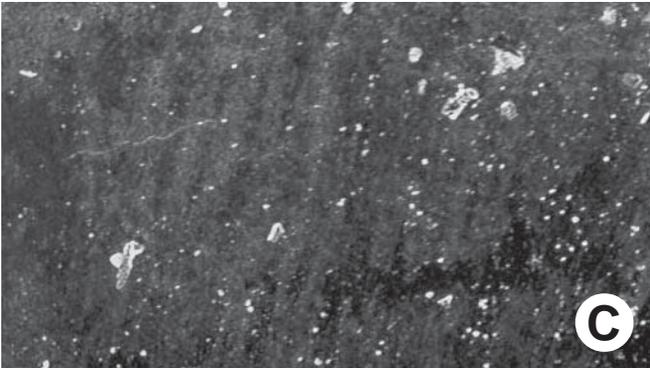
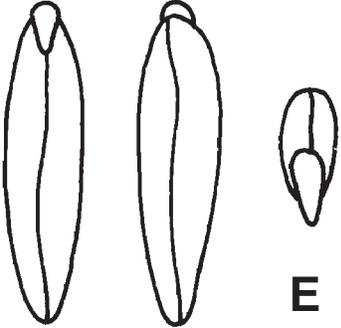
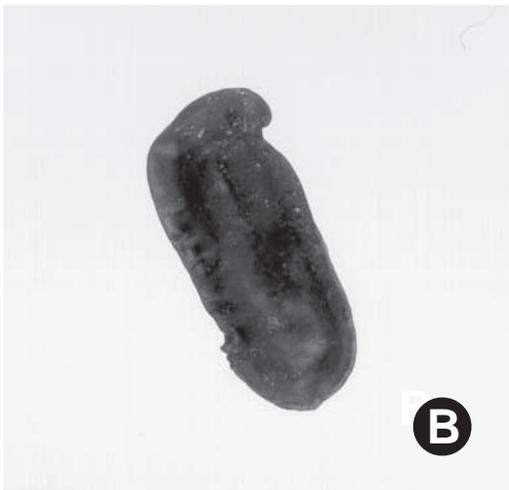
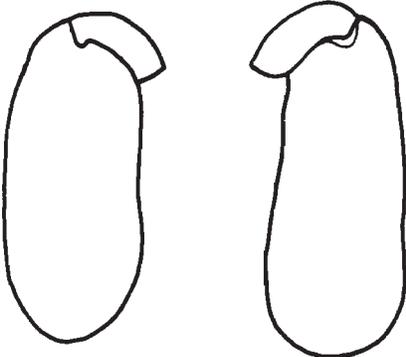
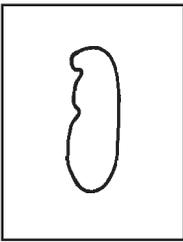
without umbo on seed faces. Testa not adhering to endocarp; more or less glossy; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; dark reddish brown; recessed. Hilum partially concealed; concealed by funicular remnant or wing; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.9 mm long; with curved outline; oval; between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens not discernible. Endosperm present. 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 bulbous; lobe tip slightly curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Brazil and Surinam.

Notes: Lima (1989) analyzed the morphological characters of fruits, seeds, and seedlings of the tribe, and his characters and illustrations were used as a much-appreciated source of accurate data. He also discussed the phylogeny of the tribe. The species counts are derived from Polhill (1981d), who also provided fruit and seed illustrations. Sousa and Sousa (1981) provided data to support their conclusion that the New World Lonchocarpaceae be considered for tribal status—a segregate of the Dalbergieae. Hauman (1954) provided data on the Dalbergieae of Central Africa, and Lock (1989) listed the Dalbergieae for all of Africa. Thothathri (1986) reviewed the taxonomic status and systematic position of Asiatic Dalbergieae and monographed tribe Dalbergieae for the Indian subcontinent (Thothathri 1987). Morphological (Lima 1989) and molecular (Doyle et al. 1997) evidence indicates that tribe Dalbergieae is polyphyletic. Lima (1980) monographed *Vataireopsis* and recognized four species, but Polhill (1981d) recognized three species and noted that “in time this may be amalgamated with *Vatairea*, the supplementary lateral wings on this seed-chamber (figure 3/9), visible from ovary stage, (figure 3/9),

being the only significant difference and a small ridge or thickening is apparent even in species of *Vatairea*” (4.02). Whether maintaining or combining the two genera, one should remember that the testa remains with the embryo in *Vataireopsis* and is fused with the endocarp in *Vatairea*.

Vataireopsis: V. speciosa W.A. Ducke (A–E). A, Fruits
($\times 1.1$); B, seed ($\times 2.6$); C–D, testa ($\times 50$, $\times 1000$); E,
embryos ($\times 2$).



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

Phylogenetic Number: 4.02.

Tribe: Dalbergieae.

Group: Andira.

Species Studied—Species in Genus: 7 spp.—8 spp.

Fruit a legume or nutlet; unilocular; $8.5\text{--}14 \times 2.5\text{--}8 \times 0.6\text{--}3.5$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (to slightly curved); not plicate; not twisted; asymmetrical or symmetrical; circular or samaroid; when asymmetrical with both sutures parallelly to unequally curved; not inflated; seed chamber compressed to flattened (wing); without beak; rounded or short tapered at apex; apex oblique or 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 or drupaceous (*V. guianensis* J.B.C.F. Aublet); seed chambers externally visible. Fruit margin not constricted; without sulcus; embellished or plain; with wing. Fruit wing present or absent; 1; up to 80 mm wide; samaroid; basal; on 1 suture. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown to reddish brown; glabrous; without spines; not smooth; with elevated features; irregularly veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick (over seed chamber); surface uniformly veined; 1-layered; without balsamic vesicles; with fibers; fibrous throughout; ligneous. Endocarp dull; monochrome; dark reddish brown; nonseptate; coriaceous; exfoliating (with fused testa); separating from epicarp; entire. Seed 1; length oblique to fruit length. Funiculus less than 0.5 mm long; straight. Aril absent.

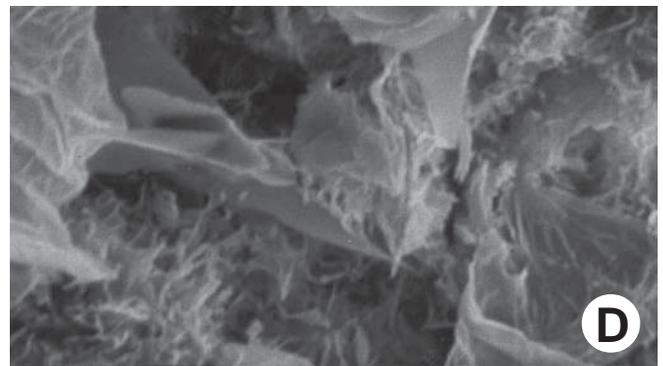
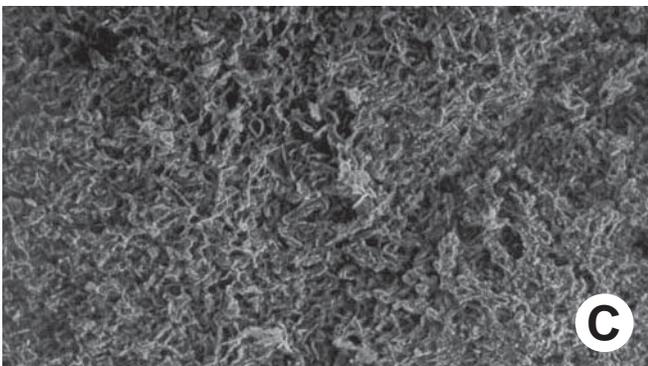
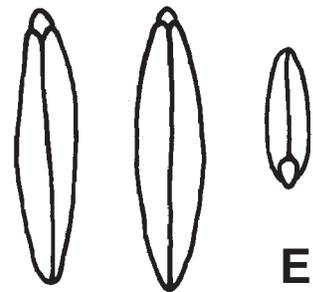
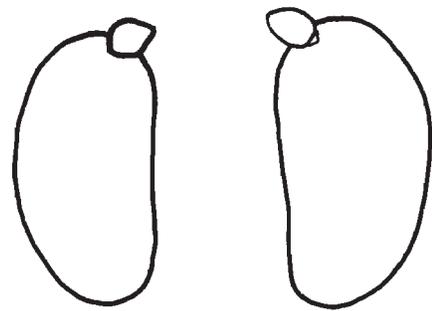
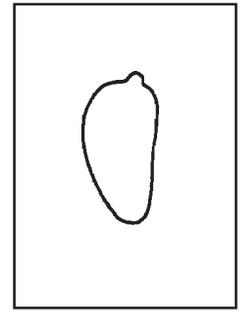
Seed $15\text{--}65 \times 10\text{--}45 \times 0.4\text{--}8$ mm; not overgrown or overgrown, 1 seed filling entire fruit cavity (*V. guianensis*); not angular; asymmetrical or symmetrical; oblong, obovate, or circular; compressed; with surface ridged; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent (testa fused to endocarp and endocarp falling with embryo or not). Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at

radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; greenish tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique or parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous or linear; deflexed and parallel to cotyledon width or straight with embryonic axis (*V. guianensis*); centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Mexico and Central America to Brazil.

Notes: Lima (1982b) monographed the genus and recognized eight species, while Polhill (1981d) noted "ca. seven species." The testa is fused with the endocarp. Refer to *Vataireopsis* (4.01) for a discussion of the two genera.

Vatairea: *V. lundellii* (P.C. Standley) P.C. Standley (*C–E*), *V. spp.* (*A–B*). *A*, Fruits ($\times 0.6$); *B*, embryos ($\times 2$); *C–D*, endocarp (functioning as testa) ($\times 50$, $\times 1000$); *E*, embryos ($\times 2$).



Genus: *Hymenolobium* G. Bentham

Phylogenetic Number: 4.03.

Tribe: Dalbergieae.

Group: Andira.

Species Studied—Species in Genus: 11 spp.—17 spp.

Fruit a legume; unilocular; $4.5\text{--}20 \times 1.5\text{--}6 \times 0.17\text{--}0.18$ cm; with deciduous corolla; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted or twisted (at base in *H. modestum* A. Ducke and folded in other species); symmetrical or asymmetrical; oblong, oblanceolate, linear, elliptic, or circular; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; flattened; without beak; short tapered, rounded, or emarginate at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered at base; base aligned or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous, membranous, or chartaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; embellished; with wing. Fruit wing 1; 2.5 mm wide; samaroid (and occasionally lower portion of one wing folds over itself); on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; reddish purple or brown; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined (and with or without one or two major veins arising from stipe); not tuberculate; not exfoliating; without cracks. Mesocarp present (or nearly so in wing areas of some species) or absent; thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous or chartaceous. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–3(–4); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; slightly curved. Aril absent.

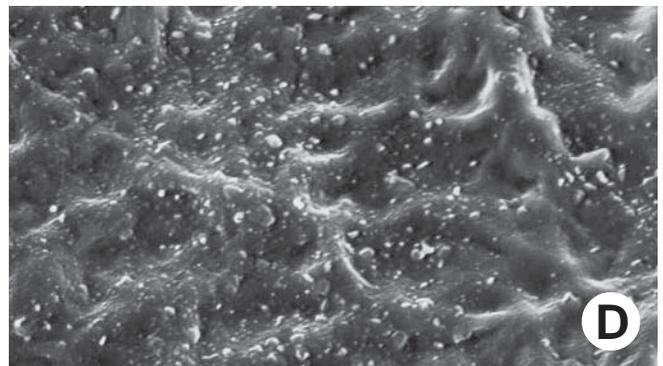
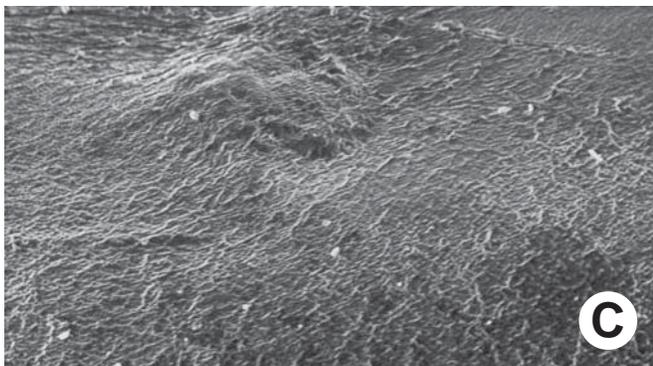
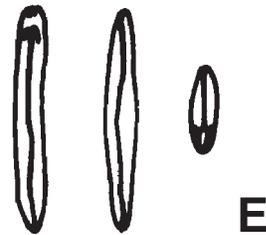
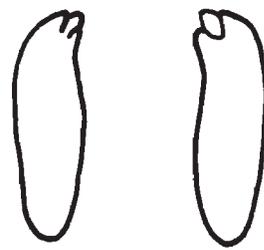
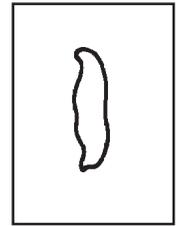
Seed $12\text{--}40 \times 4\text{--}9 \times 2\text{--}2.5$ mm; not overgrown; not angular; asymmetrical; oblong, linear, or C-shaped; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish purple; glabrous; not smooth; with elevated features;

longitudinally wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to lens (at base of seed); not bifurcating; color of testa; reddish purple; slightly raised. Hilum fully concealed; concealed by funiculus; without faboid split; punctiform; between cotyledon and radicle lobe; flush; not within corona, halo, or rim. Lens discernible or not discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; up to 1 mm long; not in groove of raphe; nearly 180 degrees from hilum; mounded; similar color as testa; darker than testa; reddish purple; 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; differing at apex (1 concealed by overarching radicle and other auriculate and concealing radicle); not concealing radicle; notched at radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed or straight; oblique or parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; lobe tip straight; deflexed and parallel to cotyledon width or straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical South America and Costa Rica.

Notes: Mattos (1979b) monographed the genus, recognizing 17 species, and we are using this count rather than the 10–15 count of Polhill (1981d). Lima (1982a) reported on the morphology of the species in this genus that are deposited in the herbarium of the Botanic Garden at Rio de Janeiro (RB).

Hymenolobium: *H. heringerianum* C.T. Rizzini (C–E), *H.* spp. (A–B). A, Fruits ($\times 1.1$); B, seeds (curved seed apex has damaged testa) ($\times 2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



Genus: *Andira* A.L. de Jussieu

Phylogenetic Number: 4.04.

Tribe: Dalbergieae.

Group: *Andira*.

Species Studied—Species in Genus: 14 spp.—ca. 30 spp.
(R.T. Pennington, personal communication, 1998).

Fruit a legume (described by R.T. Pennington as a drupe—personal communication, 1998); unilocular; $2-13 \times 1.5-10 \times 1.5-10$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong, obovate, ovate, or circular; 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; drupaceous (fresh) or ligneous (dry); seed chambers externally invisible. Fruit margin not constricted; with sulcus (slight); plain. Fruit wings absent. Fruit nonstipitate or substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; dark reddish brown; glabrous or glabrate; eglandular; without spines; not smooth; with elevated or recessed features; not veined; not tuberculate; rugose, verrucose-rugose, or wrinkled; broadly pitted; not exfoliating, checking, exfoliating in part, or exfoliating; with cracks; cracking irregular. Mesocarp thick; surface uniformly veined; 1-layered; without balsamic vesicles; fibrous throughout to fleshy (some when fresh); ligneous. Endocarp dull; monochrome; brown; scurfy; nonseptate or subseptate; with septa thin (tissue paper-like), flexible; chartaceous; not exfoliating; remaining fused to 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. Aril absent.

Seed $20-80 \times 15-60 \times 15-60$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; symmetrical; oblong or circular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent or present; not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous (to membranceous). Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum

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

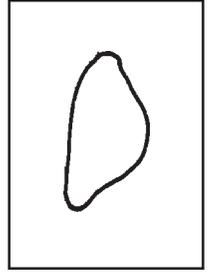
Distribution: Neotropics, with two subspecies in Africa.

Notes: According to Lock (1989), the species of *Andira* in Africa is now treated as *Andira inermis* (O.P. Swartz) K.S. Kunth ex A.-P. de Candolle subsp. *inermis*, subsp. *grandiflora* (J.B.A. Guillemin & G.S. Perrottet) R.M. Polhill, and subsp. *rooseveltii* (E.A.J. Wildeman) R.M. Polhill. Mattos (1979a) monographed the genus in Brazil and recognized 27 species and seven varieties.

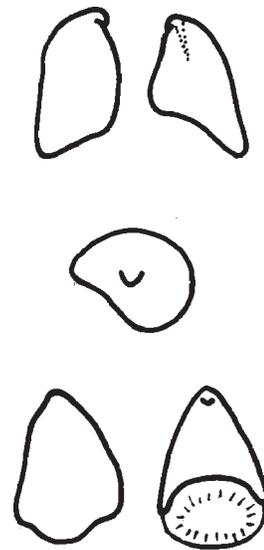
Andira: *A. fraxinifolia* G. Bentham (C-E), *A. spp.* (A-B). A, Fruits (without and with epicarps and one in transection) ($\times 0.5$); B, seeds ($\times 2$); C-D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 1$).



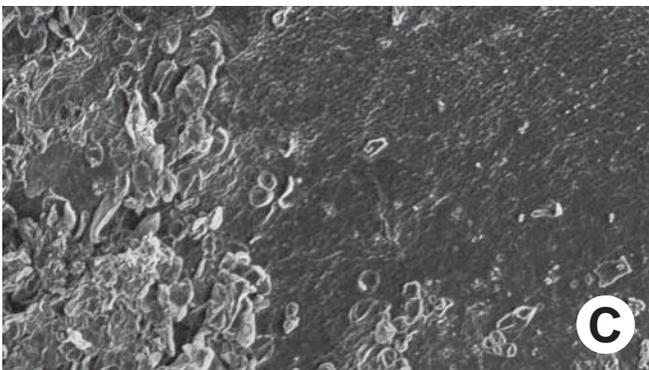
A



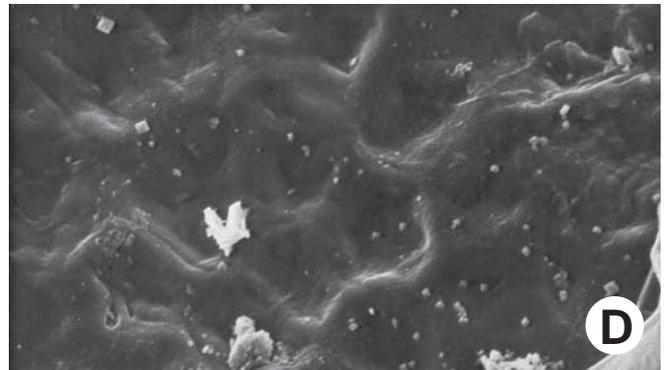
B



E



C



D

Genus: *Dalbergia* C. Linnaeus f.

Phylogenetic Number: 4.05.

Tribe: Dalbergieae.

Group: Dalbergia.

Species Studied—Species in Genus: 47 spp.—ca. 100 spp.

Fruit a legume; unilocular; $1.3\text{--}14.5 \times 1\text{--}3.5 \times 0.1\text{--}0.6$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight to curved (to slightly curved); not plicate; not twisted; symmetrical or asymmetrical; oblong, lanceolate, elliptic, fusiform, circular, reniform, or falcate; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures unequally curved; widest near middle or D-shaped; not inflated; flattened; without beak; rounded at apex; apex aligned or right-angled with longitudinal axis of fruit; rounded at base; base aligned or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; membranous or coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose or torulose. Fruit margin not constricted or constricted along both margins; without sulcus; embellished or plain; with wing. Fruit wing present or absent; 1; up to 30 mm wide; continuous wing around fruit; on both sutures. Fruit stipitate; with the stipe 10–30 mm long. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull or glossy; monochrome; reddish brown or tan; glabrous or pubescent and indurate; with 1 type of pubescence; tomentose; with pubescence gray (assumed); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; faintly wrinkled or verrucose-rugose; not exfoliating; without or with cracks (over seed chamber). Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; spongy; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1(–4); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril absent.

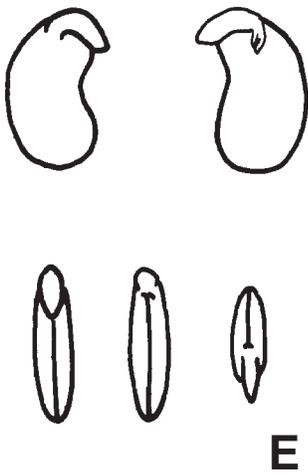
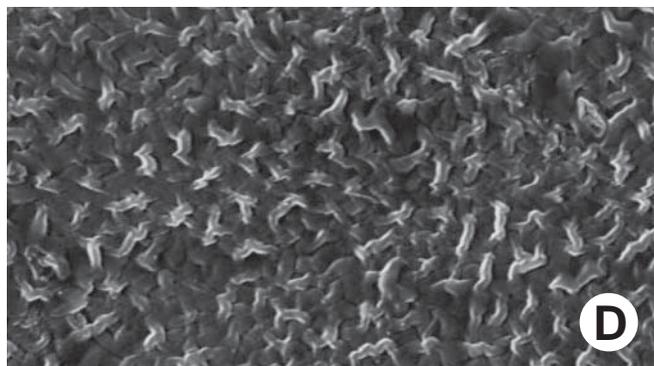
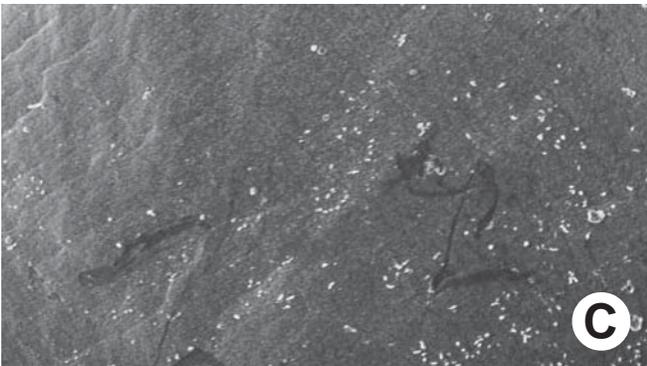
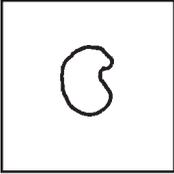
Seed $4\text{--}20 \times 2\text{--}11 \times 2\text{--}2.3$ mm; not overgrown; not angular; asymmetrical; reniform or oblong; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth or not smooth; with elevated or recessed features; shagreen; punctate (scattered especially near hilar area); chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible or visible; from hilum to lens (or lens not visible and terminating well before base of seed); not bifurcating; darker than testa; black; raised. Hilum fully concealed or visible; concealed by funicular remnant; with or without faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; punctiform; between cotyledon and radicle lobe; raised; not within corona, halo, or rim or within halo. Hilum halo color lighter than testa. Lens 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; up to 2 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; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan or green (yellowish); 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 curved or hooked; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed or rudimentary; glabrous.

Distribution: Pantropical.

Notes: Hoehne (1941) reported on the 42 species of *Dalbergia* that he recognized in Brazil, and Carvalho (1997) reviewed Brazilian *Dalbergia* accepting just 41 species of which three were newly described by him. Cronquist (1954) treated *Dalbergia* in the Congo, and

Sunarno and Ohashi (1997) treated the 21 species of Borneo, including four new ones. The seeds of *Dalbergia* are difficult to score for raphe and lens characters. Some seeds have a black mark on the reddish-brown testae, confluent with the hilum which may represent a raphe or a lens. If a raphe is apparent, then it does not go to the end of the seeds, and if a lens is apparent, then it is atypical in shape and thickness.

Dalbergia: *D. arbutifolia* A. Ducke (C–E), *D. spp.* (A–B).
A, Fruits ($\times 0.6$); B, seeds ($\times 3$); C–D, testa ($\times 50$,
 $\times 1000$); E, embryos ($\times 2$).



Genus: *Machaerium* C.H. Persoon

Phylogenetic Number: 4.06.

Tribe: Dalbergieae.

Group: Dalbergia.

Species Studied—Species in Genus: 73 spp.—ca. 120 spp.

Fruit a legume; unilocular; $2-9.5 \times 0.6-4 \times 0.17-0.5$ cm; with deciduous corolla; with deciduous or persistent calyx; with calyx shorter than fruit; without or with orifice formed by curving of fruit or fruit segments; straight, curved, 0.5-coiled, or 1-coiled; not plicate; not twisted; asymmetrical; falcate, C-shaped, coiled, circular, or samaroid; when asymmetrical with both sutures parallelly or unequally curved; not inflated; flattened or compressed; without beak; rounded or short tapered at apex; apex aligned or right-angled with longitudinal axis of fruit; rounded at base; base aligned or right angled 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; embellished or plain; with wings. Fruit wings absent or present; up to 30; samaroid; apical (and usually straight with seed chamber straight to curved or sharply bent (to 90 degrees in *M. robiniifolium* (A.-P. de Candolle) J.R.T. Vogel); on 1 valve; on 1 suture. Fruit stipitate to substipitate; with the stipe 2.5–10 mm long. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome or multicolored; bichrome (wing reddish-brown and seed chamber greenish-brown); brown (to dark or light reddish); glabrous, glabrate, or pubescent and indurate; with hairs appressed or erect; with 1 type of pubescence; puberulent; with pubescence gray or brown (reddish); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined (especially wings); not tuberculate; warty (well developed on seed chamber of *M. quinta* (J.C.B.F. Aublet) N.Y. Sandwith); not exfoliating; with (somewhat checking over seed chamber) or without cracks; cracking irregular. Mesocarp thin or thick (and corky over seed chamber); surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous or ligneous (sub). Endocarp dull; monochrome or streaked; brown; with streaking above and below seed chambers; with brown (reddish) overlay; smooth; nonseparate; chartaceous; not exfoliating; remaining

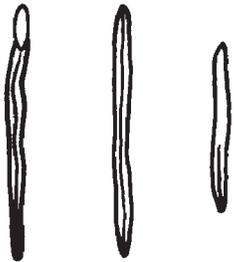
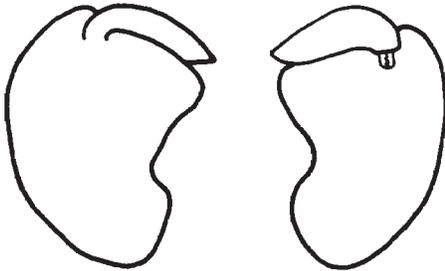
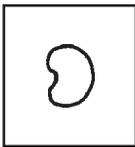
fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; thick; straight. Aril absent.

Seed $8.5-30 \times 3-15 \times 1-7$ mm; not overgrown or overgrown, 1 seed filling entire fruit cavity (especially in *M. lunatum* (C. Linnaeus Filins) W.A. Ducke); angular or not angular; asymmetrical; reniform, C-shaped, circular, ovate, or linear; flattened; with surface wrinkled, smooth, or ridged (radiating from hilum area); without visible radicle and cotyledon lobes; with deep hilar sinus or without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; dark reddish brown; with black overlay (areas where vitreous tissue is located); glabrous; not smooth or smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed (or midway to base) and terminating; not bifurcating; darker than testa; black; raised. Hilum fully concealed (remaining with fruit in *M. lunatum*) or partially concealed; concealed by funicular remnant or wing; without faboid split; punctiform or larger than punctiform; up to 25 mm long; with curved or angular outline; circular; irregular; between cotyledon and radicle lobe; recessed; not within corona, halo, or rim or within halo. Hilum halo color darker (black) than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth or smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially or not concealing radicle; split over radicle; with lobes; with lobes touching (auriculate), overlapping, or not touching; without or with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown (to dark brown), tan, or green (bright); 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, curved, or hooked; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed or moderately developed; glabrous.

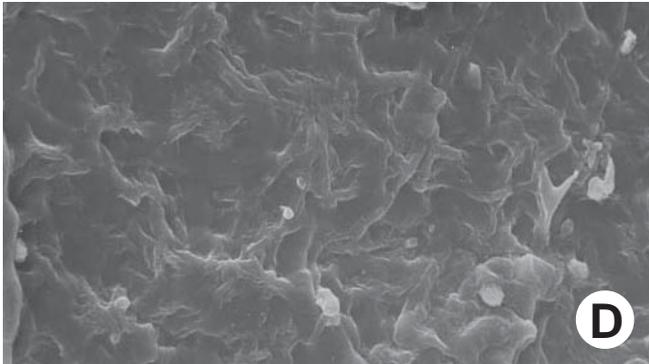
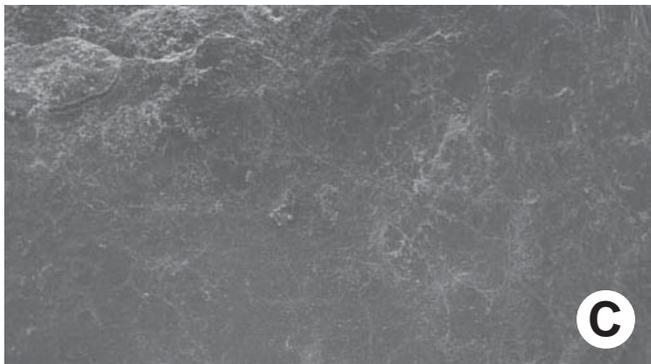
Distribution: Mexico, Central America to Argentina, with *M. lunatum* (C. Linnaeus) A. Ducke naturalized along west coast of Africa.

Notes: Rudd (1977) monographed the 14 species of *Machaerium* in Mexico, and Tamayo (1945) monographed the 5 species in Argentina. Seeds of *M. robiniifolium* have a unique testa morphology. The testa, like other testae in *Machaerium*, is chartaceous, but there are areas along the “raphe” axis that are thickened and contain vitreous black patches which are quite thick. These patches are visible on the surface of the testa.

Machaerium: *M. opacum* J.R.T. Vogel (C–E), *M. spp.* (A–B). Fruits ($\times 0.8$); B, seeds ($\times 1.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



E



Genus: *Fissicalyx* G. Bentham

Phylogenetic Number: 4.07.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume; unilocular; $4-6 \times 2.5-7 \times 0.4-0.8$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; oblong; not inflated; flattened; without beak; truncate 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 visible. Fruit margin not constricted; without sulcus; embellished; with wing. Fruit wing 1; up to 25 mm wide; samaroid; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; tan (yellowish with darker seed chamber); pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; 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 to reticulately veined (transversely on wings and prominent midrib over seed chamber); not tuberculate; not exfoliating; without cracks. Mesocarp present (around seed chamber); thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome (with a few random reddish-brown “glands?”); tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; flattened; straight. Aril absent.

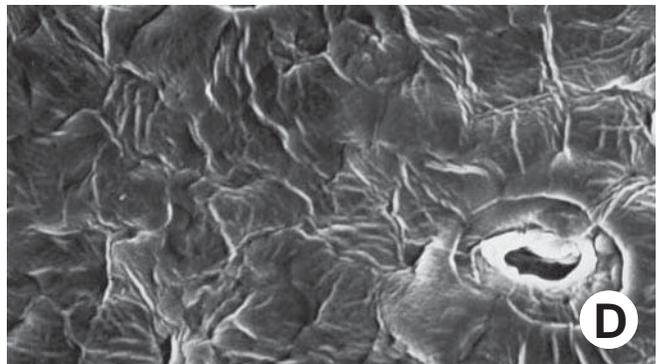
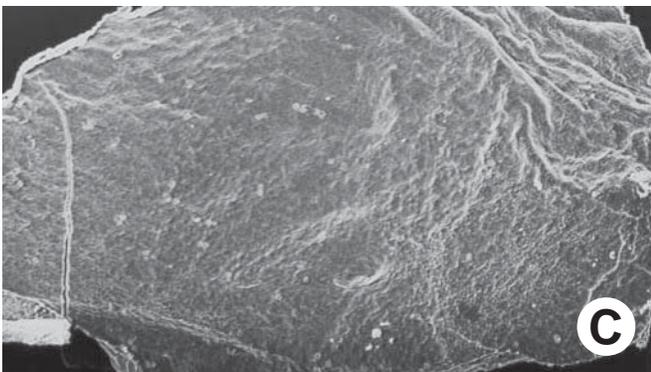
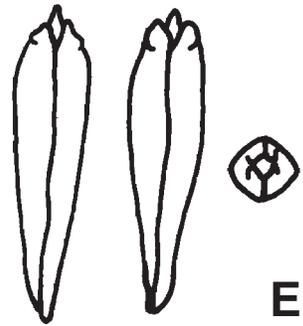
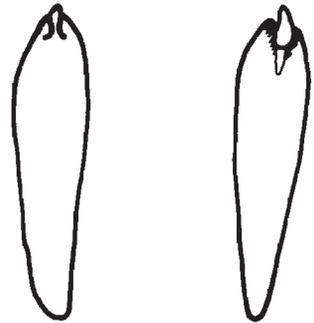
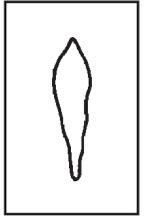
Seed $15-25 \times 4.5-12 \times 4$ mm; not overgrown; angular; symmetrical; linear; more or less terete; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or streaked (occasionally with 1 streak on each face); with infrequent streaks; reddish brown; with brown (dark reddish) overlay; glabrous; not smooth; with elevated features; wrinkled (large and small); chartaceous.

Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; reddish brown; slightly raised. Hilum partially concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 1.2 mm long; with curved outline; elliptic; subapical to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons not smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; straight with embryonic axis or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Panama, Venezuela, and Guyana.

Notes: Seeds were difficult to obtain, thus our data are based on limited material.

Fissicalyx: *F. fendleri* G. Bentham (A–E). A, Fruits ($\times 0.8$); B, seed ($\times 4.2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2.5$).



Genus: *Platymiscium* J.R.T. Vogel

Phylogenetic Number: 4.08.

Tribe: Dalbergieae.

Group: Dalbergia.

Species Studied—Species in Genus: 16 spp.—ca. 18 spp.
(R.T. Pennington, personal communication, 1998).

Fruit a legume; unilocular; $4\text{--}15 \times 1.5\text{--}4.5 \times 0.09\text{--}0.4$ 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; symmetrical; elliptic or oblong; not inflated; flattened; without beak; rounded at apex; apex aligned or oblique (slightly) 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 constricted or not constricted; slightly constricted along both margins; without sulcus; embellished; with wing. Fruit wing 1; up to 40 mm wide; samaroid; on both sutures. Fruit stipitate; with the stipe 7–10 mm long. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; brown (to greenish to reddish) or tan; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; wrinkled or tuberculate (scattered); not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; reddish brown; smooth and reticulate; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; thick; straight. Aril absent.

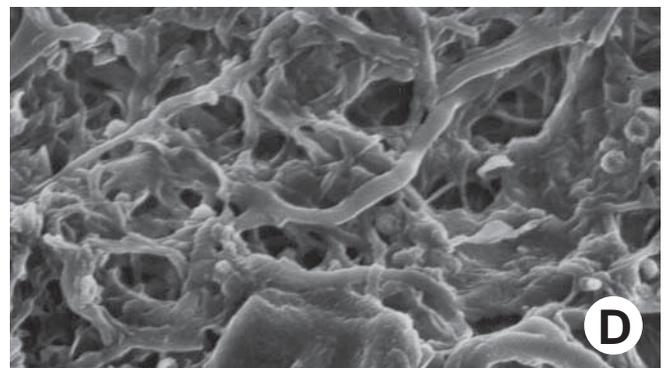
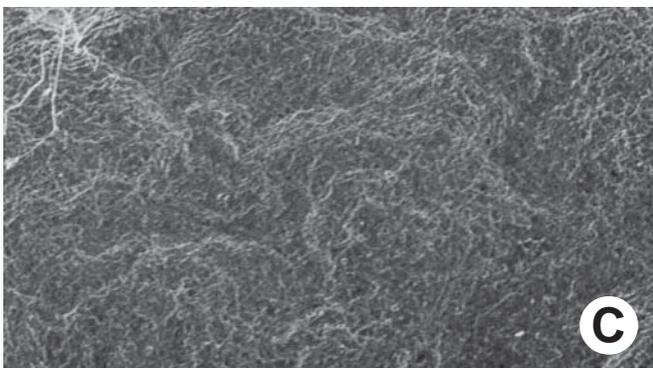
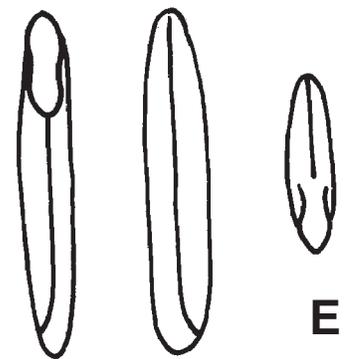
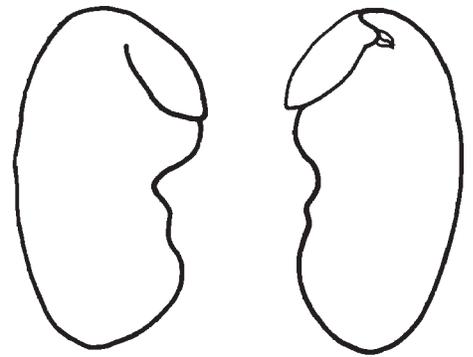
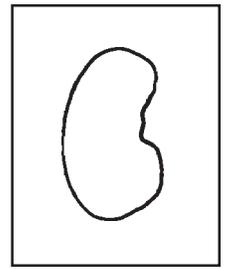
Seed $7\text{--}20 \times 3\text{--}10 \times 1.5$ mm; not overgrown; not angular; asymmetrical; reniform (to subreniform); flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown (to greenish); glabrous; smooth or not smooth; with elevated features; slightly wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe faintly visible or not visible; from hilum to lens; not bifurcating; slightly darker than testa; brown (to greenish); raised. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform;

marginal according to radicle tip; flush; not within corona, halo, or rim. Lens faintly discernible or not discernible; less than 0.5 mm in length; with margins straight or curved; oblong; not in groove of raphe; adjacent to hilum; up to 8 mm from 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; (almost) partially concealing or not concealing radicle; entire over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown or tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

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

Notes: Pittier (1918) provided some fruit and seed data for *Platymiscium pinnatum* (N. von Jacquin) A. Dugand, and Zamora and Klitgaard (1997) published a new species for Costa Rica, *P. curuense* N. Zamora & B.B. Klitgaard, which is included in the species count.

Platymiscium: *P. filipes* G. Benth (C–E), *P.* spp. (A–B). A, Fruits ($\times 0.5$); B, seeds ($\times 1.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



Genus: *Grazilodendron* H.C. de Lima

Phylogenetic Number: 4.09.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume; unilocular; 8–12 × 4–5 × 0.5 cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong or elliptic; when asymmetrical with both sutures parallelly curved; not inflated; flattened; 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; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; embellished; with wing. Fruit wing 1; up to 50 mm wide; samaroid; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; greenish brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; whitish 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 less than 0.5 mm long; of 1 length only; flattened; straight. Aril absent.

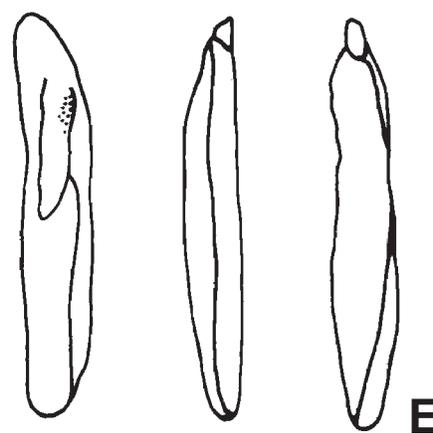
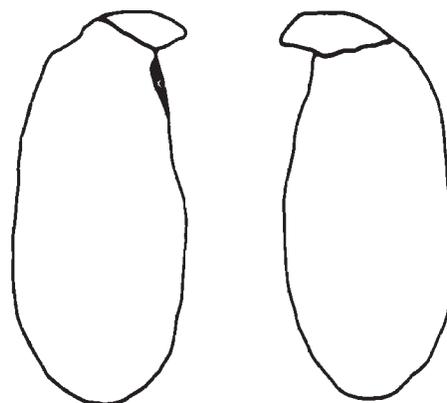
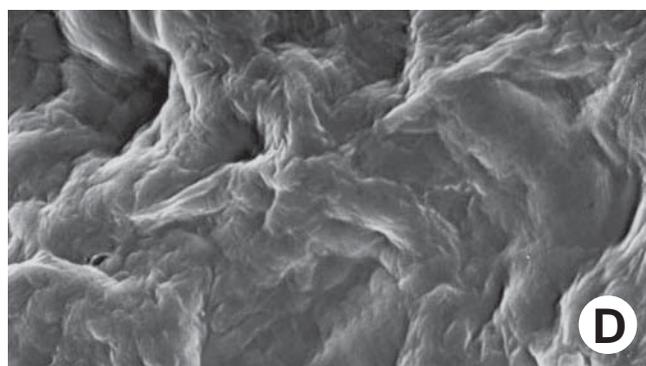
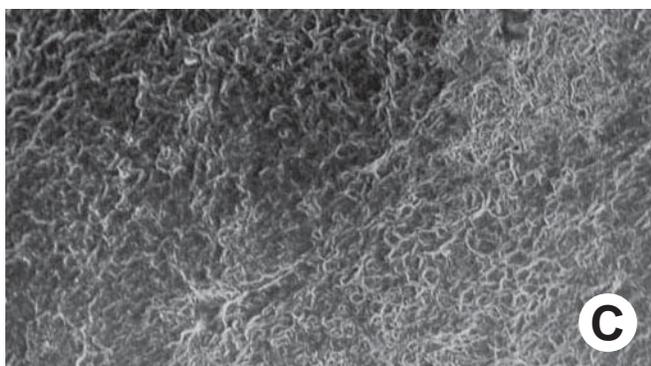
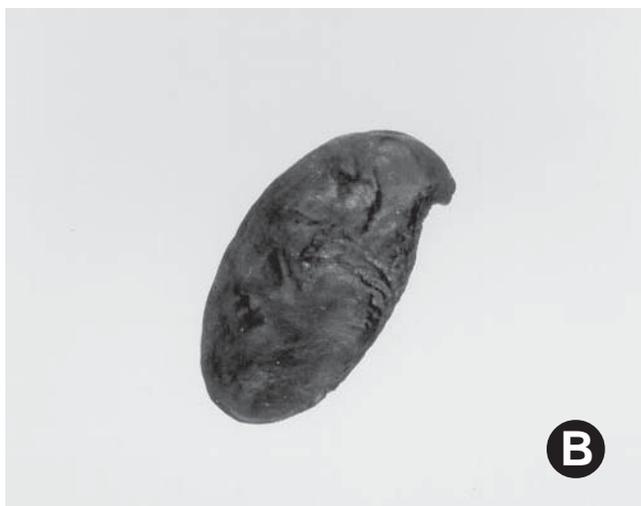
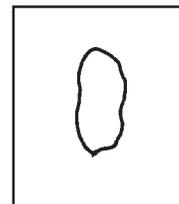
Seed 25–30 × 10–14 × 2.5 mm; not overgrown; not angular; asymmetrical; oblong; flattened; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; not smooth; with elevated features; wrinkled and shagreen; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; dark reddish brown; raised. Hilum visible or partially concealed; concealed by wing; without faboid split;

larger than punctiform; 0.5 mm long; with curved outline; elliptic; between cotyledon and radicle lobe; flush; within rim (not well developed). Hilum rim color darker than testa. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes not touching or touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous or linear; lobe tip straight or curved; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Brazil.

Notes: Lima (1983) founded this monotypic genus and sent us seeds and fruits for our study.

Grazilodendron: *G. rio-docensis* H.C. de Lima (A–E). A, Fruits (× 0.6); B, seed (× 2.2); C–D, testa (× 50, × 1000); E, embryos (× 2.5).



Genus: *Paramachaerium* A. Ducke

Phylogenetic Number: 4.10.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume or nutlet; unilocular; $2.5\text{--}12 \times 2\text{--}6 \times 0.7\text{--}1$ cm; with deciduous corolla; with deciduous calyx; straight or curved (slightly); not plicate; not twisted; asymmetrical; oblong, lanceolate, falcate, C-shaped (barely), or samaroid; when asymmetrical with both sutures parallelly curved, unequally curved, or nearly straight; not inflated; flattened; without beak; rounded or short tapered at apex; apex oblique or right-angled with longitudinal axis of fruit; short tapered or rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or ligneous (especially seed chambers); seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished or plain; with wing. Fruit wing present or absent (in *P. schomburgkii*); 1; up to 100 mm wide; samaroid; basal; on 1 suture. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown (but turning black on drying) or black; glabrate or pubescent but soon deciduous; with 1 type of pubescence; pilose or tomentose; with pubescence brown (reddish); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick (over seed chamber); surface uniformly veined; 2-layered; without balsamic vesicles; with fibers; with fibers over solid layer; coriaceous or ligneous. Endocarp dull; monochrome; tan; smooth; septate or nonseptate; with septa thicker than paper, firm (solid); with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1 or 2; length transverse to fruit length; neither overlapping nor touching or overlapping and touching; in 1 series. Funiculus of 1 length only; straight. Aril absent.

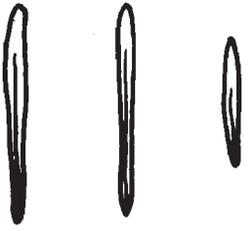
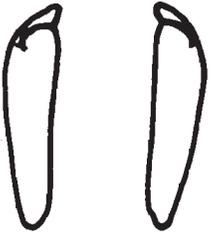
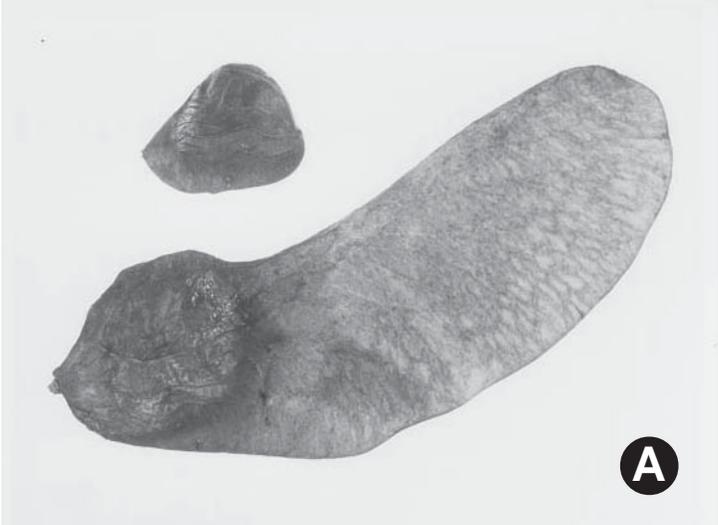
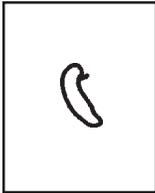
Seed $1.4 \times 0.4 \times 0.3$ mm; not overgrown; not angular; asymmetrical; linear, oblong, reniform (to oblong), or triangular; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external

groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown (brown to blackish); glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary; glabrous.

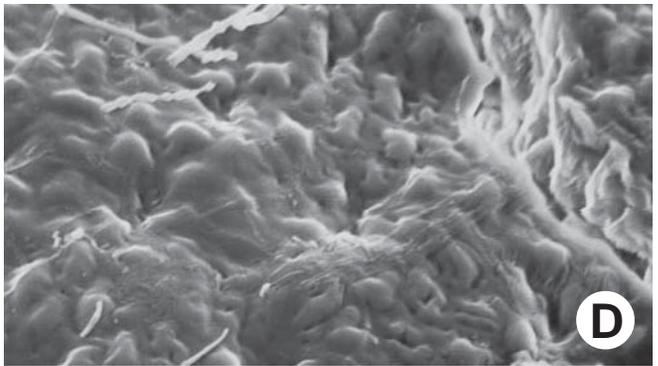
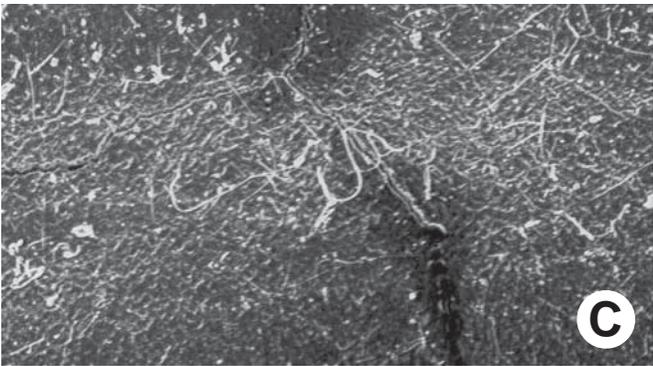
Distribution: Panama, Guyana, and Brazil.

Notes: Rudd (1981b) supplied the count of five species, and we are not using the three-species count of Polhill (1981d). Rudd noted, "that the two species, *P. schomburgkii* and *P. ormosioides* (A. Ducke) A. Ducke with the least wing development on the pods which are presumably best adapted to flotation, are reported to occur on periodically inundated land, 'igapó.' Two other species, *P. gruberi* G.K. Brizicky and *P. schunkei* V.E. Rudd, with conspicuous wing development and *P. krukovii* V.E. Rudd, expected to have winged pods, are found in locations not subject to flooding." Brizicky (1960) presented fruit and seed data for the Panamanian species, *P. gruberi*.

Paramachaerium: *P. schomburgkii* (G. Bentham) A. Ducke (B–E), *P. spp.* (A). A, Fruits ($\times 0.8$); B, seeds ($\times 5.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



E



Genus: *Ramorinoa* C.L. Spegazzini

Phylogenetic Number: 4.11.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume; unilocular; $3.8\text{--}6.5 \times 2.5\text{--}3.5 \times 1.5\text{--}2.5$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong or ovate; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; compressed or terete; without beak; rounded at apex; apex oblique or aligned 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; ligneous; seed chambers externally visible; with the raised seed chambers not torulose (at most faintly). Fruit margin not constricted; without sulcus; embellished or plain; with wing. Fruit wing 1; up to 0.5 mm wide; sutural; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; brown; 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; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; monochrome; tan; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–4; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; straight. Aril present or absent; dry; rim-aril; gray.

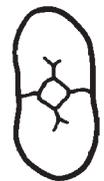
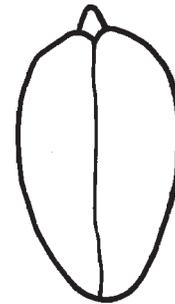
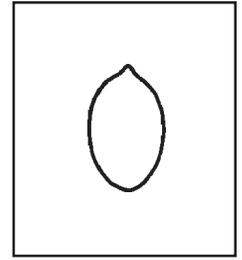
Seed $12\text{--}13 \times 9\text{--}10 \times 6.5\text{--}7$ mm; not overgrown; not angular; symmetrical; ovate; compressed; with surface smooth; without or with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; not smooth or smooth; with elevated

features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; without faboid split; punctiform; subapical to radicle tip; deeply recessed; 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; partially concealing radicle; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed (barely) or rudimentary; glabrous.

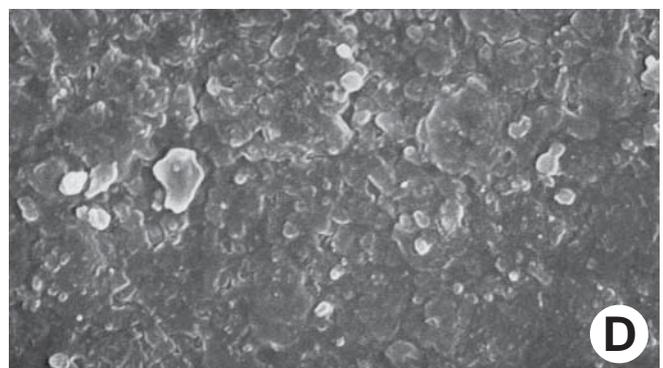
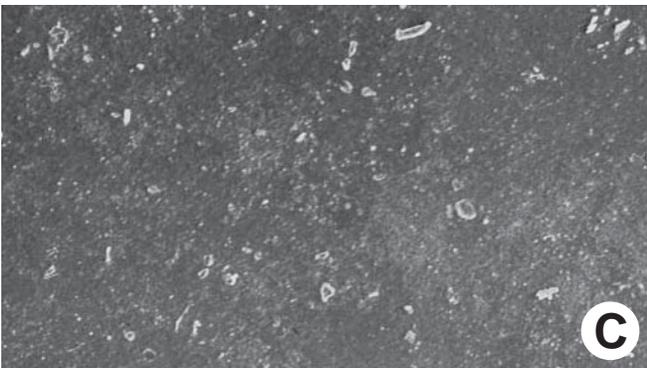
Distribution: Western Argentina.

Notes: Hunziker and Cocucci (1961) reported on the fruits and seeds of *Ramorinoa girolae*. As noted in Gunn (1991), dorsoventrally compressed seeds are rare in the Fabaceae. *Ramorinoa* is one of those rare genera as are the caesalpinoid genera *Cassia* (2.16) and *Afzelia* (4.20).

Ramorinoa: *R. girolae* C.L. Spegazzini (A–E). A, Fruits ($\times 1.2$); B, seed ($\times 3.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



G



Genus: *Centrolobium* C.F.P. von Martius ex G. Bentham

Phylogenetic Number: 4.12.

Tribe: Dalbergieae.

Group: Dalbergia.

Species Studied—Species in Genus: 5 spp.—6 or 7 spp.

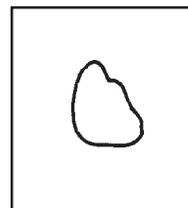
Fruit a legume or nutlet; unilocular; 10–26 × 6–10 × 2–4.5 cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; terete; without or with beak; straight or declined; with solid beak the same color and texture as fruit; rounded at apex; apex right-angled 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; liginous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with spines or with wing. Fruit wing present (usually coriaceous to nearly chartaceous); 1; 100 mm wide (widest part of fruit); samaroid; apical. Fruit stipitate to substipitate to nonstipitate (nearly); with the stipe 0.2–20 mm long. Fruit indehiscent. Replum invisible. Fruit an intact article. Epicarp dull; monochrome; dark to light brown; glabrous or pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; tomentose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular or glandular; with glandular dots (bright reddish); with spines (2–5 cm long); with spines persistent or broken off and their bases evident; with spines same color as the rest of the fruit; not smooth; with elevated features; not veined; tuberculate (if spines broken) or not tuberculate; with solid tubercles on each valve; warty, tuberculate (when spines broken), or glandular dotted; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; with fibers; with fibers below solid or compacted fibrous layer; liginous. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1(–5); length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only. Aril absent.

Seed 12–13 × 3.7–4.3 × 0.9–1.1 mm; not overgrown; angular; asymmetrical; D-shaped; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; dark reddish brown; 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; larger than punctiform; 1 mm long; with curved outline; almost circular; between cotyledon and radicle lobe; flush; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 1 mm long; with margins curved; circular; not in groove of raphe; adjacent to hilum; 1 mm from hilum; mounded; same color as testa; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without or with lobes; with lobes touching (auriculate); with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

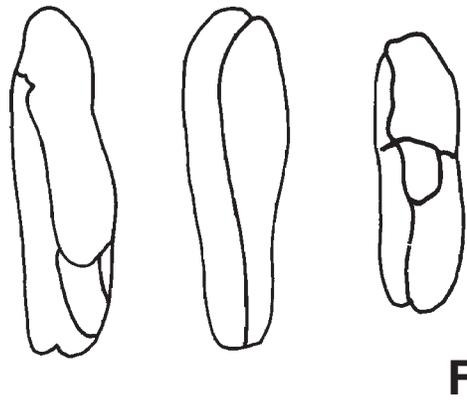
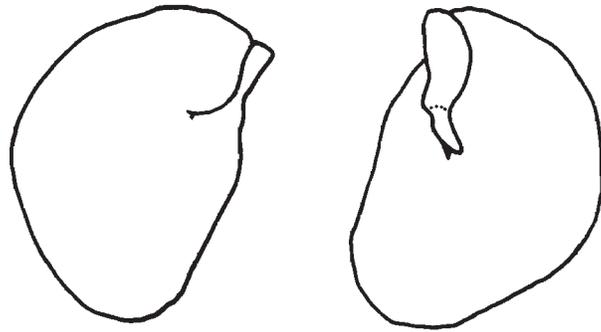
Distribution: Panama to Ecuador, Bolivia, and Brazil.

Notes: Rudd (1954) monographed the genus, and Lima (1988) studied the three species in Brazil which occur outside the Amazon region. The fruits of *Centrolobium* are unique in their size and morphology in the Fabaceae. The seed is located in a fibrous chamber within the solid or tightly packed fibrous mesocarp at the base of a wing (fig. A). The wings are effective in distribution of the genus, and apparently the spines are a defensive mechanism against herbivores.

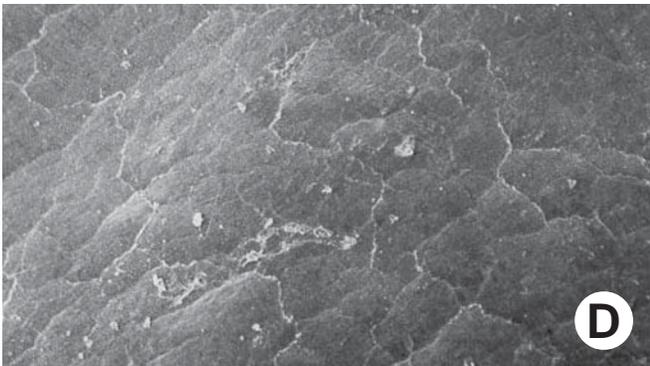
Centrolobium: *C. paraense* E.L.R. Tulasne (B–C), *C. parceanum* J. Hill (A). A, Fruits (× 0.5); B, seed in situ (× 1.6); C, seeds (× 4.4).



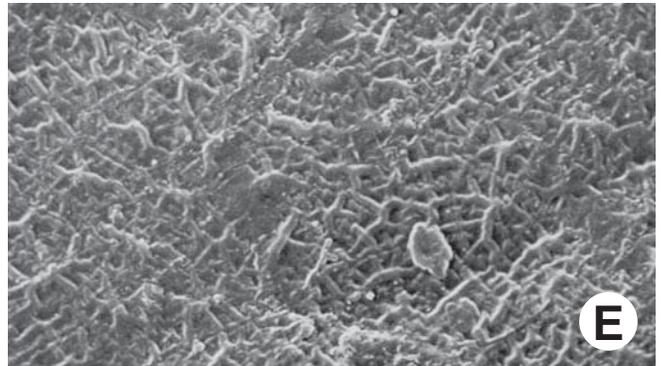
Centrolobium (con.): *C. paraense* E.L.R. Tulasne (*D-F*).
D-E, testa ($\times 50$, $\times 1000$); *F*, embryos ($\times 3$).



F



D



E

Genus: *Tipuana* (G. Bentham) G. Bentham

Phylogenetic Number: 4.13.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume; unilocular; $4.5-8 \times 2-3.2 \times 0.7-1$ cm; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; seed chamber compressed and flattened (wing); 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; seed chamber ligneous and membranous (wing); seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with wing (often eroded). Fruit wing 1; 40–60 mm wide; samaroid; on 1 suture. Fruit stipitate; with the stipe 10 mm long. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; brown to reddish brown; glabrous, pubescent but soon deciduous, 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; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick (seed chamber) or thin (wing area); surface uniformly veined; 1-layered; without balsamic vesicles; with fibers; ligneous. Endocarp dull; mottled and streaked; brown; with mottling over seed chambers; with black overlay; smooth; septate or nonseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–4; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; S-curved. Aril absent.

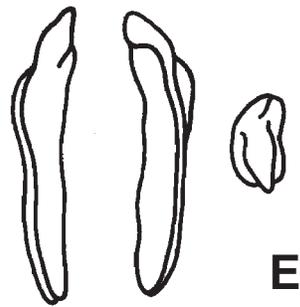
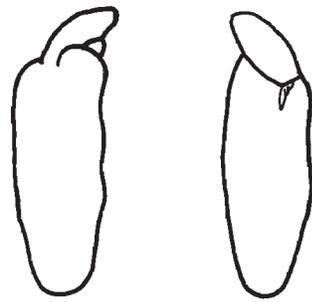
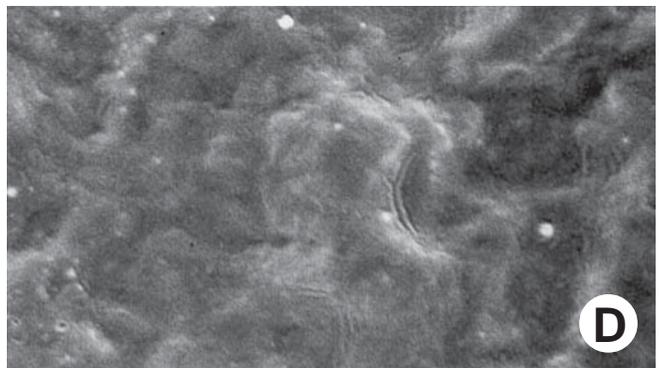
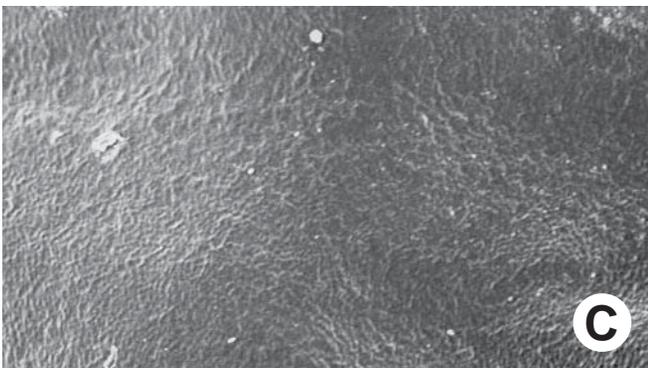
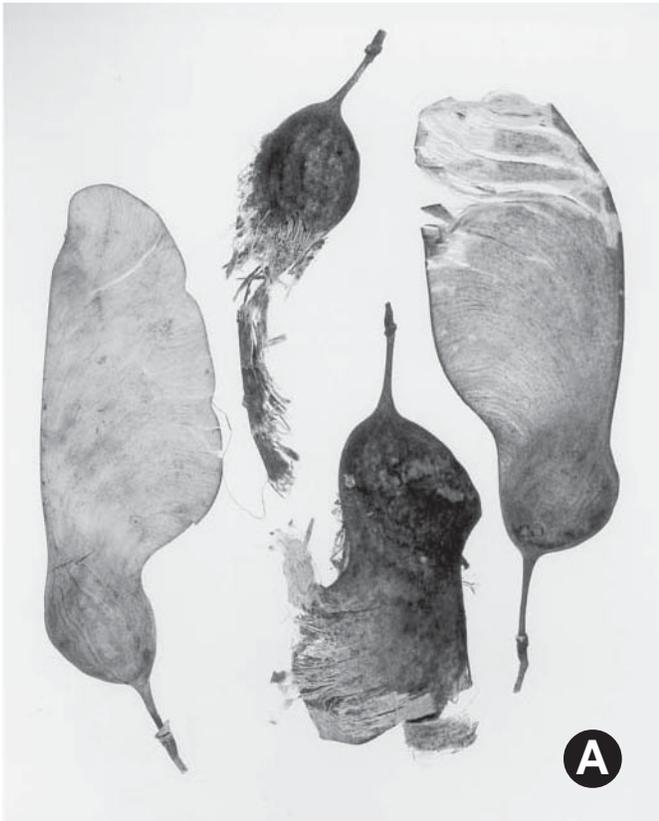
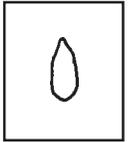
Seed $8 \times 3 \times 1.5$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface grooved (1 groove); with grooves longitudinal; with visible

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; reddish brown; glabrous; not smooth; with recessed features; grooved (1 on each face); chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; reddish brown; raised. Hilum fully concealed; concealed by funiculus; without faboid split; punctiform; between cotyledon and radicle lobe; flush; within rim. Hilum rim color darker than testa. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle (concealing margins of radicle); entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed or with 1 or both recessed (somewhat); 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; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: Bolivia to northwestern Argentina.

Notes: Rudd (1974) presented an overview of this genus.

Tipuana: *T. tipu* (G. Bentham) C.E.O. Kuntze (A–E). A, Fruits ($\times 1.1$); B, seed ($\times 5.1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Platypodium* J.R.T. Vogel

Phylogenetic Number: 4.14.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume; unilocular; $6.5\text{--}13.5 \times 1.9\text{--}4 \times 0.7\text{--}1.2$ 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; samaroid; when asymmetrical with both sutures unequally curved; not inflated; flattened (wing) or compressed (seed chamber); without beak; short tapered at apex; apex oblique (slightly) with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous (seed chamber); seed chambers externally visible; with the raised seed chambers torulose. Fruit margin not constricted; without sulcus; embellished; with wing. Fruit wing 1; samaroid; basal; on 1 suture. Fruit stipitate; with the stipe up to 15 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (though somewhat reddish-brown over seed chamber); brown (reddish over seed chamber and tan winged or with an overall reddish-brown cast) or tan; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately and 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; subligneous. 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; 2 mm long; of 1 length only; thick; nearly straight. Aril absent.

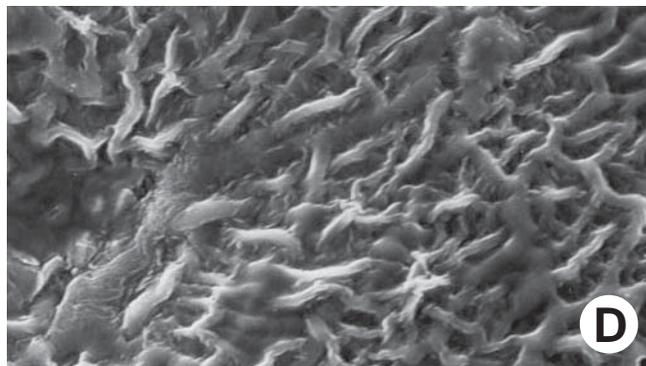
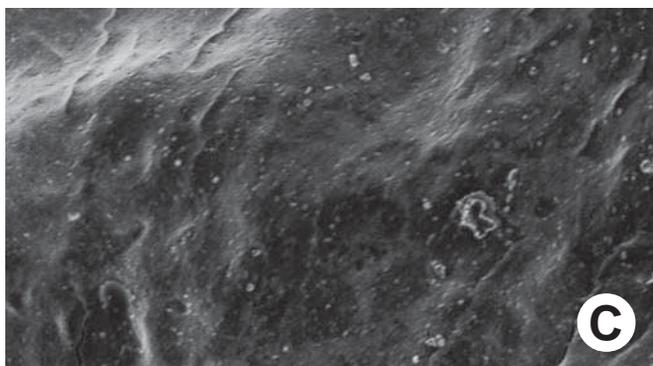
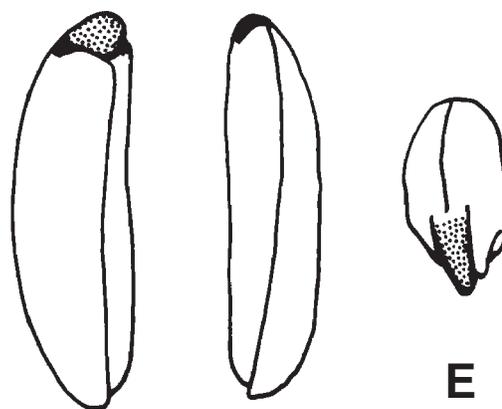
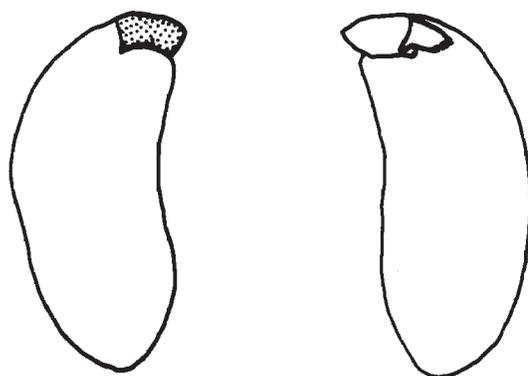
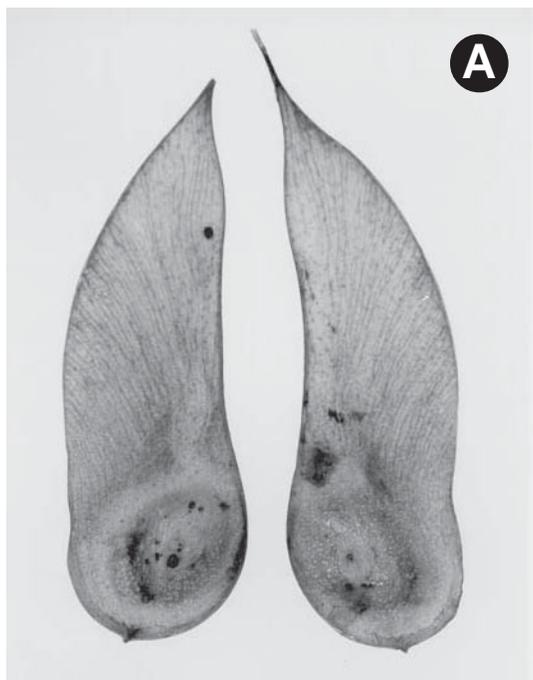
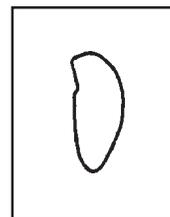
Seed $17 \times 10 \times 3$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating;

not bifurcating; slightly darker than testa; reddish brown; slightly recessed. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; 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 bulbous; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Panama, Guatemala, Colombia, Venezuela, Bolivia, Brazil, and Paraguay.

Notes: Polhill (1981d) noted that this genus has “probably only one or two species,” but recently annotated herbarium sheets indicate that there may be only one species.

Platypodium: *P. elegans* J.R.T. Vogel (A–E). A, Fruits ($\times 1.1$); B, seeds ($\times 3.2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2.5$).



Genus: *Geoffroea* N. von Jacquin

Phylogenetic Number: 4.15.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume or nutlet; unilocular; $1.7\text{--}4.5 \times 1.8\text{--}2.7 \times 1\text{--}2.5$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong or circular; when asymmetrical with both sutures parallelly curved; not inflated; terete; without beak; rounded or 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; drupaceous, fleshy (when fresh), or ligneous (when dry); seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull or glossy; monochrome; reddish brown or tan; glabrous, glabrate, or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; straight; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; faintly wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with spongy layer over solid layer; ligneous. Endocarp dull; monochrome; tan; scurfy; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only. Aril absent.

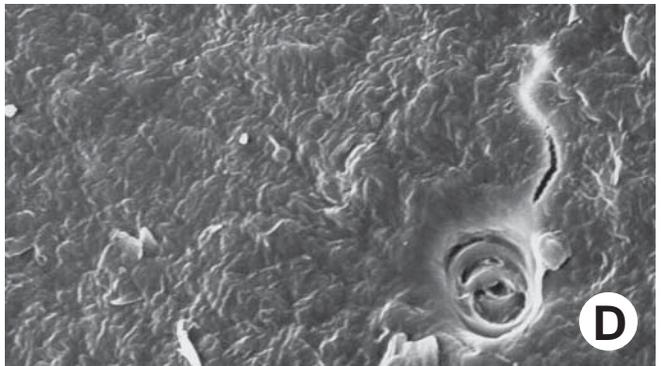
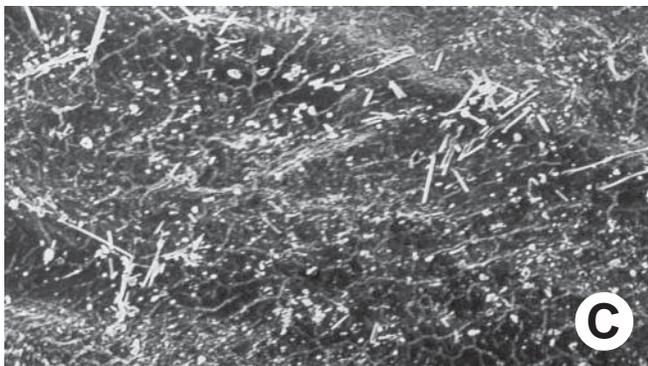
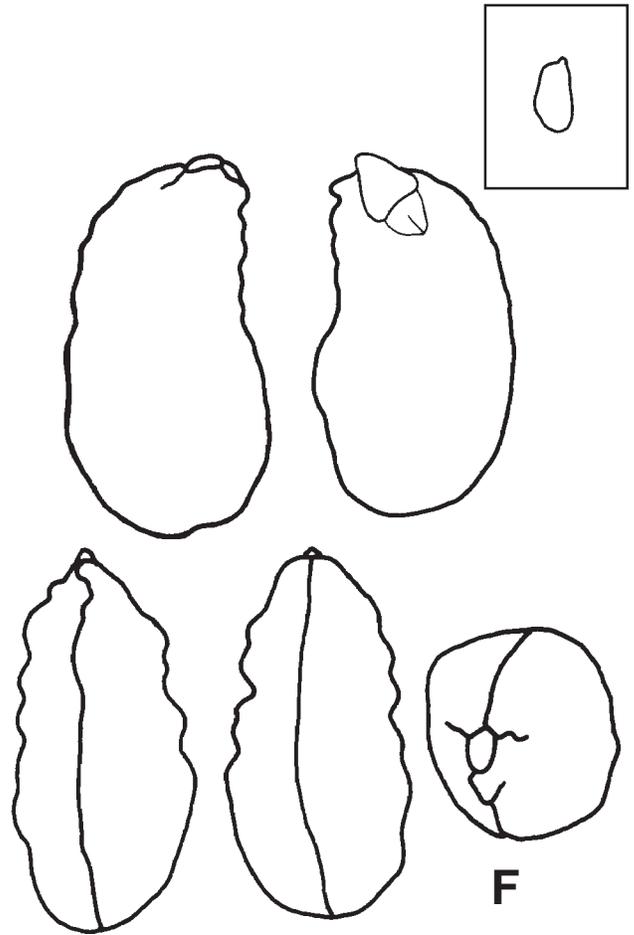
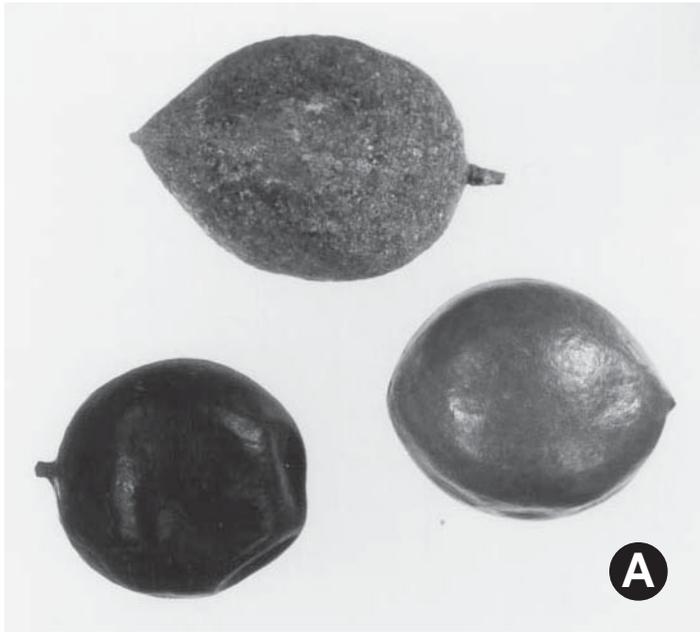
Seed $14\text{--}25 \times 3\text{--}17 \times 4\text{--}13$ mm; not overgrown; not angular or angular; asymmetrical or symmetrical; ovate or elliptic (to fusiform); terete; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa absent or present; not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to lens; bifurcating at

base of seed with each arm going up antiraphe side, turning (U-shaped) down, and approaching bifurcation; darker than testa; brown (dark reddish-brown); recessed. Hilum present; fully concealed; concealed by funicular remnant; without faboid split; punctiform; subapical to radicle tip; raised; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons not smooth (wrinkled to clearly 2–4 transversely ribbed); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing or not concealing radicle; split over radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown or red; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; straight with embryonic axis or deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Colombia and Venezuela to Chile and northern Argentina (Patagonia).

Notes: Burkart (1949) monographed the genus.

Geoffroea: *G. decorticans* (J. Gillies ex W.J. Hooker & G.A.W. Arnott) A.E. Burkart (*D–E*), *G. spinosa* N. von Jacquin (*F*), *G. spp.* (*A–C*). *A*, Entire fruits ($\times 1.7$); *B*, opened mesocarps above intact mesocarps ($\times 1.7$); *C*, seeds (left and above) and embryo (lower right) ($\times 2.1$); *D–E*, testa ($\times 50$, $\times 1000$); *F*, embryos ($\times 5$).



Genus: *Cascaronia* A.H.R Grisebach

Phylogenetic Number: 4.16.

Tribe: Dalbergieae.

Group: Dalbergia.

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

Fruit a legume; unilocular; $2\text{--}3.5 \times 0.6\text{--}1.2 \times 0.18\text{--}0.22$ cm; with deciduous corolla; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; elliptic (oblong) or oblong; when asymmetrical with both sutures nearly straight or 1 straight and 1 curved; widest near middle or D-shaped; not inflated; flattened; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished or plain; with wing (no texture difference between seed chamber and wing; whole fruit acts as samara). Fruit wing absent or present; 1; samaroid; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; brown (with reddish-brown glands); glabrous; glandular; with glandular dots; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length (radiating from base) or reticulately veined (somewhat); not tuberculate; glandular dotted; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; white or tan (almost white); smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 2 or 1; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only. Aril absent.

Seed 5–6 (using immature seed) $\times 1.5\text{--}2$ mm; not overgrown; not angular; asymmetrical; reniform (elongate); compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth;

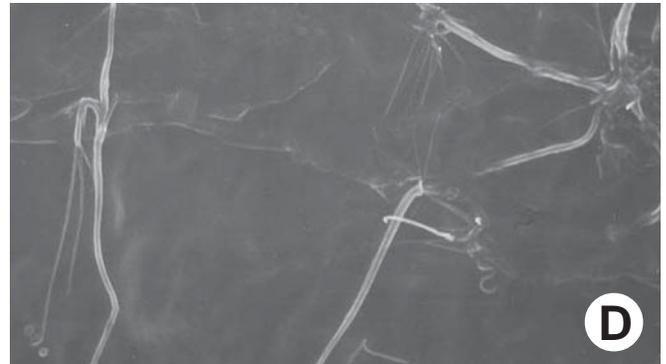
coriaceous (assumed). Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; reddish brown; recessed. Hilum visible; without faboid split; punctiform; between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; circular; in groove of raphe; adjacent to hilum; 0.3 mm from hilum; mounded; similar color as testa; darker than testa; reddish brown; not within corona, halo, or rim.

Distribution: Bolivia and Argentina.

Notes: We studied limited fruit material and immature seeds.

Cascaronia: *C. astragalina* A.H.R. Grisebach (A–D). A, Fruits ($\times 2.2$); B, seed ($\times 4.5$); C–D, testa ($\times 50$, $\times 1000$).

D



Genus: *Pterocarpus* N. von Jacquin

Phylogenetic Number: 4.17.

Tribe: Dalbergieae.

Group: Dalbergia.

Species Studied—Species in Genus: 11 spp.—20 spp.

Fruit a legume; unilocular; $2-13 \times 2-11 \times 0.5-2.5$ cm; with deciduous corolla; with deciduous calyx; without (sometimes almost coiled and forming an orifice) or with orifice formed by curving of fruit or fruit segments; straight or 0.5–1-coiled; not plicate; not twisted; asymmetrical or symmetrical; circular, elliptic, or oblong; when asymmetrical with both sutures nearly straight, 1 straight and 1 curved suture, or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed or flattened; without beak; rounded at apex; apex right-angled (to about 180 degrees), oblique, or aligned with longitudinal axis of fruit; short tapered, rounded, or emarginate (to notched) at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous, coriaceous, or ligneous (especially seed chamber); seed chambers externally visible; with the raised seed chambers torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; embellished; with wing. Fruit wing present (and entire but in time eroding) or absent (*P. officinalis* N. von Jacquin); 1; up to 50 mm wide; samaroid; on 1 suture. Fruit stipitate or substipitate; with the stipe up to 15 mm long. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; brown or black; glabrous or glabrate; with 1 type of pubescence; puberulent; with pubescence tan, gray, or brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; with spines (over the seed chambers); with spines persistent; with spines same color as the rest of the fruit; not smooth; with elevated features; not veined or reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp quite thin; surface uniformly veined or not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous to subcoriaceous. Endocarp dull; monochrome; tan; smooth; nonseptate or septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1(–3); length oblique or transverse to fruit length;

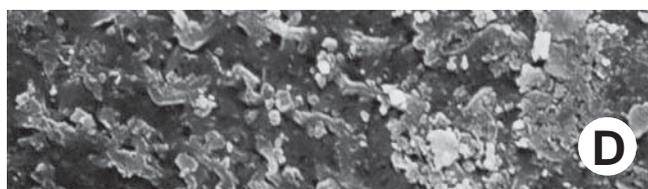
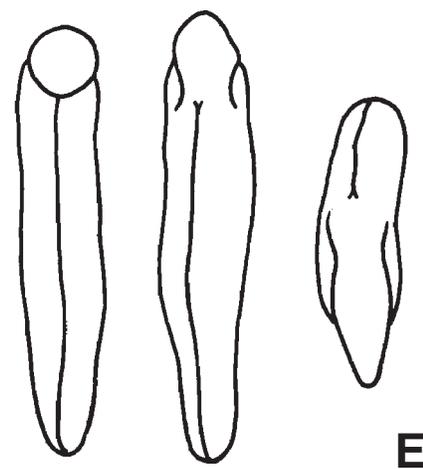
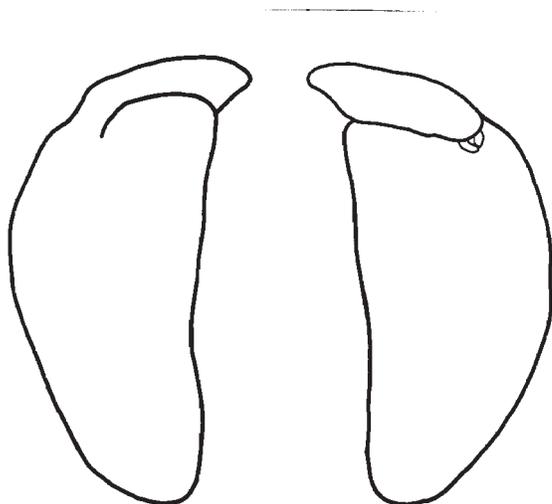
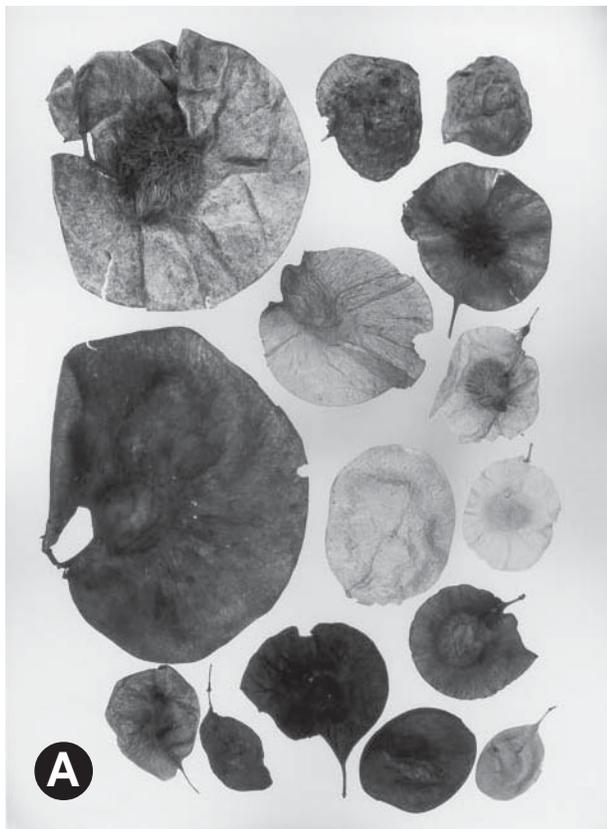
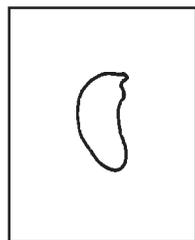
neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; triangular; straight. Aril absent.

Seed $7-14 \times 2-9 \times 3-3.6$ mm; not overgrown; not angular or angular; asymmetrical; reniform, D-shaped, or irregular; compressed; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or glossy; not modified by a bloom; colored; monochrome; light to dark reddish brown or tan; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible or visible; from hilum through lens to base of seed and terminating (near base); not bifurcating; darker than testa; reddish brown; slightly raised. Hilum visible, partially concealed, or fully concealed; concealed by funicular remnant or funiculus; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform or punctiform; 0.3–1 mm long; with curved outline; circular or elliptic; between cotyledon and radicle lobe; recessed; within rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; nearly circular (with or without attenuate ends); not in groove of raphe; confluent (or nearly so) with hilum; mounded; same color as testa; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth or not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded or with only 1 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; partially concealing radicle; notched over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; lobe tip straight or curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Pantropical.

Notes: Rojo (1977) studied the Malesia-Pacific species and listed the 20 species worldwide that he recognized. His report focused on fruit characters and ecological factors relevant to species dispersal and speciation. The monograph by Breitenback (1973) of the excellent timber tree of South Africa, kiaat or Transvaal-teak (*P. angolensis* A.-P. de Candolle) included an evaluation of fruits of selected species. The fruits of many species (about 80 percent) are winged, but some fruits have the wings reduced to a keel. The seed chamber may be smooth to spiny even within one species: *P. indicus* C.L. von Willdenow.

Pterocarpus: *P. erinaceus* J.L.M. Poiret (*C-E*), *P. spp.*
(*A-B*). *A*, Fruits ($\times 0.4$); *B*, seeds ($\times 1.6$); *C-D*, testa
($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



Abreae (5.01)

Genus: *Abrus* M. Adanson

Phylogenetic Number: 5.01.

Tribe: Abreae.

Species Studied—Species in Genus: 10 spp.—17 spp.

Fruit a legume; unilocular; $3\text{--}4.5 \times 1 \times 0.5$ cm; with deciduous corolla; with deciduous calyx; straight; not plicate; not twisted; asymmetrical or symmetrical; oblong; with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; without beak; short tapered at apex; apex aligned or right-angled with longitudinal axis of fruit; short tapered or rounded at base; base oblique with longitudinal axis of fruit (slightly); with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along 1 or along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan; pubescent but soon deciduous; with 1 type of pubescence; puberulent; with pubescence gray-brown or gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth (nearly); not veined; not tuberculate; checking; with or without cracks; cracking oblique to fruit length. Mesocarp thin; 1-layered; without balsamic vesicles; solid; ligneous (sub). Endocarp dull; monochrome; tan or white; smooth; septate (fragile and conspicuously developed to slightly developed septa) or subseptate; with septa thin (tissue paper-like), flexible; with the septa eglandular; coriaceous; not exfoliating (though somewhat in *A. precatorius*); remaining fused to epicarp; entire. Seeds 3–7; length oblique to fruit length (slightly); neither overlapping nor touching; in 1 series. Funiculus 2–3 mm long; of 1 length only; thick; straight, hooked, or triangular. Aril fleshy or dry; annular; covering less than 1/2 of seed; tongue-aril; tan.

Seed $3.5\text{--}7 \times 2.3\text{--}5.5 \times 1.8\text{--}5.5$ mm; not overgrown; not angular; symmetrical (except hilum); oblong; terete (*A. precatorius*) or quadrangular; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome, bichrome (*A. precatorius*

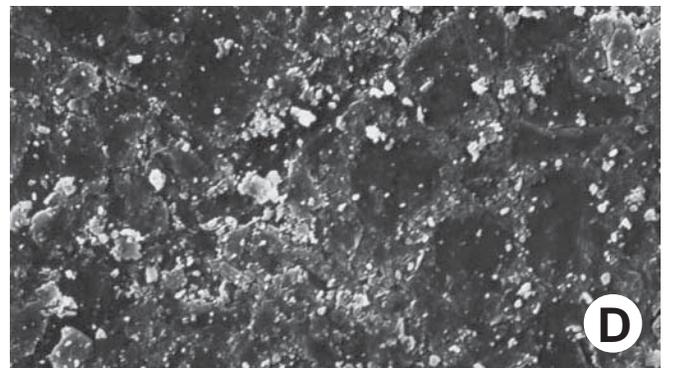
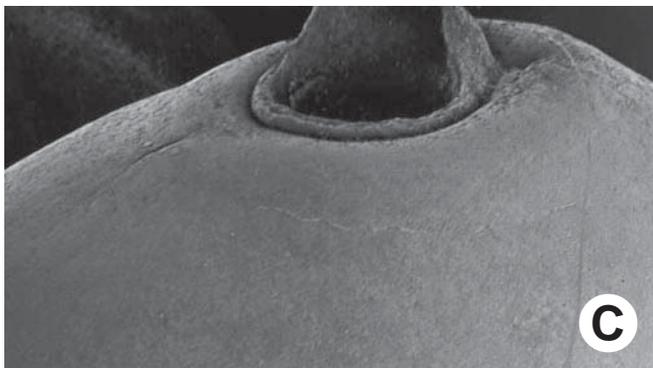
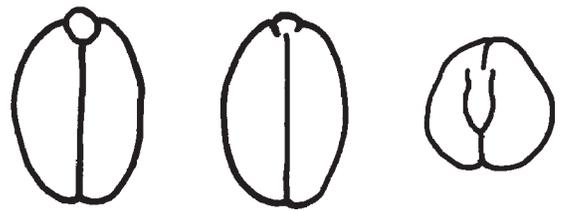
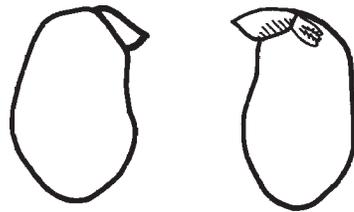
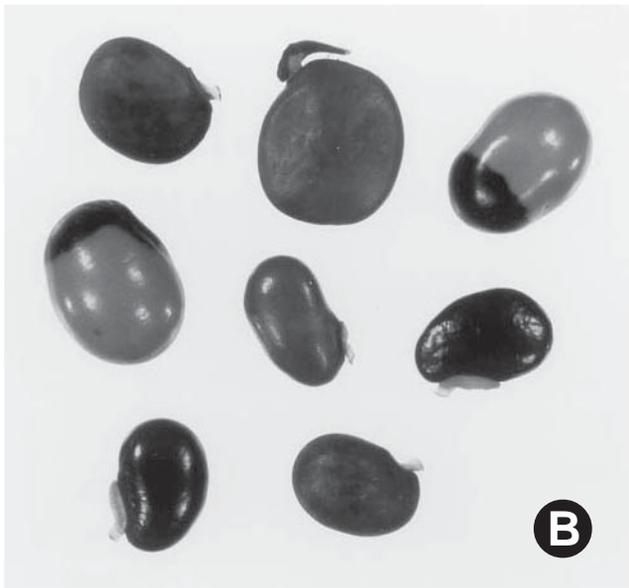
black at hilum end and scarlet to dark reddish-brown at opposite end), mottled, or streaked; with frequent to infrequent mottles; with frequent to infrequent streaks; black, brown, gray, ivory, olive, orange, red, purple, or scarlet; with black overlay; glabrous; smooth or not smooth (*A. gorsei* J. Berhart, *A. canescens* J.G. Baker); with elevated features; shagreen; coriaceous. Pleurogram absent. Fracture lines absent. Rim absent. Raphe visible or not visible; from hilum through lens to base of seed and terminating or from hilum to near base of seed and terminating; color of testa; flush. Hilum visible or partially concealed; concealed by funicular remnant (*A. canescens*); with faboid split; with the lips of the faboid split the same color as the rest of the hilum or lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1.2–3 mm long; with curved or straight outline; circular; oblong; subapical or marginal according to radicle tip (*A. canescens*); recessed; within rim. Hilum rim color of testa (but duller). Lens discernible or not discernible (*A. fruticosus* N. Wallich ex R. Wight & G.A.W. Arnott); equal to or greater than 0.5 mm in length; up to 2 mm long; with margins straight or curved; irregular or linear; not in groove of raphe; adjacent to or confluent with hilum; up to 1 mm from hilum; recessed; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thin; 1/2 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; not concealing radicle; entire over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; white or 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 length of cotyledons. Plumule well developed; glabrous.

Distribution: Pantropic and pansubtropic.

Notes: Polhill (1981e, 1994a,b) evaluated the placement of *Abrus* and concluded that the genus is best placed in its own monotypic tribe situated between the Dalbergieae and Amorphaeae. Verdcourt (1970c) monographed *Abrus*, and in accepting this work, we reject Breteler (1960). *Abrus precatorius* has bicolored scarlet (red) and black seeds which are deadly poisonous when chewed (Gunn 1969), and according to Verdcourt, *A. aureus* R. Viguier also has red and black seeds.

Similarly colored seeds include *Rhynchosia pyramidalis* (10.80) and species of *Ormosia* (2.15). For additional micrographs of the testa, see Lersten and Gunn (1982). Because of human selection, seeds of *A. precatorius* range in color from bicolor (scarlet to dark red and black) to monochrome brown, tan, yellow, and ivory.

Abrus: *A. precatorius* C. Linnaeus (*C–E*), *A. spp.* (*A–B*). *A*,
Fruit and valves ($\times 1.4$); *B*, seeds ($\times 3.5$); *C–D*, testa
($\times 30$, $\times 1000$); *E*, embryos ($\times 5.2$).



Amorpheae (6.01–6.08)

Genus: *Apoplanesia* C.B. Presl

Phylogenetic Number: 6.01.

Tribe: Amorpheae.

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

Fruit a legume; unilocular; $0.3\text{--}0.35 \times 0.2\text{--}0.3 \times 0.2\text{--}0.23$ cm (all excluding calyx); with deciduous corolla; with persistent calyx; with calyx longer than fruit (lobes wing-like and up to 8 mm long); 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 (but with indurate style) or with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned (nearly) or 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 visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (but gland dots reddish-brown against silvery (hair) background); brown or gray (because of hairs); pubescent and indurate; with 1 type of pubescence; tomentose; with pubescence gray; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; glandular; with glandular dots; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; glassy beads; coriaceous. Endocarp glossy; monochrome; dark brown or tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; thick; straight. Aril absent.

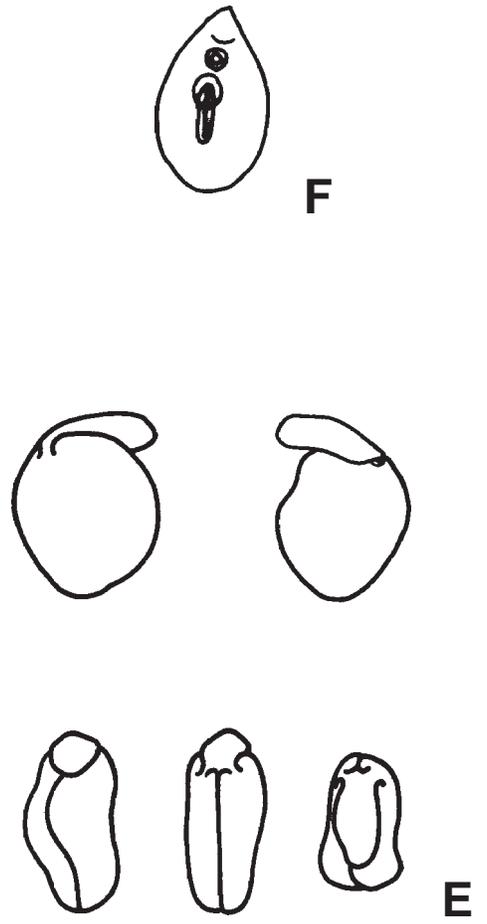
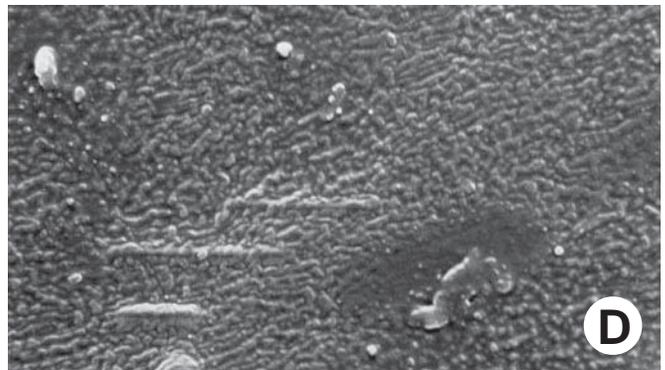
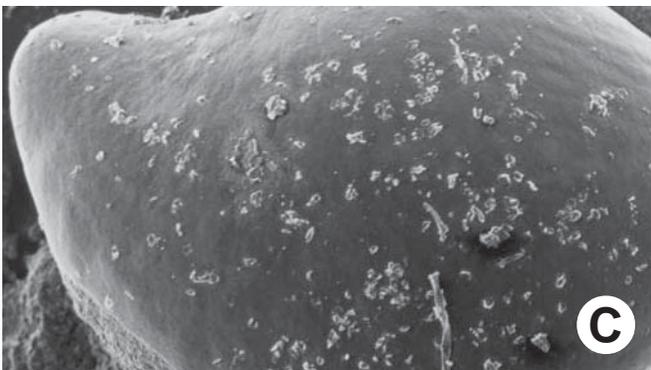
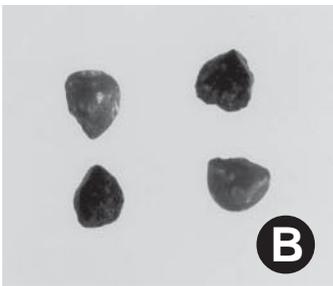
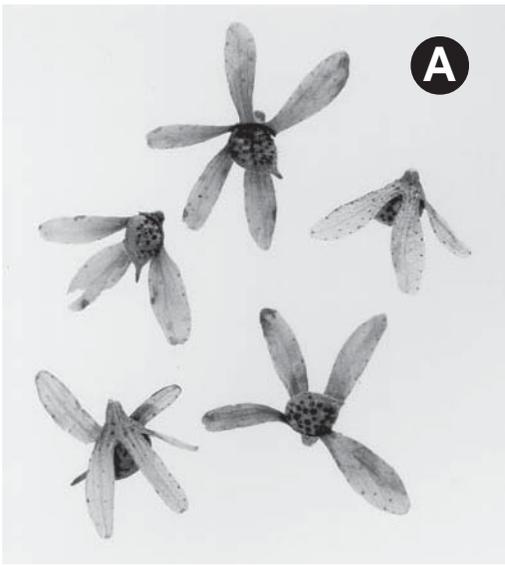
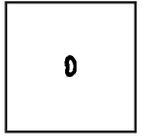
Seed $2.2\text{--}2.4 \times 1.8\text{--}2 \times 1.3\text{--}1.4$ mm; not overgrown; not angular; asymmetrical; D-shaped; compressed; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; tan; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform;

0.5 mm long; with curved outline; circular; between cotyledon and radicle lobe; flush; within rim. Hilum rim color darker than testa. Lens discernible (nearly as large as hilum—see fig. *F*); less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; adjacent to hilum (separated by hilum rim); mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thick; $1/2$ covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes not touching; 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; deflexed and parallel to cotyledon width; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southern Mexico to Venezuela.

Notes: Traditionally this tribe has been called Amorpheae. Reveal (1997) reported that the name Daleeae was published before the name Amorpheae. In accordance with the *International Code of Botanical Nomenclature* (Greuter et al. 1994), the oldest name for a taxon must be used, so Reveal suggested that this tribe should be called Daleeae. In 1999, however, Reveal (1999) reversed himself, so this tribe remains the Amorpheae. Barneby (1981) noted that this is seemingly the most archaic genus in the Amorpheae. The fruit in combination with the enlarged calyx form a unique unit in the Fabaceae. The D-shaped compressed fruit is half enclosed by enlarged calyx lobes, and this unit resembles a small fruit of *Dipterocarpus* C. Gaertner (Dipterocarpaceae).

Apoplanesia: *A. paniculata* C.B. Presl (*A–E*). *A*, Fruits with star-shaped calyx ($\times 2.3$); *B*, seeds ($\times 4.5$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 10$); *F*, hilum-lens view ($\times 10$).



Genus: *Eysenhardtia* K.S. Kunth

Phylogenetic Number: 6.02.

Tribe: Amorpheae.

Species Studied—Species in Genus: 10 spp.—11 spp.

Fruit a legume; unilocular; $0.5\text{--}2.1 \times 0.15\text{--}0.5 \times 0.1$ 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, elliptic, or linear; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; short tapered at apex; apex oblique with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base differing in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (except for glandular dots); brown (to greenish or reddish or pale to dark); glabrous; glandular; with glandular dots (to elongated dots (nearly streaks) and conspicuous to faint because of size and color); limited to a portion of fruit; upper $2/3$ glandular and lower $1/3$ eglandular; without spines; not smooth; with elevated or recessed features; faintly reticulately to irregularly (nearly reticulate) veined; not tuberculate; inconspicuously punctate; not exfoliating; without cracks. Mesocarp absent. Endocarp glossy; monochrome; brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1(–2) (and may fill $1/2$ to entire fruit); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; filiform; straight. Aril absent.

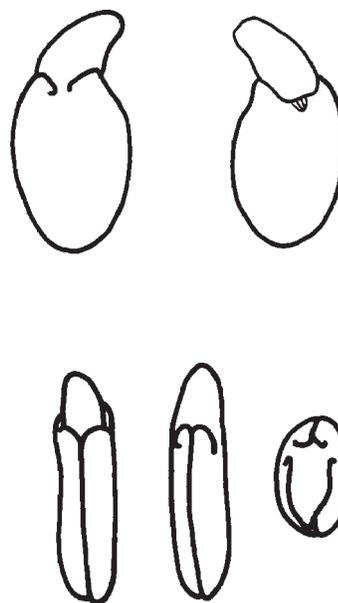
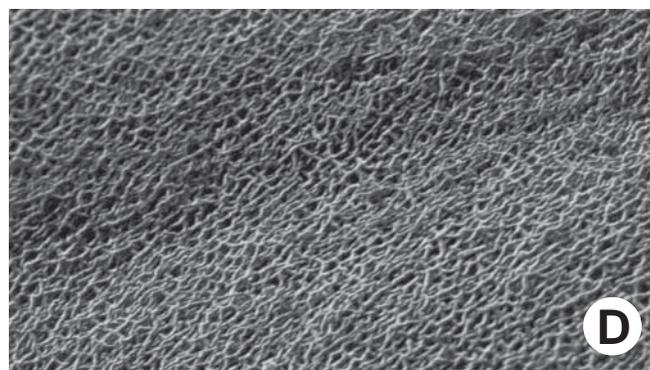
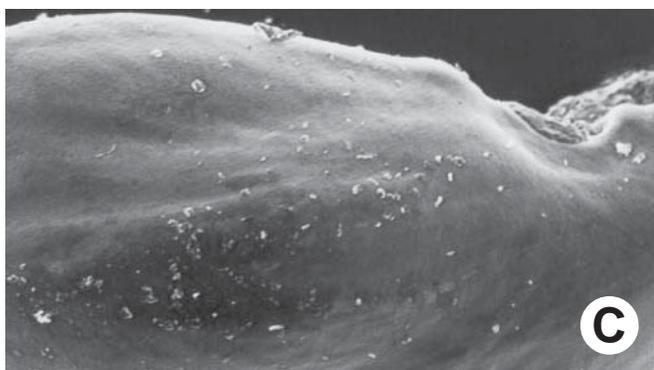
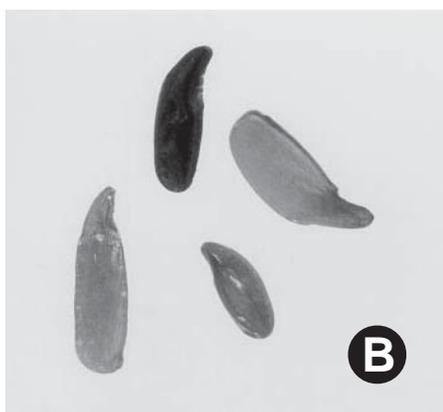
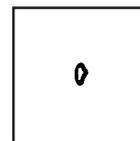
Seed $3.2\text{--}3.4 \times 1.6\text{--}1.7 \times 0.9\text{--}1.1$ mm; not overgrown; not angular; asymmetrical; oblong, reniform, or falcate; compressed to flattened; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; brown (olive to light or reddish), olive, or tan; glabrous; smooth; chartaceous. Fracture lines absent. Rim present. Raphe visible or not visible (*E. orthocarpa* (A. Gray) S. Watson); from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; black; 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 (near apex); flush; within rim. Hilum rim color of testa (difficult to find). Lens discernible or not discernible (*E. parvifolia* T.S. Brandege); less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; 0.2 mm from hilum; mounded; similar color as testa; darker than testa (barely); black; not within corona, halo, or rim. Endosperm thin; $1/2$ covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle (almost exposed); split over radicle; with lobes; with lobes not touching; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed (to almost straight in *E. parvifolia* T.S. Brandege); oblique to length of seed. Radicle bulbous; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: Southwestern United States, Mexico, and Guatemala.

Notes: The species count is based on Lang and Isely (1982), who recognized ca. 10 species in their monograph, and not on Barneby (1981). The seed fills about two-thirds of the fruit.

Eysenhardtia: *E. spinosa* G. Engelmann (C–E), *E.* spp. (A–B). A, Fruits (some with a calyx) ($\times 3.3$); B, seeds ($\times 4.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Parryella* J. Torrey & A. Gray

Phylogenetic Number: 6.03.

Tribe: Amorpheae.

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

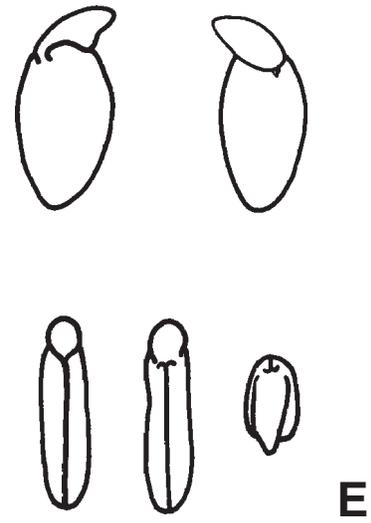
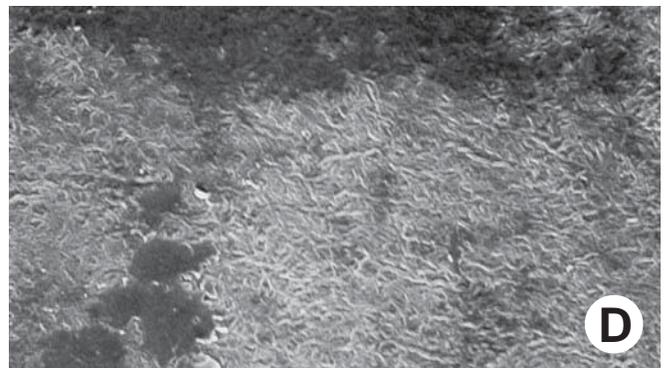
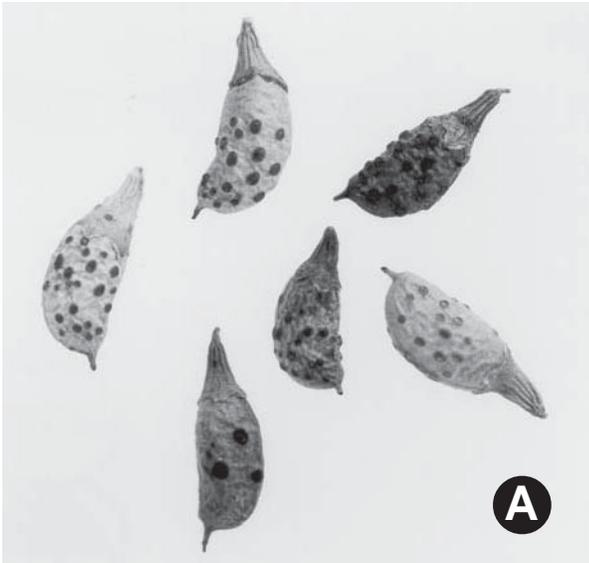
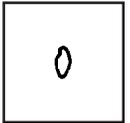
Fruit a legume; unilocular; $0.5\text{--}0.8 \times 0.25\text{--}0.35 \times 0.15\text{--}0.22$ cm; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; without or with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; 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. Epicarp semiglossy; monochrome (with reddish-brown to dark reddish-brown glandular dots); tan; glabrous; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp absent. Endocarp glossy; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; straight. Aril absent.

Seed $4\text{--}4.2 \times 2\text{--}2.4 \times 1.8\text{--}2$ mm; not overgrown; not angular; asymmetrical; elliptic; terete; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy (primarily caused by glandular exudate); not modified by a bloom; colored; monochrome; tan; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; brown; raised. 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; recessed; within corona. Hilum corona color darker than testa. Lens not discernible. Endosperm thin; $1/2$ covering entire embryo; adnate to testa. Cotyledons not smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; similar at apex; completely 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; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southwestern United States.

Parryella: P. filifolia J. Torrey & A. Gray (A–E). A, Fruits with calyx ($\times 3.8$); B, seeds ($\times 3.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Amorpha* C. Linnaeus

Phylogenetic Number: 6.04.

Tribe: Amorpheae.

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

Fruit a legume; unilocular; $0.4\text{--}1.05 \times 0.15\text{--}0.45 \times 0.14\text{--}0.18$ cm; with deciduous corolla; with persistent calyx; with calyx equal in length to or calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (to slightly curved); not plicate; not twisted; asymmetrical; falcate or oblong; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures unequally curved; widest near middle, D-shaped, or widest near apex; not inflated; compressed; without or with beak; with solid beak the same color and texture as fruit; rounded at apex; apex aligned to oblique with longitudinal axis of fruit; tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or fragile, thinner than chartaceous like *Trifolium* (21.06); seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate to nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (sometimes with conspicuously darker colored glandular dots); brown or tan; with surface texture uniform or not uniform, with patches of different texture not restricted to the base and apex; glabrous, glabrate, or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular or eglandular; with glandular dots; without spines; not smooth; with elevated or recessed features; not veined; not tuberculate; faintly wrinkled; punctate (because of empty glandular dots); not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; glassy beads (reddish to dark-brown); coriaceous. Endocarp dull to glossy; monochrome; reddish brown or tan; smooth or vitreous (because of glandular exudates); nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; filiform or thick; straight. Aril present or absent; dry; rim-aril; light tan.

Seed $2.5\text{--}5 \times 1.6\text{--}3 \times 1.1\text{--}1.3$ mm; not overgrown; not angular; asymmetrical; D-shaped, elliptic, or oblong (all with radicular beak); compressed; with visible radicle

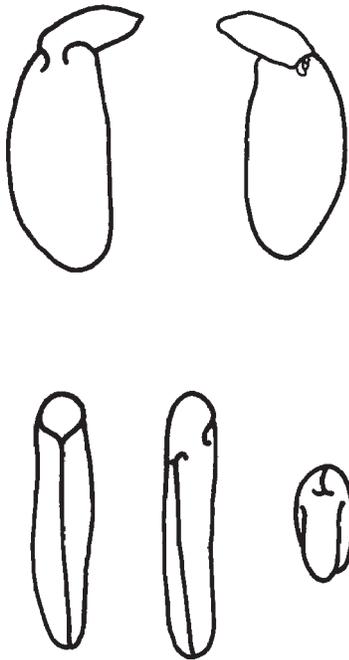
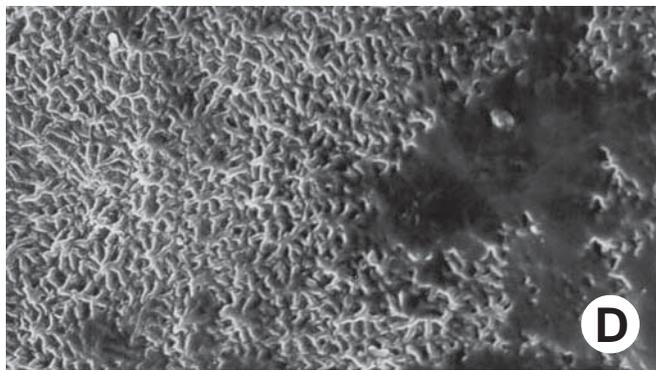
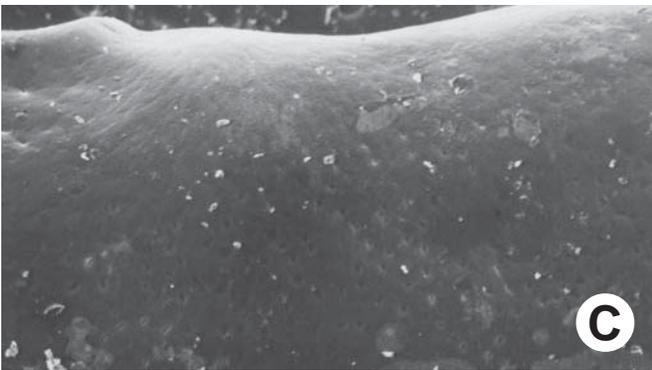
and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy (because of glandular exudate) or dull; not modified by a bloom; colored; monochrome; brown (reddish to orange to olive), tan, or black; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Raphe from hilum to lens or near base of seed and terminating; not bifurcating; darker than testa; tan or brown (dark to light); flush. 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; recessed; within rim. Hilum rim color of testa (essentially). Lens 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; 1.5 mm from hilum; barely mounded; dissimilar color from testa; darker than testa; dark brown; not within corona, halo, or rim. Endosperm thick; 1/2 covering entire embryo; adnate to testa or adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle (barely); split over radicle; with lobes; with lobes not touching; with the interface division terminating at base of radicle; without margins recessed; green or tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle bulbous; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: United States and Canada.

Notes: Palmer (1931) monographed *Amorpha* and illustrated its fruits, and Wilbur (1975) described the fruits and seeds in his revision of the genus. We followed the latter revision.

Amorpha: *A. croceolanata* P.W. Watson (C–E), *A. spp.* (A–B). A, Fruits with calyx ($\times 3.4$); B, seeds ($\times 5$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).

D



Genus: *Errazurizia* R.A. Philippi

Phylogenetic Number: 6.05.

Tribe: Amorpheae.

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

Fruit a legume; unilocular; $0.4\text{--}1.1 \times 0.45\text{--}0.8 \times 0.5\text{--}0.6$ 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; asymmetrical or symmetrical; elliptic or ovate; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; without or with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base differing in texture; chartaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (except for glandular dots); brown or gray (because of gray hairs); pubescent and indurate; with 1 type of pubescence; villous; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular; with glandular dots; limited to a portion of fruit; upper 1/2 glandular and lower 1/2 eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; filiform; straight. Aril absent.

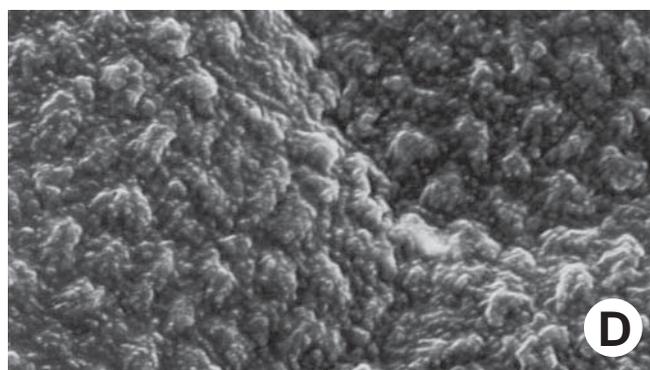
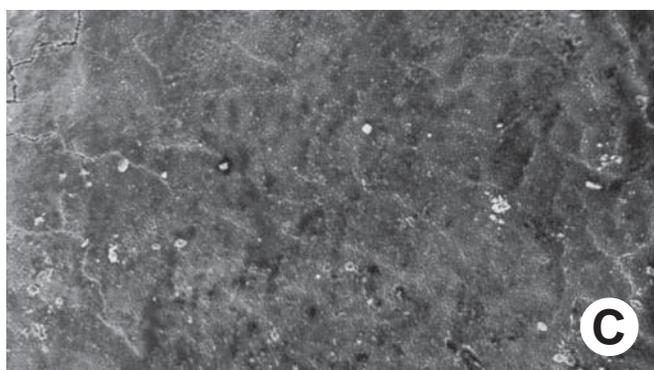
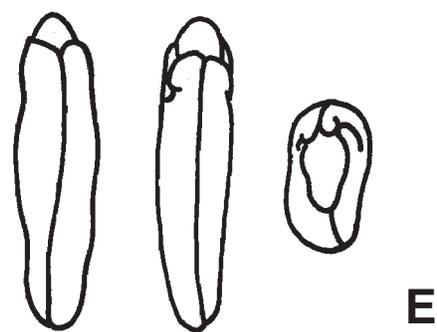
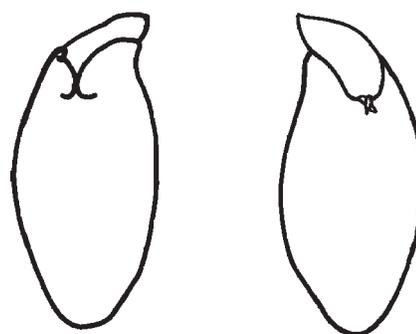
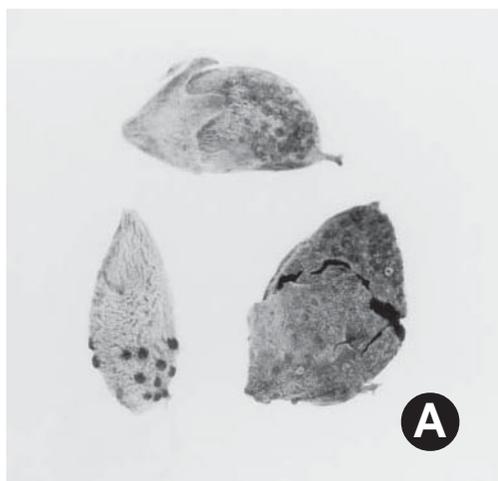
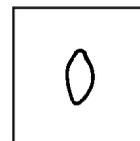
Seed $3\text{--}7.5 \times 2.7\text{--}5 \times 2\text{--}4.5$ mm; not overgrown; not angular; symmetrical (except for hilum); elliptic; compressed; without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull (with splotches of glandular residue which are shiny); not modified by a bloom; colored; monochrome; black, brown, tan, or purple; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from lens to base of seed and terminating; not bifurcating; darker than testa; black; deeply recessed. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; marginal according to radicle tip; deeply recessed; not

within corona, halo, or rim. Lens not discernible. Endosperm thick; 1/2 covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes touching (auriculate); with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; green or tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle bulbous or linear; lobe tip curved; deflexed and parallel to cotyledon width; 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: Three species in southwestern United States and northwestern Mexico and one species along the coast of Chile.

Notes: Barneby (1977) monographed *Errazurizia*.

Errazurizia: *E. rotundata* (E.O. Wooton) R.C. Barneby (C-E), *E. spp.* (A-B). A, Fruits with calyx ($\times 2.7$); B, seeds ($\times 2.9$); C-D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Psorothamnus* P.A. Rydberg

Phylogenetic Number: 6.06.

Tribe: Amorpheae.

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

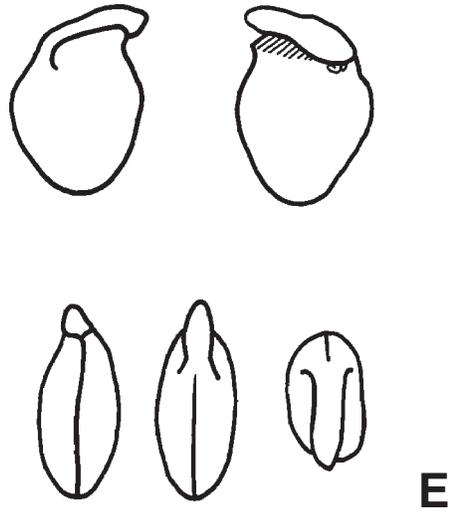
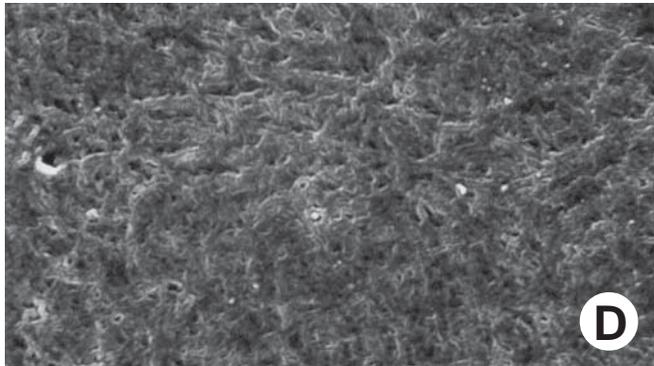
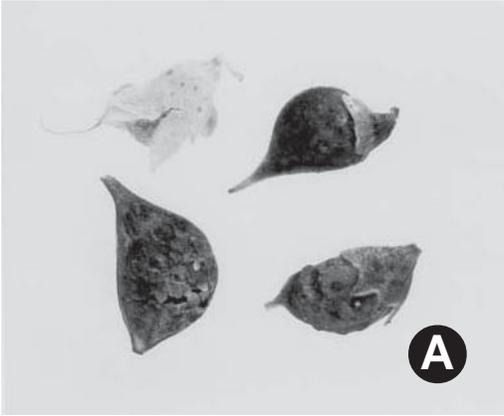
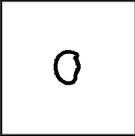
Fruit a legume; unilocular; $0.2-1 \times 0.36-0.6 \times 0.36-0.6$ cm; with deciduous corolla; with persistent calyx; with calyx longer or shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned to 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 not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome (with glossy reddish-brown glandular dots); reddish brown; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular; with glandular dots; without spines; not smooth; with elevated features; not veined; not tuberculate; shagreen; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1(–7) (–2 in *P. kingii* (S. Watson) R.C. Barneby or 3–7 in “one extralimital species” Barneby (1977)); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; straight. Aril absent.

Seed $4.2-6 \times 3-4 \times 2-3$ mm; not overgrown; not angular; asymmetrical; D-shaped; 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 (faintly); with frequent mottles; red; with red overlay; glabrous; smooth; coriaceous. Fracture lines absent. Raphe faintly visible or not visible; from hilum through lens to base of seed and terminating; not bifurcating; color of or lighter than testa. 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; recessed; not within corona, halo, or rim. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; mounded; dissimilar color from testa; darker than testa; black (-brown) or brown; not within corona, halo, or rim. Endosperm thin; 1/2 covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at or split over radicle; without or with lobes; with lobes not touching; with the interface division terminating at base of radicle; yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; parallel or oblique to length of seed. Radicle linear; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southwestern United States and northwestern Mexico.

Psorothamnus: *P. arborescens* (J. Torrey) R.C. Barneby (C–E), *P. spp.* (A–B). A, Fruits with and without calyx ($\times 2.3$); B, seeds ($\times 3.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Marina* F.M. Liebmann

Phylogenetic Number: 6.07.

Tribe: Amorpheae.

Species Studied—Species in Genus: 10 spp.—38 spp.

Fruit a legume or nutlet (Barneby 1977); unilocular; 0.15–0.33 × 0.13–0.26 × 0.13–0.26 cm; with persistent or deciduous androecial sheath; with deciduous corolla; with persistent calyx; with calyx longer than, equal in length to, or shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; harp-shaped; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near middle or D-shaped; not inflated; compressed; without beak; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Fruit a nutlet; entire. Epicarp dull; monochrome; brown (with large reddish-brown glandular dots); glabrous; glandular; with glandular dots; not smooth (because of large glandular dots); with elevated features; not veined; not tuberculate; glandular dotted; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; tan; more or less smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; straight. Aril absent.

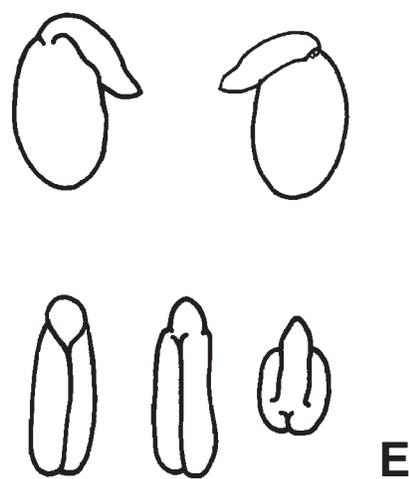
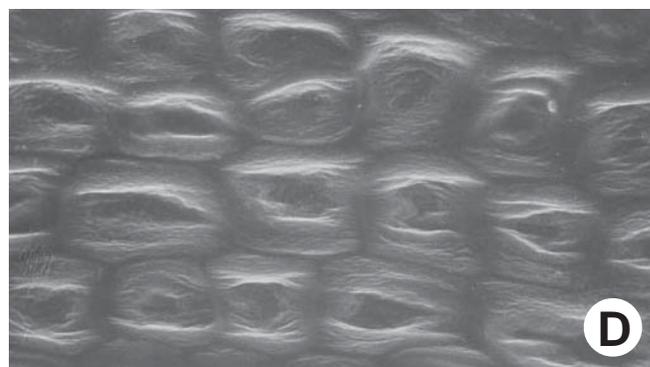
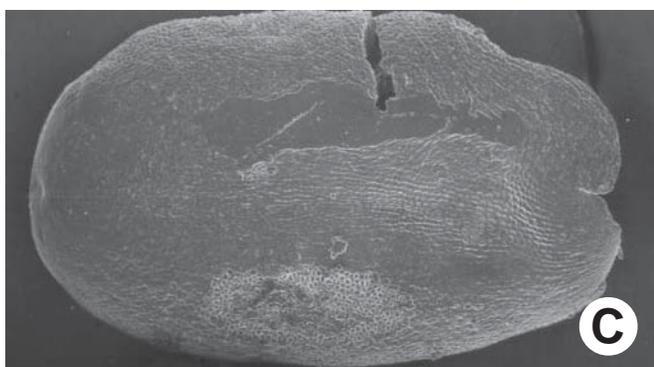
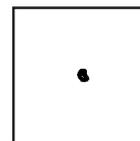
Seed 1.2–2.5 × 1.2–1.8 × 0.8–1.1 mm; not overgrown; not angular; asymmetrical; reniform (like *Crotalaria*); compressed; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not or partially adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; olive or tan; 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; recessed; within rim. Hilum rim color lighter to 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; mounded; similar color as testa; darker than testa; dark tan; not within corona, halo, or rim. Endosperm thin;

1/2 covering entire embryo; adnate to testa. Cotyledons smooth or not smooth (each outer face with a medial groove); both outer faces convex; both the same thickness; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed. Radicle linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southwestern United States, Mexico, and Central America; adventive in northern Venezuela and Cuba.

Notes: Barneby (1977) monographed *Marina* and noted that there were three fruit types: (1) harp-shaped, compressed, not nutlike, seed cavity larger than seed, and bearing blister glands arranged in more-or-less definite crescents; (2) obliquely obovoid, terete, not nutlike, seed cavity larger than seed, and bearing blister glands arranged in more-or-less definite crescents; and (3) shape unstated by Barneby, nutlike, closely investing and adherent to seed, and pustulate with scattered or crowded glands arranged in no special pattern.

Marina: *M. neglecta* (B.L. Robinson) R.C. Barneby (*C–E*), *M. spp.* (*A–B*). *A*, Fruits in calyx (× 5.1); *B*, seeds (× 10); *C–D*, testa (× 50, × 1000); *E*, embryos (× 10).



Genus: *Dalea* Lucanus

Phylogenetic Number: 6.08.

Tribe: Amorpheae.

Species Studied—Species in Genus: ca. 60 spp.—ca. 160 spp.

Fruit a legume; unilocular; $0.2\text{--}0.6 \times 0.17\text{--}0.21 \times 0.09\text{--}0.15$ cm; with persistent (with keel and standard) or deciduous androecial sheath; with persistent (with androecial sheath) or deciduous corolla; with keel and with standard; with persistent calyx (with or without prominent glandular dots between ribs); with calyx longer, equal to, or shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; asymmetrical; C-shaped, subcircular and circular, obovate, triangular, or harp-shaped; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures unequally curved; widest near middle or D-shaped; not inflated (except fragile base may be slightly larger than seed); compressed to terete; without or with beak; straight; with solid beak the same color and texture as fruit; rounded 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 or differing in texture; upper $1/4\text{--}2/3$ firm and/or pubescent and lower $3/4\text{--}1/3$ fragile and glabrous; membranous to chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit often indehiscent or with all layers dehiscent (occasionally in species such as *D. leporina* (W. Aiton) A.A. Bullock and *D. urceolata* E.L. Greene); splitting along sutures. Dehiscence of valves along both sutures; passive. Replum invisible. Epicarp dull; multicolored; bichrome (and additionally large reddish-brown glands); brown (apically brown, basally tan); glabrous or pubescent and indurate; with 1 type of pubescence; pilose or villous; with pubescence red (-brown) or with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular or eglandular; with glandular dots (arranged in crescents or random and either faint or prominent and large or tiny (microglandular in Barneby 1977); limited to a portion of fruit; upper $1/4\text{--}2/3$ glandular and lower $3/4\text{--}1/3$ eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately

veined; not tuberculate; occasionally warty or wrinkled (occasionally); not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1 (mostly); 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.

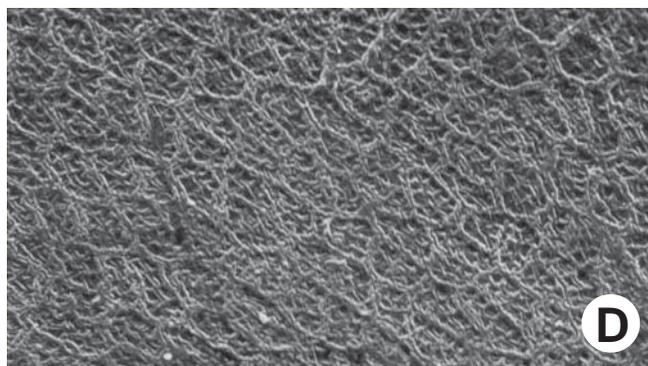
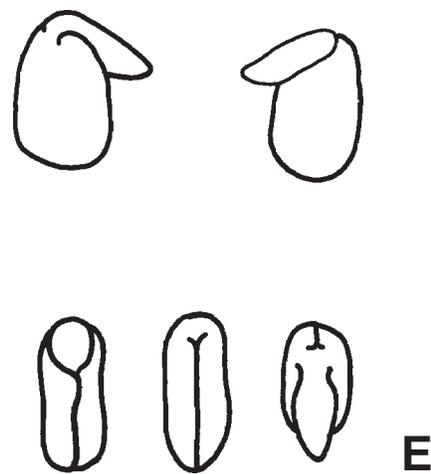
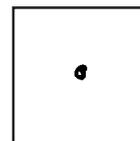
Seed $1\text{--}4.2 \times 1.2\text{--}2.6 \times 0.5\text{--}1.4$ mm; not overgrown; not angular; asymmetrical; elliptic (oblong), mitaform, or reniform; compressed; with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; brown (reddish to pale or), green, olive, or tan; 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; recessed; within rim. Hilum rim color lighter than testa. Lens discernible or not discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; $0.3\text{--}0.5$ mm long; with margins straight or curved; linear, triangular, or wedge-shaped; circular; not in groove of raphe; adjacent to hilum (and penetrating hilum rim); mounded; same color as, similar color as, or dissimilar color from testa; lighter or darker than testa; black or tan; within rim (penetrating rim) or not within corona, halo, or rim. Endosperm thin; $1/2$ 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; partially concealing radicle; split over radicle; with lobes; with lobes not touching; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed or oblique; oblique to length of seed. Radicle bulbous or linear; lobe tip straight or curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than $1/2$ length of cotyledons or $1/2$ to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Canada to Argentina.

Notes: Barneby (1977) monographed *Dalea* (including *Parosela* sensu P.A. Rydberg, *Petalostemum* C.L. Michaux, and *Kuhistera* J.B.A.P.M. de Lamarck, but excluding *Marina* F.M. Liebmann). Barneby also

provided literate descriptions of the interesting and varied external topography of the fruit. The species count follows Barneby (1981). Although it appears that fruits of most species of *Dalea* do not have a regular dehiscence mechanism, the lower half is fragile and ruptures irregularly, allowing the seed to fall out easily.

Dalea: *D. purpurea* E.P. Ventenat (C–E), *D. spp.* (A–B). A, Fruits within calyx ($\times 3.1$); B, seeds ($\times 5.2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Millettieae (A–X, 41 genera)

Genus: *Afgekia* W.G. Craib

Tribe: Millettieae.

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

Fruit a legume; unilocular; $7-17 \times 3-7.5 \times$ ca. 1 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; elliptic to fusiform or obliquely obovate; when asymmetrical with both sutures parallelly or unequally curved; not inflated; cruciform; without beak; rounded to short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; tapered to truncate at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; leathery to ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; with surface texture uniform; glabrate or pubescent and indurate; with hairs erect; with 1 type of pubescence; velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with vitreous layer over solid layer; ligneous. Endocarp dull; opaque; mottled; white; with mottling (dark); with brown overlay; hairy; without adhering pieces of testa; with hairs scattered over endocarp; nonseptate; chartaceous to pulpy; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 20–30 mm long; of 1 length only; thick; curved. Aril dry; rim-aril and tongue-aril; white to tan.

Seed $15-60 \times 13-40 \times 10-13$ mm; not overgrown; not angular; symmetrical; elliptic to ovate to circular (nearly); terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glossy; not

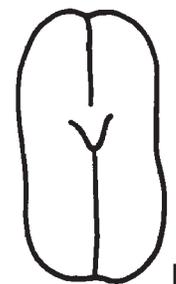
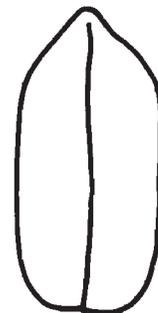
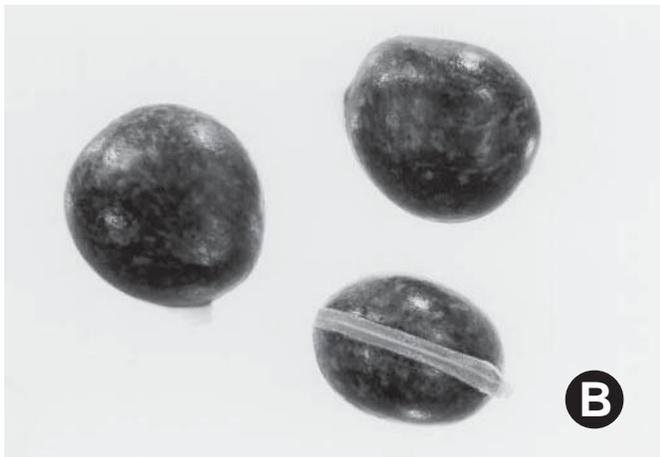
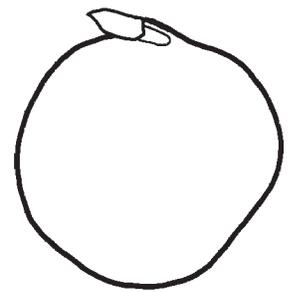
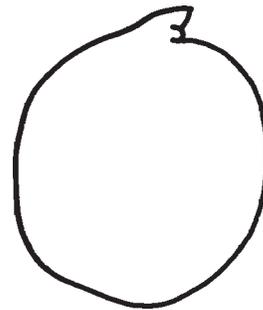
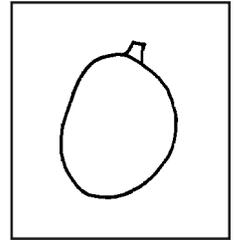
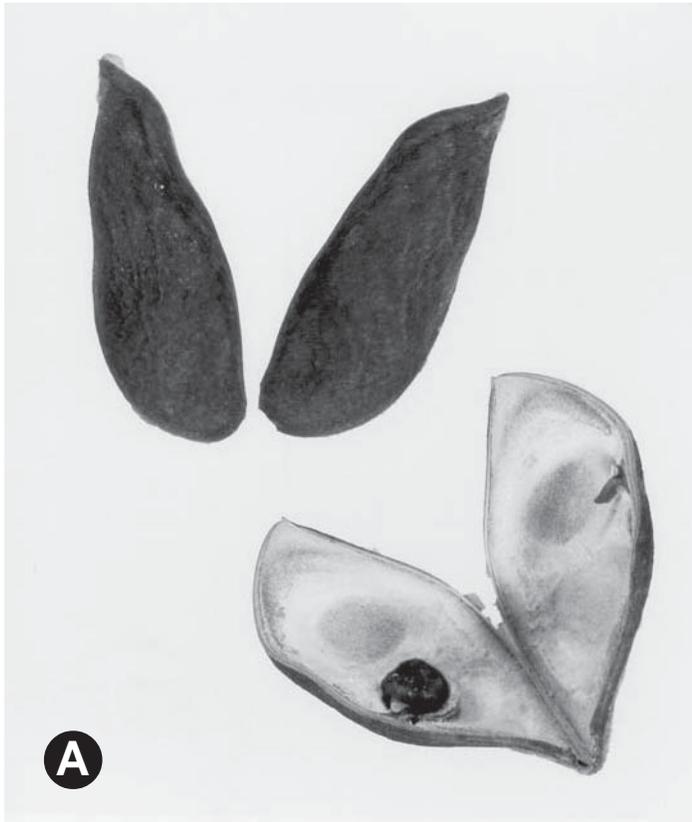
modified by a bloom; colored; mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 15–25 mm long; with straight outline; linear; apical according to radicle tip but marginal according to seed length; flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 3–3.5 mm long; with margins straight; narrowly triangular; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; pale yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Southern China, Burma, and Thailand.

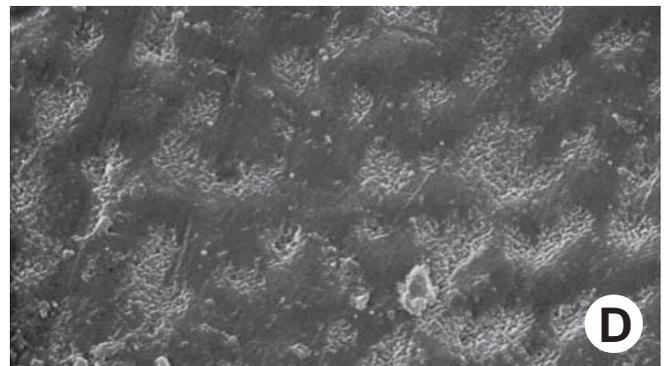
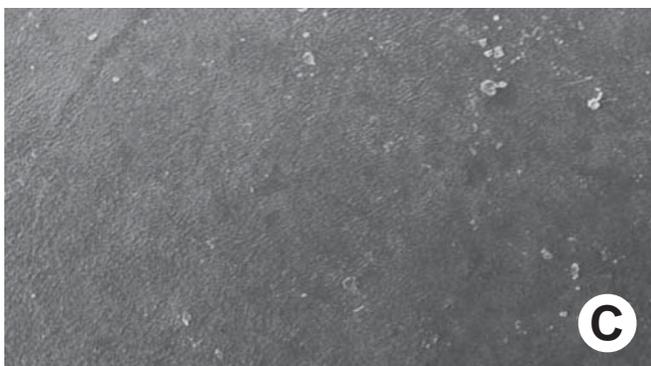
Notes: Geesink (1981) treated this tribe, as others before him, under the tribal name Tephroseae, but we now know that its correct name is Millettieae. Recent tribal studies (Geesink 1981, 1984; Polhill 1994a,b) have arranged the genera in alphabetical order without phylogenetic numbers, and they are so arranged here. Geesink (1984) monographed tribe Millettieae and presented descriptive notes about fruits and seeds and *in situ* fruit and seed drawings. However, we are not entirely following Geesink (1984) for generic parameters because he either questioned the status of many of his new genera or did not make the necessary species transfers. The few new genera which he clearly recognized are being accepted. Lavin et al. (1998) developed a preliminary infratribal classification of six informal groups using phytochrome nucleotides: Millettia group, Lonchocarpus group, Derris group, Tephrosia group, “primitive” group, and Phaseoleae group. Lavin (1987) transferred *Sphinctospermum* to Millettieae. Lavin and Doyle (1991) carried out

cladistic analyses integrating morphological and chloroplast DNA data and concluded that it is a member of Robineae, where we have placed it (now 8.12). Only one species of *Afgekia* was studied although some information from *A. filipes* (S.T. Dunn) R. Geesink was included.

Afgekia: *A. sericea* W.G. Craib (A–E). A, Fruits ($\times 0.8$);
B, seeds ($\times 2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos
($\times 2$).



E



Genus: *Aganope* F.A.W. Miquel

Tribe: Millettieae.

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

Fruit a legume; unilocular; 4.5–25 × 2.5–5 × 0.25–0.8 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight to curved; not plicate; not twisted; symmetrical or asymmetrical; elliptic or irregular; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; narrowing slightly once or twice on one side; not inflated; compressed to flattened; without beak; rounded or short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; rounded or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins or constricted on 1 margin and slightly constricted on the other margin; without sulcus; embellished. Fruit wings 1 or 2; 2.5–10 mm wide; sutural; on 1 or both sutures. Fruit substipitate or nonstipitate; with the stipe up to 3 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; glabrous, glabrate, or pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous; with pubescence golden; with pubescence uniformly distributed or denser near sutures, sparse centrally; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; papillose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; monochrome or mottled; brown or tan to brown; with mottling (dark); with brown overlay; smooth to scurfy; without adhering pieces of testa; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6; length parallel with to oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2–3 mm long; of 1 length only; flattened; triangular. Aril absent.

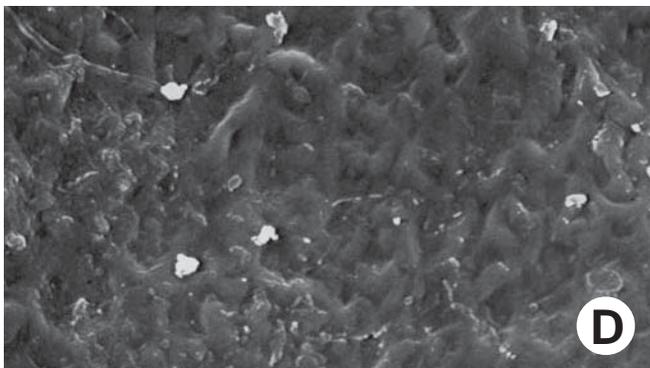
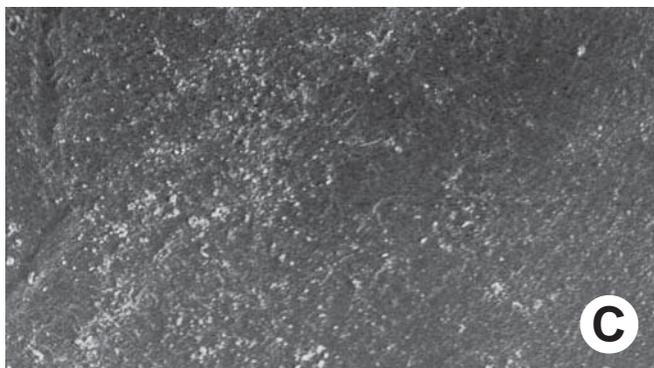
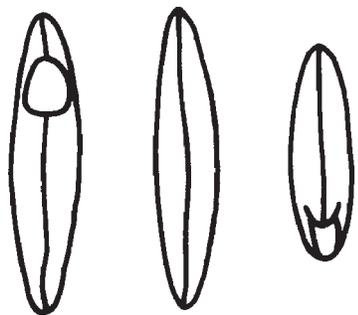
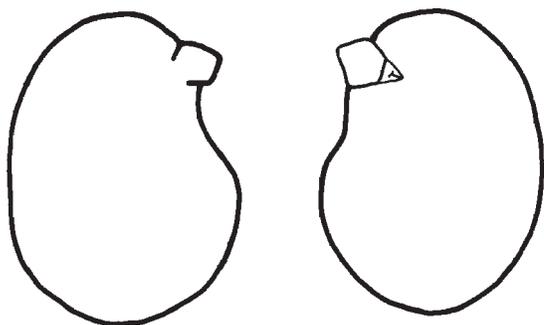
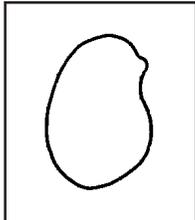
Seed 21–28 × 9.5–17 × 3–6.5 mm; not overgrown; not angular; asymmetrical; flattened; with surface wrinkled; with visible radicle and cotyledon lobes; without

external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown; with brown (darker) overlay; glabrous; not smooth or smooth; with elevated features; veined and wrinkled, veined, or wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; darker than testa; flush. Hilum visible; without faboid split; larger than punctiform; 1.3–1.8 mm long; with curved outline; circular or fusiform; apical according to radicle tip but marginal according to seed length; flush; within halo. Hilum halo color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; up to 3.5 mm long; with margins straight; triangular; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; 1–3 grooves on each face, 5–7-branched grooves (from veins of testa) on each face, or wrinkled; both outer faces convex; both the same thickness; both more or less of equal length or 1 longer than other; not folded; margin entire or not entire 180 degrees from base of radicle; wavy; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown, green, or tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled (nearly); oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Tropical Africa to Southeastern Asia.

Notes: Geesink (1984) placed *Aganope* and *Xeroderris* in *Ostryocarpus* without making species transfers. Following Wiersema et al. (1990), Thothathri (1992), Lock and Heald (1994), Polhill (1994a,b), and Schot (1994), we recognize *Aganope* as a separate genus from *Ostryocarpus* and *Xeroderris*.

Aganope: *A. impressa* (S.T. Dunn) R.M. Polhill (C–E), *A. spp.* (A–B). A, Fruits (× 0.4); B, seeds (× 1.7); C–D, testa (× 50, × 1000); E, embryos (× 2).



Genus: *Antheroporum* F. Gagnepain

Tribe: Millettieae.

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

Fruit a legume; unilocular; 6–9 × 3–4 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic to fusiform; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; inflated; compressed to terete; without beak; short tapered at apex; apex oblique to right-angled with longitudinal axis of fruit; short tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome to multicolored; mottled; brown; with brown overlay; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; very short sericeous; with pubescence tan; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; slitted obliquely; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with spongy layer over solid layer; ligneous. Endocarp dull; opaque; monochrome; brown; smooth and cracked (usually marginally); without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–2); length parallel with to oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2–3 mm long; of 1 length only; partially filiform and partially thick; triangular. Aril dry; rim-aril and tongue-aril; tan.

Seed 15–20 × 13–16 × 7–10 mm; not overgrown; not angular; asymmetrical; obliquely elliptic or ovate (obliquely); compressed to terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glossy; not modified by a bloom; colored; monochrome or

mottled; with infrequent mottles; brown or red; with brown (darker) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; without faboid split; larger than punctiform; 2–3 mm long; with curved outline; elliptic to circular; apical according to radicle tip but marginal according to seed length; raised; within halo. Hilum halo color darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; glandular dotted (yellow latex-like substance inside); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat and glandular dotted (with yellow latex-like substance inside); glabrous around base of radicle. Embryonic axis right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

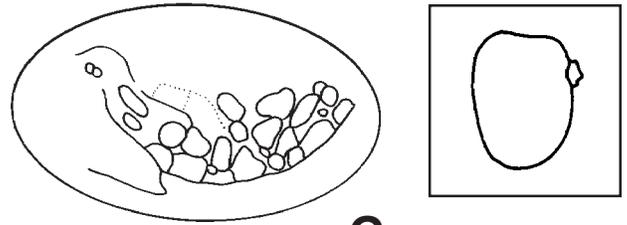
Distribution: Thailand, Indochina, and southern China.

Notes: The cotyledons have pits that vary in size and distribution and that are the same color as the nonpitted areas. When hydrated, however, the pits swell and are filled with a yellow, latex-like substance.

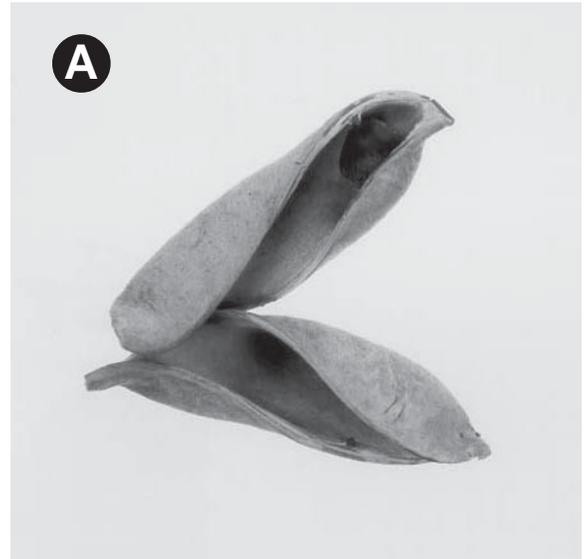
Antheroporum: *A. pierrei* F. Gagnepain (A–G). A, Fruit (× 0.7); B, seed (× 2.7); C–D, testa (× 50, × 1000); E, embryos (× 3); F, cotyledon with glands (× 3.3); G, magnification of inner cotyledon surface with glands (× 10).



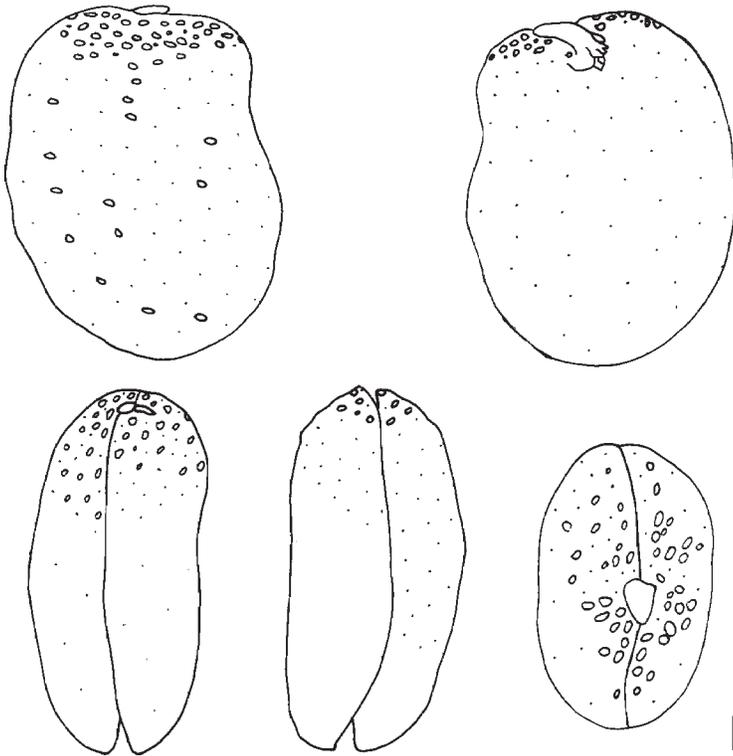
F



G



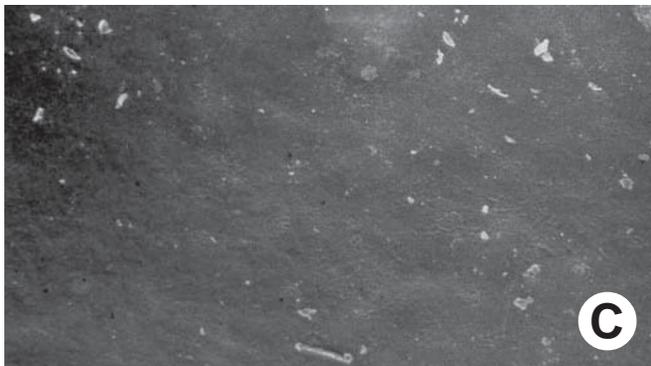
A



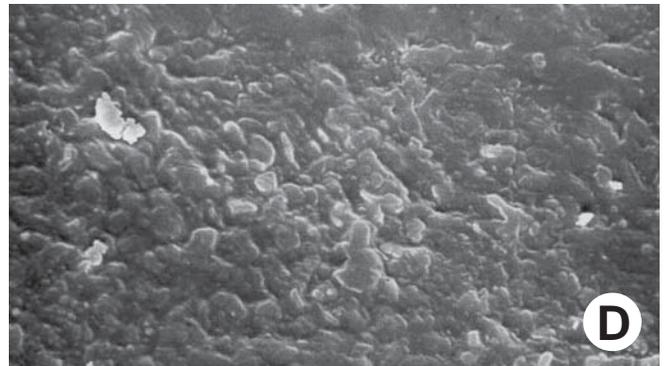
E



B



C



D

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

Tribe: Millettieae.

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

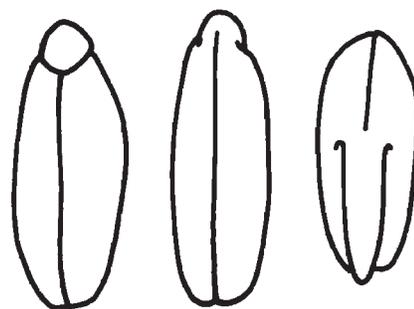
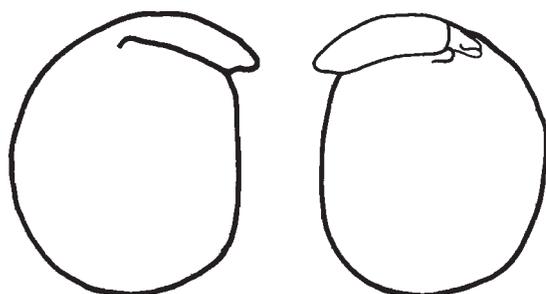
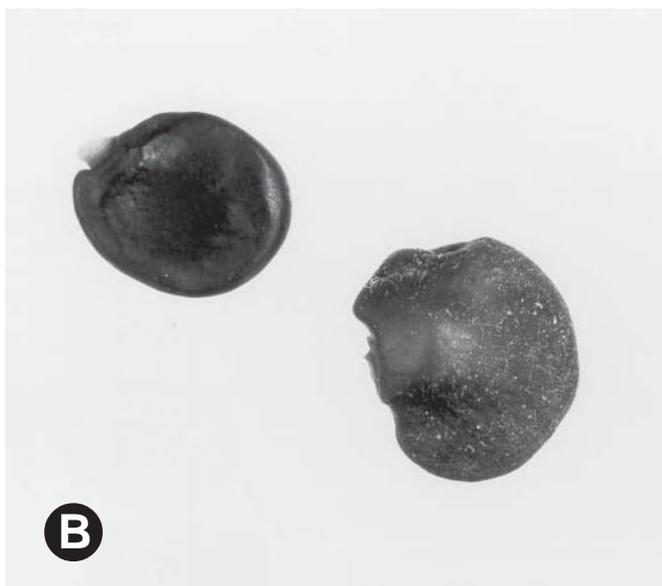
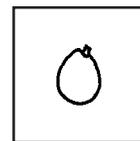
Fruit a legume; unilocular; $3.7\text{--}6.5 \times 0.9\text{--}1.3 \times 0.2\text{--}0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; falcate or fusiform (or obliquely so); when asymmetrical with both sutures parallelly curved; not inflated; compressed; with or without beak; declined; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan; with brown or yellow overlay; with surface texture uniform; glabrate; with hairs appressed; with 1 type of pubescence; sparsely sericeous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; slitted obliquely; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; opaque; white; smooth; without adhering pieces of testa; nonseptate to 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 parallel with, oblique to, or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5–2 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril and tongue-aril; cream or yellow.

Seed $7\text{--}12 \times 5\text{--}10 \times 3\text{--}4.2$ mm; not overgrown; not angular; symmetrical or asymmetrical; circular, elliptic, or ovate (obliquely); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp;

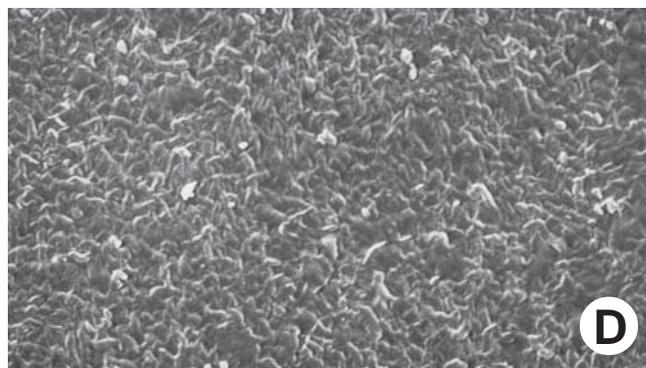
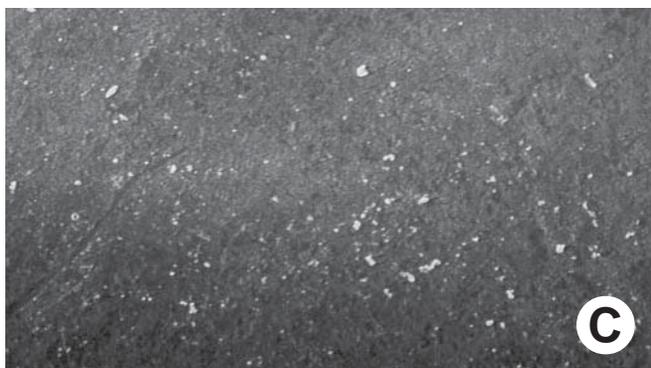
not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; red-brown or brown; glabrous; smooth or not smooth; with elevated features; minutely rugose or wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; larger than punctiform; 1.2–2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; within rim. Hilum rim color lighter or darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 1.2–1.8 mm long; with margins straight or curved; linear or 2 oblong mounds separated by groove; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; brown; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth or not smooth; sparsely glandular dotted (yellow latex-like substance inside); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; green or tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or linear; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Bolivia, Peru, and Argentina.

Apurimacia: *A. michelii* (H.H. Rusby) H.A.T. Harms (*C–E*), *A. spp.* (*A–B*). *A*, Fruits ($\times 1.6$); *B*, seeds ($\times 4$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



E



Genus: *Austroteenisia* R. Geesink

Tribe: Millettieae.

Species Studied—Species in Genus: 1 sp.—4 spp.

Fruit a legume; unilocular; $3\text{--}10.8 \times 0.9\text{--}2.1 \times 0.1\text{--}0.2$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic to fusiform to oblong to moniliform (slightly) or falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened; 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 or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; 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. Fruit indehiscent. Epicarp dull; multicolored; mottled; tan; with brown overlay; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous; with pubescence golden; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; monochrome; tan; smooth; without adhering pieces of testa; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Aril absent.

Seed ca. $4.5 \times 3 \times 1.5$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; larger than punctiform; ca. 0.7 mm long; with curved outline; circular; apical according to radicle tip but marginal according to seed

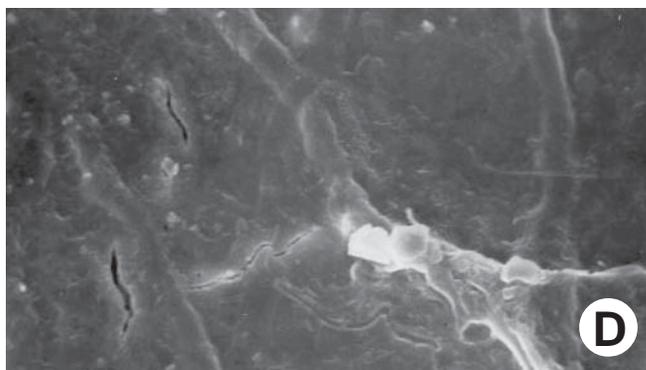
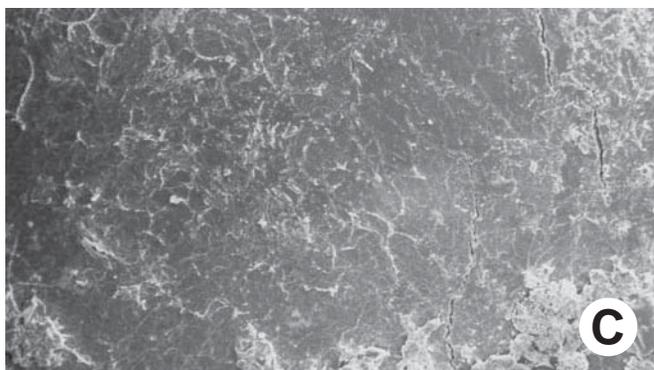
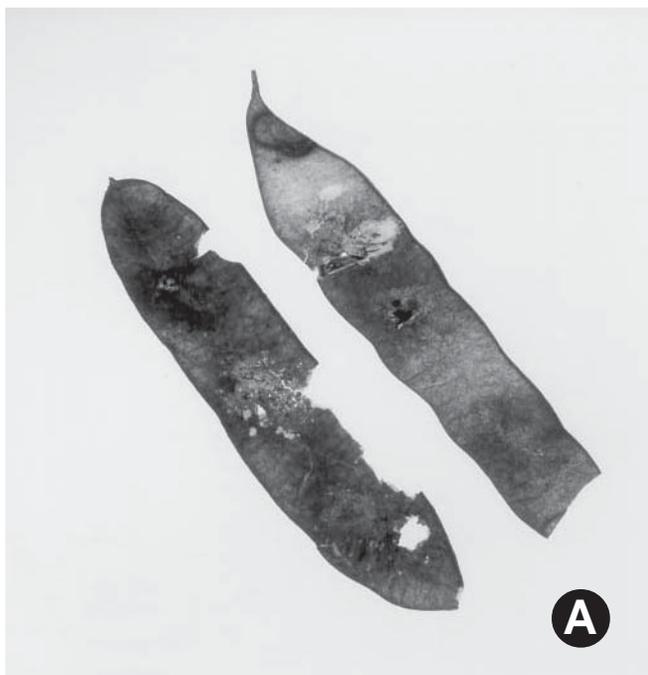
length; recessed; not within corona, halo, or rim. Lens not discernible.

Distribution: Northern Australia (2 spp.) and New Guinea (1 sp.).

Notes: Dixon (1997) revised the genus, describing one new species which increased the species count to four. The only seeds available for study were badly damaged by insects.

Austroteenisia: *A. blackii* (F. von Mueller) R. Geesink (A–D). A, Fruits ($\times 1.3$); B, seed ($\times 8$); C–D, testa ($\times 50$, $\times 1000$).

0



Genus: *Behaimia* A.H.R Grisebach

Tribe: Millettieae.

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

Fruit a legume; unilocular; $2.2-3 \times 1-1.3 \times 0.3-0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic to fusiform to obovate; not inflated; compressed; with beak; straight or declined; with solid beak the same color and texture as fruit; truncate at apex; apex aligned to oblique with longitudinal axis of fruit; rounded to tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; 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; active; with valves reflexing. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; glabrate to pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous; with pubescence golden; when mature denser near sutures, sparse centrally; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; transversely veined relative to fruit length and reticulately veined; not tuberculate; occasionally lenticular; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; opaque; monochrome; tan to brown; smooth and scurfy (marginally); without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; separating from epicarp; entire. Seeds 1(-2); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5-2 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; tan.

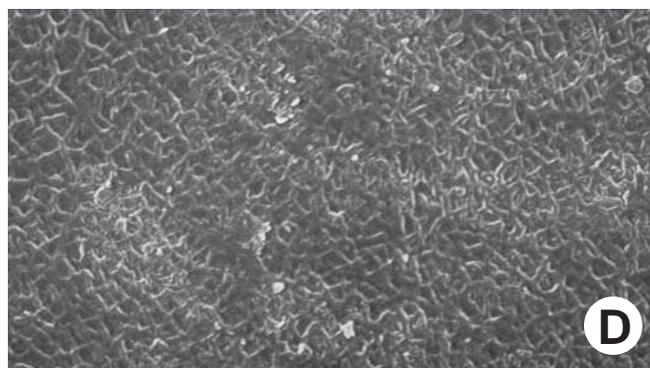
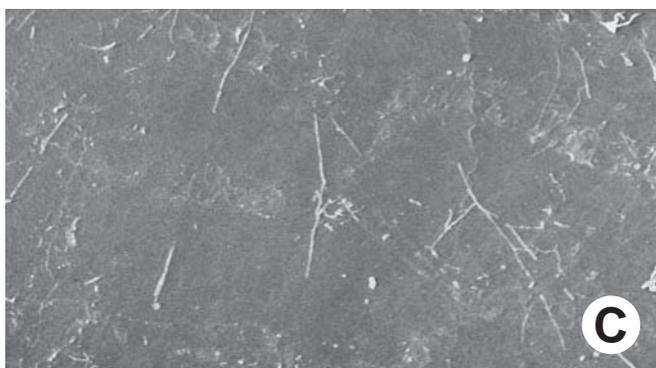
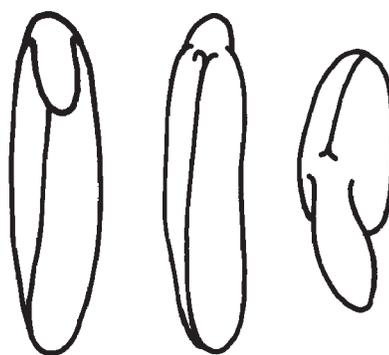
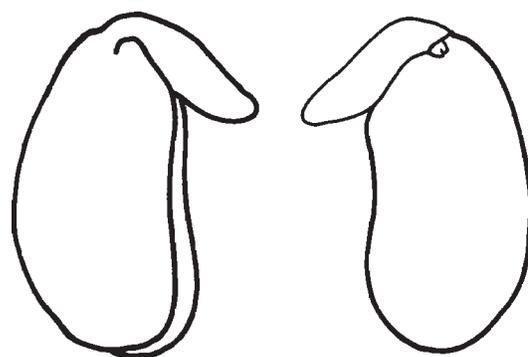
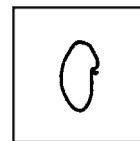
Seed $8-10.5 \times 5-7 \times 2-3$ mm; not overgrown; not angular; symmetrical; elliptic to reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glossy; not modified by a bloom; colored; mottled; with infrequent mottles; brown; with brown (darker or lighter) overlay; glabrous; smooth;

chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; larger than punctiform; 0.8-1 mm long; with curved outline; circular; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight; oblong; not in groove of raphe; adjacent to hilum; ca. 0.5 mm from hilum; mounded; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Cuba.

Notes: Lewis (1988) illustrated and elaborated on the description of this little-known and rarely collected genus.

Behaimia: *B. cubensis* A.H.R. Grisebach (A-E). A, Fruits ($\times 2.2$); B, seeds ($\times 4.3$); C-D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Bergeronia* M. Micheli

Tribe: Millettieae.

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

Fruit a legume or loment (or a loment segment); unilocular; 3–8.5 × 0.5–0.8 × 0.3–0.5 cm; with persistent 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; C-shaped and moniliform; when asymmetrical with both sutures parallelly curved; 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 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; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Loment indehiscent. Loment segments (articles) conspicuous; 10–15 mm long; widest across seed area; with upper 1 different shape than middle ones and lower 1 different shape than middle ones; oblong. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs erect and appressed; with 2 types of pubescence; sericeous and villous; with pubescence tan; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain to swollen (slightly); eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp thin (thicker near sutures); surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; mottled; tan; with mottling (dark); with brown overlay; scurfy and smooth; without adhering pieces of testa; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–7; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril; cream.

Seed 5–7 × 4–4.5 × 2–2.5 mm; not overgrown; angular or not angular; asymmetrical; oblong to reniform; compressed; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliat-

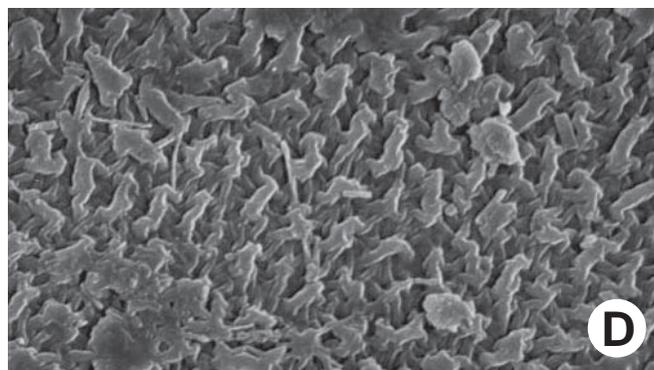
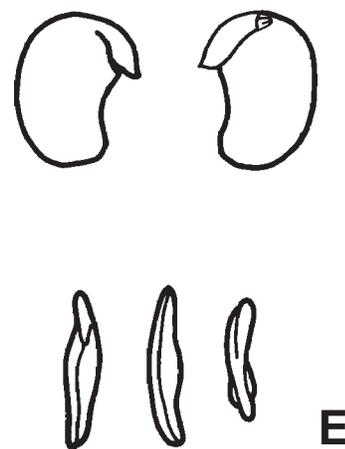
ing; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.3 mm long; with curved outline; circular to elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7–1 mm long; with margins straight; narrowly triangular; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; very dark brown; within halo. Lens halo color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; 1 longer than other; 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 oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip slightly curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Paraguay and northern Argentina.

Notes: Micheli (1883) had excellent seed-fruit drawings.

Bergeronia: *B. sericea* M. Micheli (A–E). A, Fruits (× 1.3); B, seed (× 7); C–D, testa (× 50, × 1000); E, embryos (× 5).

3



Genus: *Callerya* Endlicher

Tribe: Millettieae.

Species Studied—Species in Genus: 7 spp.—19 spp.

Fruit a legume; unilocular; 4–29 × 1–6 × 0.5–4.8 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; fusiform, linear, ovate, or irregular; when asymmetrical with both sutures unequally curved; inflated or not inflated; compressed to terete; with or without beak; straight, declined, or hooked; with solid beak the same color and texture as fruit; long tapered, tapered, or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; rounded or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted only on 1 margin; without or with sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate to stipitate; with the stipe up to 12 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown or green; with brown overlay; with surface texture uniform; glabrous, glabrate, or pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; sericeous, tomentose, velutinous, or villous; with pubescence brown or golden; with pubescence uniformly distributed (sometimes wearing off centrally); with simple hairs; stiff or pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated or recessed features; not veined; not tuberculate; lenticular, rugose, warty, or wrinkled; grooved; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick, thin, or trace; surface not veined; 1- or 2-layered; with or without balsamic vesicles; without fibers; solid or with solid layer over solid layer or vitreous layer over solid layer; chartaceous to coriaceous to ligneous. Endocarp dull; opaque or translucent; monochrome or mottled; tan or white; with mottling (dark); with brown overlay; scurfy and smooth; without adhering pieces of testa; septate or subseptate; with septa thin (tissue paper-like), flexible or thicker than paper, firm; with septa eglandular; chartaceous; exfoliating in part or not exfoliating;

remaining fused to mesocarp and epicarp; entire. Seeds 1–7 (according to Schot (1994), 2–3 seeds may be fused together in some species.); length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; at least 1.5–2 mm long; of 1 length only; thick; contorted or triangular. Aril dry; rim-aril, tongue-aril, rim-aril and tongue-aril, or 2-lipped rim-aril; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream to tan to brown.

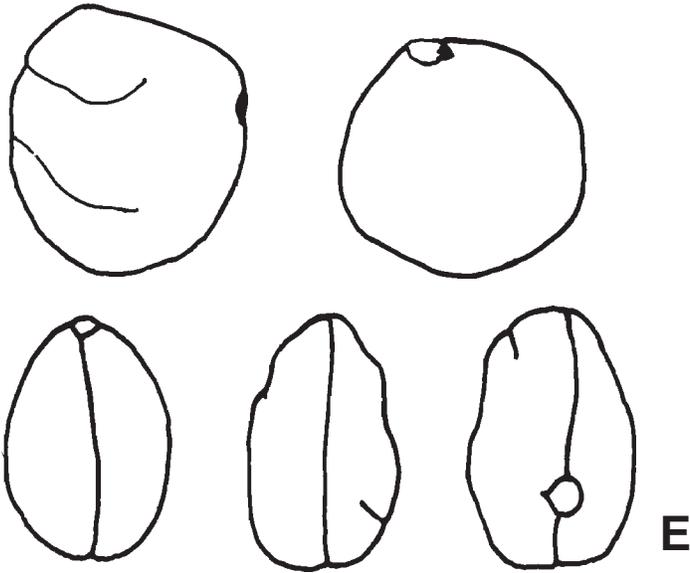
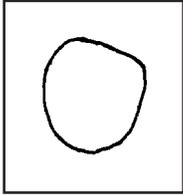
Seed 9–65 × 9–40 × 2–26 mm; not overgrown; not angular or angular; symmetrical; circular, elliptic, mitaform, oblong, or ovate; terete to compressed to flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome, mottled, or streaked; with infrequent mottles; with infrequent streaks; brown; with brown (darker or lighter) overlay; minutely pubescent (patchy, in literature); smooth or not smooth; with elevated features; veined and wrinkled, veined, wrinkled, or rugose; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with or without faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2–5 mm long; with curved outline; elliptic to oval; subapical to radicle tip or apical according to radicle tip but marginal according to seed length; raised, flush, or recessed; within rim or not within corona, halo, or rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 2–3 mm long; with margins straight or curved; oblong, 2 oblong mounds separated by groove, or ovate; not in groove of raphe; confluent with hilum; mounded; same color as testa; not within corona, halo, or rim. Endosperm present or absent; thin; covering entire embryo; adnate to embryo. Cotyledons smooth or not smooth; 1–3 grooves on each face or rugose; both outer faces convex; both the same thickness or 1 thicker than the other; both more or less of equal length or 1 longer than other; not folded or with both folded; not sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire or not entire 180 degrees from base of radicle; wavy; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without or with margin recessed; with 1 margin recessed;

recessed on side opposite from radicle; light green or tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

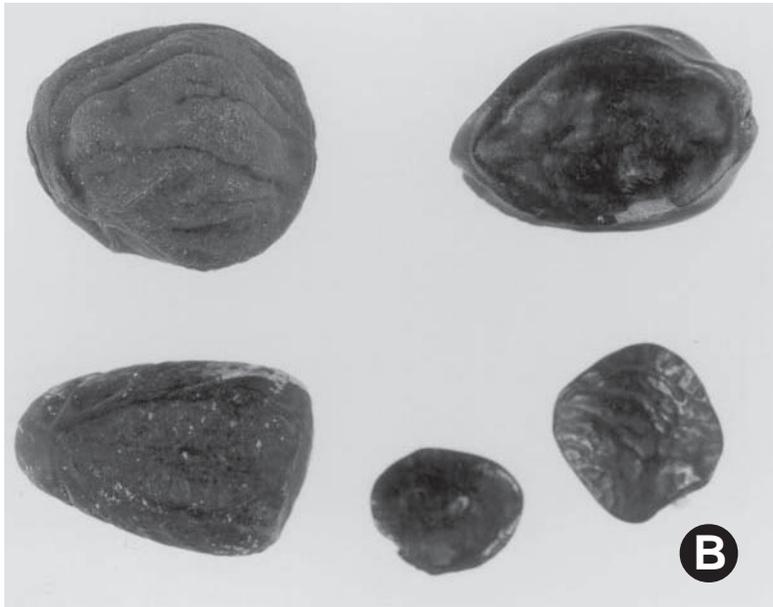
Distribution: India to southeastern Asia, China, Australia, and Philippines (introduced into Japan and Florida, USA).

Notes: Geesink (1984) suggested that *Callerya* should be reinstated and included *Padbruggea*, *Whitfordiodendron*, and paniculate sections of *Millettia* (sect. *Eurybotyae* and sect. *Austromillettia*). Schot (1994) agreed and made the necessary combinations.

Callerya: *C. cinerea* (G. Bentham) A.M. Schot (*C–D*), *C. speciosa* (J.G. Champion) A.M. Schot (*E*), *C. spp.* (*A–B*). *A*, Fruits ($\times 0.5$); *B*, seeds ($\times 2$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 2.6$).



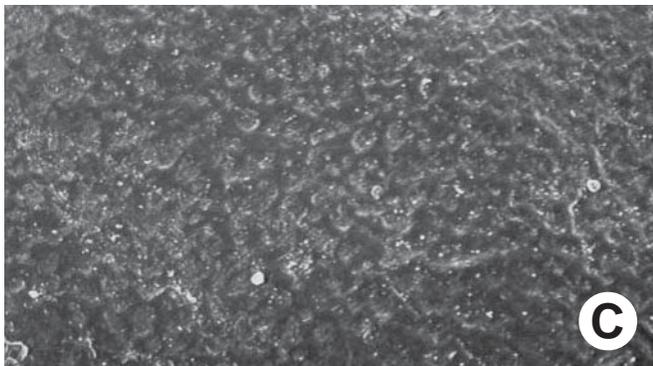
E



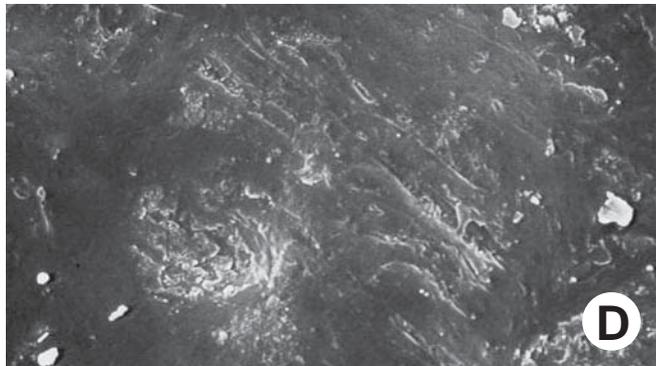
B



A



C



D

Genus: *Chadsia* W. Bojer

Tribe: Millettieae.

Species Studied—Species in Genus: 2 spp.—18 spp.

Fruit a legume; unilocular; 4–17 × 0.5–1.1 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; fusiform to linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; declined; with solid beak the same color and texture as fruit; long tapered or tapered at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered or tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous; with pubescence white; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome; tan; smooth; without adhering pieces of testa; subseptate; with septa thin (tissue paper-like), flexible; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 6–10; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca 0.5 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; cream.

Seed 5.7–8 × 3.5–4.5 × 2–2.5 mm; not overgrown; angular or not angular; symmetrical; elliptic to oblong to reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; brown; with black overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings

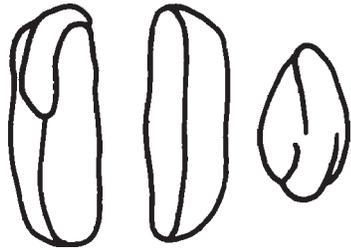
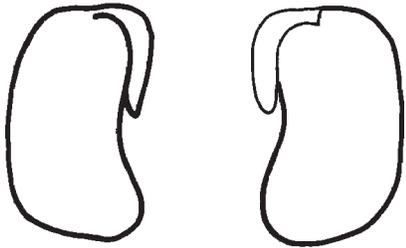
absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–0.8 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; within halo. Hilum halo color darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; within halo. Lens halo color darker than testa. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; pale tan; inner face with central ridge on 1 and central groove on other; glabrous around base of radicle. Embryonic axis parallel; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; with 180-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Madagascar.

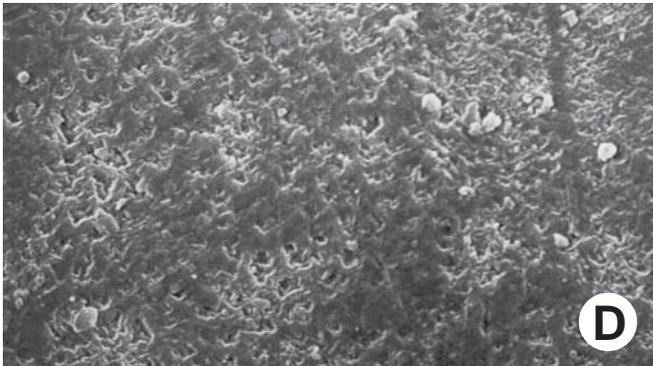
Notes: Only one valve from one fruit and one seed were studied.

Chadsia: *C. andravinensis* H.E. Baillon (A–E). A, Fruit (× 1.4); B, seeds (× 6); C–D, testa (× 50, × 1000); E, embryos (× 5).

0



E



Genus: *Craibia* H.A.T. Harms & S.T. Dunn

Tribe: Millettieae.

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

Fruit a legume; unilocular; 7–11 × 2.5–3.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregular or obliquely obovate; when asymmetrical with both sutures unequally curved; not inflated; compressed; with beak; straight or declined; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered or tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous or leathery; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled or streaked; brown; with brown (darker) overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; slitted obliquely; not exfoliating or exfoliating in part; without or with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined or uniformly veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer or spongy layer over solid layer; coriaceous. Endocarp dull; opaque; monochrome or mottled; tan or white; with mottling (dark); with brown overlay; scurfy and transversely wrinkled; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2(–6); length oblique to fruit length; neither overlapping nor touching or touching; in 1 series. Funiculus measured; ca. 1 mm long; of 1 length only; flattened; straight or triangular. Aril dry; rim-aril and tongue-aril; brown, cream, tan, or yellow.

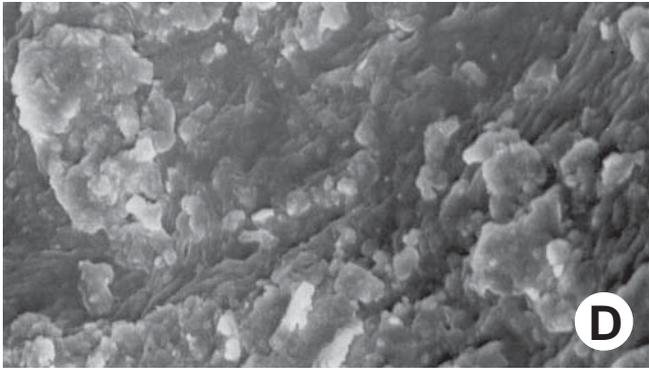
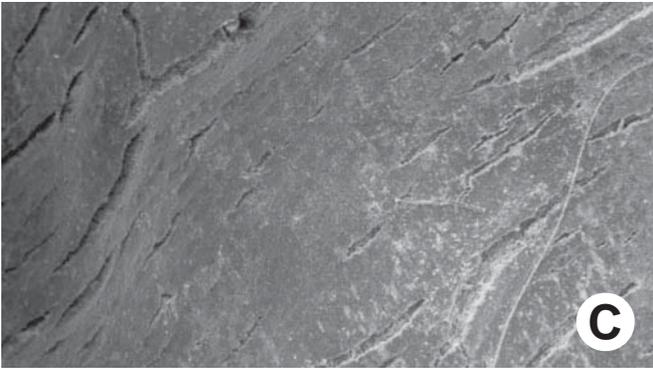
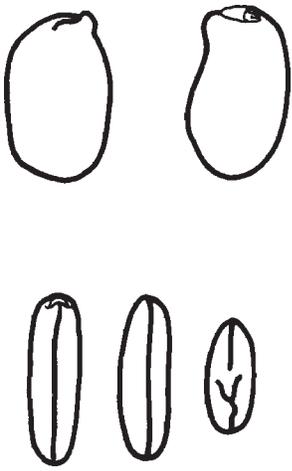
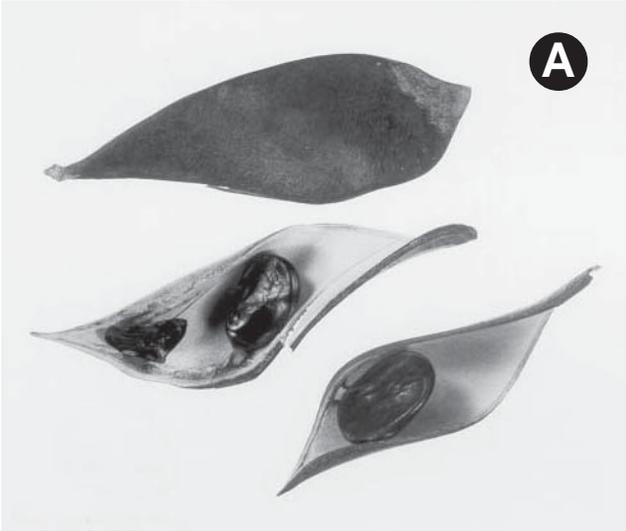
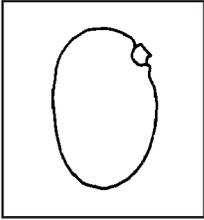
Seed 16–20 × 10–14 × 3–9 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; elliptic or irregular; compressed or flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; with or without medial ridge on each face. Cuticle not

exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified or modified by a bloom; colored; monochrome or mottled; with infrequent mottles; dark brown; with brown (darker) overlay; glabrous; smooth or not smooth; with elevated or recessed features; wrinkled; pitted with small separate pits; chartaceous to coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; color of testa; raised. Hilum partially concealed; concealed by aril; without faboid split; larger than punctiform; 2.5–4 mm long; with curved outline; elliptic; subapical to radicle tip or marginal according to radicle tip; recessed; within rim. Hilum rim color of or darker than testa. Lens not discernible. Endosperm absent. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; with both folded or not folded; sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat or wrinkled; glabrous around base of radicle. Embryonic axis oblique or parallel; oblique, parallel, or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous to triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: Tropical Africa.

Notes: Gillett (1960b) treated the genus.

Craibia: *C. brownii* S.T. Dunn (C–E), *C. spp* (A–B). A, Fruits (× 0.7); B, seeds (× 2.1); C–D, testa (× 50, × 1000); E, embryos (× 1).



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

Tribe: Millettieae.

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

Fruit a legume; unilocular; $5-10 \times 1.3-1.5 \times$ ca. 0.25 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; linear to moniliform; when asymmetrical with both sutures nearly straight or parallelly curved; not inflated; flattened; without or with beak (short); declined; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered to rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted; slightly constricted along both margins; without sulcus; embellished. Fruit wing 1; 2–3 mm wide; sutural; on 1 suture (upper). Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down. Replum invisible. Epicarp with surface texture uniform; pubescent and indurate; hairs appressed; 1 type of pubescence; densely sericeous; pubescence brown (rusty); with pubescence uniformly distributed; simple hairs; pliable; hair bases plain; eglandular; without spines; smooth or not smooth; elevated features; veined or not veined; transversely veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp glossy; opaque; monochrome; golden tan; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 2–8; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5–2 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril and tongue-aril; brown.

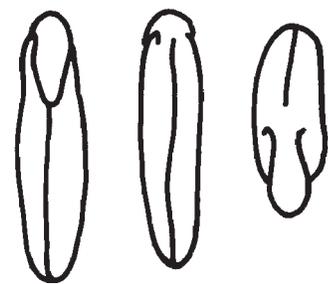
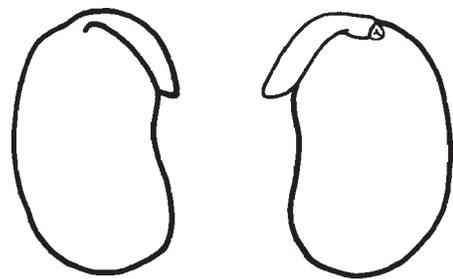
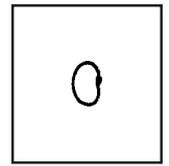
Seed ca. $6 \times$ ca. $4.5 \times$ ca. 2 mm; not overgrown; not angular; symmetrical; elliptic to reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; reddish brown; with black overlay;

glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; ca. 1 mm long; with curved outline; broadly elliptic; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; with 180-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

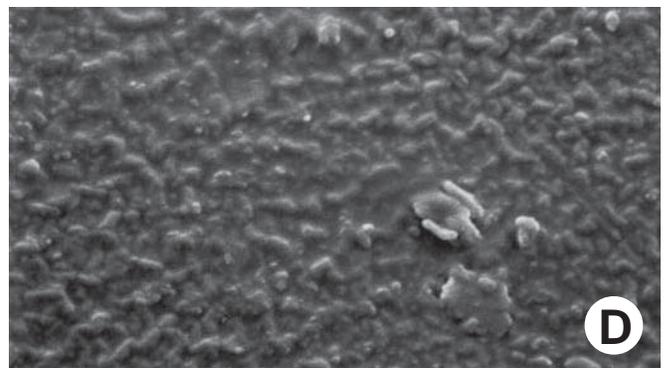
Distribution: China (Yunnan).

Notes: Geesink (1984) noted that “only few collections are extant.”

Craspedolobium: *C. schochii* H.A.T. Harms (A–E). A, Fruits ($\times 1.1$); B, seeds ($\times 6.2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



E



Genus: *Cyclolobium* G. Bentham

Tribe: Millettieae.

Species Studied—Species in Genus: 3 spp.—5 or 6 spp.

Fruit a legume; unilocular; $3\text{--}5.5 \times 1.8\text{--}2.9 \times 0.3\text{--}0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; circular, elliptic, obliquely obovate, or obliquely ovate; when asymmetrical with both sutures parallelly or unequally curved; not inflated; flattened; without beak; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished. Fruit wings 1 or 2; 2–4 mm wide; sutural; on 1 or both sutures. Fruit stipitate; with the stipe 5–7 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; orange brown; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; papillose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; opaque; monochrome; creamy yellow; smooth and scurfy; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–3) (three in literature, not observed); length parallel with or oblique to fruit length. Funiculus measured; 0.5–1 mm long; of 1 length only; filiform; straight. Aril absent.

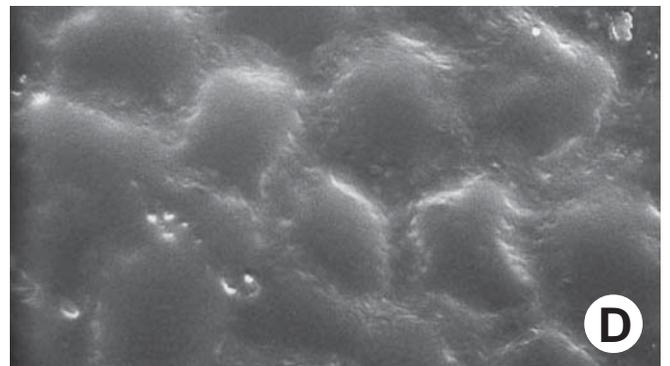
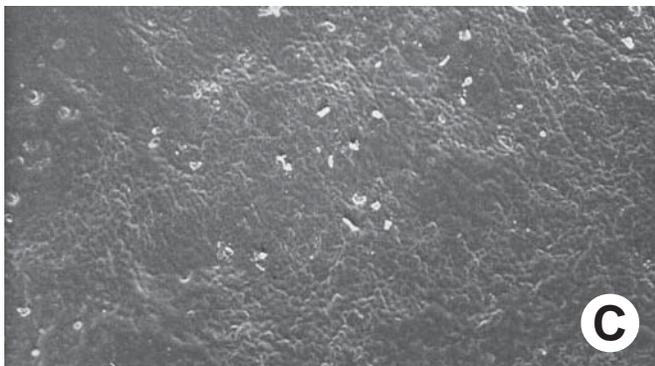
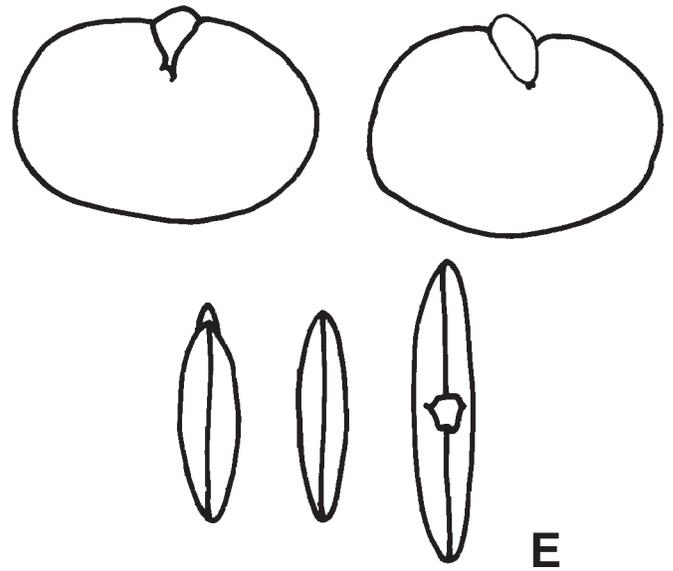
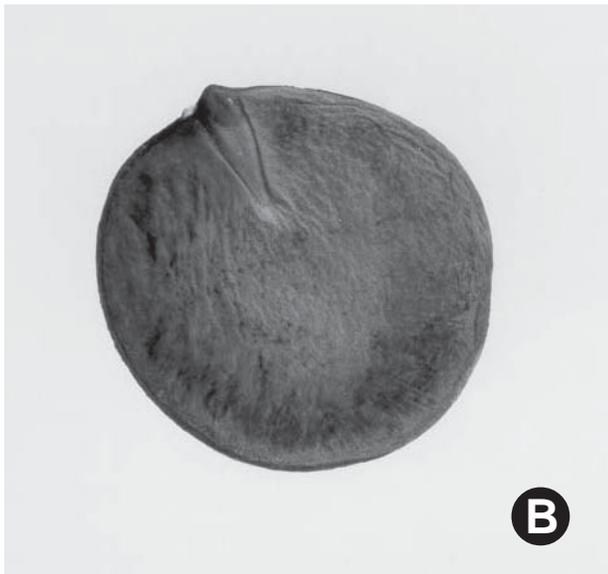
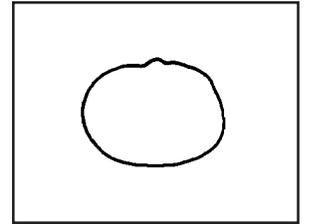
Seed $17\text{--}22 \times 16\text{--}21 \times 2.5\text{--}3$ mm; not overgrown; not angular; symmetrical to asymmetrical; elliptic to ovate or irregular; flattened; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; orange; with brown overlay; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through base of seed and up the other side; not bifurcating; darker than testa; brown;

raised. Hilum fully concealed; concealed by funicular remnant; larger than punctiform; ca. 0.5 mm long; with curved outline; elliptic; subapical to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical South America.

Notes: Hoehne (1941) monographed the genus.

Cyclolobium: *C. blanchetianum* E.L.R. Tulasne (B–E), *C.* spp. (A). A, Fruits ($\times 1.5$); B, seed ($\times 2.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



Genus: *Dahlstedtia* G.O.A. Malme

Tribe: Millettieae.

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

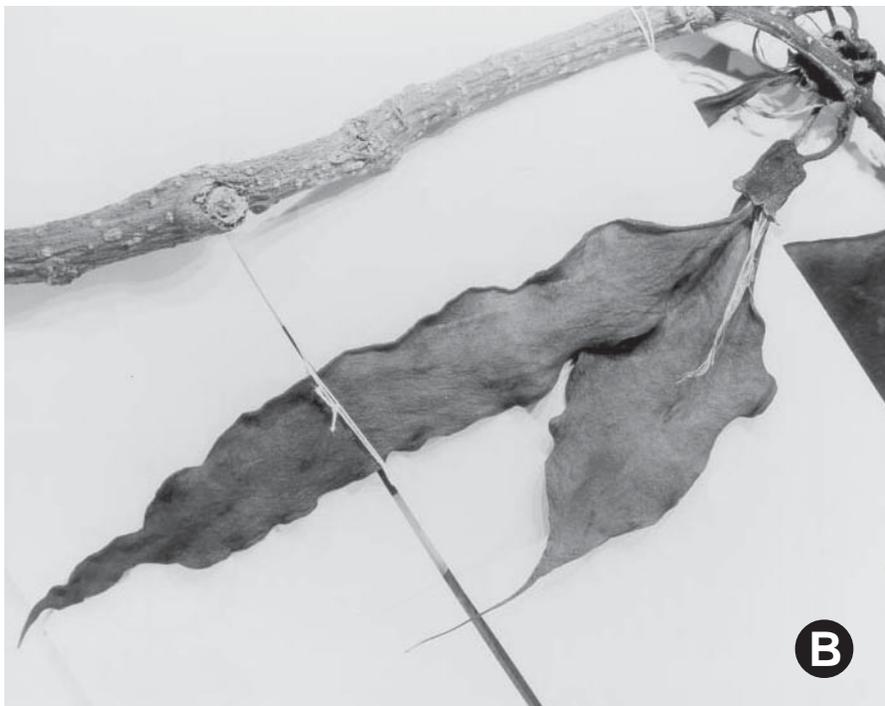
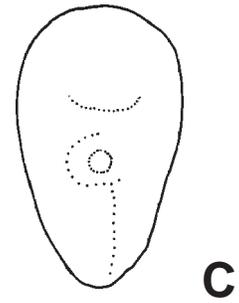
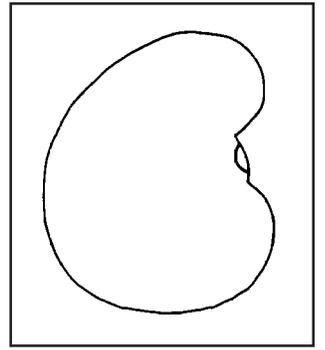
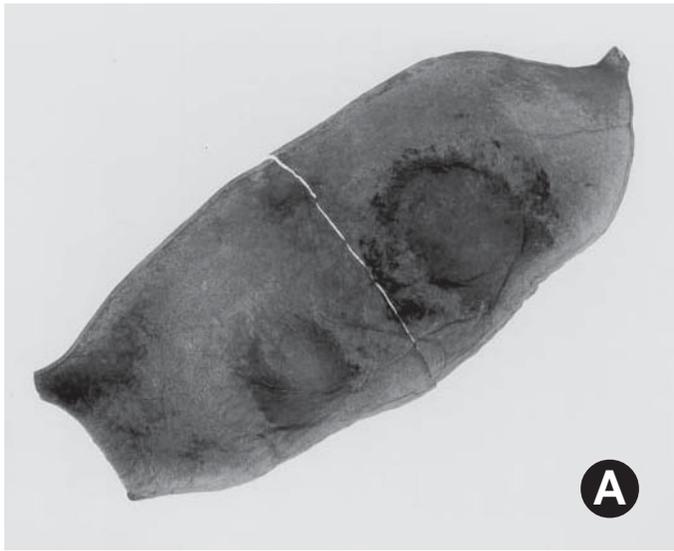
Fruit a legume; unilocular; $7-16 \times 2.5-5 \times$ up to 3 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregular; when asymmetrical with both sutures unequally curved; not inflated or inflated (slightly, in literature); compressed; without beak; blunt to short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; tapered to short tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent (from literature). Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; veined; reticulately veined to irregularly veined; not tuberculate; wrinkled; not exfoliating; without cracks. Seeds 1–4 (from literature); length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series.

Seed $30-35 \times 20-25 \times 15-20$ mm; not overgrown; not angular; asymmetrical; obliquely reniform; compressed. Testa present. Hilum larger than punctiform; with curved outline; circular.

Distribution: Southern Brazil.

Notes: Only one immature fruit was available for study. Other information was derived from photocopies of herbarium specimens and the literature (Geesink 1984).

Dahlstedtia: *D. pinnata* (G. Bentham) G.O.A. Malme
(A–C). A, Fruit ($\times 1$); B, fruits ($\times 1$); C, seed ($\times 1$).



Genus: *Dalbergiella* E.G. Baker

Tribe: Millettieae.

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

Fruit a legume; unilocular; $7-10 \times 2-2.5 \times 0.75-0.9$ cm; with deciduous corolla; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; oblong or lanceolate; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; long tapered at apex; apex oblique 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; membranous; seed chambers externally visible. Fruit margin not constricted or slightly constricted only on 1 margin; without sulcus; embellished; with wing and fringe (reddish-brown hairs along sutures of *D. nysae*). Fruit wing present (both species have winged fruit though wing is inconspicuous); 1; up to 30 mm wide; samaroid or continuous wing around fruit; on both sutures. Fruit substipitate. Fruit indehiscent. Replum invisible. Fruit entire. Epicarp dull; monochrome; greenish brown or tan (with reddish-brown fringe); pubescent and indurate or glabrous; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple or complex hairs (plumose hairs especially along sutures in *D. nysae*); pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; spongy; chartaceous. Endocarp glossy; monochrome; golden brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; up to 70 mm long; filiform; straight. Aril present (*D. nysae*) or absent (*D. welwitschii* (E.G. Baker) E.G. Baker); fleshy; knotty; covering less than 1/2 of seed; tan.

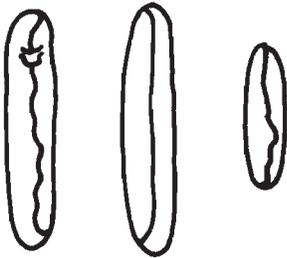
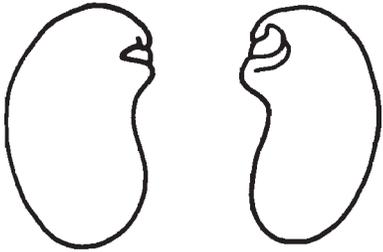
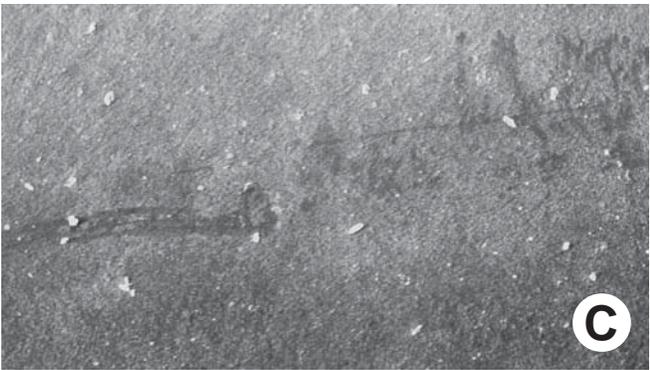
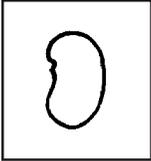
Seed $12-15 \times 6-10 \times 1.8-2$ mm; not overgrown; not angular; asymmetrical; D-shaped or reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or streaked; with frequent streaks; reddish brown; with

brown (bright reddish) overlay; glabrous; smooth; coriaceous or chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1 mm long; with straight outline; oblong; marginal according to radicle tip or between cotyledon and radicle lobe; flush; not within corona, halo, or rim. Lens not discernible. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; 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 width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

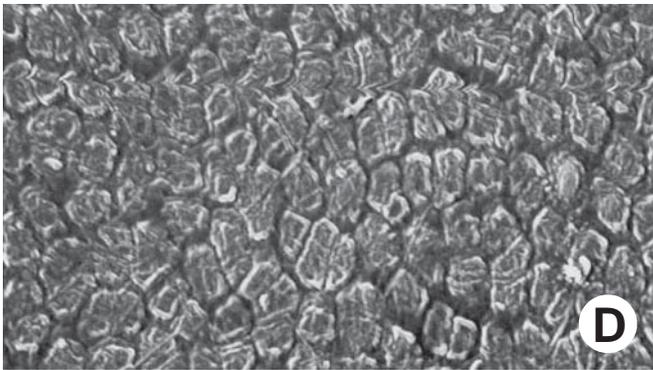
Distribution: Tropical Africa.

Notes: Geesink (1981) had placed *Dalbergiella* in the Tephrosieae (now Millettieae), but later (Geesink 1984) transferred the genus to the Dalbergieae without relating *Dalbergiella* to other genera in the Dalbergieae. The fruits of *Dalbergiella nysae* and *D. welwitschii* are similar in many respects, but there is one significant difference. The fruits of *D. nysae* are tan with a reddish-brown fringe composed of plumose hairs along the sutures, while *D. welwitschii* is greenish-brown with sutures that are entire and hairs that are simple. The seeds of *D. nysae* also have an aril, which is absent on seeds of *D. welwitschii*. It is unfortunate that we were unable to study fruits and seeds of the third species: *D. gossweileri* E.G. Baker.

Dalbergiella: *D. nysae* E.G. Baker (C–E), *D. spp.* (A–B). A, Fruits ($\times 0.9$); B, seeds ($\times 2.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



E



Genus: *Derris* J. de Loureiro

Tribe: Millettieae.

Species Studied—Species in Genus: Ca. 15 spp.—ca. 45 spp.

Fruit a legume; unilocular; $2.5-14(-20) \times 0.8-3.5 \times 0.2-1$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic, moniliform (slightly), oblong, falcate, irregular, or obliquely obovate; when asymmetrical with both sutures parallelly or unequally curved; not inflated; compressed or flattened; without or with beak; declined; with solid beak the same color and texture as fruit; rounded, blunt, tapered, or long tapered at apex; apex aligned or oblique with longitudinal axis of fruit; rounded or tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins or only on 1 margin; without sulcus; embellished. Fruit wings 1 or 2; 1–5 mm wide; sutural; on 1 or both sutures. Fruit substipitate or nonstipitate; with the stipe up to 3 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; brown or tan; with brown (darker) overlay; with mottling over seed chambers; with surface texture uniform; glabrous, pubescent and indurate, or pubescent but soon deciduous; with hairs erect or appressed; with 1 type of pubescence; sparsely puberulent to pilose or sericeous (sparsely); with pubescence golden to brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; sometimes dotted; not exfoliating; without cracks. Mesocarp present or absent; thin; 1-layered; without balsamic vesicles; without fibers; solid or firm-walled open empty cells; chartaceous. Endocarp dull; opaque or translucent; monochrome or mottled; brown, tan, white, or yellow; with mottling (dark); with brown overlay; floury-filamentous or smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating or exfoliating in part; remaining fused to mesocarp and epicarp or to only the epicarp; entire. Seeds 1–2(–8); length oblique or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–3 mm long; of 1 length only;

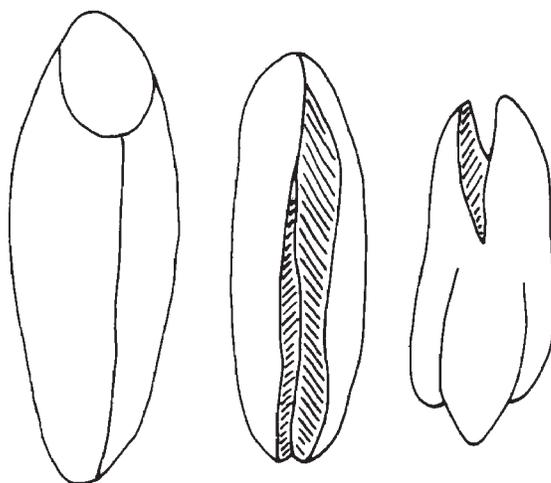
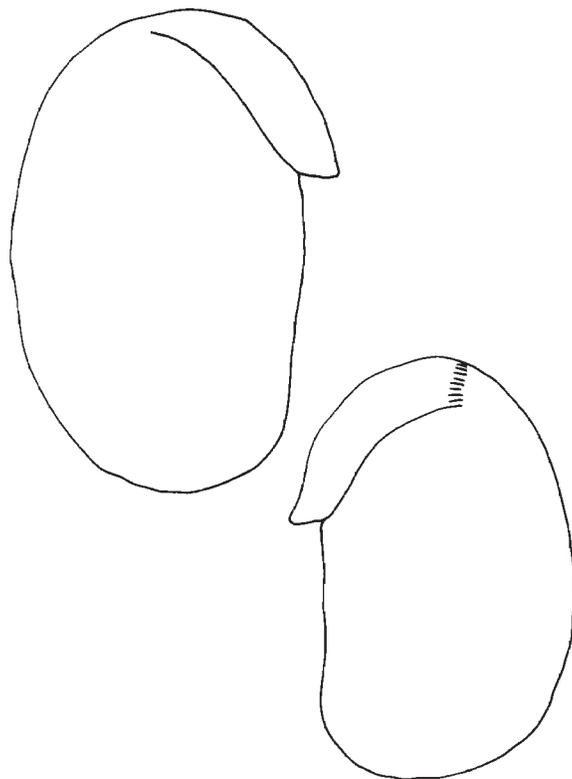
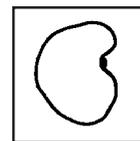
flattened; straight or triangular. Aril present or absent; dry; rim-aril; cream.

Seed $3.5-25 \times 3-17 \times 1.8-10$ mm; not overgrown; not angular; symmetrical or asymmetrical; elliptic, ovate, or reniform; compressed or flattened; with surface smooth or wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle present or absent; not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown (various shades); glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible or visible; from hilum to near base of seed and terminating; not bifurcating; slightly lighter than testa; recessed. Hilum partially or fully concealed; concealed by aril or funiculus; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–4 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; flush or recessed; within halo or not within corona, halo, or rim. Hilum halo color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 0.5–1.5 mm long; with margins straight; linear or triangular; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown or black; not within corona, halo, or rim. Endosperm present or absent; trace; covering entire embryo, covering at least 1/2 of embryo, but not entire embryo, or restricted to region of embryo; adnate to testa or embryo. Cotyledons smooth or not smooth; sulcate or wrinkled; both outer faces convex; both the same thickness; 1 longer than other or both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at or split over radicle; with or without lobes; with lobes touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan or tan and brown; inner face flat or concave; glabrous around base of radicle. Embryonic axis oblique, right angled, or straight; oblique, parallel, or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous, linear, or triangular; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary, moderately developed, or well developed; glabrous.

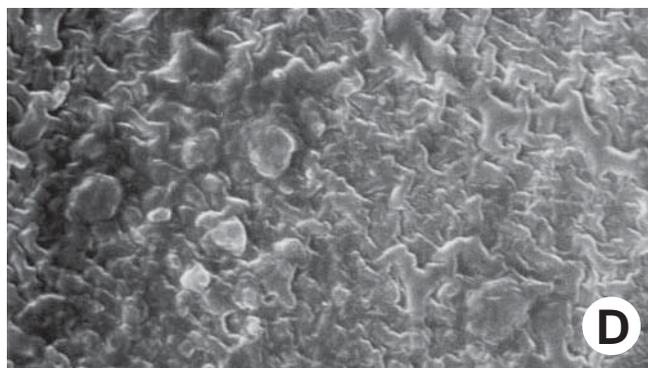
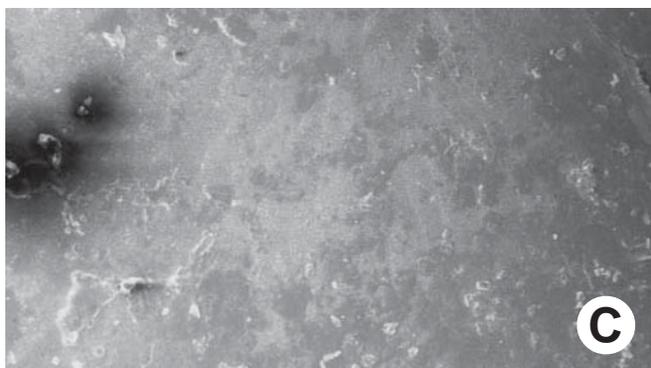
Distribution: Southeast Asia; *D. trifoliata* J. de Loureiro from east Africa to Australia and west Pacific; 4–5 spp. in South America (*Deguelia* J.B.C.F. Aublet in Geesink (1984)).

Notes: Geesink (1981) recognized three sections: *Derris* sect. *Brachypterum* (R. Wight & G.A.W. Arnott) G. Bentham, “three or possibly more species in southeast Asia,” which he raised to generic rank (Geesink 1984); *Derris* sect. *Paraderris* F.A.W. Miquel, “six species in southeast Asia,” which he also raised to generic rank (Geesink 1984); and *Derris* sect. *Derris*, “(including section *Dipteroderris* Bentham) more than 50 species in southeast Asia, one mangrove species extending to east Africa, three species in Australia, and four species in Brazil and the Guianas.” Thothathri (1982) treated *Derris* for India, and recognized four sections: *Derris* sect. *Brachypterum*; *Derris* sect. *Derris*; *Derris* sect. *Dipteroderris* G. Bentham; and *Derris* sect. *Paraderris*. We did not accept either *Brachypterum* R. Wight & G.A.W. Arnott or *Paraderris* (F.A.W. Miquel) R. Geesink at the generic rank.

Derris: *D. robusta* (W. Roxburgh ex A.-P. de Candolle) G. Bentham (*C-E*), *D. spp.* (*A-B*). *A*, Fruits ($\times 0.6$); *B*, seeds ($\times 2.1$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 14$).



E



Genus: *Dewevrea* M. Micheli

Tribe: Millettieae.

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

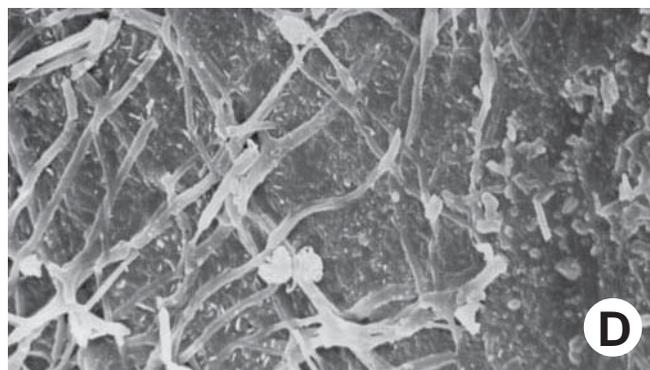
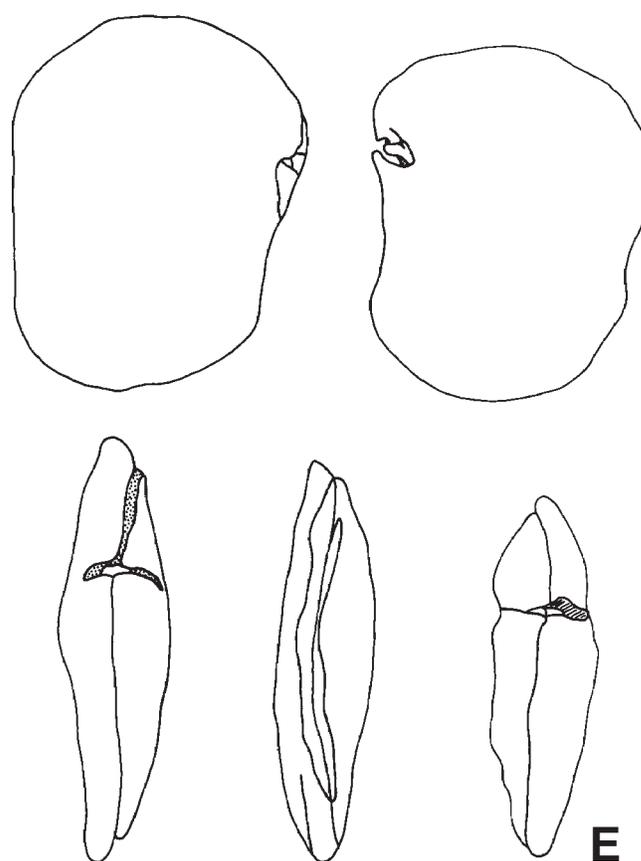
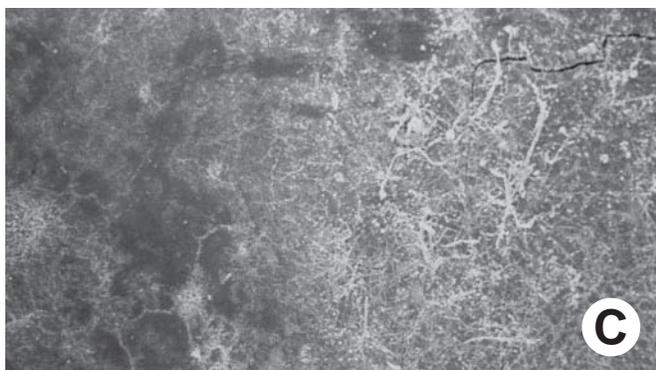
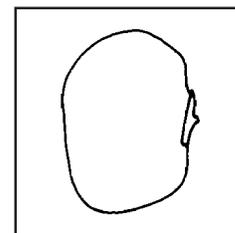
Fruit a legume; unilocular; 15–17 × 2.5–3 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; narrowly obovate; when asymmetrical with both sutures parallelly curved; not inflated; compressed to flattened; with beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligenous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with ridges or thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent but soon deciduous; with hairs erect; with 1 type of pubescence; sparsely velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases swollen (slightly); eglandular; without spines; not smooth; with elevated features; veined (immature fruit) or not veined (mature fruit); reticulately veined; not tuberculate; lenticular (mature fruit); not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; 2- or 3-layered; without balsamic vesicles; without fibers; with vitreous layer over solid layer or with vitreous layer over 2 distinct solid layers; ligenous. Endocarp dull; opaque; mottled; brown; with mottling (dark); with brown overlay; smooth and floury-filamentous; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2.5 mm long; of 1 length only; thick; broadly triangular. Aril dry; rim-aril and tongue-aril; brown.

Seed 24.5–26 × 16.5–20 × ca. 8 mm; not overgrown; angular or not angular; symmetrical; oblong or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on

each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible; from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; dark brown; raised. Hilum fully concealed; concealed by funicular remnant; larger than punctiform; 6–6.5 mm long; with curved outline; narrowly elliptic; apical according to radicle tip but marginal according to seed length; flush; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 4 mm long; with margins straight; oblong; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; convoluted; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched (strongly to shallowly so); similar at apex; partially concealing radicle; notched at or split over radicle; brown; inner face wrinkled; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed. Radicle triangular; lobe tip straight; straight with embryonic axis. Plumule rudimentary; glabrous.

Distribution: Equatorial West Africa.

Dewevrea: *D. bilabiata* M. Micheli (A–E). A, Fruits (× 0.6); B, seeds (× 1.8); C–D, testa (× 50, × 1000); E, embryos (× 2).



Genus: *Disynstemon* R. Viguier

Tribe: Millettieae.

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

Fruit a legume; unilocular; 6–8 × 1.3–1.5 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; terete; without beak; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; lignous; 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 type of pubescence; puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; pitted; not exfoliating; without cracks. Mesocarp thick; 3-layered; without balsamic vesicles; without fibers; with solid layer over vitreous layer over solid layer; coriaceous. Endocarp dull; translucent; mottled; white; with mottling (dark); with brown overlay; smooth; without adhering pieces of testa; nonseptate; chartaceous; exfoliating; separating from mesocarp; entire. Seeds 5–8; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2.5 mm long; of 1 length only; thick; broadly triangular. Aril dry; rim-aril and tongue-aril; tan.

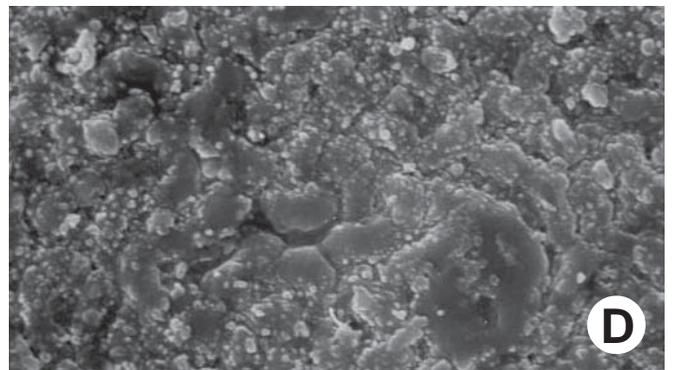
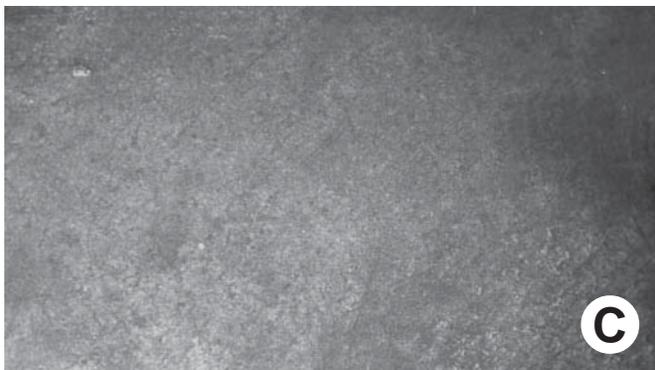
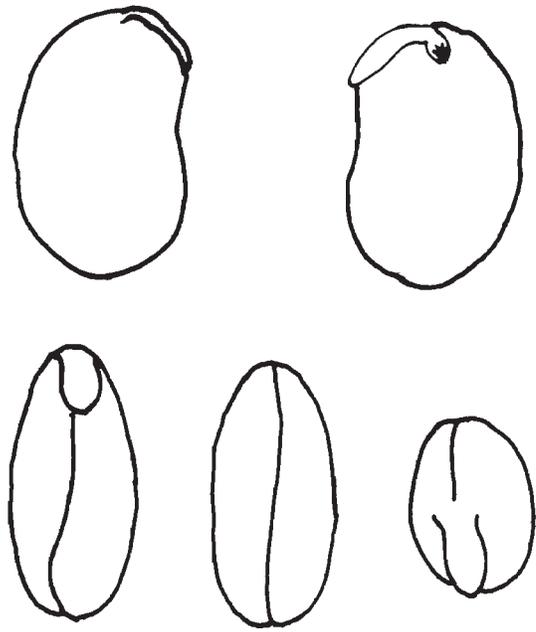
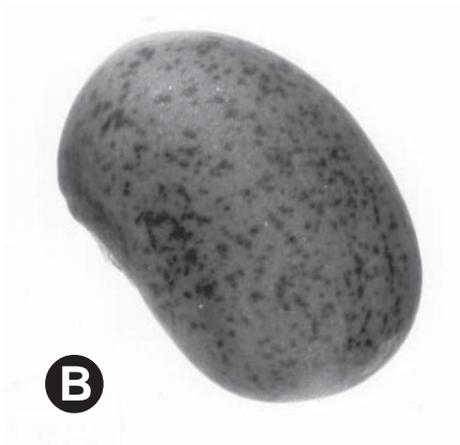
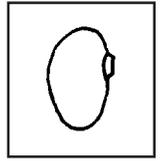
Seed 8–9 × 6–7 × 4.5–5 mm; not overgrown; not angular; symmetrical; elliptic; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; color of testa; brown; slightly raised. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the

rest of the hilum; larger than punctiform; 1.5–2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; raised; within rim. Hilum rim color slightly darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 2 mm long; with margins straight; linear to triangular; not in groove of raphe; confluent with hilum; slightly mounded; similar color as testa; slightly 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; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Madagascar.

Notes: Peltier (1977) treated *Disynstemon*.

Disynstemon: *D. paullinioides* (J.C. Baker) M.A.G. Peltier (A–E). A, Fruit (× 1.4); B, seed (× 6.7); C–D, testa (× 50, × 1000); E, embryos (× 3.1).



Genus: *Endosamara* R. Geesink

Tribe: Millettieae.

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

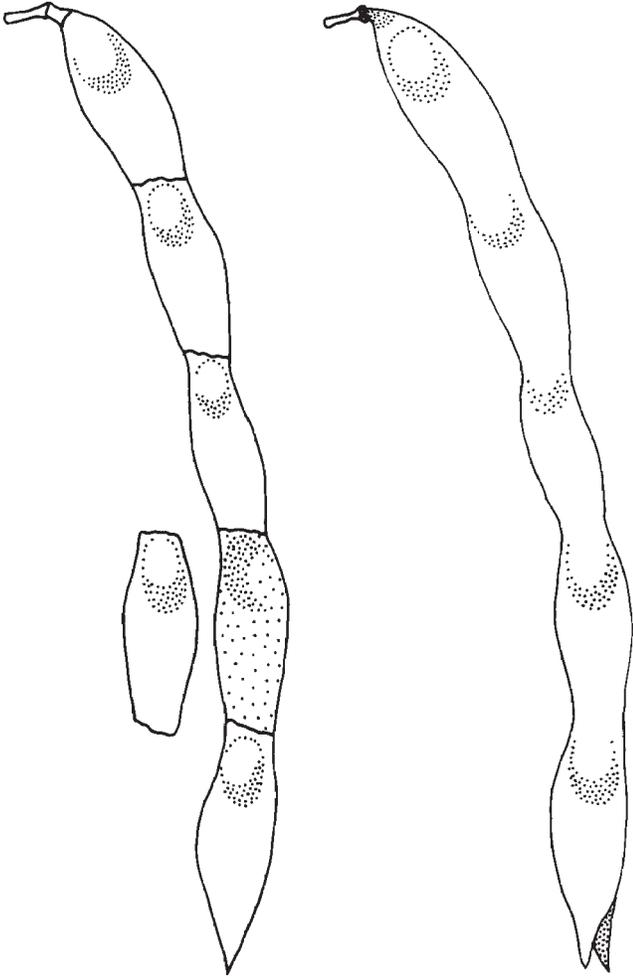
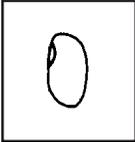
Fruit a legume; unilocular; 10–25 × 1–1.6 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear (or nearly so); when asymmetrical with both sutures parallelly curved; with or without beak; straight; with solid beak the same color and texture as fruit; rounded or tapered at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture. Fruit margin constricted (in literature) or not constricted; slightly constricted along both margins. Fruit wings absent. Fruit substipitate; with the stipe 2–3 mm long. Fruit with epicarp and mesocarp dehiscent and endocarp not dehiscent; with epicarp and mesocarp splitting along suture, endocarp lomented, forming an envelope around each seed, with a flat winglike part. Dehiscence of valves along both sutures; apical and down. Epicarp glabrous; without spines. Endocarp chartaceous; separating from mesocarp; separating into 1-seeded winged segments. Seeds 4–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Aril absent.

Seed ca. 10 × 5–7 × 2–6 mm; not overgrown; not angular; symmetrical; elliptic (with one end somewhat pointed); terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible; from hilum through lens to base of seed and terminating; not bifurcating; color of testa; raised. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2–3 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight; triangular; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim.

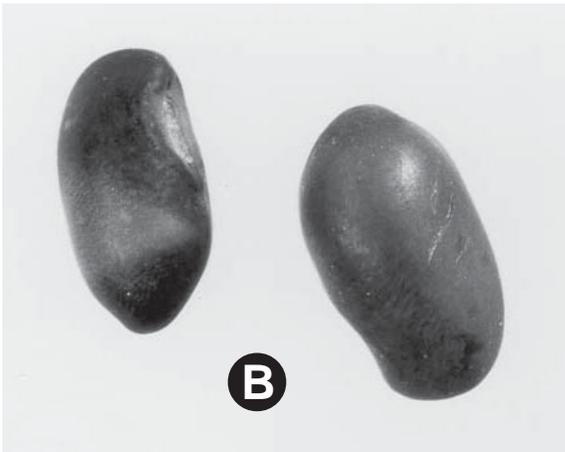
Distribution: South India to Indochina and Philippines.

Notes: Geesink (1984) noted that Dunn (1912) placed *Millettia racemosa* (W. Roxburgh) G. Benth in the monotypic section *Bracteatae*. Dunn mentioned the separating endocarp, but may have considered the lomentation of the endocarp to be an artifact. Geesink regarded this lomentation to be unique in the Fabaceae, but it is also found in *Glottidium* (8.01). No fruits and only one seed were studied; limited information was taken from literature and photocopies of herbarium specimens. Adema (personal communication, 1998) confirmed that there are two species in this genus, and his species count is used.

Endosamara: *E. racemosa* (W. Roxburgh) R. Geesink (A–B). A, Fruits (× 0.7); B, seeds (× 3.8).



A



B

Genus: *Fordia* W.B. Hemsley

Tribe: Millettieae.

Species Studied—Species in Genus: 3 spp.—ca. 16 spp.

Fruit a legume; unilocular; 6–30 × 1.5–5 × 0.4–0.8 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; fusiform, obovate, falcate, elliptic, or obliquely obovate; when asymmetrical with both sutures parallelly or unequally curved; not inflated; flattened; with beak; straight or declined; with solid beak the same color and texture as fruit; tapered or long tapered at apex; apex aligned or oblique with longitudinal axis of fruit; rounded, tapered, or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished or plain; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate to stipitate; with the stipe up to 15 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; dark brown to tan; with brown overlay; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 type of pubescence; sparsely puberulent to velutinous; with pubescence white or brown to black (nearly); with pubescence uniformly distributed; with simple hairs; stiff or pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated or recessed features; not veined; not tuberculate; dotted or striate; slitted obliquely; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined or uniformly veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid or with spongy layer over solid layer; coriaceous. Endocarp dull; opaque; monochrome or mottled; tan to brown; with mottling (dark); with brown overlay; floury-filamentous to scurfy; without adhering pieces of testa; nonseptate; chartaceous; exfoliating in part or not exfoliating; remaining fused to mesocarp and epicarp or separating from mesocarp; entire. Seeds 2–7; length oblique or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2.5 mm long; of 1 length only; thick; convoluted. Aril dry; 2-lipped rim-aril or rim-aril; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; brown.

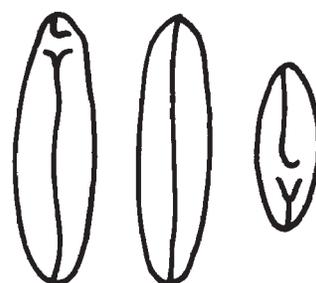
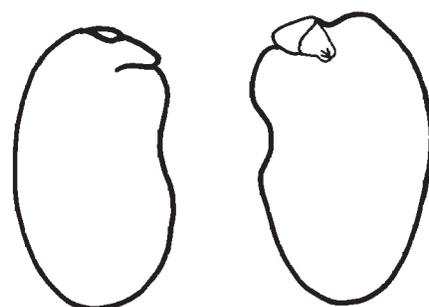
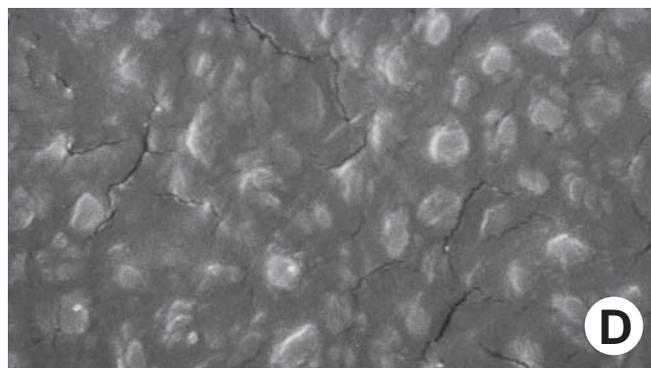
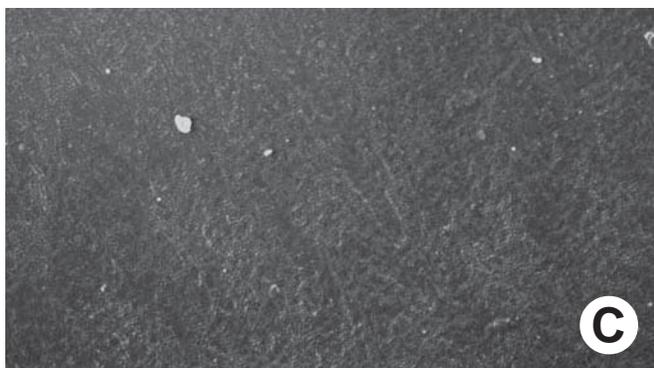
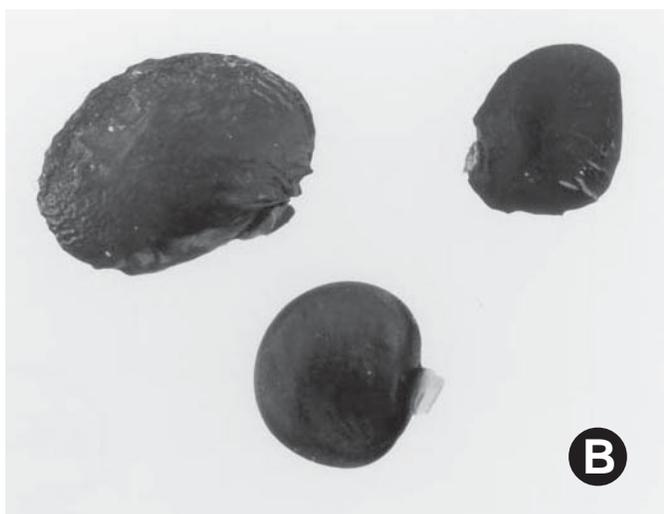
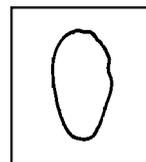
Seed 10–23 × 10–22 × 4–5 mm; not overgrown; not angular or angular (in literature); symmetrical or asymmetrical; circular, elliptic, irregular, or quadrangular (rarely); compressed to flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome, mottled, or streaked; with infrequent mottles; with infrequent streaks; brown; with brown (darker) overlay; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent or present; irregular. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating; not bifurcating; darker than testa; raised. Hilum partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2–4.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; raised or flush; within halo or rim. Hilum halo color darker than testa. Hilum rim color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 2–4 mm long; with margins straight; linear to triangular (narrowly); not in groove of raphe; confluent with hilum; flush; same or similar color as testa; darker than testa; 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; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown or tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: Continental southeastern Asia, Sumatra, and Borneo.

Notes: Dasuki and Schot (1991) revised *Fordia*, and included *Imbralyx* Geesink. Schot (1991) provided a phylogenetic analysis that supported uniting *Fordia* and *Imbralyx*. Buijsen (1988) also revised *Fordia*, but did

not include *Imbralyx*. We followed Dasuki and Schot, and included *Imbralyx* in *Fordia*. Some information was supplemented from those sources. Few seeds were available for study.

Fordia: *F. splendidissima* (C.L. von Blume ex F.A.W. Miquel) J.R.M. Buijsen (*C-E*), *F. spp.* (*A-B*). *A*, Fruits ($\times 0.9$); *B*, seeds ($\times 2.1$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 2.5$).



E

Genus: *Hesperothamnus* T.S. Brandege

Tribe: Millettieae.

Species Studied—Species in Genus: 2 spp.—ca. 5 spp.

Fruit a legume; unilocular; 5–10 × 0.6–1.7 × 0.3–0.6 cm; with deciduous or persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear to moniliform or falcate (slightly); when asymmetrical with both sutures parallelly curved; not inflated; compressed; with or without beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan to green; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous to tomentose; with pubescence golden or white; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid or with solid layer over solid layer; coriaceous. Endocarp dull; opaque or translucent; monochrome; green or white; smooth and scurfy or cracked and scurfy; without adhering pieces of testa; nonseptate; chartaceous; exfoliating in part or not exfoliating; separating from mesocarp; entire. Seeds 2–4; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2.5 mm long; of 1 length only; thick; contorted. Aril dry; rim-aril and tongue-aril; creamy yellow.

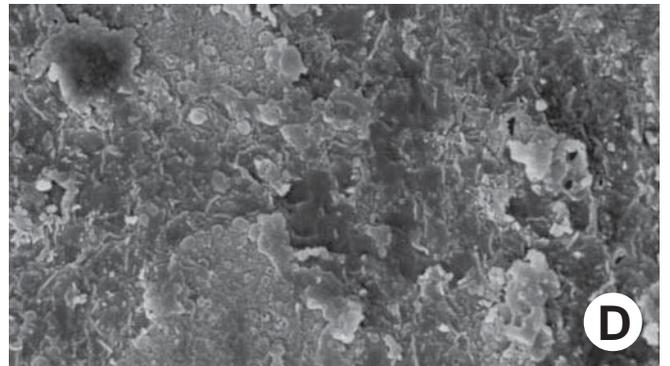
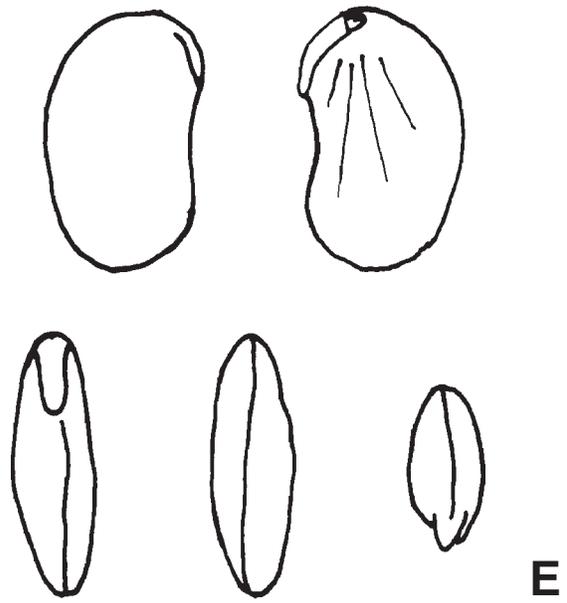
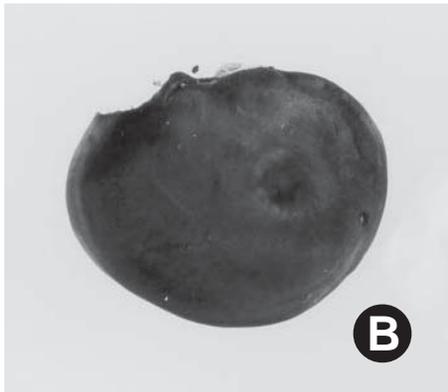
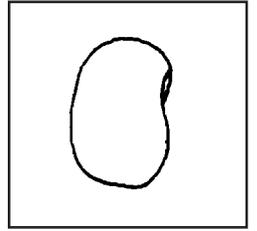
Seed ca. 11 × 7–9 × 3–3.5 mm; not overgrown; not angular; symmetrical; elliptic; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of

adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth or not smooth; with elevated features; lightly rugose; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; ca. 1.8 mm long; with curved outline; oval; recessed; within rim. Hilum rim color of testa. Lens not discernible. Endosperm absent. Cotyledons smooth; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Mexico.

Notes: This genus was included in *Millettia* by Geesink (1984). Because Geesink did not make any combinations for the species of this genus in *Millettia* (and there has been no recent treatment of the group), we have recognized the genus. Only one whole, mature seed was seen.

Hesperothamnus: *H. littoralis* (T.S. Brandege) T.S. Brandege (B–E), *H.* spp. (A). A, Fruits (× 1.7); B, seed (× 2.2); C–D, testa (× 50, × 1000); E, embryos (× 2.6).



Genus: *Kunstleria* D. Prain

Tribe: Millettieae.

Species Studied—Species in Genus: 3 spp.—10 spp.

Fruit a legume; unilocular; $6-15 \times (1.5-2) \times 0.1(-0.3)$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical (slightly); elliptic; when asymmetrical with 1 straight and 1 curved suture; narrowing slightly once or twice on one side; not inflated; flattened; with or without beak; straight or declined; with solid beak the same color and texture as fruit; emarginate or rounded at apex; apex aligned or oblique with longitudinal axis of fruit; cordate, unequally cordate, rounded, or unequally rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin constricted or not constricted; slightly constricted only on 1 margin; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous to tomentose; with pubescence brown to 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 absent. Endocarp dull; opaque; monochrome or mottled; brown; with mottling (dark); with brown overlay; scurfy; with adhering pieces of testa; 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; ca. 0.7 mm long; of 1 length only; flattened; straight. Aril absent.

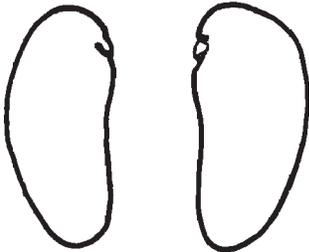
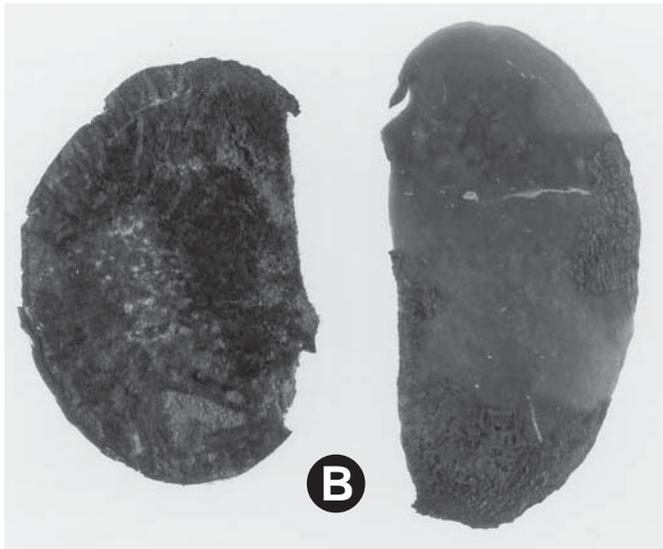
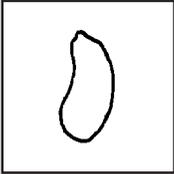
Seed $18-33 \times 10-16 \times 0.3-1$ mm; not overgrown; not angular; asymmetrical; reniform (with beak-like flap near end furthest from hilum); flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa with or without pieces of adhering epicarp; partially adhering to endocarp; fused to endocarp, at most a transparent brown tissue; dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with elevated features; rugose; chartaceous.

Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; color of testa; raised. Hilum visible; without faboid split; larger than punctiform; 1–3 mm long; with curved outline; fusiform; apical according to radicle tip but marginal according to seed length; raised or flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces flat; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis parallel; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

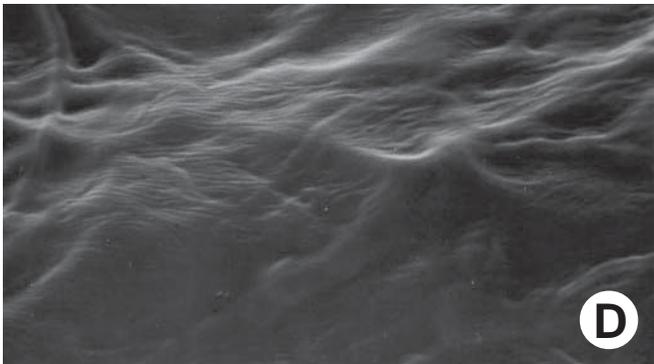
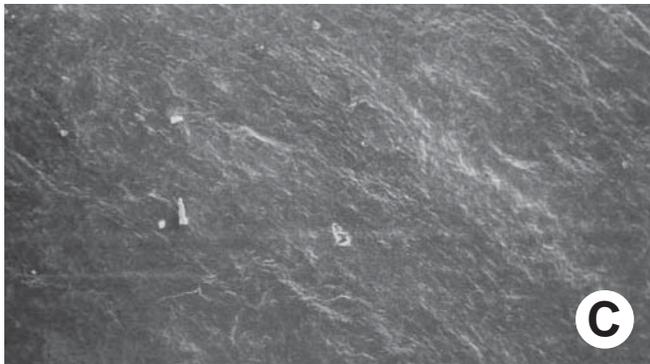
Distribution: Western Malesia, Philippines (neither in Java nor in Australia), and India (Kerala).

Notes: Mohanan and Nair (1981) reported it from India for the first time. Geesink (1984) transferred the two Australian and New Guinean species to *Austrosteenisia*. Ridder-Numan (1995) considered *Kunstleria* to be closely related to *Butea* (10.04), *Meizotropis* (10.06), and *Spatholobus* (10.05, Phaseolae subtribe Erythrineae). Further study by Ridder-Numan and Ham (1997) supported the close relationships of these four genera, but was unable to resolve the placement of *Spatholobus*. Our fruit and seed data do not support this. Ridder-Numan and Kornet (1994) revised *Kunstleria*.

Kunstleria: *K.* spp. (A–E). A, Fruits ($\times 0.7$); B, seeds ($\times 2.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



E



Genus: *Leptoderris* S.T. Dunn

Tribe: Millettieae.

Species Studied—Species in Genus: 6 spp.—20–30 spp.

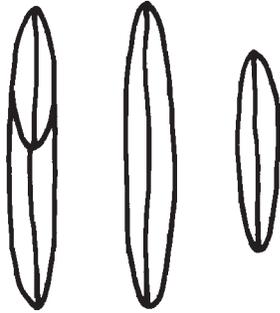
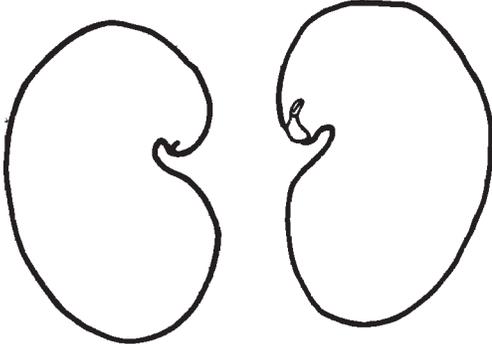
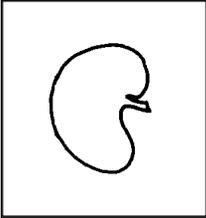
Fruit a legume; unilocular; $2.6\text{--}10 \times 1.2\text{--}3.6 \times 0.3\text{--}0.4$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; circular (or obliquely so), elliptic, or falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened; with or without beak; straight; with solid beak the same color and texture as fruit; emarginate or rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas or wing. Fruit wing present or absent; 1; up to 4 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; multicolored; mottled; tan; with brown overlay; with surface texture uniform; glabrate or pubescent and indurate; with hairs appressed; with 1 type of pubescence; sericeous to strigose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff or pliable; with hair bases swollen or plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; sometimes wrinkled; not exfoliating; without cracks. Mesocarp present or absent; thin or trace; surface uniformly veined or not veined; 1-layered; without balsamic vesicles; without fibers; firm-walled open empty cells or mealy; chartaceous. Endocarp dull; translucent; monochrome or mottled; tan; with mottling (dark); with brown overlay; scurfy, veined, or scurfy and veined; without adhering pieces of testa; nonseptate; chartaceous; exfoliating in part or not exfoliating; remaining fused to mesocarp and epicarp or just to epicarp; entire. Seeds 1(–3); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–7.5 mm long; of 1 length only; flattened; straight. Aril absent.

Seed $13\text{--}23 \times 11\text{--}20 \times 1.8\text{--}3$ mm; not overgrown; not angular; symmetrical; reniform; flattened; with surface smooth or wrinkled; without visible radicle and cotyledon lobes; with deep hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa with or

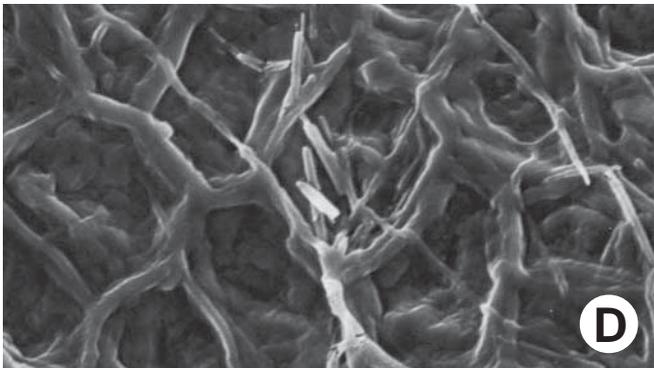
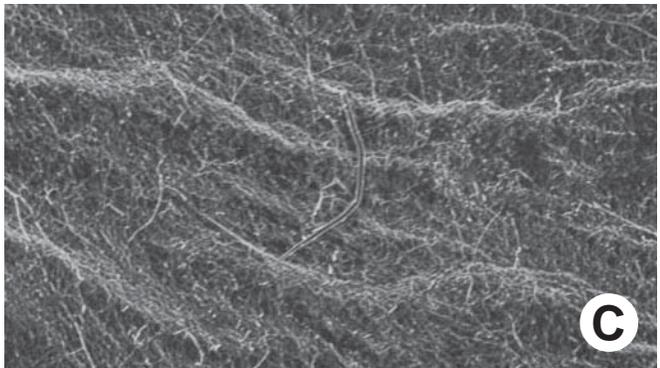
without pieces of adhering epicarp; partially or not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown; with brown overlay; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating; not bifurcating; darker than testa; raised. Hilum visible or fully concealed; concealed by funiculus; without faboid split; larger than punctiform; 0.8–1.5 mm long; with curved outline; fusiform; apical according to radicle tip but marginal according to seed length; raised; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat or wavy; glabrous around base of radicle. Embryonic axis oblique, parallel, or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight or curved; deflexed and parallel to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Africa.

Leptoderris: *L. aurantiaca* S.T. Dunn (*E*), *L. nobilis* S.T. Dunn (*C–D*), *L. spp.* (*A–B*). *A*, Fruits ($\times 0.9$); *B*, seeds ($\times 2.2$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 3$).



E



Genus: *Lonchocarpus* K.S. Kunth

Tribe: Millettieae.

Species Studied—Species in Genus: Ca. 48 spp.—ca. 150 spp.

Fruit a legume; unilocular; $2-16 \times 0.9-4.5 \times 0.1-1$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic, falcate, fusiform, linear (nearly), moniliform, obovate, or obliquely obovate; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed or flattened; without or with beak (very short); straight; with solid beak the same color and texture as fruit; rounded, emarginate, truncate, tapered, or long tapered at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered, tapered, or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous to chartaceous to coriaceous to ligneous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins or only on 1 margin; with or without sulcus; plain or embellished; with ridges or wings. Fruit wings absent or present; 2; 1–2 mm wide; sutural; on 1 suture. Fruit nonstipitate to substipitate to stipitate; with the stipe 0–7 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan to brown or yellow; with brown overlay; with surface texture uniform; glabrous, glabrate, pubescent and indurate, or pubescent but soon deciduous; with hairs erect or appressed; with 1 type of pubescence; puberulent or velutinous; with pubescence golden to brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; veined or not veined; reticulately or irregularly veined; not tuberculate or tuberculate; with solid tubercles on each valve; papillose or rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1- or 2-layered; without or with balsamic vesicles; without fibers; without reniform canals; solid or with solid layer over solid layer or spongy layer over solid layer; coriaceous or chartaceous. Endocarp dull or glossy; opaque or translucent; monochrome; brown to

tan or yellow; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured or less than 0.5 mm long; 0.5–6 mm long; of 1 length only; flattened or thick; curved, straight, or triangular. Aril dry; rim-aril; without tongue (or flap-like) on lips of 2-lipped rim-aril; white to tan.

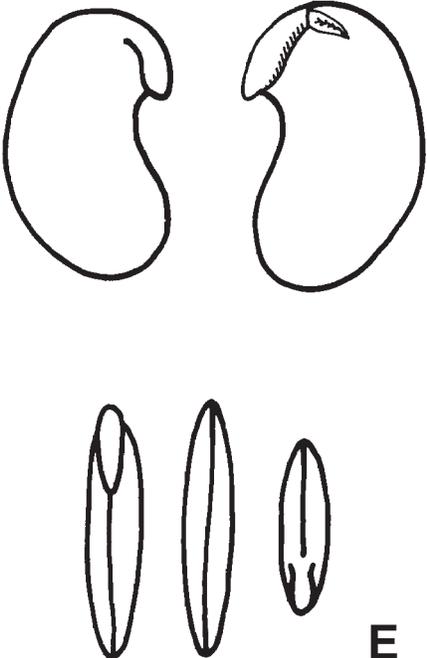
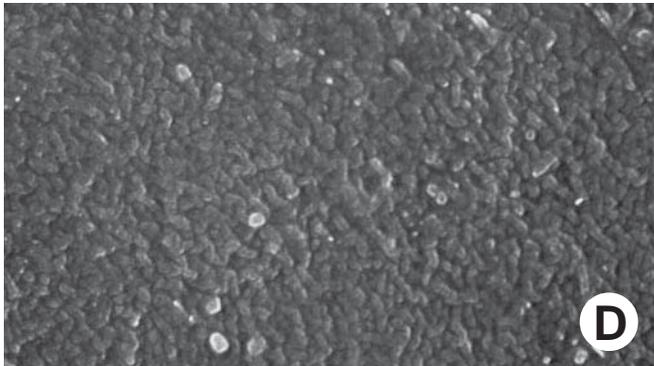
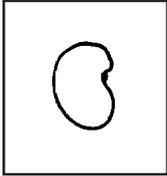
Seed $8-27 \times 4-16 \times 1-4$ mm; not overgrown; not angular; symmetrical; reniform to C-shaped or ovate; compressed or flattened; with surface smooth; without or with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with deep or shallow hilar sinus or without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull to glossy; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; pale to dark brown, purple, or tan; with brown overlay; glabrous; smooth or not smooth; with elevated features; rugose or wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating; not bifurcating; color of or darker than testa; brown; flush or raised. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum or lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1–4 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim or within rim or halo. Hilum halo color lighter or darker than testa. Hilum rim color lighter or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; brown; within rim or not within corona, halo, or rim. Lens rim color darker than testa. Endosperm thin; not pluglike and not resembling tip of radicle; covering entire embryo or at least 1/2 of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown, green, or tan; inner face flat; glabrous around base of radicle. Embryo-

onic axis oblique or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Central America, tropical South America, and *L. sericeus* (J.L.M. Poiret) K.S. Kunth ex A.-P. de Candolle in the West Indies.

Notes: Pittier (1917) monographed the Central American species of *Lonchocarpus*. Geesink (1984) included *Willardia* J.N. Rose and *Terua* P.C. Standley & F.J. Hermann. Wiersema et al. (1990) recognized *Willardia*, but Sousa (1992) reduced *Willardia* to a section of *Lonchocarpus*, making the combinations. *Lonchocarpus* spp. are frequently used as a fish poison and as a commercial source of rotenone.

Lonchocarpus: *L. capassa* R.A. Rolfe (C–E), *L. spp.* (A–B).
A, Fruits ($\times 0.5$); B, seeds ($\times 1.5$); C–D, testa ($\times 50$,
 $\times 1000$); E, embryos ($\times 2.5$).



Genus: *Millettia* R. Wight & G.A.W. Arnott

Tribe: Millettieae.

Species Studied—Species in Genus: Ca. 26 spp.—ca. 90 spp.

Fruit a legume; unilocular; $4-23 \times 0.6-4 \times$ up to 3.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear, oblanceolate, obovate, or irregularly fusiform; when asymmetrical with both sutures parallelly curved; inflated or not inflated; compressed or terete; without beak; blunt to short tapered to tapered to long tapered at apex; apex aligned with longitudinal axis of fruit; rounded, tapered, or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous, leathery, or ligneous; seed chambers externally visible or invisible; with the raised seed chambers torulose or not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; with or without sulcus; plain. Fruit wings absent or present (3 spp., Adema, personal communication, 1998); 2 or 4; valvular (along suture or parallel to it, but not on it; perpendicular to the plane through the sutures); on both valves. Fruit stipitate, substipitate, or nonstipitate; with the stipe 5–20 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan to brown (dark); with brown overlay; with surface texture uniform; glabrous, glabrate, pubescent and indurate, or pubescent but soon deciduous; with hairs erect; with 1 type of pubescence; tomentose or velutinous; with pubescence tan to brown; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; densely lenticular, rugose, or verrucose-rugose; not exfoliating; without cracks. Mesocarp thick or thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; without reniform canals; solid or with solid layer over solid layer; ligneous or coriaceous. Endocarp dull; opaque to translucent; monochrome or mottled; brown, orange, or tan; with mottling; with brown overlay; fibrous, scurfy, or smooth; without adhering pieces of testa; septate, subseptate, or nonseptate; with septa thin (tissue paper-like), flexible or thicker than paper, firm; with septa eglandular; chartaceous or pulpy; exfoliating

in part or not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–8; length oblique or transverse to fruit length; touching or neither overlapping nor touching; in 1 series. Funiculus measured; 1–10 mm long; of 1 length only; flattened or thick; straight or triangular. Aril dry; hippocrepiform rim-aril and tongue-aril, 2-lipped rim-aril, or partial rim-aril; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; cream to tan.

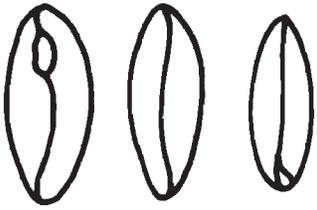
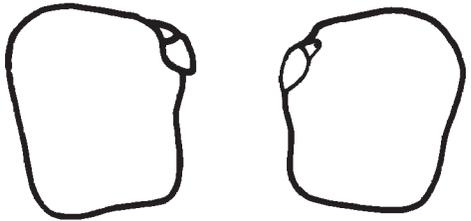
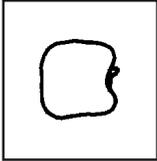
Seed $8-50 \times 6-35 \times 1-25$ mm; overgrown, 1 seed filling entire fruit cavity or not overgrown; not angular; symmetrical or asymmetrical; oblong to ovate, reniform, irregular, or rhombic (irregularly); terete, compressed, or flattened; with surface smooth or wrinkled; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus or without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull to glossy; not modified by a bloom; colored; monochrome; brown to black; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent or present; transverse. Rim absent. Wings absent. Raphe not visible or visible; from hilum through lens to base of seed and terminating; not bifurcating; color of testa; brown; slightly raised or recessed (slightly). Hilum visible or fully concealed; concealed by radicle lobe; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–4 mm long; with curved outline; circular or elliptic; subapical to radicle tip or apical according to radicle tip but marginal according to seed length; raised, flush, or recessed; within rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1–2 mm long; with margins straight; linear to triangular or oblong; not in groove of raphe; confluent with hilum; flush; same or similar color as testa; darker than testa; brown to black; not within corona, halo, or rim. Endosperm present or absent; thin; not pluglike and not resembling tip of radicle; covering entire embryo or covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially

concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown, orange, white, or yellow; inner face flat or concave; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length or 1/2 to nearly length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

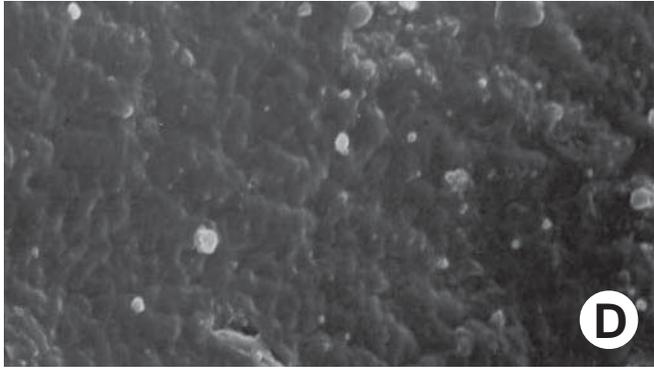
Distribution: Tropical Africa and Asia to Malaysia.

Notes: Geesink (1984) included both *Hesperothamnus* and *Pongamia* in *Millettia*. We recognized both genera because neither he nor anyone else made the species transfers for either genus. Wei (1985) revised the Chinese species of *Millettia*.

Milletia: *M. cinerea* G. Benth (E), *M. grandis* (E.H.F. Meyer) H.C. Skeels (C-D), *M. spp.* (A-B). A, Fruits ($\times 0.5$); B, seeds ($\times 1$); C-D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



E



Genus: *Muelleria* C. Linnaeus f.

Tribe: Millettieae.

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

Fruit a loment (or a loment segment); 1–10 × 0.6–3 × 0.6–2.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregularly moniliform; when asymmetrical with both sutures parallelly curved; not inflated; terete to compressed; with or without beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or 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; leathery or ligneous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins or constricted on 1 margin and slightly constricted on the other margin; without sulcus; plain. Fruit wings absent. Fruit stipitate, substipitate, or nonstipitate; with the stipe 5–10 mm long. Fruit indehiscent. Loment an intact article; indehiscent. Loment segments (articles) conspicuous; 10–30 mm long; widest across seed area; with all essentially similar in shape; circular or D-shaped. Epicarp dull; multicolored; mottled; green to brown; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; rugose or wrinkled; not exfoliating; without cracks. Mesocarp thick or thin; 1-layered; without balsamic vesicles; without fibers; without reniform canals; solid; ligneous or coriaceous. Endocarp dull; translucent; mottled; tan; with brown overlay; scurfy or smooth; without adhering pieces of testa; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 1 mm long; of 1 length only; flattened; straight. Aril absent.

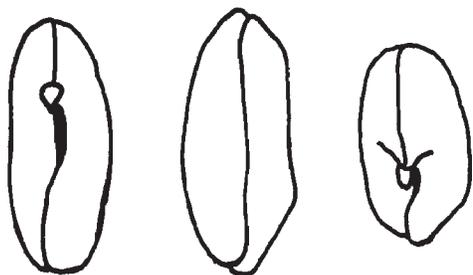
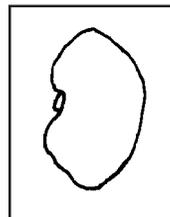
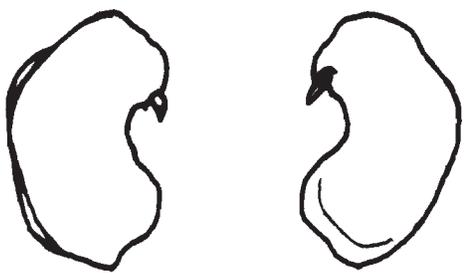
Seed 15–20 × 6–12 × 5–10 mm; not overgrown; not angular; symmetrical or asymmetrical; ovate or reniform; terete; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with deep hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa without pieces of adhering epicarp; not adhering to endocarp; free

from endocarp; dull; not modified by a bloom; colored; monochrome or streaked; with frequent streaks; brown; with brown overlay; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; brown; flush. Hilum partially or fully concealed; concealed by funicular remnant; larger than punctiform; 2–5 mm long; with curved outline; elliptic; marginal according to radicle tip; raised; within rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 2–4 mm long; with margins straight; linear; not in groove of raphe; confluent with or adjacent to hilum; ca. 1 mm from hilum; flush; similar color as testa; darker than testa; brown; within halo or not within corona, halo, or rim. Lens halo color darker than testa. Endosperm trace; not pluglike and not resembling tip of radicle; restricted to region of embryo; adnate to testa. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan to yellow; inner face concave; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

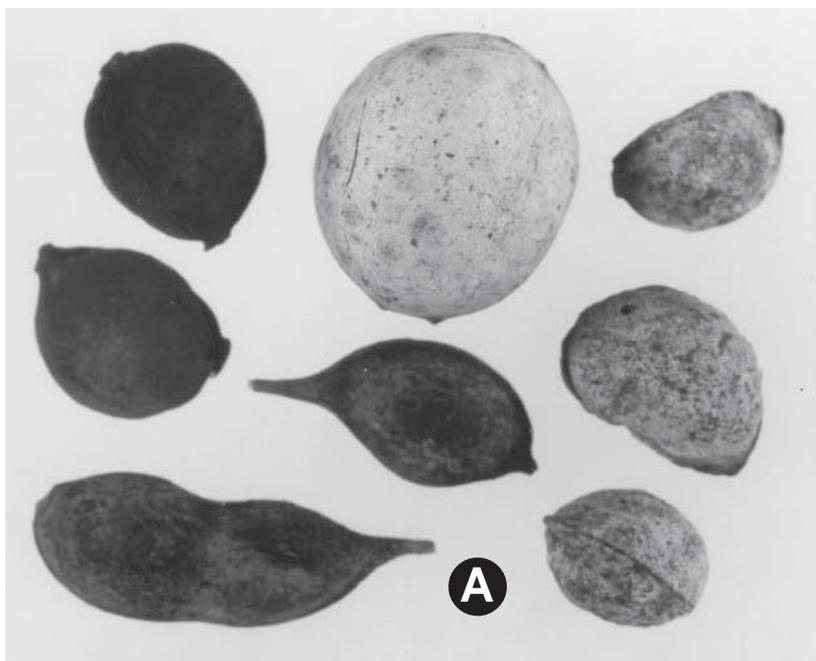
Distribution: Central and South America.

Notes: Fortunato and Palese (1997) transferred *Muelleria fluvialis* (C.A.M. Lindman) A. Burkart to *Lonchocarpus* as *L. fluvialis* (C.A.M. Lindman) R.H. Fortunato & R. Palese.

Muelleria: *M. moniliformis* C. Linnaeus f. (B–E), *M.* spp. (A). A, Loments and loment segments (× 1.4); B, seed (× 3.3); C–D, testa (× 50, × 1000); E, embryos (× 1.8).



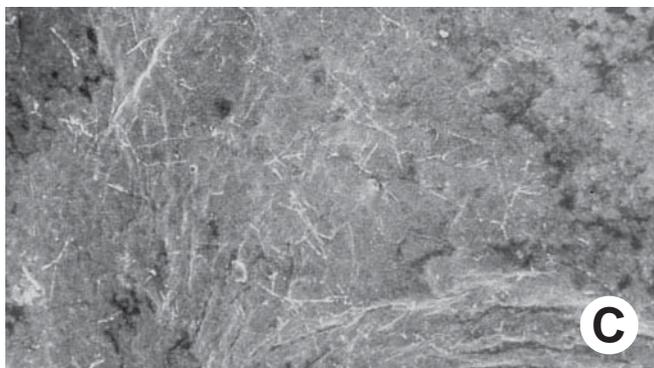
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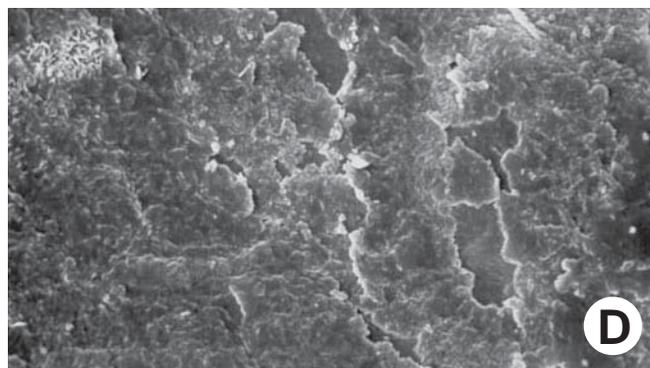
A



B



C



D

Genus: *Mundulea* (A.-P. de Candolle) G. Bentham

Tribe: Millettieae.

Species Studied—Species in Genus: 2 spp.—ca. 16 spp.

Fruit a legume; unilocular; $5-11 \times 0.7-1 \times 0.2-0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear or moniliform; not inflated; compressed or flattened; with beak; straight; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to 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; embellished; with ridges. 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; monochrome; brown to tan; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 type of pubescence; tomentose to velutinous; with pubescence brown to tan; with pubescence uniformly distributed; with simple hairs; stiff; 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 uniformly veined; 1-layered; without balsamic vesicles; without fibers; without reniform canals; solid; chartaceous. Endocarp dull; translucent; monochrome; yellow; scurfy and smooth; without adhering pieces of testa; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 4–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–1 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; cream.

Seed $4-7 \times 3-5 \times 1.2-2.3$ mm; not overgrown; not angular; symmetrical; ovate to reniform; compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face.

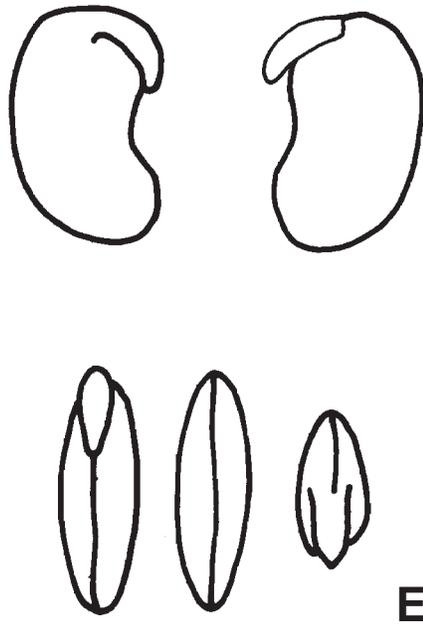
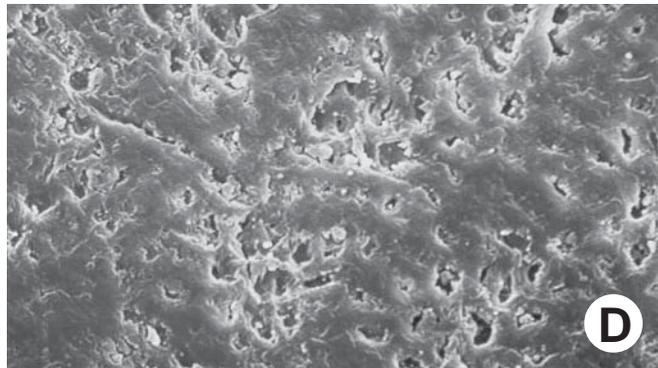
Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; green to tan; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible.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

Distribution: Madagascar with *M. sericea* also in many African countries, India, and Sri Lanka.

Notes: Geesink (1984) noted “*Mundulea* is strikingly similar to *Tephrosia*,” and our fruit and seed observations support him.

Mundulea: *M. sericea* (C.L. von Willdenow) A.J.B. Chevalier (C–E), *M. spp.* (A–B). A, Fruits ($\times 1$); B, seeds ($\times 5.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).

8



Genus: *Ostryocarpus* J.D. Hooker

Tribe: Millettieae.

Species Studied—Species in Genus: 1 sp.—6 spp.

Fruit a legume; unilocular; $6-7 \times 4-5 \times 0.3-0.5$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic to ovate or obliquely ovate; when asymmetrical with both sutures unequally curved; not inflated; flattened; with or without beak; straight or hooked; with papery fragile beak up to 1 cm long or solid beak the same color and texture as fruit; rounded or tapered at apex; apex aligned or oblique 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 wings 2; 2–3 mm wide; sutural; on both valves; on 1 suture. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; sometimes blistered; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; opaque; monochrome; brown; smooth or transversely wrinkled; with or without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–6 (from literature); length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 4–5 mm long; of 1 length only; flattened; straight. Aril absent.

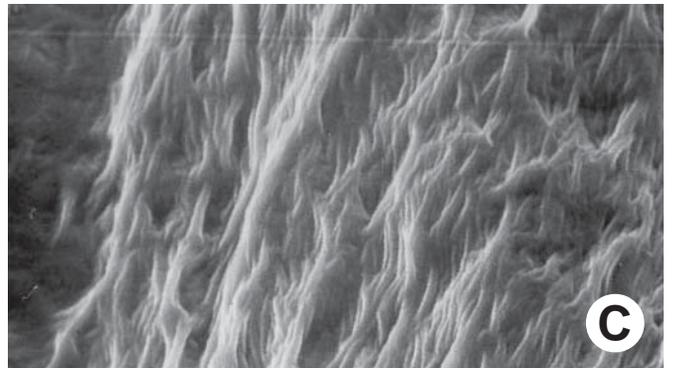
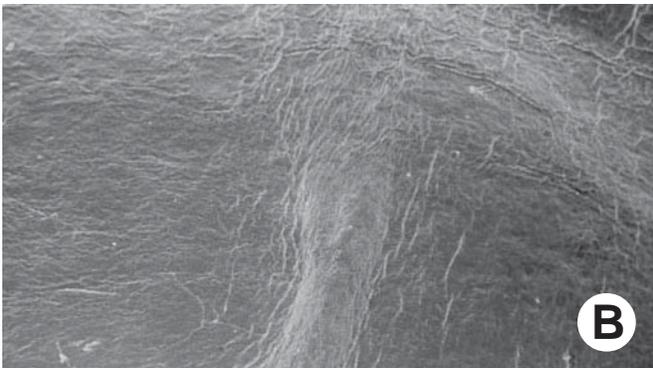
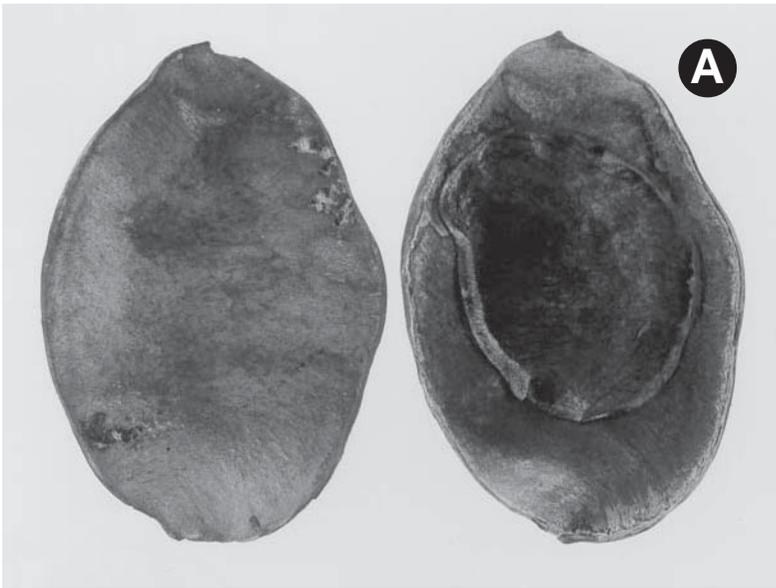
Seed ca. $36 \times 28 \times 3.5$ mm; not overgrown; not angular; asymmetrical; irregularly reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Testa without pieces of adhering epicarp; completely adhering to endocarp; fused to endocarp, at most a transparent brown tissue; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by fusion to endocarp. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; with only 1 folded; sufficiently folded for inner face to touch itself;

portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar at apex; 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 differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Africa to southeast Asia.

Notes: Little material was available for study, and no mature seeds were seen. The only seed was destroyed during rehydration and examination and could not be illustrated.

Ostryocarpus: *O. riparius* J.D. Hooker (A–C). A, Fruits ($\times 1.2$); B–C, testa ($\times 50$, $\times 1000$).



Genus: *Piscidia* C. Linnaeus

Tribe: Millettieae.

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

Fruit a legume; unilocular; 3–20 × 0.8–5 × 0.3–0.8 cm; with deciduous or persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear or moniliform; not inflated; compressed; without or with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished. Fruit wings 4; 1–25 mm wide; valvular; on both valves. Fruit stipitate or substipitate; with the stipe 5–15 mm long. Fruit indehiscent. Epicarp dull; monochrome or multicolored; mottled or streaked; brown or green; with brown overlay; with surface texture uniform; glabrous or pubescent and indurate; with hairs erect and appressed, erect, or appressed; with 1 type of pubescence; sericeous, puberulent, or tomentose to velutinous; with pubescence white to brown; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; veined or not veined; transversely veined relative to fruit length (on wings) or reticulately veined (on legume); not tuberculate; irregularly papillose; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; without reniform canals; spongy; coriaceous. Endocarp dull; opaque or translucent; monochrome; brown or tan; smooth; without adhering pieces of testa; septate or nonseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–10; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured or less than 0.5 mm long; up to 1 mm long; of 1 length only; triangular; straight. Aril fleshy or dry; when fleshy annular; entire; covering less than 1/2 of seed; when dry rim-aril; cream to white.

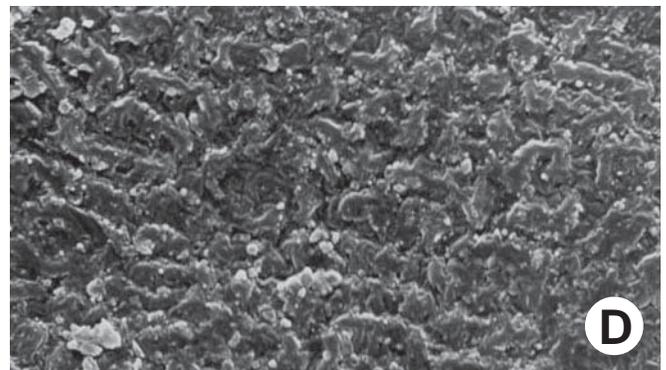
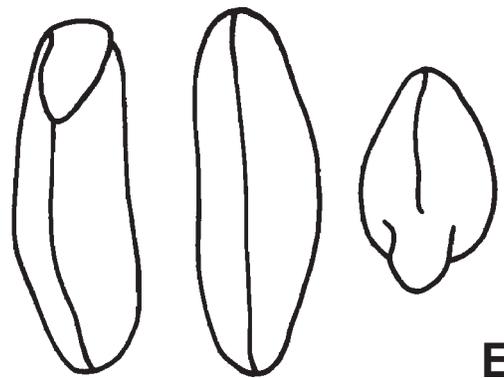
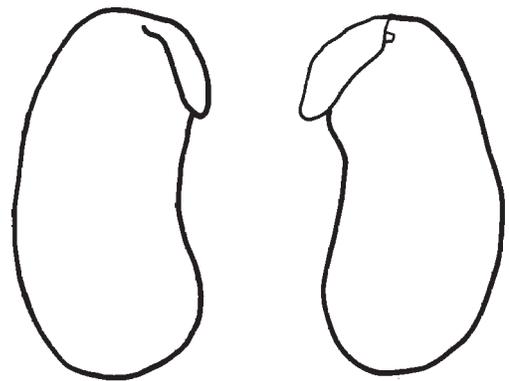
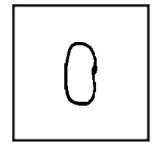
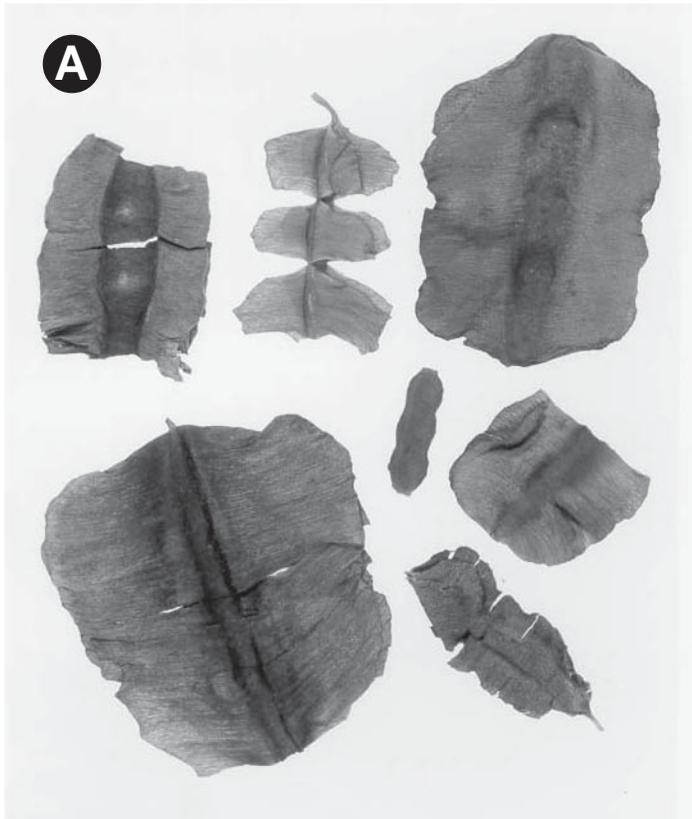
Seed 4–10 × 2.5–5 × 1.5–3.2 mm; not overgrown; not angular; symmetrical; elliptic or reniform; compressed;

with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus or without hilar sinus; with or without umbo on seed faces; with umbo on both faces of seed; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent or present; transverse. Rim absent. Wings absent. Raphe from hilum through lens and terminating before base of seed; not bifurcating; darker than testa; brown; flush. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 0.8 mm long; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat or wrinkled; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous to linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Florida, West Indies, and Central America.

Notes: Rudd (1969) summarized the genus.

Piscidia: *P. mollis* J.N. Rose (C–E), *P. spp.* (A–B). A, Fruits (× 0.8); B, seeds (× 4.8); C–D, testa (× 50, × 1000); E, embryos (× 5).



Genus: *Platycyamus* G. Bentham

Tribe: Millettieae.

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

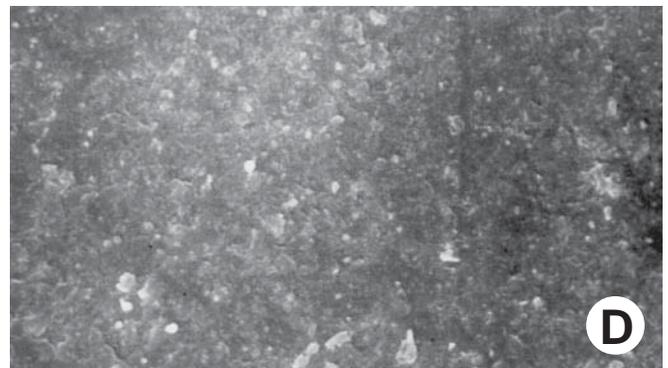
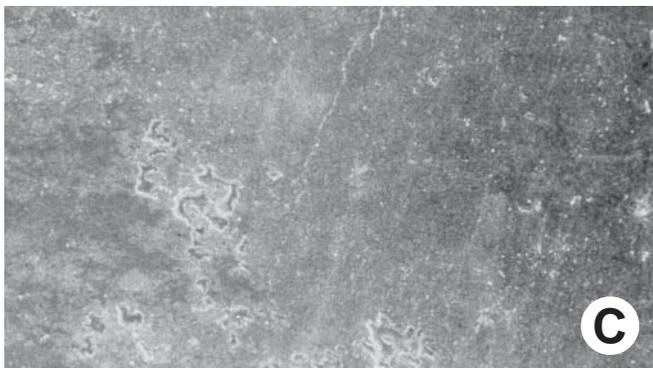
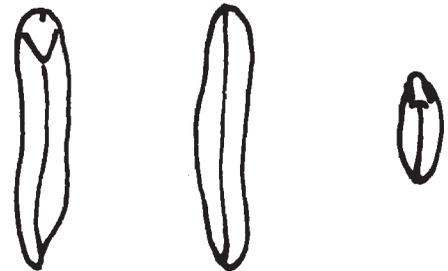
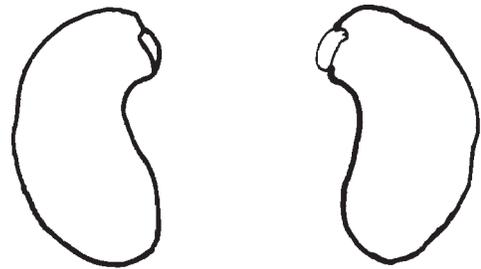
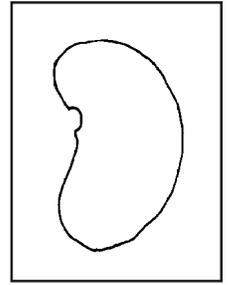
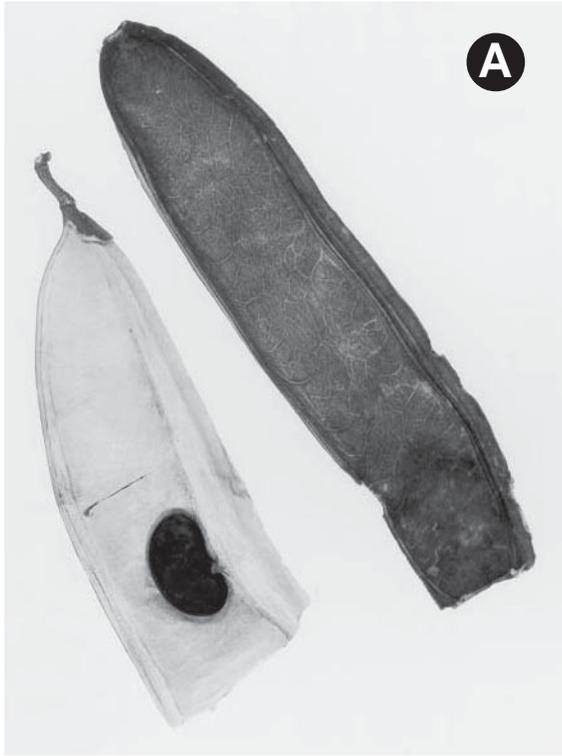
Fruit a legume; unilocular; 15–20 × 3.5–4 × 0.4–0.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; falcate to fusiform; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; tapered at apex; apex oblique with longitudinal axis of fruit; rounded to tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with ridges and wing. Fruit wing 1; 5–8 mm wide; sutural; on 1 suture. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; monochrome; orange-brown or orangish brown; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with vitreous layer over solid layer; chartaceous. Endocarp dull; translucent; monochrome; yellow; smooth; without adhering pieces of testa; nonseptate; 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 measured; ca. 4 mm long; of 1 length only; flattened and thick; straight. Aril dry; hippocrepiform rim-aril; entire; covering less than 1/2 of seed; brown.

Seed 22–23 × 13–14 × 2–4 mm; not overgrown; not angular; asymmetrical; reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; with deep hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with recessed features; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split;

with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; ca. 3 mm long; with curved outline; elliptic to circular; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 3 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; ca. 1 mm from hilum; flush; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip slightly curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Brazil (1 sp.) and Peru (1 sp.).

Platycyamus: *P. regnellii* G. Bentham (A–E). A, Fruits (× 0.6); B, seed (× 2.5); C–D, testa (× 50, × 1000); E, embryos (× 1.2).



Genus: *Platysepalum* F.M.J. Welwitsch ex J.G. Baker

Tribe: Millettieae.

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

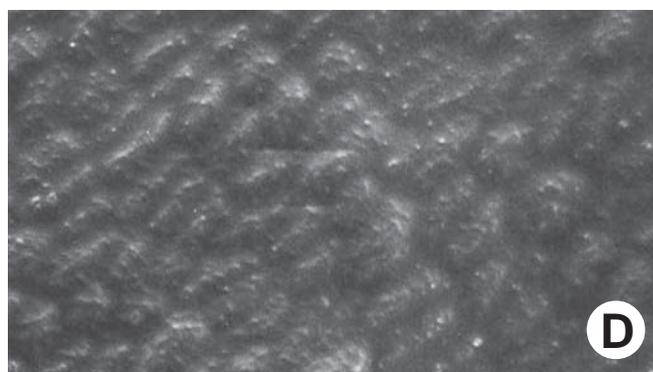
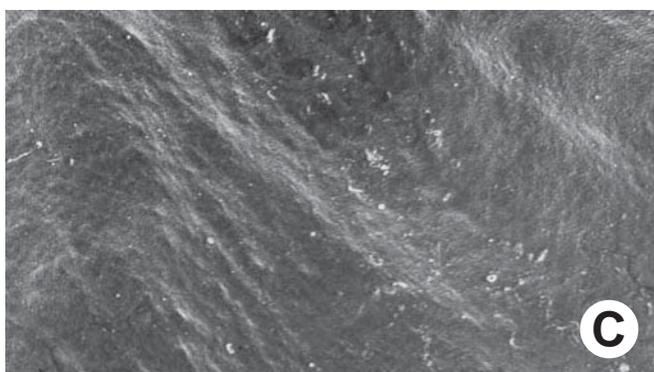
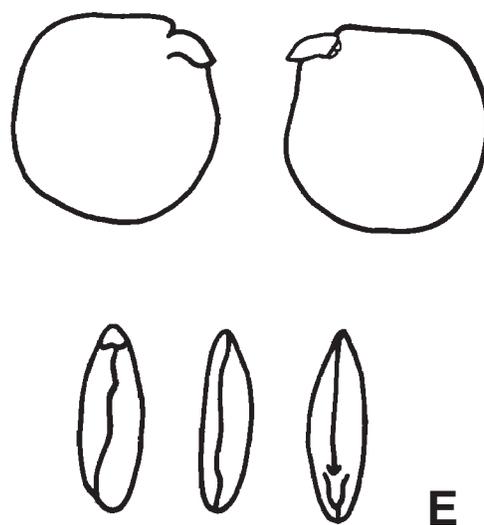
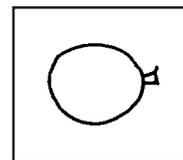
Fruit a legume; unilocular; $10\text{--}17 \times 2\text{--}4 \times 0.5\text{--}1$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; falcate or fusiform; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without or with beak; straight; with solid beak the same color and texture as fruit; rounded or tapered at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered to tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally invisible or visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; embellished or plain; with ridges. Fruit nonstipitate. Fruit with all layers dehiscing (tardily); splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 or 2 types of pubescence; densely velutinous; with pubescence brown to golden; with long and short golden to brown hairs intermixed; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; transversely veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2- or 3-layered; without balsamic vesicles; without fibers; with solid layer over solid layer or spongy layer over solid layer or with solid layer over 2 distinct solid layers; ligneous. Endocarp dull; opaque; monochrome or mottled; brown or white; with mottling (dark); with brown overlay; floury-filamentous; without adhering pieces of testa; subseptate or nonseptate; with septa eglandular; chartaceous; exfoliating in part or not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–5; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–4 mm long; of 1 length only; flattened or thick; curved or straight. Aril fleshy or dry; when fleshy annular; crenate; covering less than 1/2 of seed; when dry rim-aril and tongue-aril; tan.

Seed $11\text{--}27 \times 10\text{--}13 \times 3\text{--}5$ mm; not overgrown; not angular; symmetrical or asymmetrical; nearly circular or ovate (irregularly); compressed to flattened; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; black to brown (dark); glabrous; not smooth; with elevated or recessed features; finely, transversely ridged; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially or fully concealed; concealed by aril or funicular remnant; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1.5–5 mm long; with curved outline; elliptic to fusiform; apical at apex of radicle tip or apical according to radicle tip but marginal according to seed length; recessed; within rim or not within corona, halo, or rim. Hilum rim color of testa. Lens barely discernible; equal to or greater than 0.5 mm in length; 1–4 mm long; with margins straight; linear or oblong; not in groove of raphe; confluent with hilum; mounded or flush; same color as testa; black to brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled; oblique to perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical Africa.

Notes: Gillett (1960a) provided a key to the species.

Platysepalum: *P. hirsutum* (S.T. Dunn) F.N. Hepper (C–E), *P. spp.* (A–B). A, Fruits ($\times 1.1$); B, seeds ($\times 2.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



Genus: *Poecilanthe* G. Bentham

Tribe: Millettieae.

Species Studied—Species in Genus: 4 spp.—9 spp.

Fruit a legume; unilocular; $3.7\text{--}7 \times 1.5\text{--}3 \times 1$ 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 or widest near apex; not inflated; compressed; without beak; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate to nonstipitate; with the stipe up to 4.5 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down (assumed); passive or active; with valves (mature valves tend to fracture at right angles to sutures (Lewis 1988)) breaking. Replum invisible. Fruit entire. Epicarp dull; monochrome; dark reddish brown; glabrous; eglandular; without or with (on some seed chambers) spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without or with cracks (if dehisced); cracking oblique to fruit length. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; monochrome; tan; smooth; nonseptate or septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–4; length parallel with or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.1–0.5 mm long; of 1 length only; flattened; straight. Aril absent.

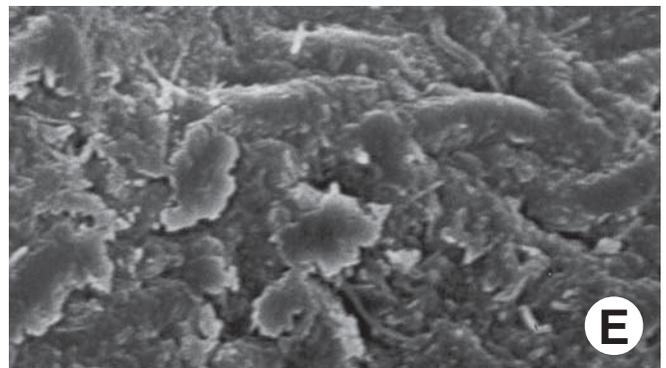
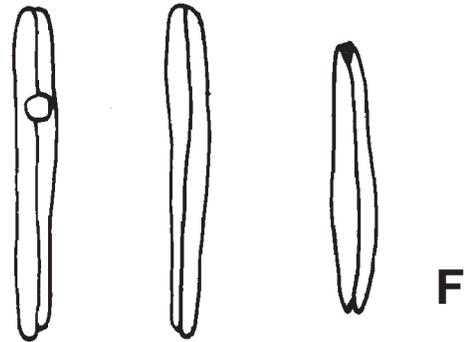
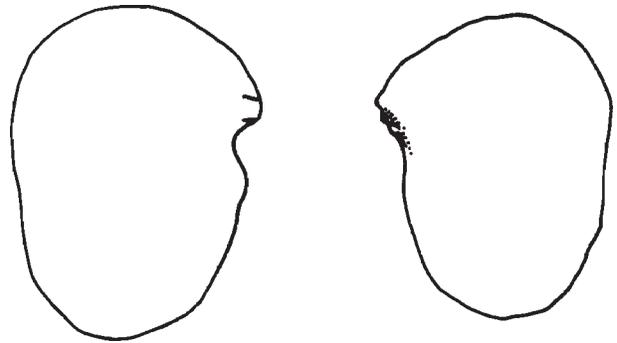
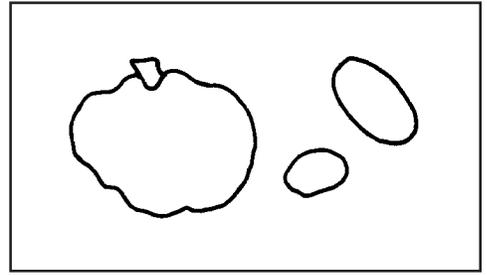
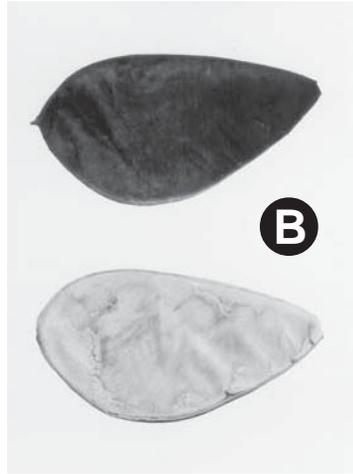
Seed 10–22 × 9–20 × 2.5 mm; not overgrown or overgrown, 1 seed filling entire fruit cavity (*P. amazonica*); not angular; asymmetrical or symmetrical; elliptic, ovate, or reniform (somewhat); compressed or flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth or smooth; with elevated features; wrinkled; 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; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons not smooth (slightly wrinkled); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical South America.

Notes: Geesink (1981) had placed *Poecilanthe* in the Tephrosieae (now Millettieae), but later (1984) transferred the genus to the Robineae without relating *Poecilanthe* to other genera in the Robineae. Lavin (1987) and Lavin and Sousa (1995), however, convincingly demonstrated that *Poecilanthe* does not belong to Robineae and has close affinity to Dalbergieae. Our species count includes *P. itapuana* G.P. Lewis (1989). Based on published seed and fruit data about the genus and the lack of a monograph or a résumé of this genus, we have omitted from our study fruit and seed data of *P. falcata* (J. Velloso de Miranda) A. Ducke (including *P. grandiflora* G. Bentham). Even with this arbitrary decision, we are still faced with a genus having similar fruits but two distinct seed types: (1) Glossy with hard testa, straight embryonic axis, and seed length at right angles to fruit length as in *P. effusa* (J.E. Huber) W.A. Ducke, *P. itapuana*, and, by inference of Lewis, *P. subcordata* G. Bentham and (2) dull with thin testa, curved embryonic axis, and seed and fruit length parallel as in *P. amazonica*.

Poecilanthe: *P. amazonica* (W.A. Ducke) W.A. Ducke (*B*, *D–F*), *P. effusa* (J.E. Huber) W.A. Ducke (*A*); *P.* spp. (*C*). *A*, Valve (× 0.9); *B*, fruit and valve (× 0.8); *C*, seeds (× 1.7); *D–E*, testa (× 50, × 1000); *F*, embryos (× 2).



Genus: *Pongamia* E.P. Ventenat

Tribe: Millettieae.

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

Fruit a legume; unilocular; $3.9-7 \times 1.7-3.5 \times 0.3-1.2$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; obliquely obovate or elliptic (flattened); when asymmetrical with both sutures unequally curved; inflated or not inflated (when immature); compressed; without beak; blunt at apex; apex aligned to oblique with longitudinal axis of fruit; tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; leathery or ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate or stipitate, 2–7 mm long. Fruit indehiscent or with all layers dehiscent (pods not spontaneously dehiscent, but only during seed imbibition; Adema, personal communication, 1998); splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown to green; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 3-layered; without balsamic vesicles; without fibers; without reniform canals; with solid layer over vitreous layer over solid layer; coriaceous. Endocarp dull; opaque; mottled; tan; with mottling; with brown overlay; scurfy and smooth; without adhering pieces of testa; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; ca. 1 mm long; triangular; straight. Aril present or absent; dry; partial rim-aril; cream.

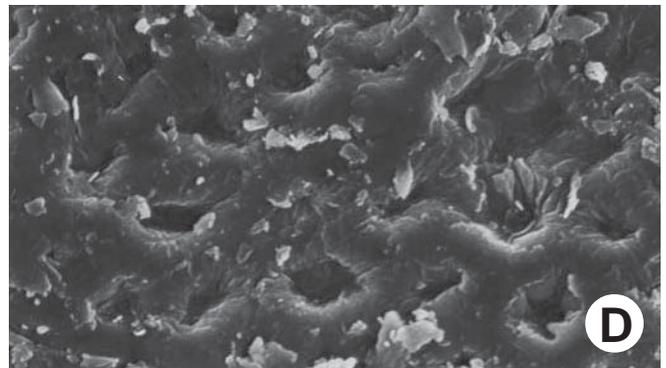
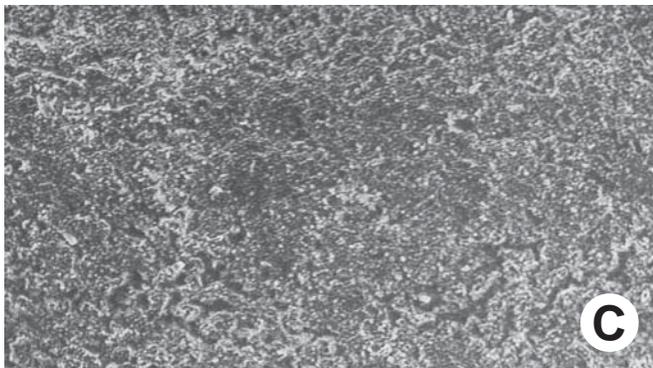
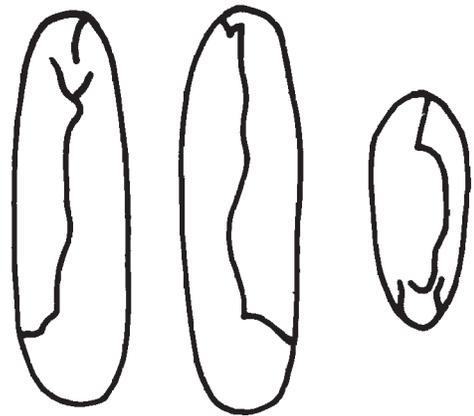
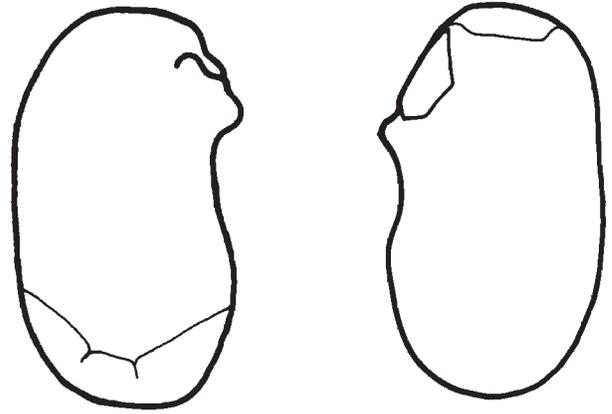
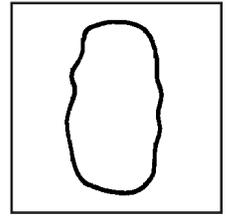
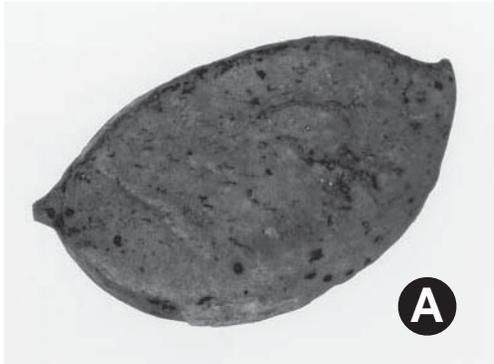
Seed $12-35 \times 12-21 \times 4-11$ mm; not overgrown; not angular; symmetrical; ovate to reniform; compressed or flattened; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; black to brown or yellow; glabrous; not smooth; with elevated

features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1(–2) mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim (small). Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; recessed; same color as testa; black to brown; within rim. Lens rim color of testa. Endosperm trace; not pluglike and not resembling tip of radicle; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded or with both folded (with short portions folded over the other cotyledon); not sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at or split over radicle; with or without lobes; with lobes touching (auriculate); with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Coastal southeastern Asia to western Pacific and northern Australia.

Notes: Thothathri (1961) treated this genus as distinct from *Millettia*, and it was included in *Millettia* by Geesink (1984). We have recognized *Pongamia* because Geesink did not make any combinations for its species in *Millettia* and there has not been a recent treatment of the group. Only immature fruits were seen.

Pongamia: *P. pinnata* (C. Linnaeus) J.B. Pierre (A–E). A, Fruit ($\times 1.3$); B, seeds ($\times 2.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2$).



Genus: *Pongamiopsis* R. Viguier

Tribe: Millettieae.

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

Fruit a legume; unilocular; $2.6-4.5 \times 1.3-3 \times 0.9-2.3$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; obliquely obovate or irregularly fusiform; when asymmetrical with both sutures unequally curved; inflated; terete; with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; rounded or short tapered 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; embellished or plain; with ridges. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; monochrome; tan; with surface texture uniform; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; puberulent or sericeous; with pubescence white; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick or thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; ligneous or coriaceous. Endocarp dull; opaque; monochrome; tan; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2 mm long; of 1 length only; thick; straight. Aril dry; very thin rim-aril; tan.

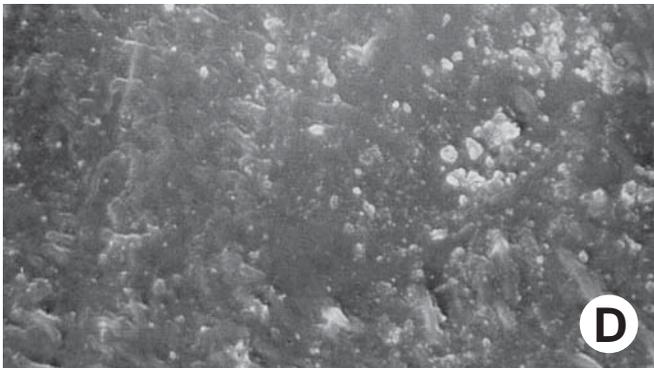
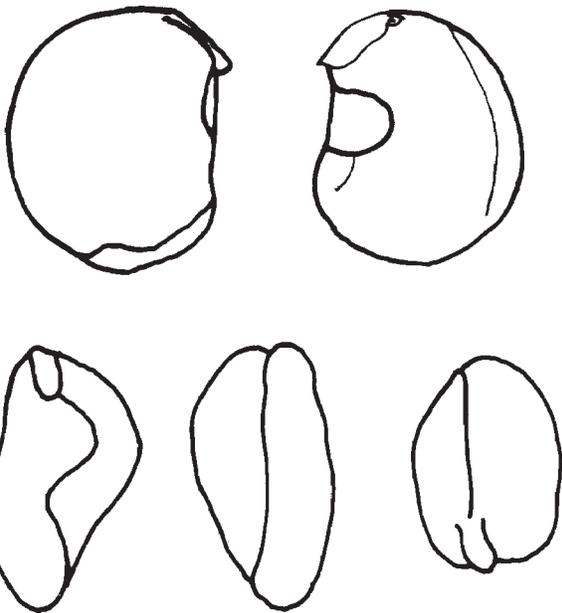
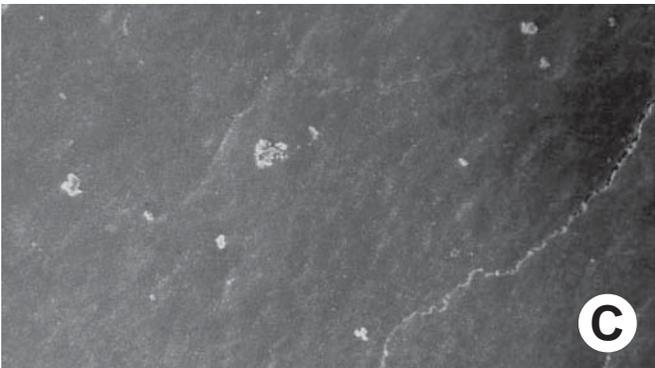
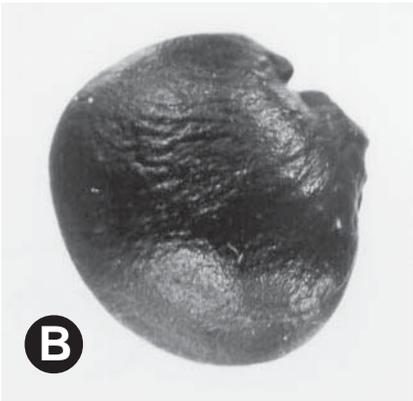
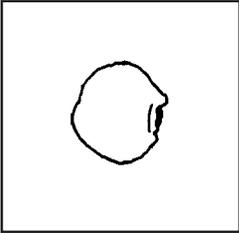
Seed $10-15 \times 10-12 \times 6-7$ mm; not overgrown; not angular; asymmetrical; irregular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with elevated features; transversely ridged; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous;

larger than punctiform; ca. 2.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; raised; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7–1 mm long; with margins curved; ovate; not in groove of raphe; adjacent to hilum; 1 mm from hilum; mounded; same color as testa; dark 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; with both folded (one more than the other); sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face wavy; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Madagascar.

Notes: Little material was available for study. Only one seed was studied internally, and the fruit of only one species was studied internally.

Pongamiopsis: *P. pervilleana* (H.E. Baillon) R. Viguier (C–E), *P. spp.* (A–B). A, Fruits ($\times 1.4$); B, seed ($\times 4.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 2.8$).



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

Tribe: Millettieae.

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

Fruit a legume; unilocular; $1.3\text{--}2.3 \times 0.9\text{--}1.1 \times 0.1\text{--}0.2$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic or obliquely obovate; when asymmetrical with both sutures unequally curved; not inflated; flattened; with beak; declined; with solid beak the same color and texture as fruit; rounded at apex; apex oblique with longitudinal axis of fruit; rounded to short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible or invisible. Fruit margin not constricted; without sulcus; embellished or plain; with ridges. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Epicarp dull; monochrome; tan; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 type of pubescence; puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Seeds 1–6; length parallel or oblique to fruit length; neither overlapping nor touching; in 1 series. Aril dry; very small rim-aril; tan.

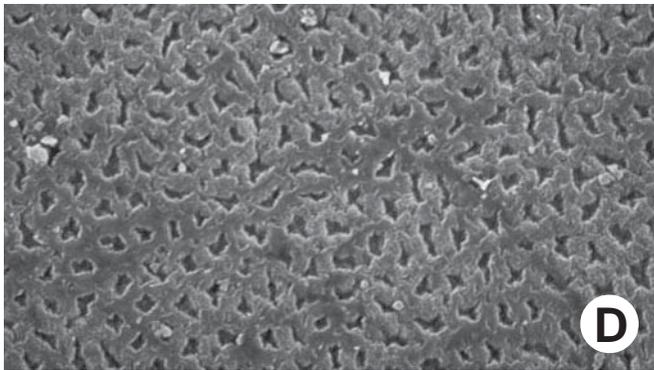
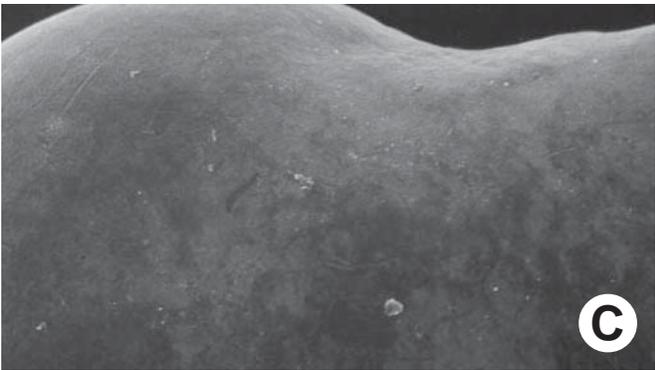
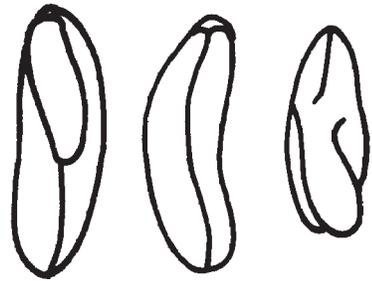
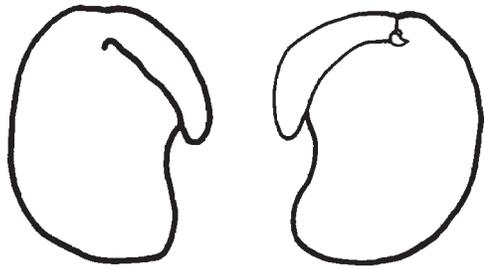
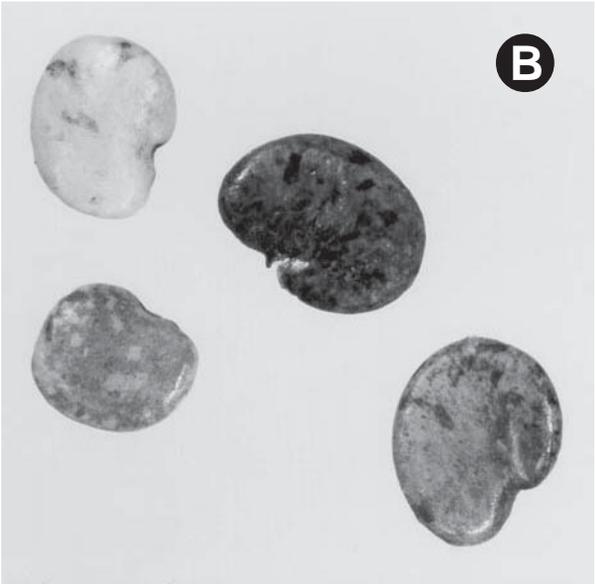
Seed $2.5\text{--}3.5 \times 2\text{--}3 \times 1\text{--}1.2$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; with deep or shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull to glossy; not modified by a bloom; colored; mottled; with frequent mottles; tan; with brown and gray overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; recessed; within halo. Hilum halo color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight; narrowly triangular; not in groove of raphe; confluent with hilum; flush;

same color as testa; tan; not within corona, halo, or rim. Endosperm present or absent; thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique to parallel (nearly); oblique to perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or linear; lobe tip curved; with 90-degree turn; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa and southern Arabia.

Notes: Little material was available for study.

Ptycholobium: *P. biflorum* (E.H.F. Meyer) R.K. Brummitt (A), *P. contortum* (N.E. Brown) R.K. Brummitt (C–E), *P. spp.* (B). A, Fruits ($\times 2.9$); B, seeds ($\times 8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Pyranthus* D.J. Du Puy & J.-N. Labat

Tribe: Millettieae.

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

Fruit a legume; unilocular; 6–11 × 0.5–0.9 × 0.2–0.3 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; falcate or irregularly fusiform; when asymmetrical with both sutures parallelly or unequally curved; not inflated; compressed to flattened; without or with beak; declined; with solid beak the same color and texture as fruit; long tapered at apex; apex oblique with longitudinal axis of fruit; long tapered to tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown or gray; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 or 2 types of pubescence; pilose to velutinous to villous; with pubescence brown, tan, or white; with long white and short golden hairs intermixed or contiguous areas of golden and white hairs; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with vitreous layer over solid layer or spongy layer over solid layer; coriaceous. Endocarp dull; opaque; monochrome or mottled; tan; with mottling over seed chambers; with brown overlay; smooth and floury-filamentous; without adhering pieces of testa; subseptate; with septa eglandular; chartaceous; exfoliating in part or not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 6–10; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2 mm long; of 1 length only; flattened; straight. Aril dry; very small rim-aril; white.

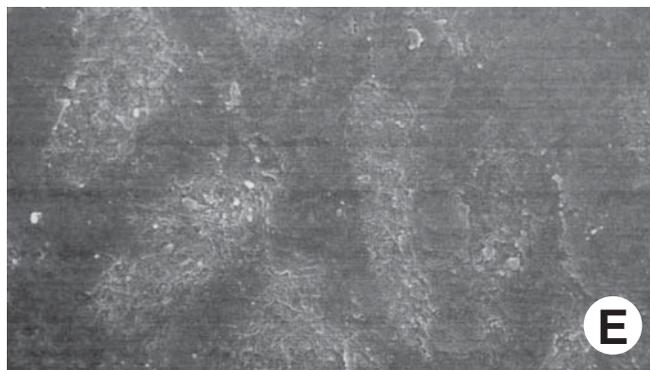
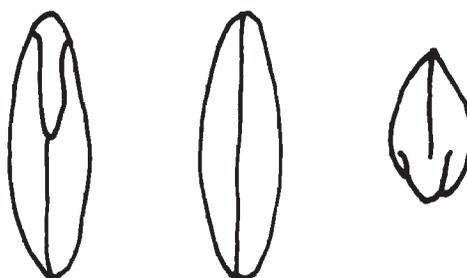
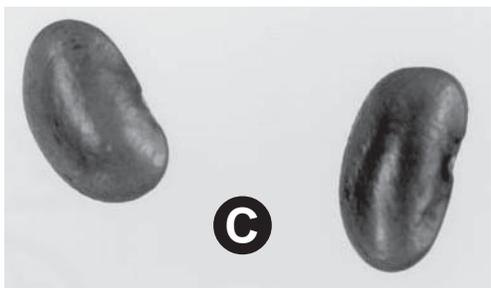
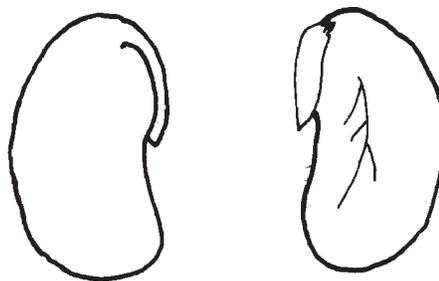
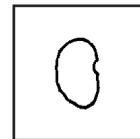
Seed 4–6 × 2.5–3 × 2–2.5 mm; not overgrown; not angular; symmetrical; reniform; compressed to terete

(nearly); with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle absent. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown; with brown (darker) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 0.5–0.8 mm long; with curved outline; oval; apical according to radicle tip but marginal according to seed length; recessed; within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight or curved; linear; hourglass or dumbbell-shaped; not in groove of raphe; confluent with hilum; slightly mounded; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat or wrinkled; glabrous around base of radicle. Embryonic axis oblique; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons to with 180-degree turn (nearly); centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Madagascar.

Notes: This genus was described and monographed by Du Puy and Labat (1995). They stated, “this genus appears to be somewhat intermediate between *Mundulea* and *Chadsia*, with *P. ambatoana* forming the closest link to the latter.”

Pyranthus: *P. alasoia* D.J. Du Puy & J.-N. Labat (A, C-F), *P. ambatoana* (H.E. Baillon) D.J. Du Puy & J.-N. Labat (B). A–B, Fruits (× 0.7); C, seeds (× 4.5); D–E, testa (× 50, × 1000); F, embryos (× 4.5).



Genus: *Requienia* A.-P. de Candolle

Tribe: Millettieae.

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

Fruit a legume; unilocular; $0.7\text{--}1.1 \times 0.25\text{--}0.35 \times 0.12\text{--}0.17$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; obliquely obovate; when asymmetrical with both sutures unequally curved; 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 oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; creamy yellow; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp present or absent; trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; without reniform canals; solid; chartaceous. Endocarp dull; opaque; monochrome; creamy yellow; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; ca. 0.8 mm long; flattened; curved. Aril dry; rim-aril; cream.

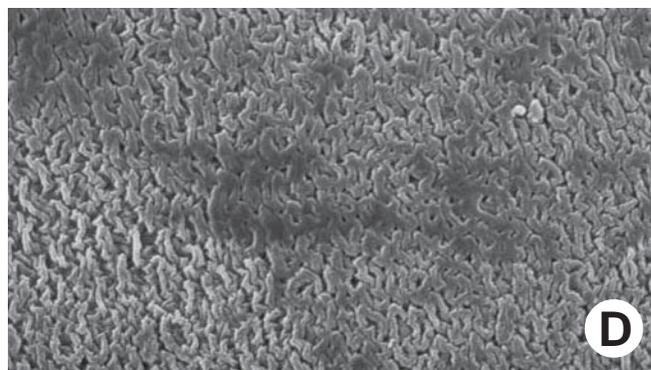
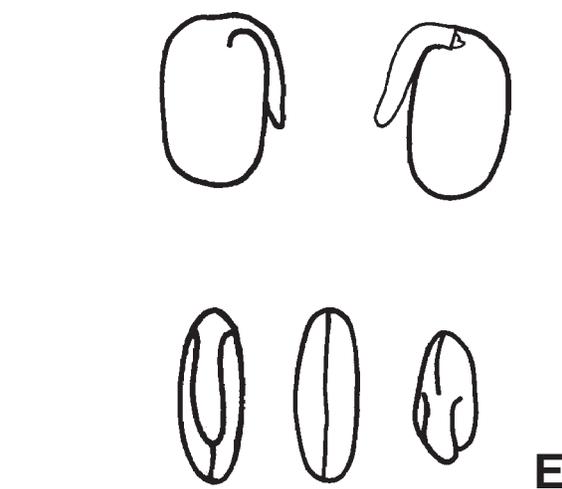
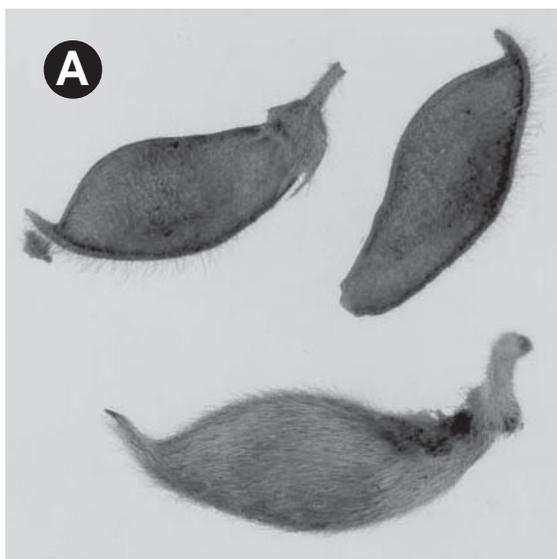
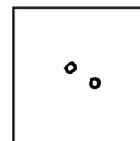
Seed $1.8\text{--}2.2 \times 1.5\text{--}2 \times 1.5\text{--}1.8$ mm; not overgrown; not angular; symmetrical; circular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the

faboid split the same color as the rest of the hilum; larger than punctiform; ca. 0.5 mm long; with curved outline; circular; apical according to radicle tip but marginal according to seed length; recessed; within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 0.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; within halo. Lens halo color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; with 90-degree turn; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical and southern Africa.

Notes: Geesink (1984) noted that *Requienia* is closely related to *Tephrosia*. Our fruit and seed data neither support nor reject Geesink's contention. Brummitt (1980) illustrated the seeds and fruits of *R. sphaerosperma*.

Requienia: *R. sphaerosperma* A.-P. de Candolle (B–E), *R.* spp. (A). A, Fruits ($\times 5.9$); B, seeds ($\times 10$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Sarcodum* J. de Loureiro

Tribe: Millettieae.

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

Fruit a legume; unilocular; $6.2-9 \times 0.8-1.3 \times 0.5-0.7$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with or without beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; tapered at base; base aligned to oblique 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 constricted or not constricted; slightly constricted along both margins; without sulcus; embellished; with ridges. Fruit wings absent. Fruit substipitate; ca. 5 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; dark brown; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; exfoliating or exfoliating in part; without or with cracks; cracking oblique to fruit length. Mesocarp present or absent; trace; surface uniformly veined; 1-layered; without balsamic vesicles; without fibers; without reniform canals; spongy; chartaceous. Endocarp dull; opaque; monochrome; tan; smooth and scurfy; without adhering pieces of testa; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating, exfoliating in part, or not exfoliating; separating from mesocarp; entire. Seeds 4–8; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2.5–3 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; brown.

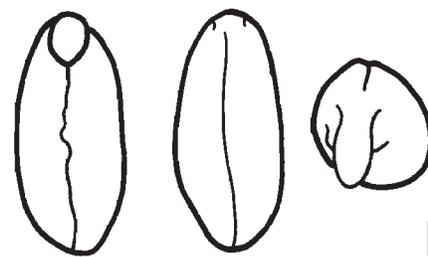
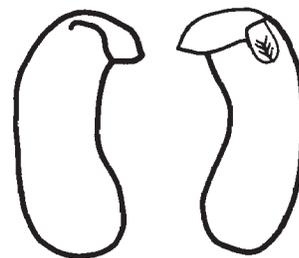
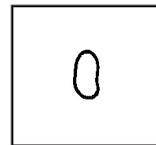
Seed 5–7.5 \times 3.5–5(–7) \times 2.5–4.5 mm; not angular; symmetrical or asymmetrical; elliptic to reniform; terete; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not

modified by a bloom; colored; monochrome; dark brown; glabrous; smooth; chartaceous. Fracture lines present or absent; irregular. Rim absent. Wings absent. Raphe from hilum through lens and terminating before base of seed; not bifurcating; color of testa; brown; raised. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2–2.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; not within corona, halo, or rim. Endosperm thin; not pluglike and not resembling tip of radicle; covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan to yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or well developed; glabrous.

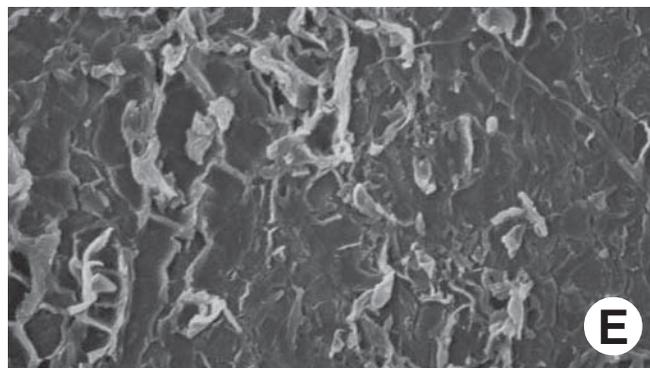
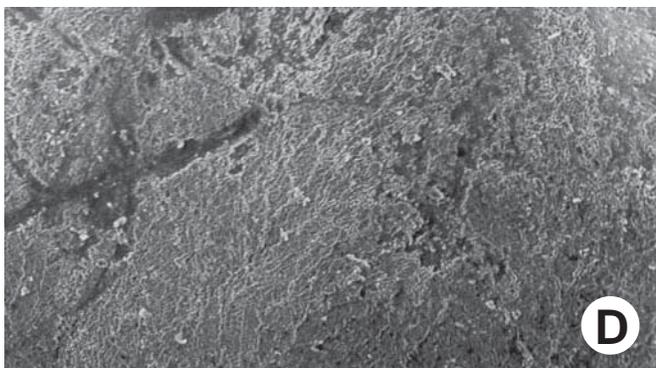
Distribution: Indochina, Indonesia to the Philippines (1 sp.); and Solomon Islands (1 sp.).

Notes: Geesink (1981) noted that the species from the Solomon Islands is the “genus unknown” in Verdcourt (1979, page 589).

Sarcodum: *S. binnendyckianum* (W.S. Kurz) R. Geesink (*D–F*), *S. scandens* J. de Loureiro (*A–C*). *A–B*, Fruit ($\times 1.4$, $\times 1.5$); *C*, seed ($\times 11.3$); *D–E*, testa ($\times 50$, $\times 1000$); *F*, embryos ($\times 5$).



F



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

Tribe: Millettieae.

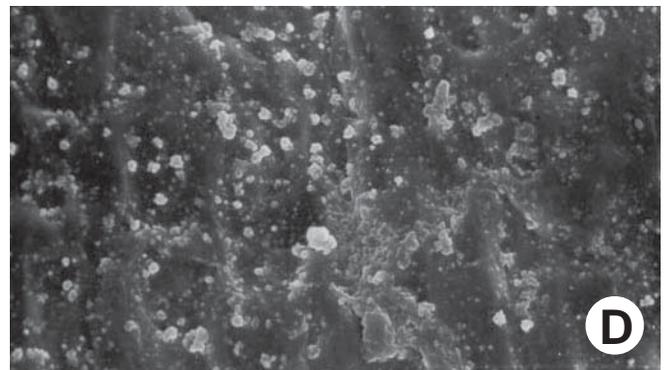
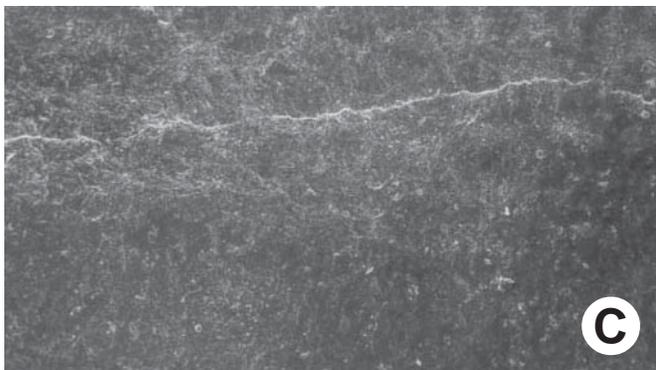
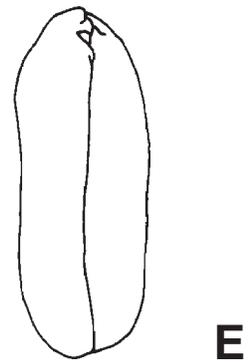
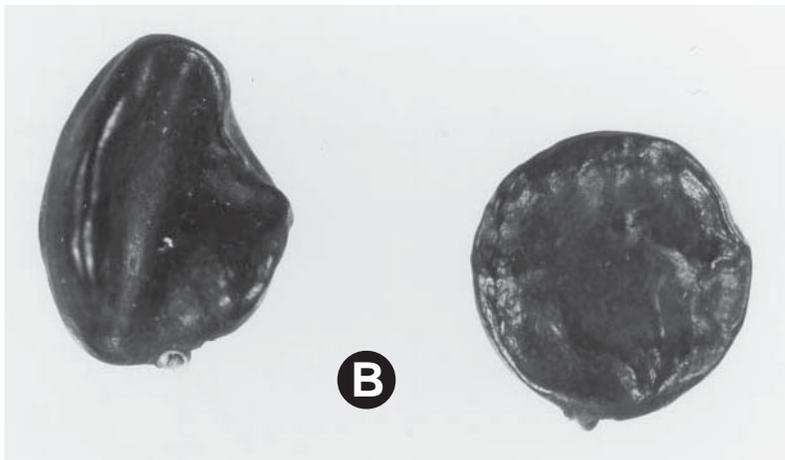
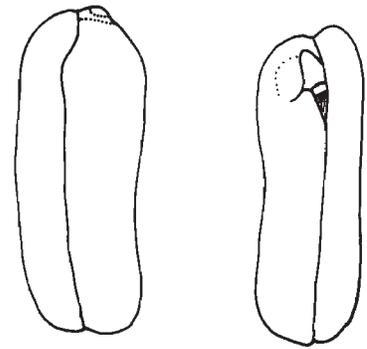
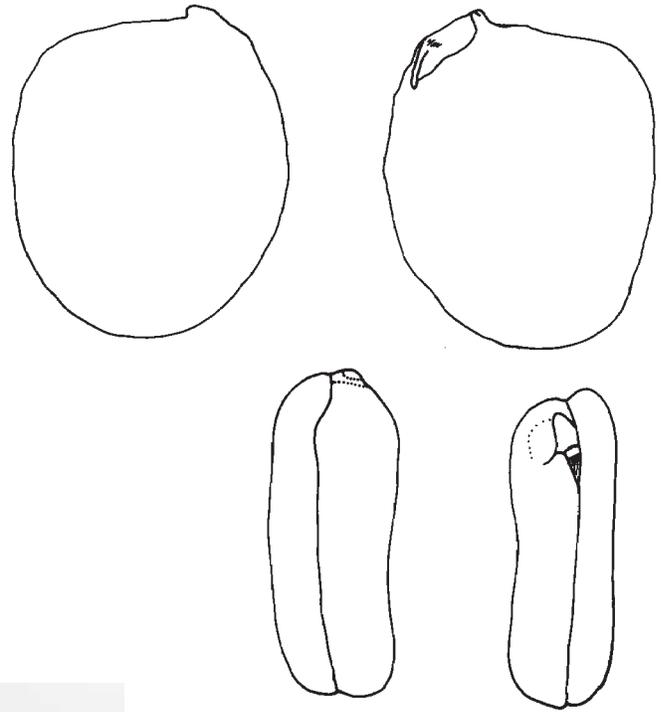
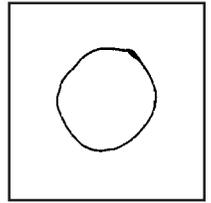
Species Studied—Species in Genus: 4 spp.—6 spp.

Fruit a legume; unilocular; 5–11 × 2–3.5 × 2–3 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregular or obliquely obovate; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near apex; not inflated; terete; with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; leathery to ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown overlay; with surface texture uniform; pubescent and indurate; with hairs appressed; with 1 type of pubescence; villous; with pubescence brown; with pubescence uniformly distributed or denser near sutures, sparse centrally; with simple hairs; stiff; with hair bases plain; glandular or eglandular; with glandular dots; distributed over entire fruit; without spines; not smooth; with elevated and recessed features, elevated features, or recessed features; veined or not veined; reticulately veined; not tuberculate; pustulate; grooved; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick; surface uniformly veined; 2-layered; without balsamic vesicles; without fibers; without reniform canals; with solid layer over solid layer; ligneous to coriaceous. Endocarp dull; opaque; streaked; brown; with streaking; with black to brown overlay; hairy; without adhering pieces of testa; with hairs scattered over endocarp; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1(–2); length oblique to parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 3 mm long; of 1 length only; thick; straight. Aril dry; hippocrepiform rim-aril or rim-aril and tongue-aril; brown to cream.

Seed 11–18 × 11–15 × 5–10 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; circular, irregular, or ovate; terete or flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with elevated and recessed features, just elevated features, or just recessed features; wrinkled; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; ca. 2 mm long; with curved outline; circular; subapical to radicle tip; recessed; within rim. Hilum rim color lighter than testa. Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; not within corona, halo, or rim. Endosperm thin; not pluglike and not resembling tip of radicle; covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth or not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes touching (auriculate); without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; creamy white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Africa.

Schefflerodendron: *S. usambarense* H.A.T. Harms (B–E), *S.* spp. (A). A, Fruits (× 1.1); B, seed (× 2.3); C–D, testa (× 50, × 1000); E, embryos (× 3).



Genus: *Tephrosia* C.H. Persoon

Tribe: Millettieae.

Species Studied—Species in Genus: 50 spp.—ca. 400 spp.

Fruit a legume; unilocular; 0.7–14 × 0.25–1 × 0.2–0.4 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without or with orifice formed by curving of fruit or fruit segments or 1-coiled; straight; not plicate; not twisted; symmetrical or asymmetrical; falcate, fusiform, or linear; when asymmetrical with both sutures nearly straight; not inflated or inflated (rarely); compressed, flattened, or terete; with or without beak; straight or hooked; with solid beak the same color and texture as fruit; blunt, tapered, or short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; tapered or truncate at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished or plain; with ridges or thickened sutural areas. Fruit wings absent. Fruit nonstipitate or stipitate (in literature). Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown, tan, or yellow; with brown overlay; with surface texture uniform; pubescent and indurate or pubescent but soon deciduous; with hairs erect or appressed; with 1 type of pubescence; puberulent, sericeous, tomentose, or velutinous; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; stiff or pliable; with hair bases plain or swollen; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; without reniform canals; solid or with solid layer over solid layer; chartaceous to coriaceous. Endocarp dull; opaque or translucent; monochrome; tan or yellow; scurfy and smooth, scurfy, smooth, or hairy and smooth; without adhering pieces of testa; with hairs surrounding seed chambers; subseptate or nonseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part or not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–20; length parallel with, oblique to, or transverse to fruit length; touching or neither overlapping nor touching; in 1 series. Funiculus measured or

less than 0.5 mm long; 0.5–2 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril, rim-aril and tongue-aril, or 2-lipped rim-aril; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed 3–10 × 2–6 × 1.5–3 mm; not overgrown; angular or not angular; symmetrical; ovate, rectangular, or reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus or without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; black, brown, or tan; with brown overlay; glabrous; smooth or not smooth; with elevated features; reticulate; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.8–2.2 mm long; with curved outline; circular, elliptic, or oval; apical according to radicle tip but marginal according to seed length; flush or recessed; within corona. Hilum corona color lighter and darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; ca. 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; within halo. Lens halo color darker than testa. Endosperm present or absent; thin; not pluglike and not resembling tip of radicle; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to yellow or green; inner face wrinkled; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous to linear; lobe tip straight or curved; oblique to cotyledons to with 90-degree turn; centered between cotyledons; less than 1/2 or 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Pantropics (mainly Africa).

Notes: Bosman and Haas (1983) revised the species in Malesia. Geesink (1984) noted that "*Mundulea* is strikingly similar to *Tephrosia*" and also noted that *Requienia* is closely related to *Tephrosia*. Our fruit and seed data neither confirm nor reject Geesink's ideas. We reject *Caulocarpus* E.G. Baker, recognized by Geesink (1984) as a genus, and instead treat it as part of *Tephrosia*, following Geesink's suggestion that "it may represent a section or subgenus of *Tephrosia*." Species of *Tephrosia* are used worldwide for folk medicine, fish poison, insecticides, fodder, and dyes.

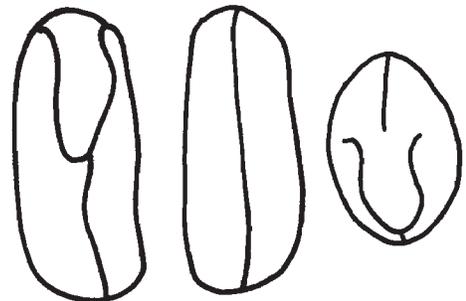
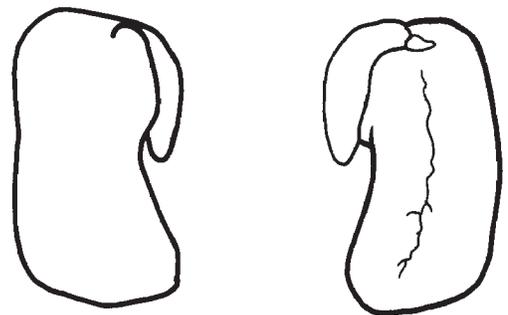
Tephrosia: *T. purpurea* (C. Linnaeus) C.H. Persoon (C–E),
T. spp. (A–B). A, Fruits ($\times 0.6$); B, seeds ($\times 3.7$); C–D,
testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



A



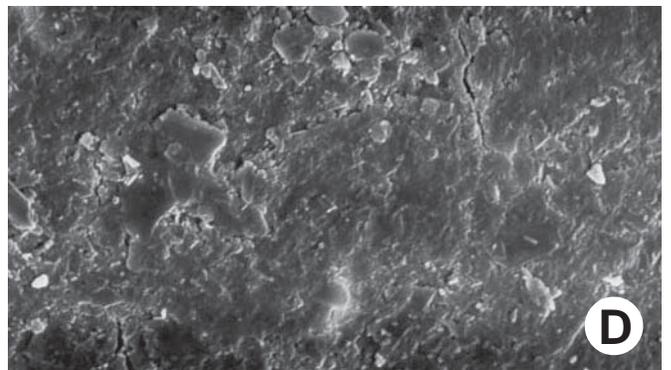
B



E



C



D

Genus: *Wisteria* T. Nuttall

Tribe: Millettieae.

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

Fruit a legume; unilocular; $7-20 \times 0.8-1.6 \times 0.6-1$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear, oblanceolate, or obliquely oblanceolate; when asymmetrical with both sutures nearly straight or parallelly curved; not inflated; compressed; with or without beak; straight; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain. 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; monochrome; brown; with surface texture uniform; glabrous or pubescent and indurate; with hairs appressed; with 1 type of pubescence; velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; minutely rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 3-layered; without balsamic vesicles; without fibers; without reniform canals; with spongy layer over vitreous over solid layer or solid layer over vitreous layer over solid layer; coriaceous or chartaceous. Endocarp dull; opaque; mottled; white; with brown overlay; pithy or smooth; without adhering pieces of testa; septate or nonseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous or pulpy; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–1.5 mm long; of 1 length only; thick; straight or triangular. Aril dry; rim-aril and tongue-aril or partial rim-aril; tan or white.

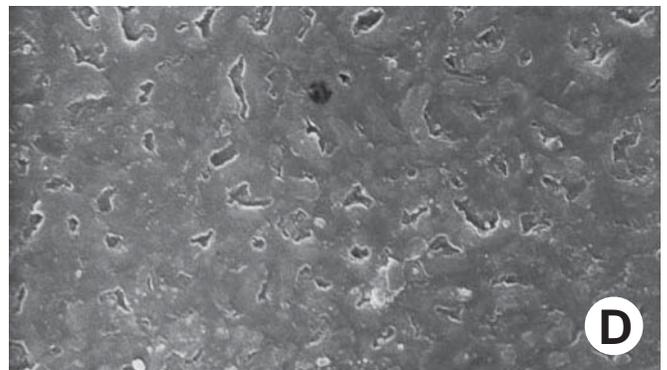
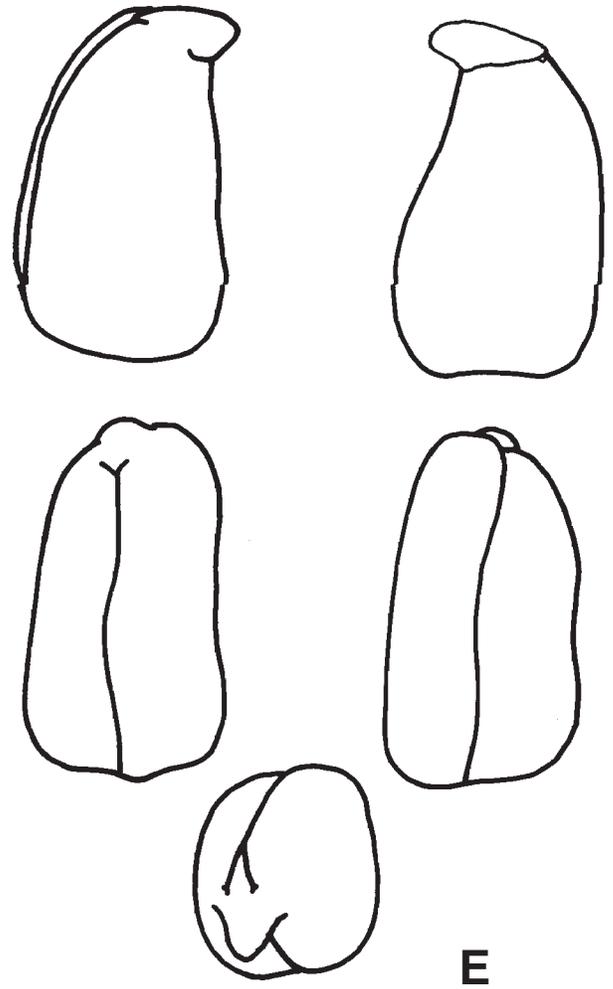
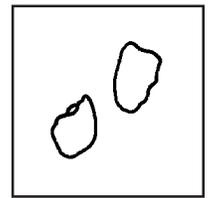
Seed $7-20 \times 5-19 \times 2.5-7$ mm; not overgrown; not angular; symmetrical or asymmetrical; oblong, obovate, or reniform; terete, compressed, or flattened; with

surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull or glossy; not modified by a bloom; colored; mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; smooth or not smooth; with elevated features; rugose; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens and terminating before base of seed; not bifurcating; darker than testa; raised. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.2–4 mm long; with curved or straight outline; elliptic or oblong; apical according to radicle tip but marginal according to seed length; recessed; within halo or rim. Hilum halo color darker than testa. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–1.5 mm long; with margins straight or curved; triangular or ovate; not in groove of raphe; confluent with or adjacent to hilum; 0.5 mm from hilum; mounded; similar color as testa; darker than testa; brown; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan to yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled; oblique to parallel to perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous to linear; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: North America, China, and Japan.

Notes: *Rehsonia* L.R. Stritch (1984) is included in *Wisteria* because Geesink (1984) maintained its type species in *Wisteria*.

Wisteria: *W. frutescens* (C. Linnaeus) J.L.M. Poir (C–E), *W. spp.* (A–B). A, Fruits ($\times 0.7$); B, seeds ($\times 2.1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Xeroderris* G.E. Roberty

Tribe: Millettieae.

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

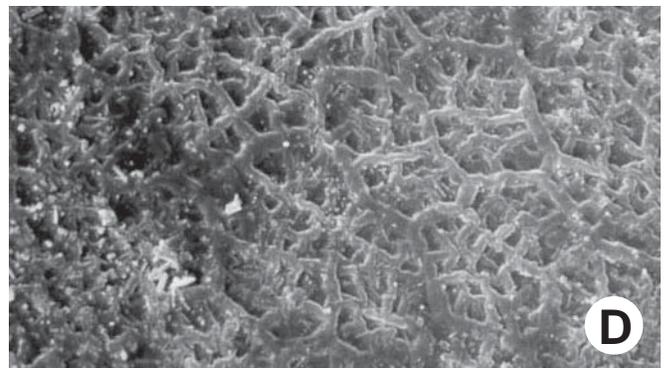
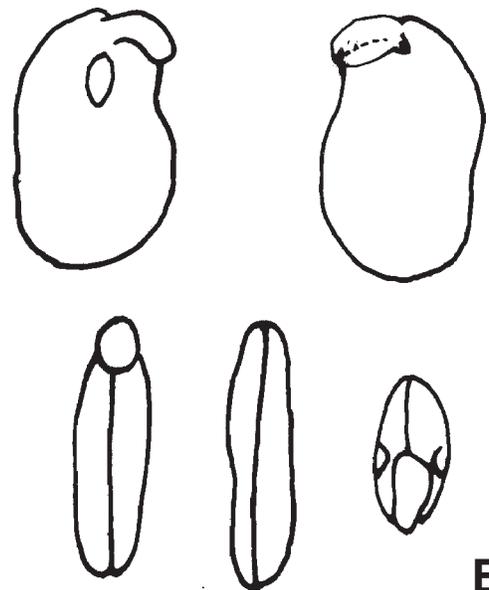
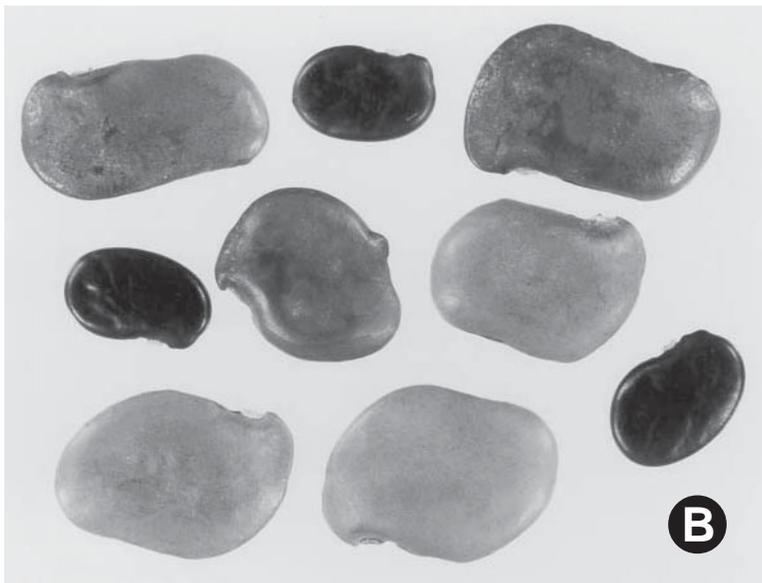
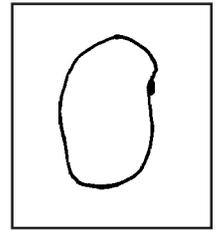
Fruit a legume; unilocular; 10–13.5 × 3–4.2 × 0.6–0.9 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; elliptic or linear; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; very slightly constricted along both margins; without sulcus; embellished. Fruit wings 2; 5.5–11 mm wide; sutural; on both sutures. Fruit substipitate; with the stipe 2–3 mm long. Fruit indehiscent. Replum invisible. Epicarp dull; multicolored; mottled; tan; with brown overlay; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface uniformly veined; 2-layered; without balsamic vesicles; without fibers; without reniform canals; with spongy layer over solid layer; coriaceous to chartaceous. Endocarp dull; opaque; monochrome; greenish tan; scurfy and smooth; without adhering pieces of testa; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 2 mm long; of 1 length only; filiform; straight. Aril fleshy; marginal hilar; entire; covering less than 1/2 of seed; tan.

Seed 16–20 × 12–13 × 3–6 mm; not overgrown; not angular; asymmetrical; irregular; flattened; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with deep hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a bloom; colored; mottled; with infrequent mottles; reddish brown; with brown (darker) overlay; glabrous; not

smooth; with elevated and recessed features, elevated features, or recessed features; wrinkled; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and terminating before base of seed; not bifurcating; color of testa; slightly raised. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; ca. 1.5 mm long; with curved outline; circular to oval; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; dimpled once (below embryo); both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa.

Xeroderris: *X. stuhlmannii* (P.H.W. Taubert) F. de A. Mendonça & E.P. Sousa (A–E). A, Fruits (× 1.1); B, seeds (× 1.8); C–D, testa (× 50, × 1000); E, embryos (× 1.7).



Robinieae (8.01–8.12)

Genus: *Sesbania* G.A. Scopoli

Phylogenetic Number: 8.01.

Tribe: Robinieae.

Group: *Sesbania*.

Species Studied—Species in Genus: 37 spp.—ca. 50 spp.

Fruit a legume; unilocular; $2\text{--}30 \times 0.2\text{--}1.5 \times 0.2\text{--}0.8$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (or slightly curved); not plicate; not twisted or twisted; symmetrical; linear or oblong; not inflated; terete or compressed; with or without beak; straight; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned with longitudinal axis of fruit; truncate or short tapered at base; base aligned (slightly) or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous or coriaceous (with thickened sutures); seed chambers externally visible; with the raised seed chambers torulose. Fruit margin not constricted or slightly constricted or constricted along both margins; without sulcus; plain or embellished; with wings. Fruit wings absent or present; 4; up to 10 mm wide; continuous wing around fruit; on both valves. Fruit stipitate or nonstipitate; with the stipe up to 15 mm long. Fruit with all layers dehiscing (to subdehiscent); splitting along sutures. Dehiscence of valves along both sutures; medial and up and down or apical and down; passive. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown (to reddish) or tan; with red overlay; glabrous; eglandular or glandular; with glandular dots; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; wrinkled; not exfoliating, exfoliating in part, or exfoliating; without cracks. Mesocarp thick or trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid or vitreous (individual “pellets”); coriaceous or ligneous (sub). Endocarp glossy; monochrome; tan (pale); smooth; septate; with septa thicker than paper, firm and with septa thin (tissue paper-like), flexible or with septa thin (tissue paper-like), flexible; with the septa eglandular; coriaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 5–40; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long (virtually no length); of 1 length

only; flattened; straight. Aril absent or present; dry. Aril rim-aril. Aril brown or white.

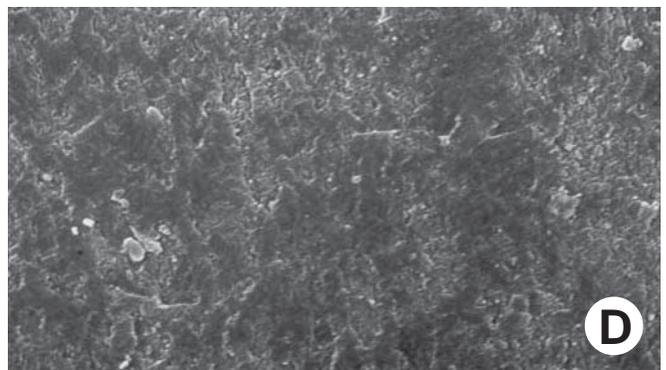
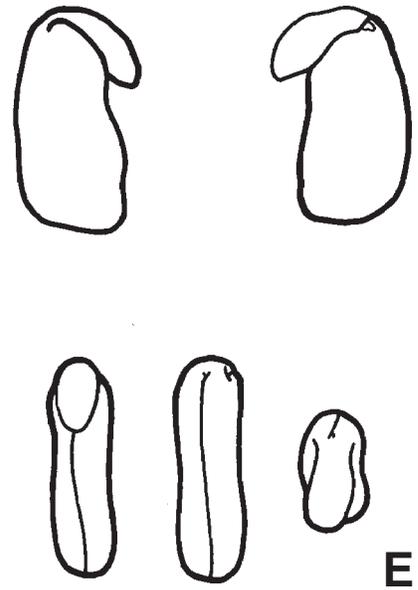
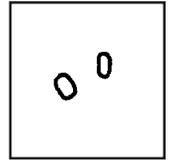
Seed $3\text{--}7 \times 1.5\text{--}5 \times 1.5\text{--}5$ mm; not overgrown; not angular; asymmetrical; oblong, rectangular, quadrangular, or mitaform; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to or partially adhering to endocarp (thin scurfy layer); glossy or dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; brown (to reddish or greenish), tan, green, olive, blue (gray), gray (blue), or orange; with brown (reddish), purple, or black overlay; glabrous; smooth; coriaceous. Fracture lines absent or present; reticulate. Rim absent. Wings absent. Raphe not visible or visible (what appears to be a raphe is scored as the lens); from lens to base of seed and bifurcating; not bifurcating; darker than testa; brown (reddish); flush. Hilum visible or fully concealed (nearly); concealed by aril (rim); with faboid split; with the lips of the faboid split the same color as or lighter colored than the rest of the hilum and therefore conspicuous; punctiform or larger than punctiform; 0.3–1.5 mm long; with curved outline; circular; marginal according to radicle tip; flush (slightly); within rim and not within corona or halo. Hilum rim color lighter or darker (slightly) than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–1.2 mm long; with margins straight or curved; linear (more or less within darker circle); circular (more or less with central line or groove) or elliptic; not in groove of raphe; confluent with hilum or adjacent to hilum; up to 1.5 mm from hilum; mounded (slightly to well developed); similar color as testa; darker than testa; brown (reddish) or black; not within corona, halo, or rim. Endosperm thick; covering entire embryo; thick layer adnate to embryo and adnate to testa (thin layer). 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; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan, yellow (pale), or white; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; deflexed and parallel to cotyledon length or deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2

length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: Pansubtropical and pantropical.

Notes: The genera, generic groups, and related data follow the tribal treatment of Lavin and Sousa (1995) and Polhill (1994a,b), and not Polhill and Sousa (1981). Gillett (1963c) monographed *Sesbania* species in Africa (excluding Madagascar) and southern Arabia, and Sachet (1987) studied the littoral species of *Sesbania* in the South Pacific. We agree with Siwundla and Stucky (1989) that *Glottidium* (8.01A) is a separate genus and that *Daubentonia* should be maintained within *Sesbania*. This finding confirms the 10 differences between *Sesbania* and *Glottidium* of Gillett. We agree with Lavin (1987) that “the diversity of the legumes and seeds of *Sesbania* is unrivalled among related genera.” Lavin and Sousa (1995) erected an infrageneric classification for *Sesbania* that included *Glottidium* as a section (see notes for *Glottidium*). Manning and Staden (1987a) discussed the role of the lens in seed imbibition.

Sesbania: *S. emerus* (J.B.C.F. Aublet) I. Urban (*C–E*), *S.*
spp. (*A–B*). *A*, Fruits ($\times 3.8$); *B*, seeds ($\times 4.4$); *C–D*,
testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 7$).



Genus: *Glottidium* A.N. Desvaux

Phylogenetic Number: 8.01A.

Tribe: Robinieae.

Group: Sesbania.

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

Fruit a legume; unilocular; $7\text{--}7.5 \times 1\text{--}1.8 \times 0.4\text{--}0.9$ 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 or symmetrical; elliptic or oblong; with both sutures parallelly curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible. Fruit margin not constricted or constricted along both margins; without sulcus; plain. Fruit wings absent (on epicarp, but endocarp winged). Fruit stipitate; with the stipe 15 mm long. Fruit with epicarp and mesocarp dehiscent and endocarp not dehiscent; with epicarp and mesocarp splitting along suture, endocarp entire forming an envelope around the seeds with flat winglike parts. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome; brown (to reddish brown); glabrous; eglandular; not smooth; with elevated features; reticulately veined; not tuberculate; warty (somewhat and tiny); not exfoliating; without cracks. Mesocarp thin (inner surface with reddish-brown reticulum); surface not veined; 1-layered (thicker near sutures); without balsamic vesicles; without fibers; solid; chartaceous or coriaceous (near sutures). Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; separating from epicarp (and 1- or 2-seeded winged indehiscent unit); entire. Seeds (1–)2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long (but as broad as 5 mm hilum); of 1 length only; filiform; straight. Aril absent.

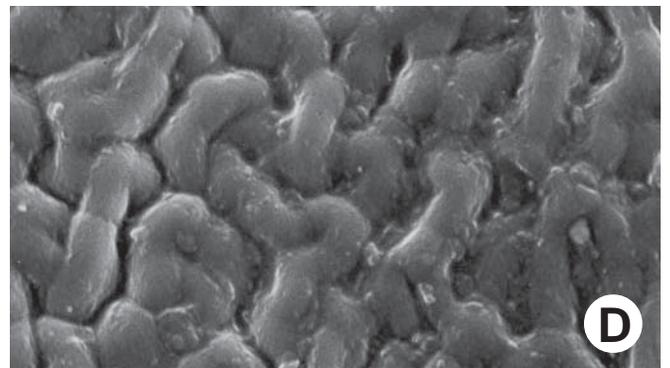
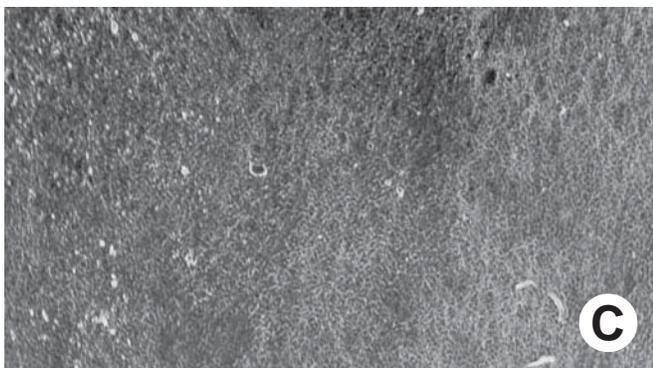
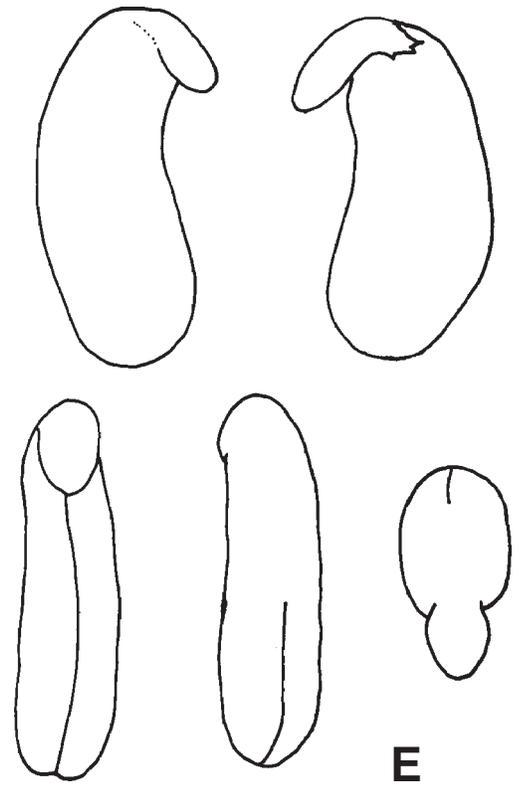
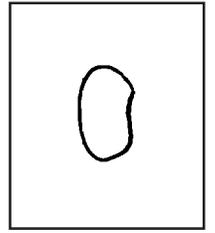
Seed $10\text{--}12 \times 4.5\text{--}6.5 \times 3.5\text{--}5$ mm; not overgrown; not angular; asymmetrical; oblong or reniform (barely); terete; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to

endocarp or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome or bichrome (if tan endocarp tissue present); reddish brown; glabrous; smooth; osseous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 5 mm long; with straight outline; oblong; marginal according to radicle tip; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 2.5 mm long; with margins straight or curved; oblong (with linear center and often ending in circular area); not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown (reddish); 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; split over radicle; with lobes; with basal groin formed by 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; without a joint evident between the radicle and the cotyledons. Radicle bulbous; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southeastern United States.

Notes: We agree with Siwundla and Stucky (1989) that *Glottidium* is a separate genus from *Sesbania* (8.01). This finding confirms the 10 differences between *Glottidium* and *Sesbania* of Gillett (1963c). Lavin (1987, 1995) and Lavin and Sousa (1995) synonymized *Glottidium* with *Sesbania*, and then created a new combination, *Sesbania* sect. *Glottidium* (A.N. Desvaux) M. Lavin. In Lavin's opinion (personal communication, 1998), recognition of this genus renders *Sesbania* (8.01) paraphyletic. Unlike other faboid legumes, the epicarp and mesocarp portions of the valves separate and free the winged chartaceous endocarp bearing two or one seeds. The two-seeded endocarp remains intact, while in *Endosamara* the multiseeded endocarp separates into lomentlike segments, each with a single seed.

Glottidium: *G. vescarium* A.N. Desvaux (A–E). A, Fruits (dehisced fruit and nondehisced endocarp) ($\times 1.3$); B, seeds ($\times 3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Hebestigma* I. Urban

Phylogenetic Number: 8.02.

Tribe: Robinieae.

Group: Hebestigma.

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

Fruit a legume; unilocular; (9–)11–22 × 2–3.7 × 1.6 cm (estimated); with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong; with both sutures nearly straight; not inflated; compressed; without beak; tapered 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; ligneous; seed chambers externally invisible. Fruit margin not constricted or slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate or substipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting (somewhat). Replum invisible. Epicarp glossy; monochrome (including striate); brown (dark reddish to greenish); glabrous; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; pitted (longitudinal and oblique); not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; monochrome; tan; below seeds smooth and scurfy (between seeds); septate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 2–8; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; triangular; straight. Aril dry. Aril tongue-aril. Aril tan.

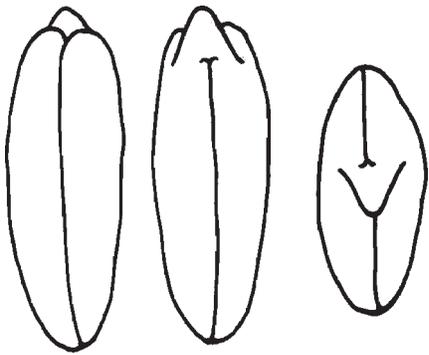
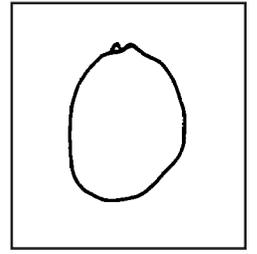
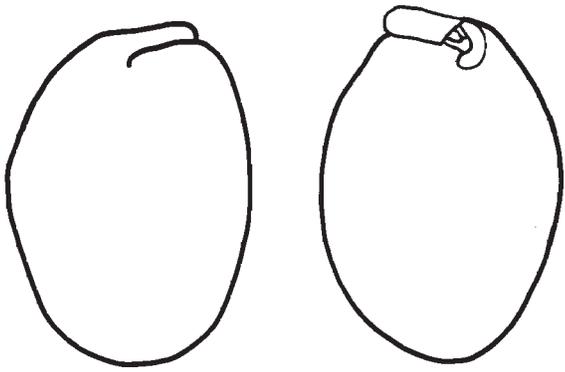
Seed 17–20 × 13–17 × 5.5–8.5 mm; not overgrown; not angular or angular (somewhat); asymmetrical or symmetrical (nearly); circular (sub), ovate, obovate, or triangular (more or less); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome; brown (to dark reddish brown when older); glabrous; smooth; osseous. Fracture lines absent. Rim absent. Wings absent. Raphe

not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; apical at apex of or subapical to radicle tip; recessed; not within corona, halo, or rim. Lens not discernible. 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; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan (reddish); 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 width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Cuba.

Notes: Lavin and Sousa (1995) monographed *Hebestigma*.

Hebestigma: *H. cubense* (K.S. Kunth) I. Urban (A–E). A, Valves (× 1.2); B, seeds (× 2); C–D, testa (× 50, × 1000); E, embryos (× 2).



E



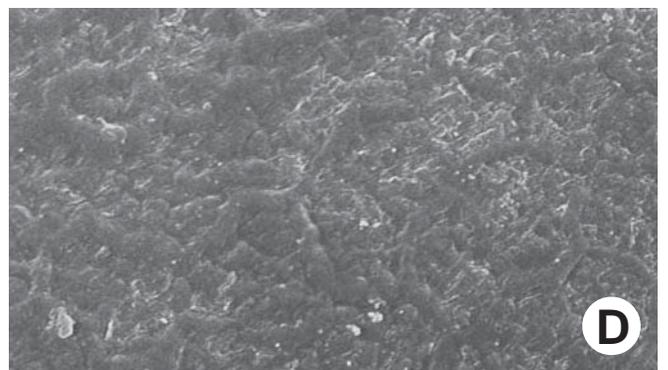
B



A



C



D

Genus: *Lennea* J.F. Klotzsch

Phylogenetic Number: 8.03.

Tribe: Robinieae.

Group: Gliricidia.

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

Fruit a legume; unilocular; 5–11 × 1.2–2 × 0.8 cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; with 1 straight and 1 curved suture; widest near apex; not inflated; compressed; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate or substipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active or passive; with valves twisting (somewhat). Replum invisible. Epicarp dull; monochrome; brown (dark reddish); glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; monochrome; tan; smooth; nonseptate; coriaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–4; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry. Aril tongue-aril.

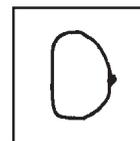
Seed 9–12 × 8–9 × 4.5–5.2 mm; not overgrown; not angular or angular (somewhat); asymmetrical; D-shaped or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; bichrome (outer rim lighter than inner face though not clearly demarked like a pleurogram or pseudopleurogram); brown (dark reddish); glabrous; not smooth; with recessed features; pitted with small separate pits; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to lens (3/4 way around seed); not bifurcating; color of testa; raised. Hilum visible or fully concealed; concealed by funicu-

lus; 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; circular; marginal according to or apical at apex of radicle tip; recessed (barely); within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.5–1.7 mm long; with margins straight or curved; wedge-shaped or irregular; not in groove of raphe; 270 degrees from hilum; mounded; same color as testa; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons not smooth; both outer faces convex; both the same thickness; 1 longer than other; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan (reddish); inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle triangular; deflexed and parallel to cotyledon width; not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different) (slightly); less than 1/2 length of cotyledons. Plumule glabrous.

Distribution: Southern Mexico and Central America.

Notes: Lavin and Sousa (1995) monographed *Lennea*.

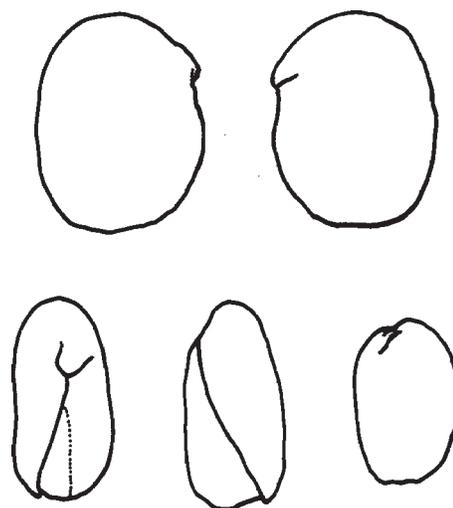
Lennea: *L. modesta* (P.C. Standley & J.A. Steyermark) P.C. Standley & J.A. Steyermark (A–E). A, Valves (× 1.4); B, seeds (× 3.9); C–D, testa (× 50, × 1000); E, embryos (× 3).



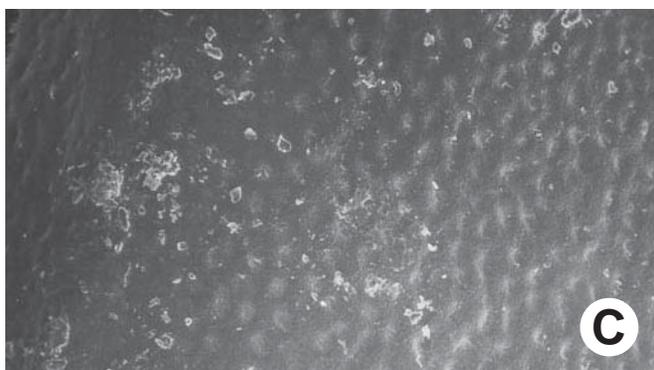
A



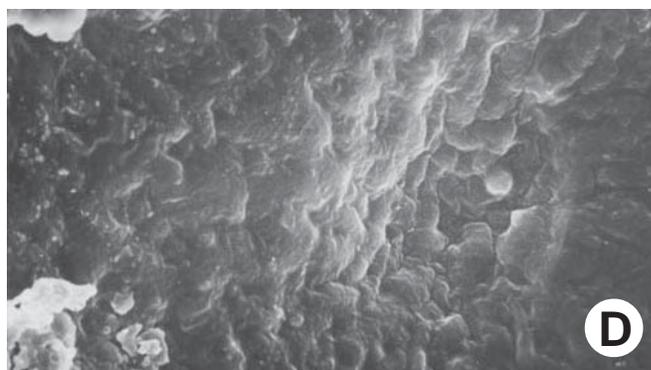
B



E



C



D

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

Phylogenetic Number: 8.04.

Tribe: Robinieae.

Group: Gliricidia.

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

Fruit a legume; unilocular; 4–17 × 0.7–2.2 with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; oblong (linear) or linear (broadly); with both sutures nearly straight; not inflated; flattened; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown (reddish); 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; spongy; septate or nonseptate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 4–5; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; triangular; straight. Aril dry. Aril tongue-aril. Aril brown (reddish) or tan.

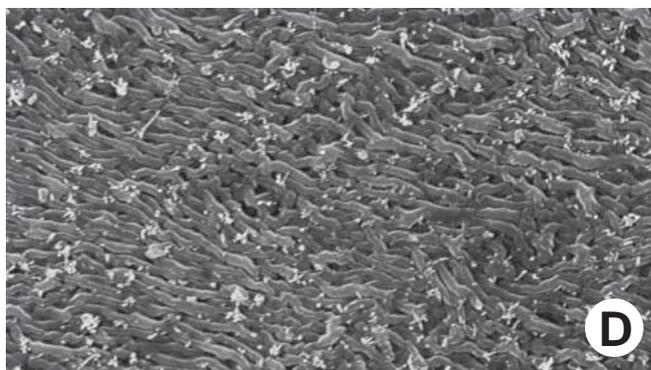
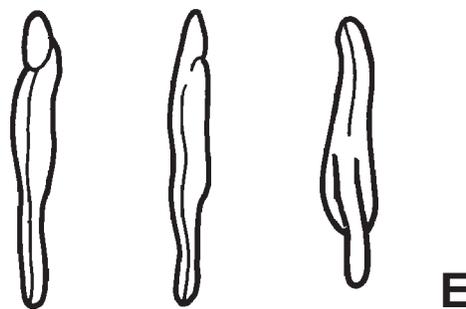
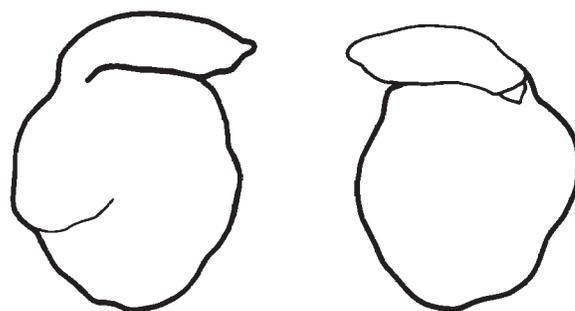
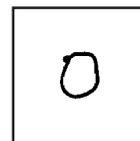
Seed 5–10 × 5–7.5 × 1–2.3 mm; not overgrown; not angular; asymmetrical; circular (sub) or ovate; flattened or compressed (nearly flattened); with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown (dark reddish); glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to lens; not bifurcating; color of testa; brown (reddish); recessed. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; apical at apex of radicle

tip; recessed; within rim. Hilum rim color of testa. Lens discernible; less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; adjacent to hilum; 1 mm from hilum; mounded; similar color as testa; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown (dark reddish); inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Southern and eastern Mexico and northern Central America.

Notes: Sousa and Lavin (1992) named a new species, and our species count includes their new species. Lavin and Sousa (1995) monographed *Hybosema*. We believe that the seeds we studied were all immature; hence the lower measurements for seed length, width, and thickness. The upper measurements are likely more accurate for mature seeds.

Hybosema: *H. ehrenbergii* (F.R.R. Schlechter) H.A.T. Harms (A–E). A, Valves (× 1.1); B, seeds (× 6.2); C–D, testa (× 50, × 1000); E, embryos (× 7).



Genus: *Poitea* E.P. Ventenat

Phylogenetic Number: 8.05.

Tribe: Robinieae.

Group: Gliricidia.

Species Studied—Species in Genus: 9 spp.—12 spp.

Fruit a legume; unilocular; $2-11 \times 0.3-0.8 \times 0.1-0.3$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; slightly curved or straight; not plicate; not twisted; symmetrical or asymmetrical; linear or oblong; with both sutures nearly straight, or unequally curved; not inflated; flattened or compressed; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered, tapered, or short tapered at base; base aligned or oblique (slightly) 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 or torulose. Fruit margin not constricted or slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting (or rarely, loosely). Replum invisible. Epicarp dull; monochrome; reddish brown; glabrous; eglandular; without spines; not smooth or smooth (rarely); with elevated features; not veined or reticulately veined; not tuberculate; wrinkled (obliquely); not exfoliating or exfoliating in part; without cracks or with cracks; cracking oblique (across each seed chamber) or transverse to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid or vitreous (granules); coriaceous. Endocarp dull; monochrome; tan or green; below seeds smooth and scurfy (sometimes around seeds); subseptate or nonseptate; with septa thin (tissue paper-like), flexible or thicker than paper, firm; with the septa eglandular; coriaceous or chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–24; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; triangular or flattened; straight. Aril absent or present; dry. Aril tongue-aril. Aril tan.

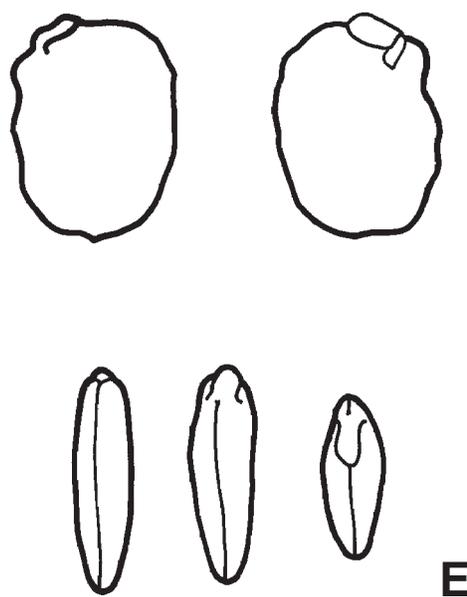
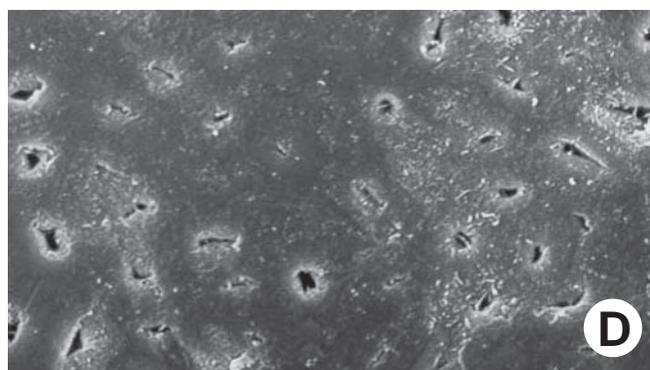
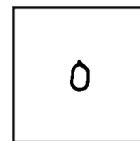
Seed $3-5 \times 2.5-4.5 \times 0.8-1.5$ mm; not overgrown; not angular; asymmetrical; circular, ovate, rectangular, reniform, obovate, or oblong; compressed (rarely to

subcircular); with surface smooth; without or with visible radicle and cotyledon lobes; without or with external groove between radicle and cotyledon lobes; with external groove between radicle and cotyledon lobes same color as testa; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or bichrome (outer margin darker than inner face like a pseudopleurogram); dark reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible (or barely so) or not visible; from hilum to lens, from lens to base of seed and terminating, or from hilum through lens to base of seed and bifurcating; not bifurcating or bifurcating at base of seed with each arm going up antiraphe side, turning (U-shaped) down, and approaching bifurcation; darker than testa (or barely so); dark reddish brown or black; flush or recessed. Hilum visible or 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 or larger than punctiform; 0.5 mm long; with curved outline; circular; apical at apex of radicle tip, between cotyledon and radicle lobe, or marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible (or barely so) or not discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5 mm long; with margins straight or curved; linear, oblong, or irregular; not in groove of raphe; 180 degrees (to 270 degrees) from or confluent with hilum; mounded to flush; similar or dissimilar color from testa; darker or lighter than testa; dark reddish brown or black; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa or 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 or partially concealing radicle; entire or split over radicle; with or without lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; greenish to reddish tan, green, or brown (reddish); 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 or bulbous; lobe tip straight; deflexed and parallel to cotyledon width or length; centered between cotyledons; less than 1/2 or 1/2 to nearly length of cotyledons. Plumule moderately developed or rudimentary; glabrous.

Distribution: Cuba, Haiti, Dominican Republic, Puerto Rico, Greater Antilles, and the island of Dominica.

Notes: Lavin (1993) monographed *Poitea*, and our species count is taken from his monograph, not from Polhill and Sousa (1981). Lavin reduced *Corynella*, *Notodon*, *Sabinea*, and *Sauvallela* to synonyms under *Poitea*.

Poitea: *P. galegeoides* É.P. Ventenat (*B–E*), *P. spp.* (*A*). *A*,
Fruits ($\times 1.2$); *B*, seeds ($\times 7.5$); *C–D*, testa ($\times 50$,
 $\times 1000$); *E*, embryos ($\times 8$).



Genus: *Gliricidia* K.S. Kunth

Phylogenetic Number: 8.06.

Tribe: Robinieae.

Group: *Gliricidia*.

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

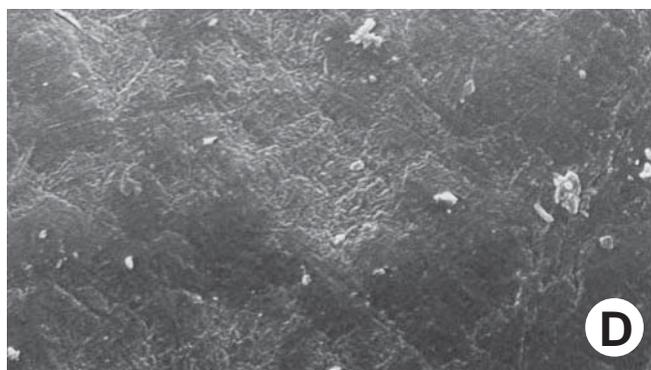
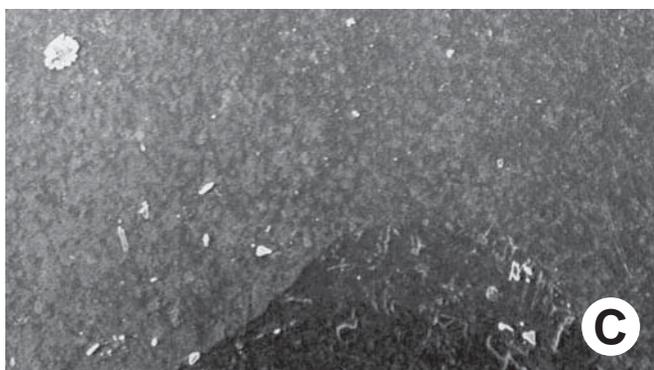
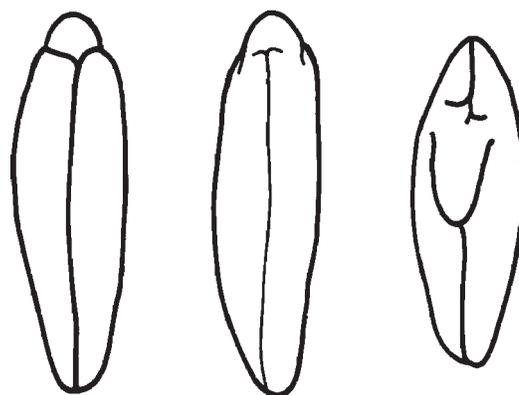
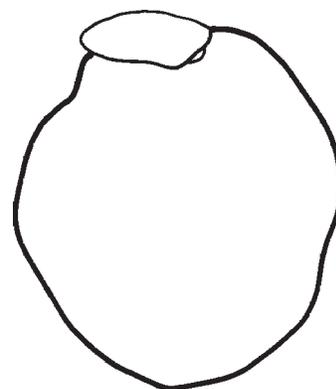
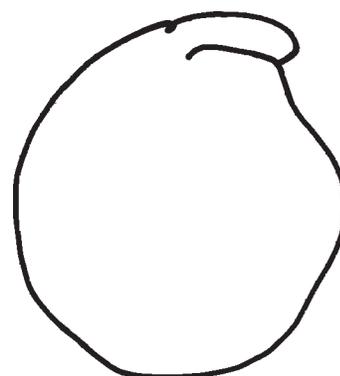
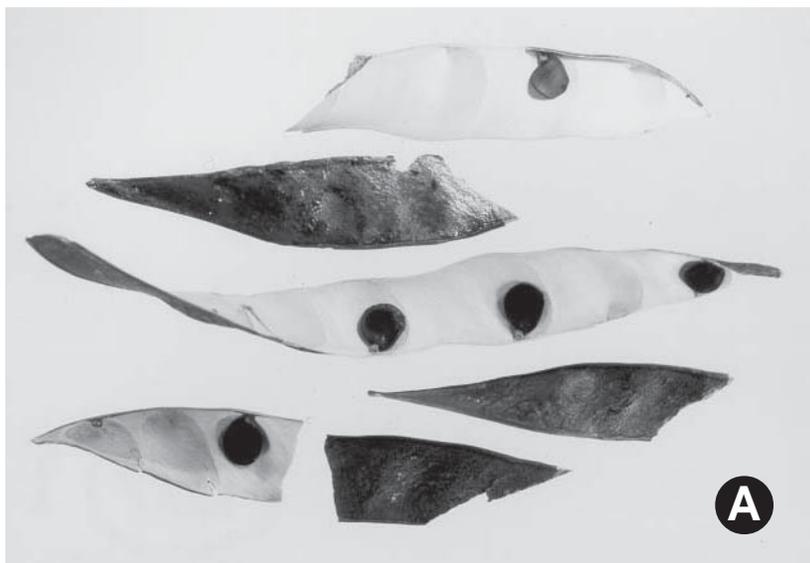
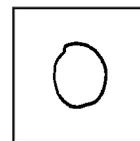
Fruit a legume; unilocular; (6–)8–31 × 1–2.5 × 0.2–0.5 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear; when asymmetrical with both sutures nearly straight; not inflated; flattened; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally visible (faintly) or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit with all layers dehiscent. Dehiscence of valves along both sutures; basal and up (*G. maculata* (K.S. Kunth) K.S. Kunth ex G.W. Walpers and *G. sepium*) or apical and down (*G. brenningii* (H.A.T. Harms) M. Lavin); active; with valves twisting. Replum invisible. Epicarp dull or semiglossy; monochrome; reddish or dark reddish brown; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; not veined or veined; reticulately veined; not tuberculate; faintly wrinkled or wrinkled and lenticular; not exfoliating; without or with (after dehiscence, *G. brenningii*) cracks; cracking transverse to fruit length. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with vitreous layer over solid layer (vitreous layer beadlike or reddish brown and solid layer tan); ligneous. Endocarp dull; monochrome; tan; spongy; septate or nonseptate; with septa thin (tissue paper-like), flexible (more of a color difference or with wrinkled margins); with septa eglandular; coriaceous or chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–15; length parallel with, transverse to, or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured or less than 0.5 mm long (*G. brenningii*); 1.5–2 mm long; of 1 length only; flattened; straight. Aril absent or present; dry; tongue-aril; reddish brown or brown.

Seed 5.5–12 × 1–10 × 1.5–3 mm; not overgrown; not angular; nearly symmetrical or asymmetrical; subcircular, circular, oblong, or ovate; flattened or compressed; 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; black or brown (reddish); glabrous; smooth or not smooth (*G. brenningii*); with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or fully concealed; concealed by funiculus or funicular remnant; 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 straight outline; oblong; apical at apex of radicle tip; flush or recessed (slightly, *G. brenningii*); not within corona, halo, or rim or within rim. Hilum rim color of testa. Lens not discernible or discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length (*G. brenningii*); up to 2 mm long; with margins straight; rhombic or wedge-shaped; not in groove of raphe; adjacent to hilum; 1–1.5 mm from hilum; mounded or flush (*G. brenningii*); dissimilar color from or similar color as testa; darker or lighter (duller, *G. brenningii*) than testa; reddish brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa or embryo. Cotyledons smooth; both outer faces convex or outer face of 1 cotyledon flat and other cotyledon convex (*G. brenningii*); both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing or not concealing (*G. brenningii*) radicle; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without or with (*G. brenningii*) margins recessed; tan, brown (reddish), 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 bulbous; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed or rudimentary; glabrous.

Distribution: Southern Mexico, Central America, and Pacific slope of Ecuador and northernmost Peru; widely cultivated.

Notes: Lavin et al. (1991) reported on the intraspecific phylogeny and tokogeny of *Gliricidia sepium*. Lavin and Sousa (1995) monographed the genus and synonymized *Yucaratonia* A.E. Burkart with it. Burkart (1969) provided excellent fruit and seed illustrations of *G. brenningii* with his description of the genus *Yucaratonia*.

Gliricidia: *G. sepium* (N. von Jacquin) K.S. Kunth ex G.W. Walpers (*A, C-E*), *G. spp.* (*B*). *A*, Dehisced fruit and valves ($\times 0.7$); *B*, seeds ($\times 5$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



Genus: *Robinia* C. Linnaeus

Phylogenetic Number: 8.07.

Tribe: Robinieae.

Group: Robinia.

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

Fruit a legume; unilocular; 4.5–10 × 0.8–1 × 0.2 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; symmetrical or asymmetrical; linear; with both sutures nearly straight; not inflated; flattened or compressed; without or with beak; with solid beak the same color and texture as fruit; 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 invisible or visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted along both margins; without sulcus; plain or embellished. Fruit wing absent or present (occasionally); 1; up to 0.2 mm wide; sutural; on 1 suture (upper). Fruit substipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures (lower suture first); apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; streaked; brown (reddish); with red overlay; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular; with glandular hairs; with spines; not smooth; with elevated or recessed features; veined or not veined; reticulately veined (faintly and incompletely); tuberculate; warty; slitted obliquely (minute); not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth; septate or nonseptate; with septa thicker than paper, firm; with the septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 2–13; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1.5 mm long; of 1 length only; thick; straight or curved (near hilum). Aril dry. Aril rim-aril. Aril tan.

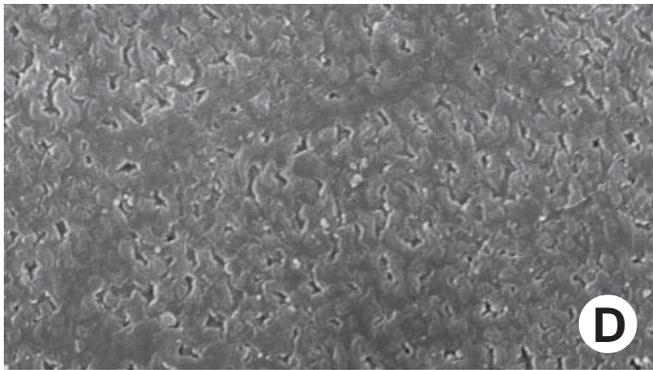
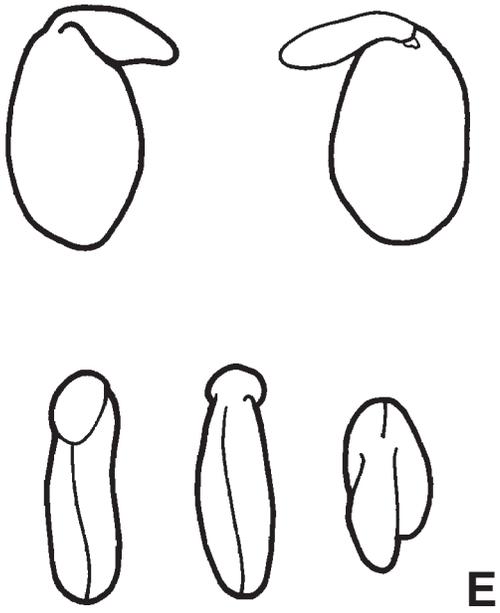
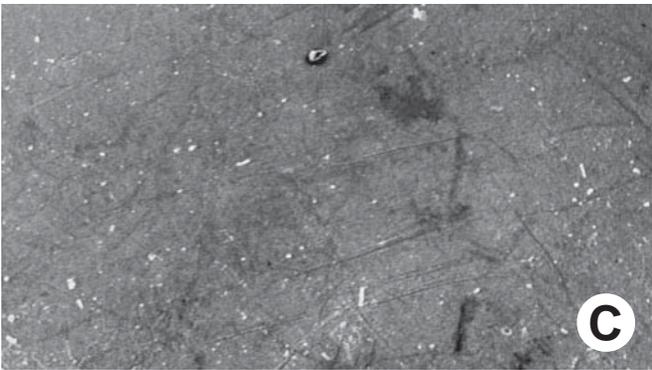
Seed 4–6 × 3–3.5 × 1.7–2 mm; not overgrown; not angular; asymmetrical; reniform or ovate; compressed; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; brown (reddish) or black; with black overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens to base of seed and terminating; not bifurcating; color of testa; brown (reddish); flush. Hilum visible or fully concealed; concealed by funiculus; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–0.8 mm long; with curved outline; circular; marginal according to radicle tip; recessed; within halo. Hilum halo color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7–0.8 mm long; with margins curved; circular or elliptic; not in groove of raphe; adjacent to hilum; 0.8 mm from hilum; mounded; similar color as testa; darker than testa; brown (reddish); not within corona, halo, or rim. Endosperm thin; 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; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

Distribution: United States and Mexico.

Notes: Isely and Peabody (1984) and Lavin and Sousa (1995) recognized only four species, as we do, rather than the 10(–20) acknowledged by Polhill and Sousa (1981), who added this caveat, “Perhaps only four or five basic species.”

Robinia: *R. pseudoacacia* C. Linnaeus (C–E), *R. spp.* (A–B). A, Fruits and valves (× 1.2); B, seeds (× 6.6); C–D, testa (× 50, × 1000); E, embryos (× 6).

♂



Genus: *Coursetia* A.-P. de Candolle

Phylogenetic Number: 8.08.

Tribe: Robinieae.

Group: Robinia.

Species Studied—Species in Genus: 19 spp.—39 spp.

Fruit a legume; unilocular; $1-17 \times 0.2-1.1 \times 0.1-0.15$ cm; with deciduous corolla; with deciduous calyx; 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 (linear), or falcate; with both sutures nearly straight; not inflated; flattened or compressed; without beak; tapered or short tapered at apex; apex aligned with longitudinal axis of fruit; tapered or 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 torulose or not torulose. Fruit margin constricted or not constricted; constricted or slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate, substipitate, or nonstipitate; with the stipe up to 20 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; reddish to greenish brown; glabrous or pubescent and indurate; with 1 or 2 types of pubescence (glandular and nonglandular hairs); puberulent, tomentose, villous, or sericeous; with pubescence gray or golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular or glandular; with glandular hairs; without or with (rarely) spines; not smooth; with elevated features; not veined; not tuberculate; rugose, warty, or wrinkled; not exfoliating or exfoliating in part; without cracks. Mesocarp thin, thick, or trace; surface not veined; 1-layered; with balsamic vesicles; without fibers; solid or mealy (reddish-brown); coriaceous or chartaceous. Endocarp glossy; monochrome; tan (to grayish) or gray; smooth, scurfy (large segments), or fibrous; septate (false septa according to Lavin (1988)) or nonseptate; with septa thicker than paper, firm; with the septa eglandular; coriaceous or chartaceous; not exfoliating; separating from epicarp (traces of mesocarp tissue remaining adnate to both epicarp and endocarp); entire. Seeds 1–30; length parallel with or 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 present or absent (may remain with funiculus in fruit); dry. Aril rim-aril or tongue-aril. Aril tan.

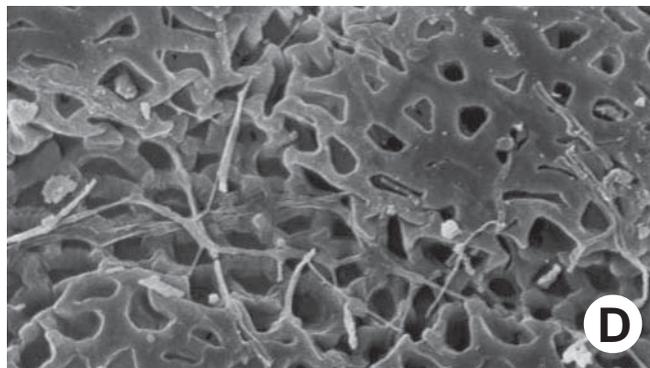
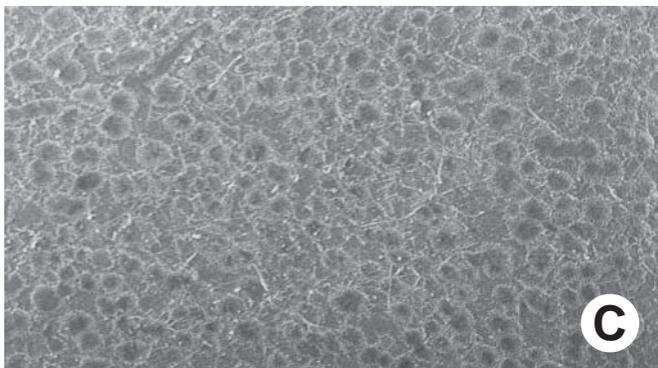
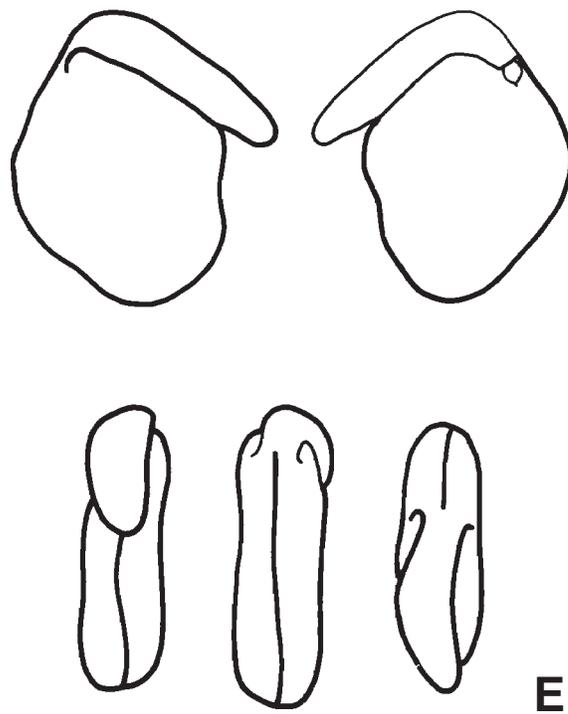
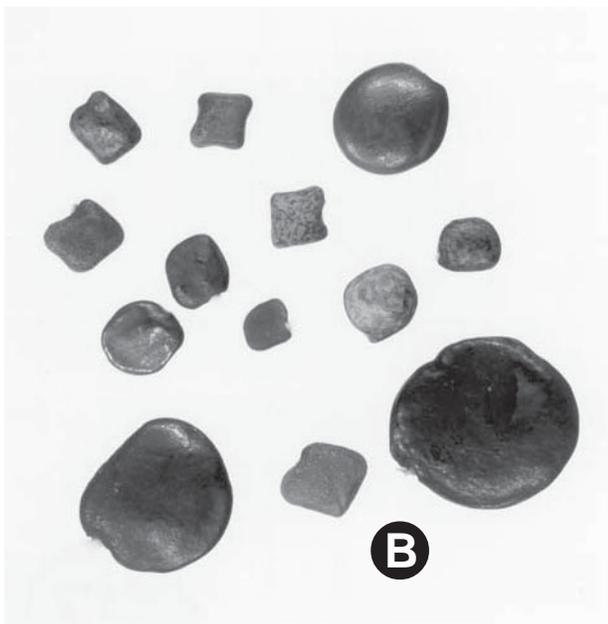
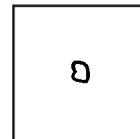
Seed $1.5-7 \times 1.5-7 \times 0.5-1.7$ mm; not overgrown; not angular or angular; asymmetrical; circular (more or less), D-shaped, ovate, quadrangular, or rectangular; compressed; with surface smooth; without or with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown (reddish), black, or gray; with black or purple overlay; glabrous; smooth or not smooth; with elevated features; tuberculate or warty; coriaceous. Fracture lines absent. Rim present. Wings absent. Raphe from hilum through lens to base of seed and terminating, from hilum to lens, or from hilum through lens and base of seed to point opposite hilum; not bifurcating; darker than testa; reddish brown; flush. Hilum partially concealed or visible; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; apical at apex of or subapical to radicle tip; recessed (barely); within rim or halo. Hilum halo color lighter than testa. Hilum rim color of or lighter than testa. Lens discernible or not discernible; less than 0.5 mm in length; with margins straight or curved; triangular; circular or elliptic; not in groove of raphe; adjacent to or confluent with hilum; up to 1 mm from hilum; flush, mounded (to barely so), or recessed; same, similar, or dissimilar color from testa; darker than testa; brown (reddish); not within corona, halo, or rim. Endosperm thin; 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 or with only 1 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; split over radicle; with lobes; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan (to greenish or reddish); 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 or bulbous (somewhat); lobe tip straight; 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: Southwestern United States, Mexico, West Indies (1 sp.), northern and western South America to Argentina.

Notes: Lavin (1987) and Polhill (1994a,b) included *Cracca*, *Neocracca*, and *Poissonia* in *Coursetia*, and these genera were recognized by Polhill and Sousa (1981). Lavin (1988) monographed *Coursetia*, and his species count is used instead of the count by Polhill and Sousa. Lavin (1988) used the outline of the fruit's seed compartment as one key character for separating sections *Madrenses*, *Poissonia*, and *Coursetia* from sections *Neocracca* and *Craccoides*. The former three sections have rounded seed compartments, and the latter two have squarish seed compartments. He also noted that unlike other genera in the Robinieae, the seeds are in compartments formed "by the lateral adhesion of the inner epidermis of each valve between seeds." Figure 8 of Lavin (1988) shows that the endocarps of the valves touch, without fusing, to form the seed compartments. Where the endocarps touch each other, they are functionally septa.

Coursetia: *C. caribaea* (N. von Jacquin) M. Lavin (C–E),
C. spp. (A–B). A, Fruits ($\times 1$); B, seeds ($\times 4.2$); C–D,
testa ($\times 50$, $\times 1000$); E, embryos ($\times 12$).



Genus: *Olneya* A. Gray

Phylogenetic Number: 8.09.

Tribe: Robinieae.

Group: Robinia.

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

Fruit a legume; unilocular; $2.5\text{--}13 \times 1\text{--}1.5 \times 0.75\text{--}1$ cm; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; moniliform or oblong; with both sutures parallelly or unequally curved; moniliform, oblong; irregular; not inflated; terete; without beak; short tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally visible; with the raised seed chambers torulose or not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing (to tardily so); splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome or multicolored; mottled (when young); brown (to yellowish or greenish or reddish); with red overlay; with mottling over seed chambers; pubescent and indurate; with 1 type of pubescence; puberulent (minute); with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; glandular; with glandular setae; 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; vitreous; coriaceous. Endocarp dull; monochrome; tan; smooth; nonseptate; coriaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–11; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril absent.

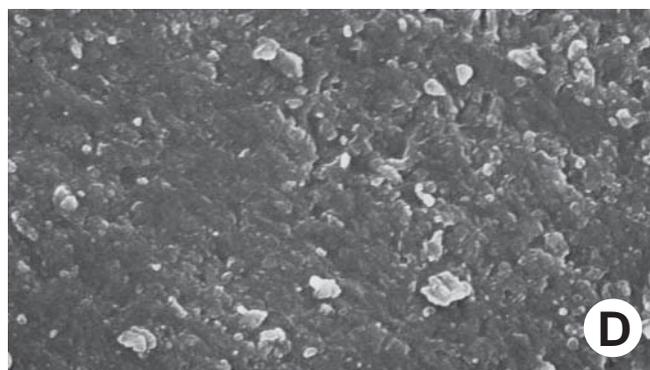
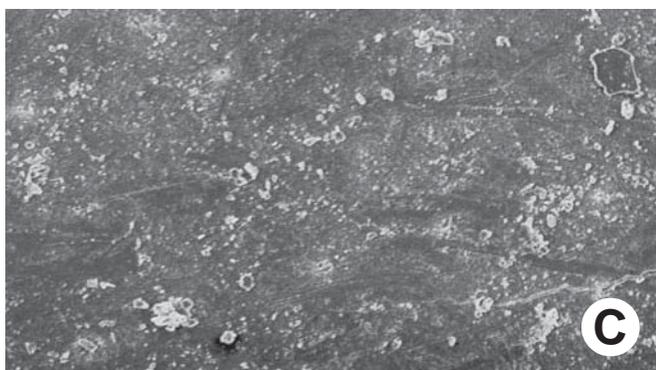
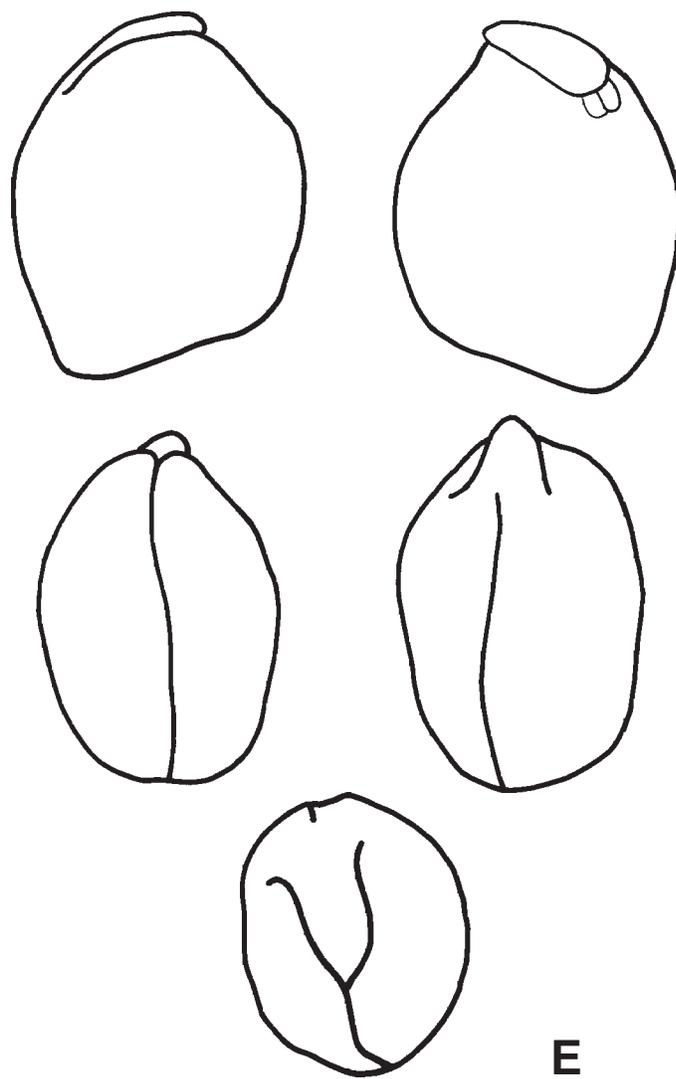
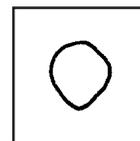
Seed $9\text{--}12 \times 6.5\text{--}9.2 \times 5.5\text{--}8$ mm; not overgrown; not angular or angular; asymmetrical; oblong; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled;

brown (reddish), purple (grayish to brownish dark), or black; with purple (pinkish) or pink overlay; glabrous; not smooth; with recessed features; pitted with stomata in the bottom of the pits; 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; larger than punctiform; 1 mm long; with curved outline; circular; subapical or marginal according to radicle tip (near apex); flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 2.5–3 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; 0.3–0.5 mm from hilum; mounded; same color as testa; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle triangular; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Southwestern United States and northern Mexico (Sonoran Desert).

Notes: Lavin and Sousa (1995) monographed *Olneya*. Cook (1919) evaluated the edibility of the young pods and seeds, and Clarke (1977) reported that native Americans ate the seeds and ground them into flour. The Seri Indians of Sonora, Mexico, extensively utilize *Olneya* as a food source, in medicine, in the production of firewood, tools, weapons, musical instruments, and sculptures, and in their religious ceremonies (Felger and Moser 1985).

Olneya: *O. tesota* A. Gray (A–E). A, Fruits and valve ($\times 1.3$); B, seeds ($\times 2.7$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Peteria* A. Gray

Phylogenetic Number: 8.10.

Tribe: Robinieae.

Group: Robinia.

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

Fruit a legume; unilocular; $3.5-7 \times 0.4-0.65 \times 0.25-0.3$ cm; with persistent or deciduous androecial sheath; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear; with both sutures nearly straight; not inflated; compressed; with or without beak; declined or hooked; with solid beak the same color and texture as fruit; tapered at apex; apex right-angled with longitudinal axis of fruit; long tapered or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose or torulose. Fruit margin not constricted (usually) or constricted (through seed abortion); constricted along both margins; 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown (reddish); 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; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 2–7; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry. Aril rim-aril (better developed along one side of hilum). Aril white.

Seed $3-6 \times 2.5-3.5 \times 2-2.6$ mm; not overgrown; not angular or angular; asymmetrical; oblong, quadrangular, or reniform (somewhat); compressed or terete; 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

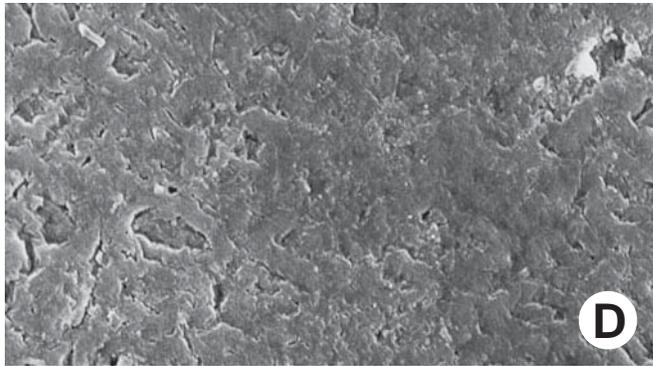
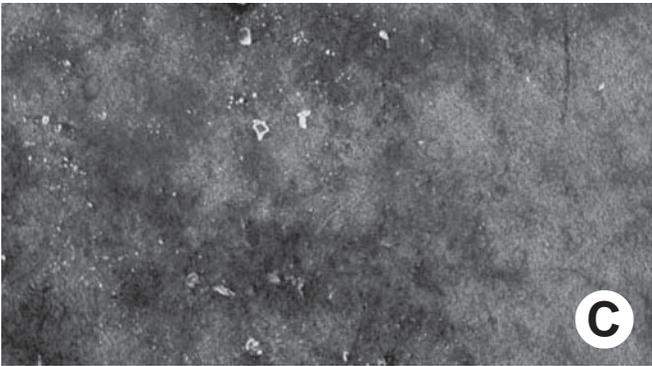
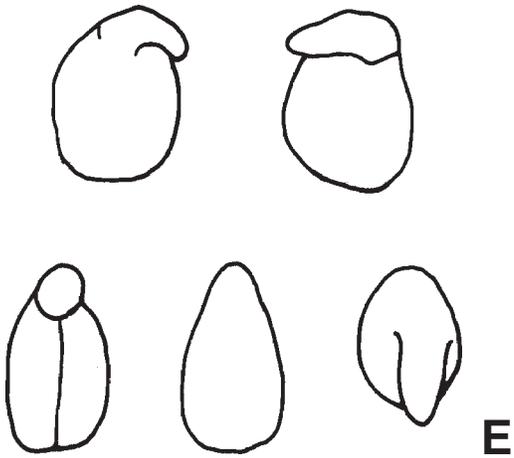
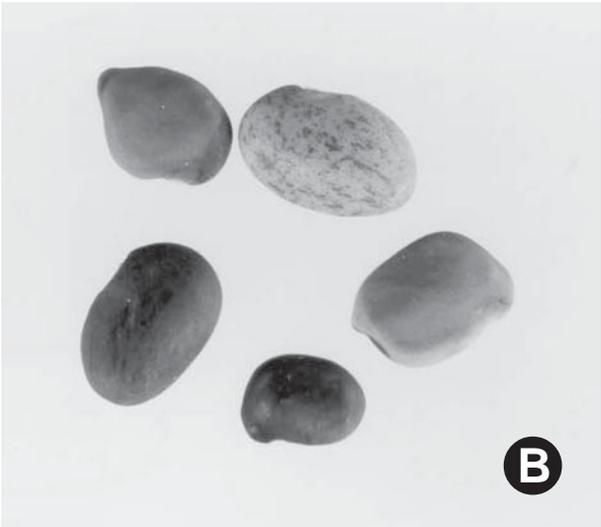
endocarp; dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; brown (reddish); with black or purple overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform or larger than punctiform; 0.3–0.5 mm long; with curved outline; circular or elliptic; marginal according to radicle tip or between cotyledon and radicle lobe; recessed; within rim. Hilum rim color of or darker than testa (to blackish). Lens discernible (obscure) or not discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–1 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; 0.7 mm from hilum; flush; same or dissimilar color from testa; darker than testa; brown (reddish); not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; with 1 or both 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 bulbous; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southwestern United States and northern Mexico.

Notes: Porter (1956) and Lavin and Sousa (1995) monographed the genus.

Peteria: *P. thompsoniae* S. Watson (C–E), *P.* spp. (A–B). A, Fruit with calyx ($\times 1.7$); B, seeds ($\times 4.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 6$).

O



Genus: *Genistidium* I.M. Johnston

Phylogenetic Number: 8.11.

Tribe: Robinieae.

Group: Robinia.

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

Fruit a legume; unilocular; $1.5\text{--}3.5 \times 0.4\text{--}0.7 \times 0.25\text{--}0.27$ cm; with persistent androecial sheath; 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 or asymmetrical; linear (broadly); with both sutures nearly straight; not inflated; compressed; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned or oblique with longitudinal axis of fruit (slightly); 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 nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome; tan; 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; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to 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; flattened; straight. Aril dry. Aril tongue-aril. Aril tan.

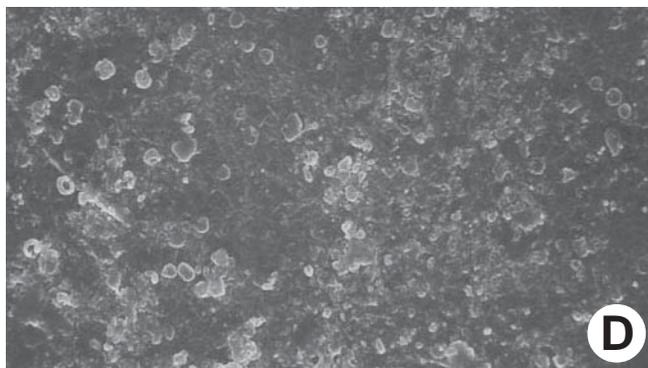
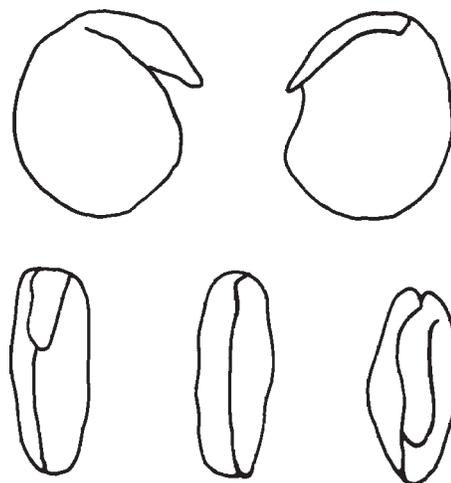
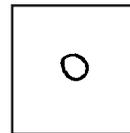
Seed $4.2 \times 3.5 \times 2$ mm; not overgrown; not angular; symmetrical; circular (sub) or oblong; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; mottled and streaked; with frequent mottles; with frequent streaks; brown (reddish); with black overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not

visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 2 mm long; with margins straight; linear (with circular center); not in groove of raphe; adjacent to hilum; 0.5 mm from hilum; mounded; similar color as testa; darker than testa; brown (reddish); not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; brown (reddish); 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 of cotyledons. Plumule rudimentary; glabrous.

Distribution: United States (Texas: Brewster County) and Mexico (Coahuila and southern Nuevo León).

Notes: Lavin and Sousa (1995) monographed *Genistidium*. Only a limited number of seeds and fruits were available for study.

Genistidium: *G. dumosum* I.M. Johnson (A–E). A, Fruit and valve ($\times 2.9$); B, seed ($\times 11.7$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 6.8$).



Genus: *Sphinctospermum* J.N. Rose

Phylogenetic Number: 8.12.

Tribe: Robinieae.

Group: Robinia.

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

Fruit a legume; unilocular; $1.5\text{--}3.5 \times 0.25\text{--}0.35 \times 1\text{--}1.5$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; flattened; with beak (very short); straight or declined; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan; with brown overlay; with mottling over seed chambers; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; striate; not exfoliating; without cracks. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; translucent; monochrome or mottled; tan; with mottling; with brown overlay; smooth; without adhering pieces of testa; septate; with septa thin (like tissue paper), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–12; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 0.5 mm long; of 1 length only; filiform; straight. Aril dry; minute rim-aril; cream.

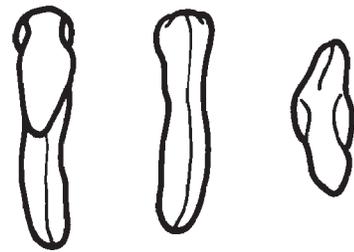
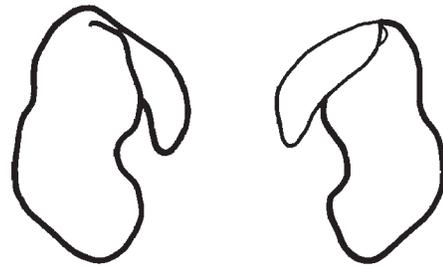
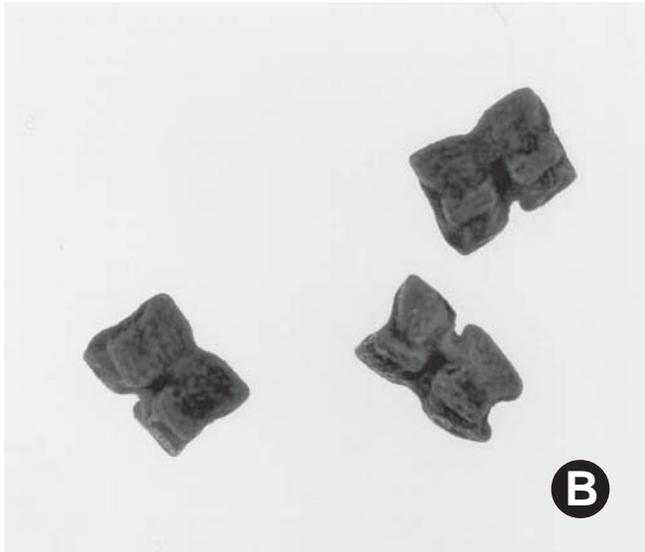
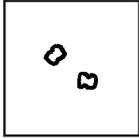
Seed $2\text{--}3 \times \text{ca. } 2 \times \text{ca. } 1.5$ mm; not overgrown; angular; symmetrical; rectangular (with central constriction); compressed (diamond-shaped); with surface grooved; with grooves transverse; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to

endocarp; free from endocarp; dull; not modified by a bloom; colored; monochrome; tan to brown; glabrous; not smooth; with elevated features; papillate; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril; punctiform (elliptic); apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim. Lens not discernible. Endosperm thick; not pluglike and not resembling tip of radicle; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces flat; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons to with 90-degree turn; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

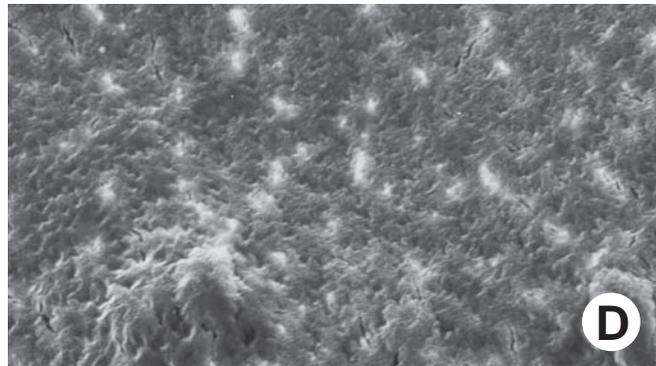
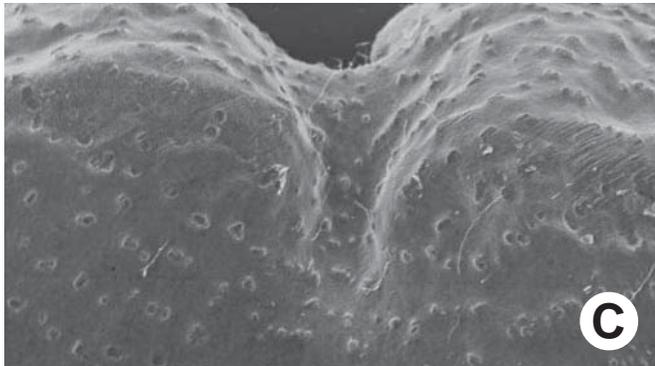
Distribution: Southwestern United States and northwestern Mexico.

Notes: Lavin (1987) transferred *Sphinctospermum* to Millettieae. Lavin and Doyle (1991) and Polhill (1994b), integrating morphological and chloroplast DNA data and analyzing it cladistically, concluded that *Sphinctospermum* should be returned to Robinieae. Lavin and Sousa (1995) monographed the genus. The strong constriction around the middle of the seeds is unique in legumes. The distinctive seeds have been referred to as hourglass shaped (Kearney and Peebles 1951).

Sphinctospermum: *S. constrictum* (S. Watson) J.N. Rose (A–E). A, Fruits ($\times 3$); B, seeds ($\times 7$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



E



Indigofereae (9.01–9.07)

Genus: *Phylloxylon* H.E. Baillon

Phylogenetic Number: 9.01.

Tribe: Indigofereae.

Species Studied—Species in Genus: 2 spp.—7 spp.

Fruit a legume; unilocular; $3\text{--}5 \times 1.3\text{--}1.5 \times 0.7\text{--}1.5$ cm; with deciduous corolla; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; oblanceolate or ovate; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; compressed or terete; without or with beak; straight; 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. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; reddish brown; glabrous; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; slightly wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth (but shredding); nonseptate; chartaceous; not exfoliating (but in shreds and margins fibrous); remaining fused to epicarp; entire. Seeds 2 or 1; 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.

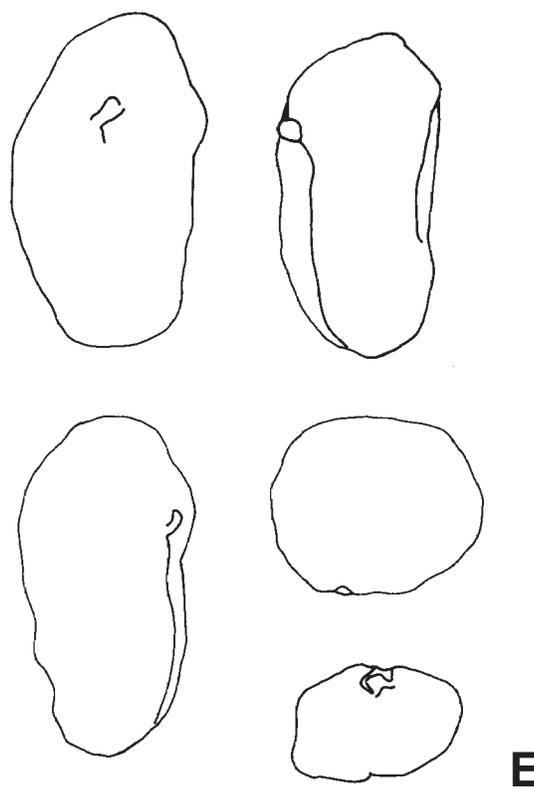
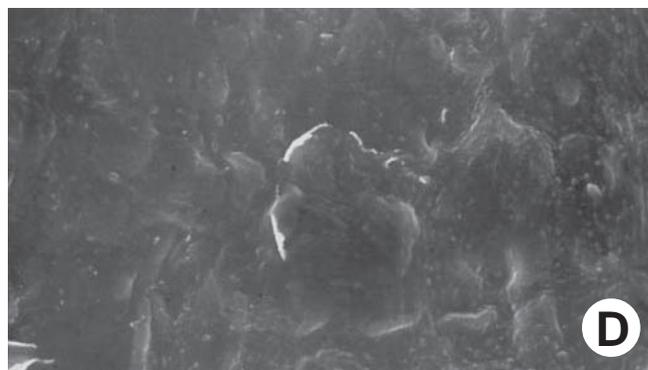
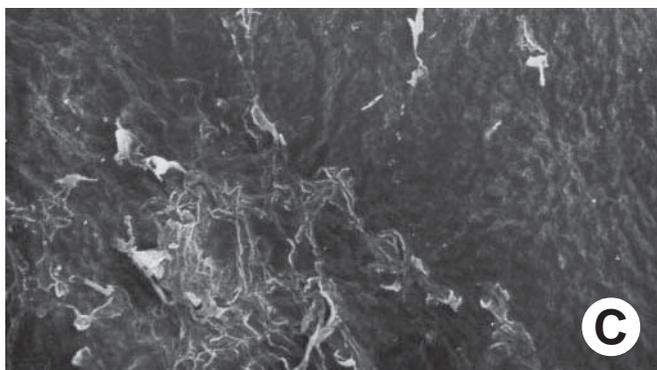
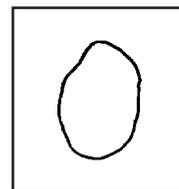
Seed $12\text{--}18 \times 10\text{--}13 \times 10\text{--}13$ mm; overgrown, 1 seed filling entire fruit cavity (or 2); not angular; asymmetrical; circular or oblong; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; slightly lighter than testa;

recessed. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; up to 2 mm long; with curved outline; circular or elliptic; subapical to radicle tip; flush; not within corona, halo, or rim. Lens not discernible. Endosperm absent. Cotyledons completely fused forming a single, indivisible mass; not smooth; wrinkled; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; tan or brown; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; truncate; straight; deflexed and parallel to cotyledon width; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Madagascar.

Notes: Schrire (1995) carried out extensive cladistic analyses with the Indigofereae genera and infrageneric taxa of *Indigofera* (9.07). Du Puy et al. (1995) revised the genus *Phylloxylon*. They changed the name of the most common and most widespread species from *P. decipiens* H.E. Baillon, also type of the genus, to *P. xylophyloides*. Peltier (1970) studied the seeds and sprouts of *P. xylophyloides*. After examining more than 200 seeds from different localities, he concluded that the cotyledons were completely fused without a trace of the line of fusion. Our observations agreed with Peltier's.

Phylloxylon: *P. xylophyloides* (J.G. Baker) D.J. Du Puy, J.-N. Labat & B.D. Schrire (A–E). A, Fruits ($\times 2.1$); B, damaged seed ($\times 4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



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

Phylogenetic Number: 9.03.

Tribe: Indigofereae.

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

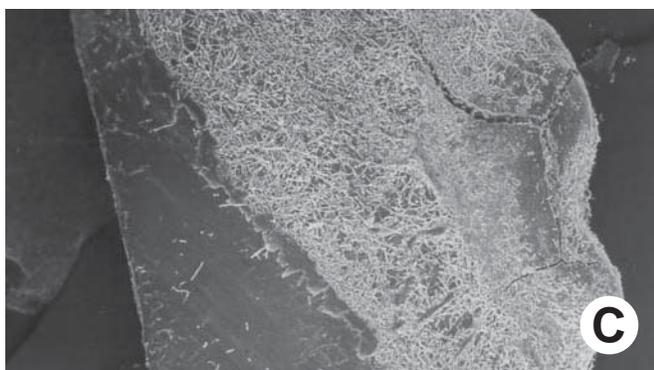
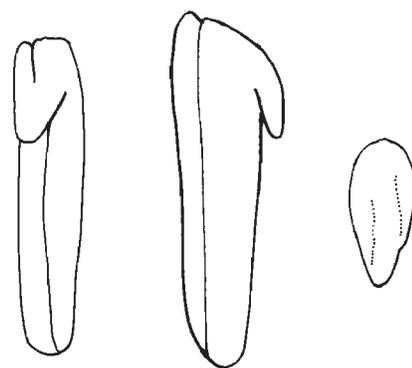
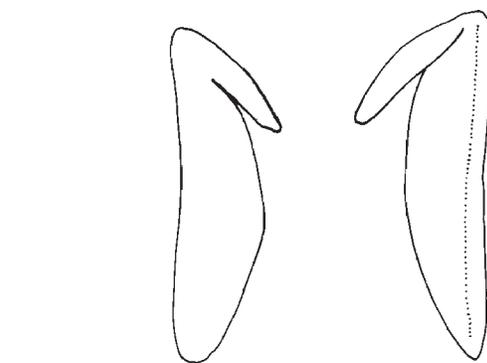
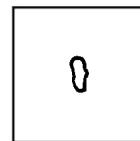
Fruit a legume; unilocular; $4.7 \times 0.4 \times 0.4$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; terete; without beak; long tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along suture. Dehiscence of valves along 1 suture (assumed); passive. Replum invisible. Epicarp dull; monochrome; brown; glabrous; eglandular; without spines; 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 dull; monochrome; reddish brown; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp. Seeds 4–6; 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 $4.6 \times 2 \times 0.6$ mm; overgrown, 1 seed filling entire fruit cavity; not angular; asymmetrical; reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; glossy; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with recessed features; finely grooved; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; punctiform; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7 mm long; with margins straight; oblong; not in groove of raphe;

adjacent to hilum; 0.7 mm from hilum; flush; same color as testa; dark brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; dark brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: South-central Africa.

Rhynchotropis: *R. poggei* (P.H.W. Taubert) H.A.T. Harms (A–E). A, Fruit ($\times 1.7$); B, seeds ($\times 6.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 15$).



Genus: *Cyamopsis* A.-P. de Candolle

Phylogenetic Number: 9.06.

Tribe: Indigofereae.

Species Studied—Species in Genus: 3 spp.—4 spp.

Fruit a legume; unilocular; $3.5\text{--}5 \times 0.4\text{--}1.8 \times 0.4\text{--}0.5$ cm; with deciduous corolla; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight (or nearly so); not plicate; not twisted; symmetrical; linear (to somewhat falcate); not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome; light to dark brown to tan to black; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with complex hairs; with T-shaped hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated and recessed features; not veined; not tuberculate; wrinkled; longitudinally grooved; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp. Seeds up to 7; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; thick; straight. Aril present or absent; dry; tongue-aril; tan.

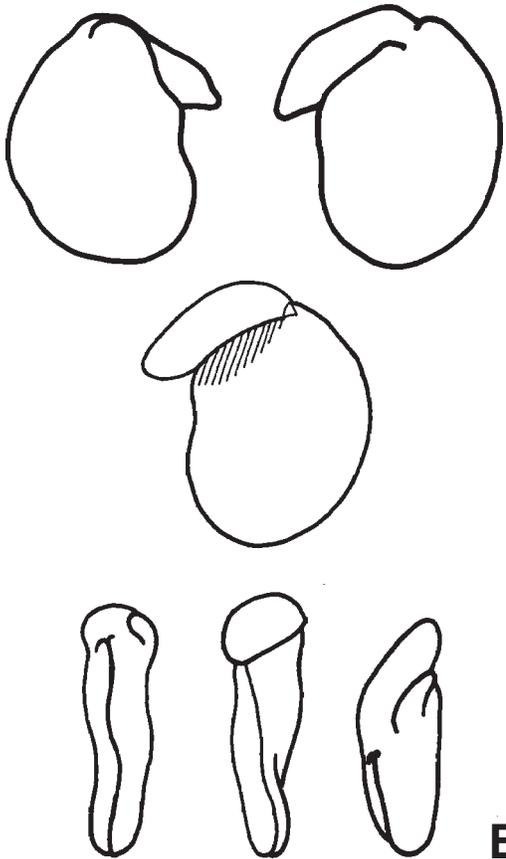
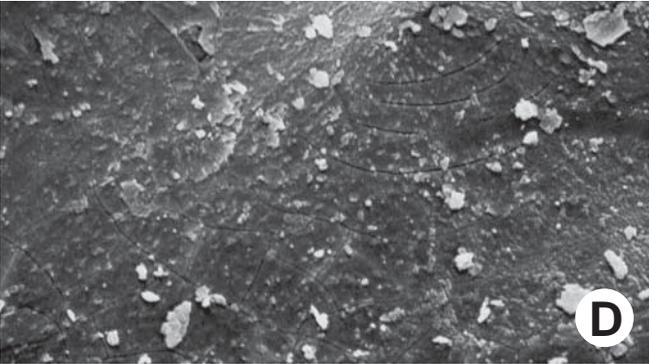
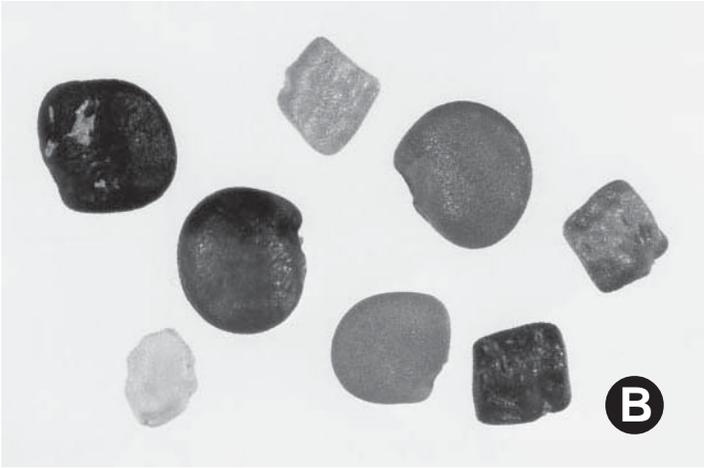
Seed $3\text{--}4 \times 3\text{--}3.4 \times 1.8\text{--}2.8$ mm; overgrown, 1 seed filling entire fruit cavity; angular to not angular; symmetrical or asymmetrical; circular, elliptic, or rectangular; compressed; with surface grooved; with grooves longitudinal and transverse (*C. senegalensis* J.B.A. Guillemin & G.S. Perrottet); with visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored or clear (*C. tetragonoloba*); monochrome or bichrome (brown and dark brown); black, brown

(greenish), cream, green, tan, or yellow; glabrous; not smooth; with elevated or recessed features; shagreen; grooved (4 parallel grooves on each face of *C. senegalensis*); coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with 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; with both folded; sufficiently or not sufficiently (just base) folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; differing at apex (1 concealed by overarched radicle and other auriculate and concealing radicle); partially concealing (depending on the cotyledon) or not concealing radicle (depending on the cotyledon); entire over radicle or split over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed. Radicle linear; lobe tip straight; deflexed and parallel to cotyledon width; not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); $1/2$ to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Arabia and drier parts of Africa. *Cyamopsis tetragonoloba* is known only from cultivation and was possibly of Indian origin.

Notes: Unlike most faboid seeds soaked in pohlstoffe for less than 24 hours, the testa of *Cyamopsis* species fragments as in *Tripodion* (13.03).

Cyamopsis: *C. tetragonoloba* (C. Linnaeus) P.H.W. Taubert (*C-E*), *C. spp.* (*A-B*). *A*, Fruits ($\times 1.2$); *B*, seeds ($\times 4.2$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



Genus: *Indigofera* C. Linnaeus

Phylogenetic Number: 9.07.

Tribe: Indigofereae.

Species Studied—Species in Genus: 87 spp.—ca. 730 spp.

Fruit a legume (see Notes) or loment (but not a true loment); 0.2–7.5 × 0.2–0.5 × 0.2–0.6 cm; with deciduous corolla; with deciduous calyx; without (more frequently) or with (occasionally) orifice formed by curving of fruit or fruit segments; straight to curved to 1-coiled; not plicate; not twisted; asymmetrical or symmetrical; circular, linear, moniliform, or falcate; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures nearly straight; widest near middle or D-shaped; not inflated; flattened, subtriangular, terete, or quadrangular; without beak; long to short tapered at apex; apex aligned to oblique with longitudinal axis of fruit; long to short 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 prickles or wings. Fruit wings present (in *I. trifoliata* C. Linnaeus fruit are slightly winged along sutures, and in *I. glandulosa* J.C. Wendland wings are broader and fringed) or absent; 4; 0.1–0.2 mm wide; valvular; on both valves. Fruit nonstipitate. Fruit with all layers dehiscing or indehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; passive. Replum invisible. Epicarp dull; monochrome (some densely minutely pubescent, giving epicarp a silver appearance or silvery patches on a dark color); reddish brown or red (brownish); glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs or glandular hairs (*I. colutea* (N.L. Burman) E.D. Merrill); with T-shaped hairs (biramous); stiff; with hair bases plain; glandular or eglandular; with glandular hairs, dots, or glandular disks (in *Trifoliata* group); with spines (curved) or without spines; not smooth; with elevated features; longitudinally veined relative to fruit length; not tuberculate; exfoliating in part or not exfoliating; with or without cracks; cracking transverse to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; mottled, streaked, or

bichrome; brown or tan; with dark spotted mottling; with black, brown, or red (to dark reddish black) overlay; smooth; septate to subseptate to nonseptate; with septa thin (tissue paper-like), flexible to thicker than paper, firm; with septa glandular or eglandular; coriaceous or chartaceous; not exfoliating or exfoliating in part; remaining fused to epicarp; entire. Seeds 1–18; length parallel with fruit length or transverse to fruit length (*I. luzonensis* I. de Kort & G. Thijsse and *I. zollingeriana* F.A.W. Miquel); touching or neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; thick; straight. Aril absent.

Seed 1–6 × 0.9–3.5 × 0.6–3.5 mm; not overgrown; angular to not angular; symmetrical (except hilum) or asymmetrical; circular, irregular, linear, quadrangular, or rectangular; terete, quadrangular, or compressed; with surface grooved; with grooves transverse; with or without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome or mottled; with frequent or infrequent mottles; brown, orange, red (dish-brown), tan, or yellow; with black or red overlay; glabrous; not smooth; with elevated or recessed features; reticulate (*I. australis* C.L. von Willdenow with interesting reticulation), shagreen, tuberculate, or tessoroid; pitted with small separate pits or large concatenated pits (with large single pits); coriaceous. Fracture lines absent. Rim absent. Raphe visible or not visible; from hilum to lens; darker than testa; black; recessed. 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; to 5 mm long; with curved outline; elliptic; apical at apex of radicle tip (*I. linifolia* (C. Linnaeus) A.J. Retzius), 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 straight or curved; irregular, wedge-shaped, hourglass, or dumbbell-shaped; not in groove of raphe; adjacent to hilum; less than 1 mm from hilum; mounded; dissimilar color from testa; darker than testa; brownish black, brown, or red (brownish); 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; differing (1 concealed by overarched radicle and other auriculate and concealing radicle) or similar at apex;

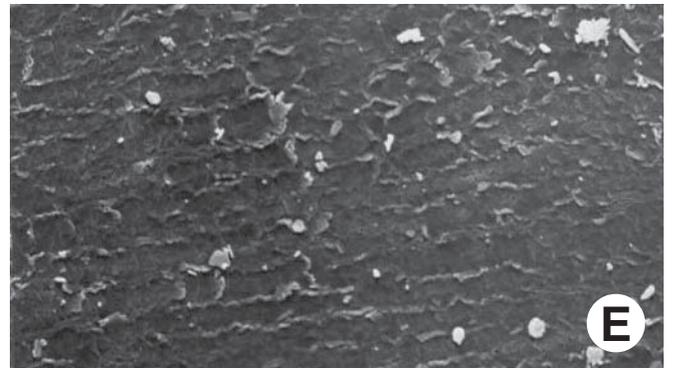
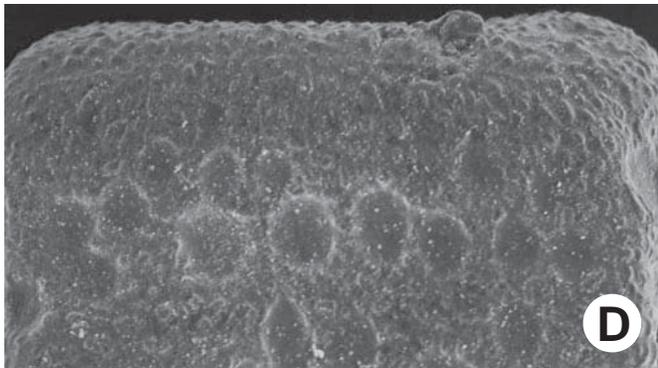
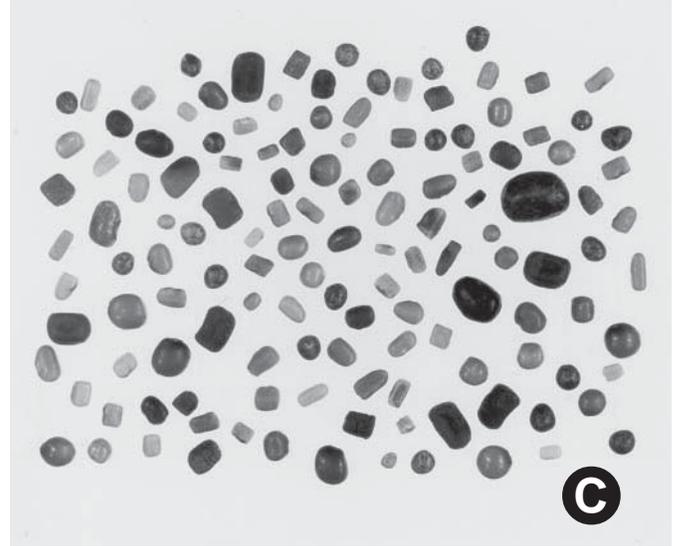
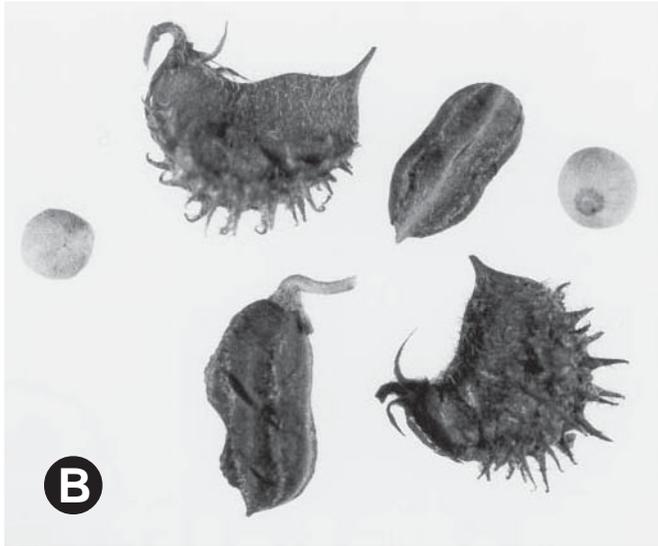
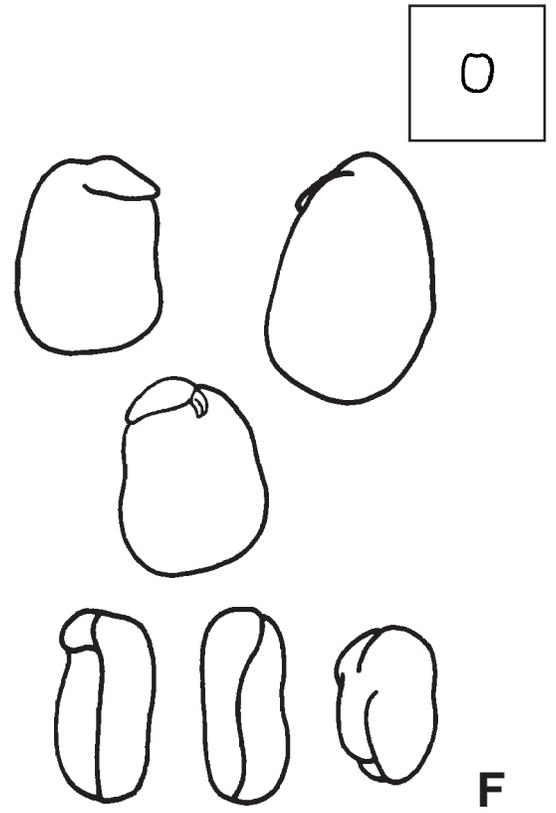
partially concealing or not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white or yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; perpendicular to length of seed. Radicle linear; deflexed and parallel to cotyledon length or width; centered or not centered between cotyledons (radicle outside 1 cotyledon and inside other, therefore junctions for each cotyledon different); less than 1/2 length of cotyledons to 1/2 to nearly length of cotyledons. Plumule rudimentary to moderately developed to well developed; glabrous.

Distribution: Pantropic and pansubtropic.

Notes: Gillett (1958) monographed *Indigofera* (including *Microcharis* G. Bentham (9.04)) in tropical Africa and recognized five subgenera. Kort and Thijsse (1984) noted that Polhill (1981f) treated *Indigofera* with its two satellite genera, *Cyamopsis* (9.06) and *Rhynchotropis* (9.03), together with the rather anomalous Madagascan genus *Phylloxylon* (9.01) (hitherto of unknown affinity) in tribe Indigofereae. Schrire (1995) performed extensive cladistic analyses with the Indigofereae genera and *Indigofera* infrageneric taxa. He concluded that *I.* subgen. *Indigastrum* (H.F. Jaubert & É. Spach) J.B. Gillett, *I.* subgen. *Microcharis* (G. Bentham) J.B. Gillett, *Cyamopsis*, and *Rhynchotropis* formed a sister clade to the remainder of *Indigofera*, so he reinstated the aforementioned *Indigofera* subgenera as genera, *Indigastrum* H.F. Jaubert & É. Spach (9.05) and *Microcharis*. Pending a general expression of opinion by the botanical community concerning Schrire's changes, we have chosen to present *Indigofera* with its traditional circumscription (Gillett 1958, 1971; Polhill 1981f). Choi and Kim (1997) sequenced the ITS region of six *Indigofera* species, and concluded that the ITS sequence will be useful for understanding *Indigofera* classification and evolution. We had seeds available for study of only of three species of *I.* subgen. *Indigastrum*: (1) *Indigofera argyraea* C.F. Ecklon & C.L.P. Zeyher (*Indigastrum argyraeum* (C.F. Ecklon & C.L.P. Zeyher) B.D. Schrire), (2) *Indigofera fastigiata* E.H.F. Meyer (*Indigastrum fastigiatum* (E.H.F. Meyer) B.D. Schrire), and (3) *Indigofera parvifolia* B. Heyne ex R. Wright & G.A.W. Arnott (*Indigastrum parvifolium* (B. Heyne ex R. Wright & G.A.W. Arnott) B.D. Schrire); and of only one species of *I.* subgen. *Microcharis*, *Indigofera disjuncta* J.B. Gillett (*Microcharis disjuncta* (J.B. Gillett) B.D. Schrire). The seed characteristics of these four species were congruent with those of the other 83 *Indigofera* species

studied. The dark spots on the outer endocarp surface are "groups of swollen coloured cells rich in tannin" (Gillett 1958, p. 2), and they can form pits in the seeds. The fruits of species such as *I. cryptantha* G. Bentham ex W.H. Harvey appear to be loment, but this is not true. These fruits are dehiscent legumes and not loment separating into articles.

Indigofera: I. kirilowii C.J.M. Maximowicz & I.V. Palibin
(*D-F*), *I. spp.* (*A-C*). *A*, Narrow fruits ($\times 1.2$); *B*, wide
fruits ($\times 5.3$); *C*, seeds ($\times 2.2$); *D-E*, testa ($\times 50$,
 $\times 1000$); *F*, embryos ($\times 6$).



Phaseoleae (10.01–10.83)

Genus: *Erythrina* C. Linnaeus

Phylogenetic Number: 10.01.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

Species Studied—Species in Genus: 85 spp.—112 spp.

Fruit a legume (breaking between seed chambers into “articles”) or nutlet; unilocular; $4\text{--}24 \times 1\text{--}3 \times 0.5\text{--}2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight, curved (or slightly curved), or 1- or 2-coiled (rarely); not plicate; not twisted; asymmetrical or symmetrical; moniliform, fusiform, linear, falcate and moniliform, falcate, or irregular; when asymmetrical with both sutures parallelly curved, both sutures unequally curved, or 1 suture straight and 1 curved (rarely); widest near middle or D-shaped; not inflated; compressed or terete; with or without beak; straight, declined, hooked, or coiled; with solid beak the same color and texture as fruit; long tapered, tapered, or short tapered at apex; apex aligned with, oblique with, right-angled with, almost reaching, or exceeding (crossing, rarely) longitudinal axis of fruit; long tapered or tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous, leathery, ligneous, or fleshy (rarely); seed chambers externally visible or invisible; with the raised seed chambers not torulose or torulose (sometimes). Fruit margin constricted or not constricted; constricted or slightly constricted along both margins or constricted or slightly constricted only on 1 margin; without sulcus; embellished or plain; with thickened sutural areas or wings. Fruit wings absent or present (rarely); 3; up to 5 mm wide; sutural (two on ventral suture, 1 on dorsal); on both sutures. Fruit stipitate or nonstipitate; with the stipe up to 44 mm long. Fruit with all layers dehiscent or indehiscent (rarely); splitting along sutures. Dehiscence of valves along both sutures or 1 suture; apical and down; active; with valves twisting or coiling (rarely). Replum invisible or visible (rarely). Epicarp dull; monochrome or multicolored; mottled; brown, black, or tan; with black or brown overlay; glabrous, glabrate, or pubescent and indurate; with 1 type of pubescence; tomentose; with pubescence golden or brown; with pubescence uniformly distributed; with

simple hairs; pliable; with hair bases plain; eglandular; without or with spines; with spines persistent; with spines same color (but slightly paler) as the rest of the fruit; smooth or not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; wrinkled or muricate; not exfoliating; without or with cracks; cracking irregular. Mesocarp thick, thin, or trace; 1- or 2-layered; without balsamic vesicles; without fibers; spongy or solid (in literature); with spongy layer over solid layer; subligneous, coriaceous, or chartaceous. Endocarp dull; monochrome or mottled; tan or brown (to dark brown); with mottling (dark); with brown or black overlay; smooth; septate, subseptate, or nonseptate; with septa thin (tissue paper-like), flexible or thicker than paper, firm; with septa eglandular; chartaceous or ligneous (rarely, according to the literature); exfoliating, exfoliating in part, or not exfoliating; remaining fused to mesocarp and epicarp, separating from mesocarp (which also separates from epicarp), or separating with mesocarp from epicarp. Seeds (1–)2–12; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 3.5 mm long; of 1 length only; flattened or thick; straight, triangular, or contorted. Aril absent or present; dry; rim-aril, tongue-aril, or partial rim-aril; fimbriate or entire; brown or tan.

Seed $5\text{--}45 \times 4\text{--}20 \times 5\text{--}20$ mm; not overgrown; not angular; asymmetrical or symmetrical; circular, elliptic, oblong, ovate, or reniform (sometimes flattened on end opposite radicle); terete to compressed; with surface smooth or ridged (dorsally); without or with 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 or glossy; not modified by a bloom; colored; monochrome, bichrome, or mottled; with frequent mottles; red, orange, brown, black, red and black, or tan to yellow; with brown (dark) or black overlay; glabrous; smooth or rarely not smooth; with elevated or recessed features; wrinkled (on drying); pitted with small separate pits; osseous or coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from lens to base of seed and bifurcating or from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; slightly raised. Hilum visible, partially concealed, or fully concealed; concealed by funiculus, funicular remnant, aril, or aril remnant; with faboid split; with the lips of the faboid split the same color as or lighter colored than the rest of the hilum and therefore con-

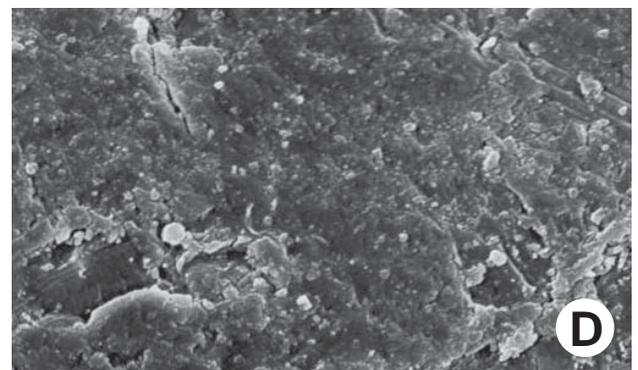
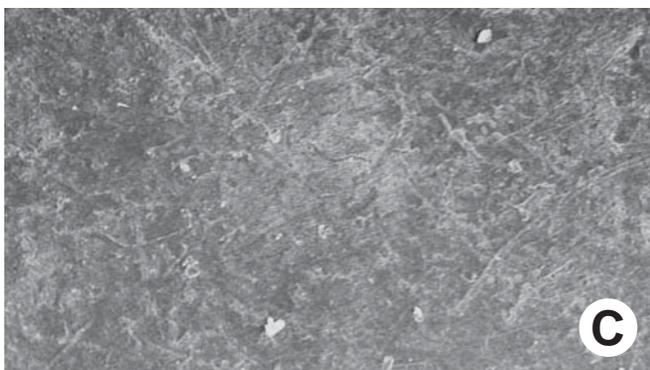
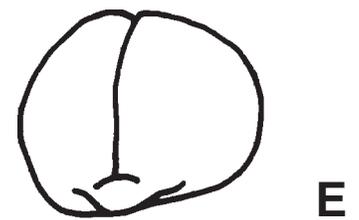
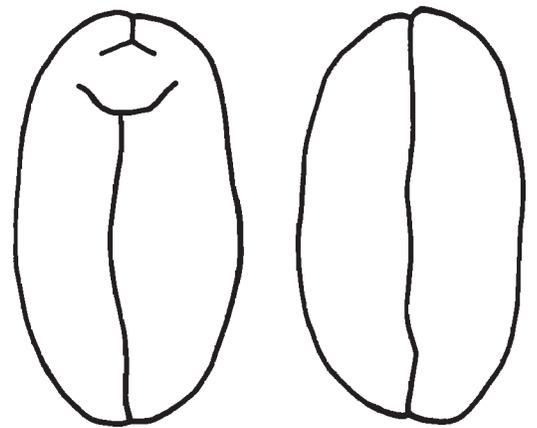
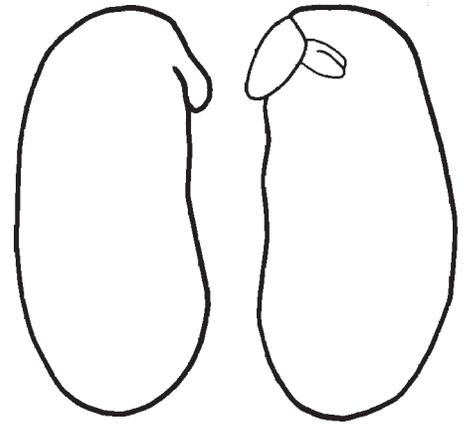
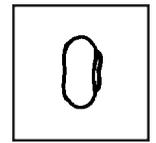
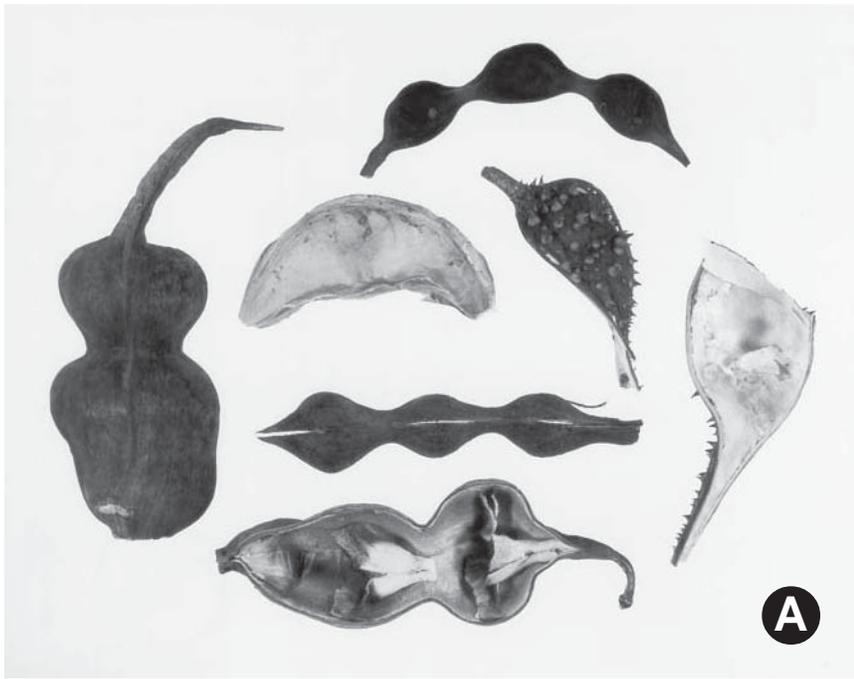
spicuous; larger than punctiform; 2–10.5 mm long; with curved outline; elliptic to oval; apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; flush, recessed, or raised; not within corona, halo, or rim or within halo or rim. Hilum halo color lighter or darker than testa. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm or less than 0.5 mm in length; up to 5.3 mm long; with margins straight or curved; linear, rhombic, wedge-shaped, elliptic, ovate, punctiform, or circular; not in groove of raphe; confluent with hilum; flush, mounded, or recessed; same color as, similar color as, or dissimilar color from testa; lighter or darker than testa; black; not within corona, halo, or rim or within halo. Lens halo color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees or not entire 180 degrees from base of radicle; notched, wavy, or bearing flaps; similar at apex; partially concealing radicle; notched at or split over radicle; without lobes; with the interface division terminating at base of radicle; without or with (rarely) 1 margin recessed; recessed on same side as radicle; white, yellow (pale), or tan; inner face flat or concave (slightly); glabrous around base of radicle. Embryonic axis oblique; oblique or parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular or bulbous; lobe tip straight or curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately or well developed; glabrous.

Distribution: Pantropics and pansubtropics.

Notes: Phaseoleae is the tribe with the most species whose seeds are used as human food on a large scale (Schery 1972; Duke 1981; Maesen and Somaatmadja 1989; Wiersema et al. 1990). In general the seeds of this tribe are considered as the archetypical seeds of subfamily Faboideae. Bruneau et al. (1995) carried out cladistic analyses of tribe Phaseoleae using chloroplast DNA restriction site data. Their results indicated that the tribe is not monophyletic and that the tribal delimitations between Phaseoleae and Desmodieae (11) and between Phaseoleae and Millettieae (7) are problematic. Krukoff and Barneby (1974) monographed *Erythrina* and recognized 105 species, and Gunn and Barnes (1977) described the seeds of 101 species. Neill (1988) studied the biosystematic relationships of the species of

Erythrina and recognized 112 species, four more than Lackey (1981b). Adema (1996) synonymized *E. stricta* and *E. suberosa* W. Roxburgh and accepted *E. stricta* as the correct name. Bruneau (1996) studied the chloroplast DNA of 51 *Erythrina* species. She concluded that a paraphyletic group of South American species is basal in the genus and that two main clades are derived from it. One is South American and Mexican and the other is Asian, from which is derived a New World group and an African clade with derived Asian and South American species.

Erythrina: *E. stricta* W. Roxburgh (*C–E*), *E. spp.* (*A–B*). *A*,
Fruits ($\times 0.5$); *B*, seeds ($\times 1.4$); *C–D*, testa ($\times 50$,
 $\times 1000$); *E*, embryos ($\times 5$).



Genus: *Strongylodon* J.R.T. Vogel

Phylogenetic Number: 10.02.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

Species Studied—Species in Genus: 2 spp.—12 spp.

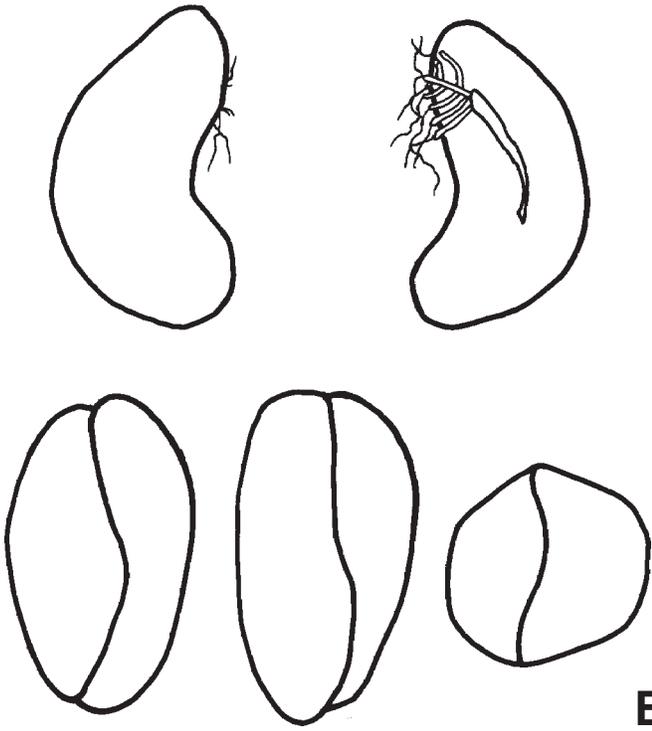
Fruit a legume; unilocular; 4–36 × 2–6 × 1.2–4 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; ovate (or nearly so), oblong, linear (Huang 1991), moniliform (Huang 1991), or irregular; when asymmetrical with both sutures parallelly or unequally curved; inflated or not inflated; terete; without or with beak; straight, coiled (Huang 1991), or hooked; with solid beak the same color and texture as fruit; short tapered or rounded at apex (Huang 1991); apex aligned or right-angled with longitudinal axis of fruit (Huang 1991); tapered or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to leathery or fragile, thinner than chartaceous like *Trifolium* (21.06); seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit stipitate or nonstipitate (Huang 1991); with the stipe 2–13 mm long. Fruit with all layers dehiscent or indehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down. Replum invisible. Epicarp dull; monochrome; tan to brown; glabrous; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; rugose; exfoliating in part; with or without cracks; cracking irregular. Mesocarp present or absent; thin; 1-layered; without balsamic vesicles; fibrous throughout; chartaceous. Endocarp dull; monochrome; tan or yellow (golden); smooth; nonseptate or subseptate (*S. loheri* S.-F. Huang); chartaceous; exfoliating; separating from epicarp; entire. Seeds 1–12; length parallel with or transverse to fruit length (Huang 1991); neither overlapping nor touching; in 1 series. Funiculus measured; up to 55 mm long; assumed of 1 length only; partially filiform and partially thick; straight or triangular. Aril absent.

Seed 9–40 × 9–34 × 12.6–33 mm; not overgrown; angular or not angular; asymmetrical; nearly circular, D-shaped (rounded), or irregular; terete (to wider than thick); with surface ridged or smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth or not smooth; with recessed features; cracked; coriaceous or chartaceous. Fracture lines absent or present; transverse. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed by funicular remnant; without faboid split; larger than punctiform; 45–55 mm long; with curved or straight outline; circular or linear (around 3/4 of seed); marginal according to radicle tip; raised or recessed; within rim or not within corona, halo, or rim. Hilum rim color of testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; up to 1.5 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; recessed; same color as testa; brown; not within corona, halo, or rim. Endosperm present or absent; thin; covering entire embryo; adnate to embryo. Cotyledons smooth or not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat to concave (slightly); glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle slightly differentiated from cotyledon; linear or triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

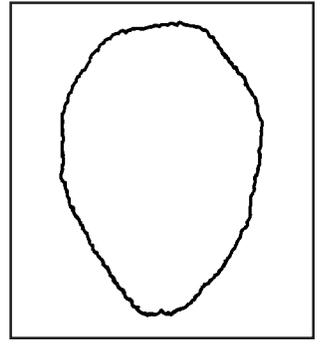
Distribution: Madagascar to Polynesia.

Notes: *Strongylodon* has 20 species according to Lackey (1981b). Huang (1991) monographed the genus and recognized 12 species, and we used the latter count. The embryo is very unusual. The plumule is highly developed. The radicle points towards the center of the cotyledons, and the epicotyl points to the outside of the cotyledons. Consequently, the plumule is exerted from the cotyledons, and the radicle is near their center.

Strongylodon: *S. macrobotrys* A. Gray (C–E), spp. (A–B). A, Fruits (× 0.6); B, seeds (× 1.3); C–D, testa (× 50, × 1000); E, embryos (× 1).



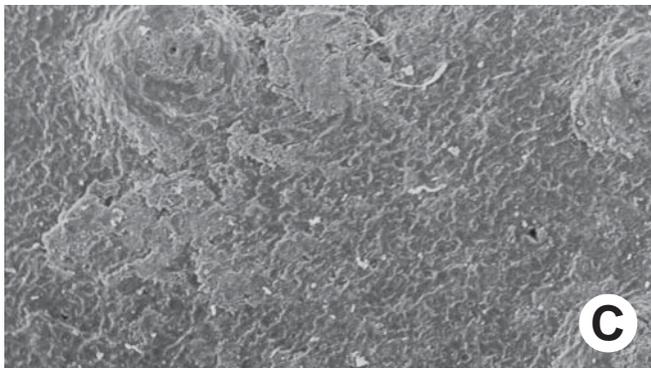
E



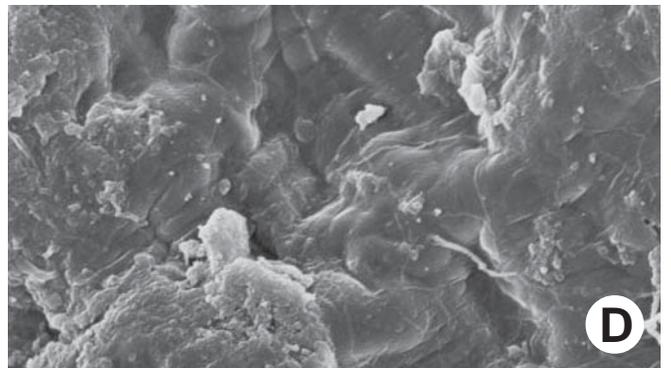
A



B



C



D

Genus: *Mucuna* M. Adanson

Phylogenetic Number: 10.03.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

Species Studied—Species in Genus: 32 spp.—100 spp.

Fruit a legume (breaking between seed chambers into “articles”) or nutlet; unilocular; $5-53 \times 2-5 \times 0.5-2.5$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear, moniliform, oblong, falcate, elliptic, fusiform, ovate, S-shaped, or irregular; when asymmetrical with both sutures parallelly or unequally curved; not inflated; flattened or compressed; without or with beak; declined; with papery fragile beak up to 1 cm long or solid beak the same color and texture as fruit; long tapered, tapered, short tapered, rounded, truncate, or cordate at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; long tapered, tapered, or truncate at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; leathery, ligneous, or fragile, thinner than chartaceous like *Trifolium* (21.6); seed chambers externally invisible or visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; constricted along both margins; without sulcus; embellished or plain; with ridges, thickened sutural areas, or wings. Fruit wings present or absent; 4; 3–15 mm wide; valvular (2 longitudinal on each valve) or sutural (2 on each suture, sometimes undulate or dentate marginally); on both valves; on both sutures. Fruit nonstipitate to substipitate to stipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; black, brown, or green; with surface texture uniform or not uniform, with patches of different texture not restricted to the base and apex; pubescent and indurate and pubescent but soon deciduous, pubescent and indurate, or pubescent but soon deciduous; with hairs erect or appressed (occasionally); with 1 or 2 types of pubescence; pilose or velutinous; with pubescence golden (reddish), red (brownish), tan, or brown (to dark brown); with longitudinal bands of lighter and darker brown; with pubescence uniformly distributed; with simple and complex hairs; with bristle-

like hairs (irritating); stiff; with hair bases plain; straight (with minute barbs in literature); straight at apex; eglandular; without spines; not smooth; with elevated or recessed features; veined or not veined; finely, reticulately veined; not tuberculate; ribbed (ribs up to 6 mm, sometimes T-shaped; sometimes revolute; oblique and running across entire fruit, oblique and with a gap at center of fruit, or irregular; sometimes with undulate to dentate margins), rugose, wrinkled, or raised reticulate; rarely, transversely grooved; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid or with spongy layer over solid layer; coriaceous or chartaceous. Endocarp dull; monochrome; brown to dark brown or white; smooth; septate or nonseptate; with septa thicker than paper, firm (up to 5 mm thick); with septa eglandular; ligneous or chartaceous; not exfoliating or exfoliating in part; remaining fused to mesocarp and epicarp. Seeds 1–16; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–30 mm long; of 1 length only; flattened or thick; curved or triangular. Aril present or absent; fleshy or dry; when fleshy annular; crenate to fimbriate; covering less than 1/2 of seed; when dry rim-aril; crenate to entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; orange or tan.

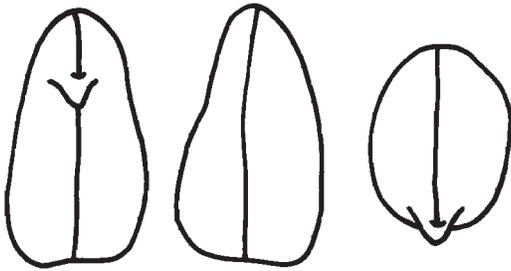
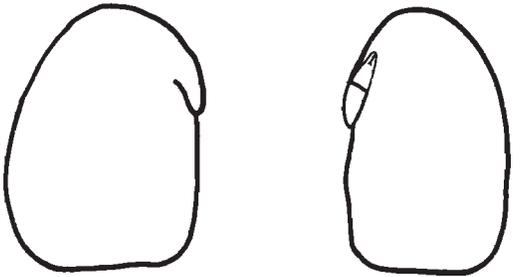
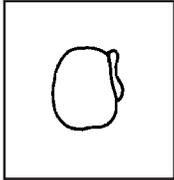
Seed $10-37 \times 7-36 \times 3-17.5$ mm; not overgrown; not angular; symmetrical or asymmetrical; circular, elliptic, oblong, ovate, or reniform; terete or compressed; with surface smooth or ridged (from literature); without visible radicle and cotyledon lobes; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome, mottled, or streaked; with frequent mottles; with frequent streaks; black, brown (dark, reddish, or orangish), orange (pale), tan, white, or purple (blackish); with black, tan, or orange overlay; glabrous; smooth or not smooth (rarely); with elevated features; rugose or rugose and wrinkled; osseous or coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 6–90 mm long; with straight (around 3/4 of seed circumference) or curved outline; elliptic or linear; marginal according to radicle tip; flush; not within corona, halo, or rim or within rim. Hilum rim color of testa. Lens not discernible or discernible; less than 0.5 mm to equal to or greater than

0.5 mm in length; 1 mm long; with margins straight or curved; linear or punctiform; not in groove of raphe; confluent with or adjacent to hilum; 1 mm from hilum; recessed; same color as testa; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; pale tan to brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Pantropics and pansubtropics.

Notes: *Mucuna* has been monographed for various parts of Asia and the Pacific by Tateishi and Ohashi (1981) and Wilmot-Dear (1984, 1987, 1990, 1991, 1992). Some of the variation used for fruits is taken from those monographs. A single species, *M. sloanei* W. Fawcett & A.B. Rendle, has been reported for Argentina (Burkart 1970). *Mucuna* seeds can be divided into two broad groups: (1) large, flat, discoid seeds with the hilum extending three-fourths of the circumference and without an aril and (2) compressed, oblong-ovoid seeds with a very short hilum and a conspicuous rim-aril. The genus *Stizolobium* P. Browne was established for the species of the latter group. Traditionally it has been recognized at subgeneric rank as *Mucuna* subgen. *Stizolobium* (P. Browne) D. Prain (Verdcourt 1970c). Aminah et al. (1974) studied the irritating hairs of *Mucuna*. Various species from all over the world are well known as ocean drift seeds with the common names true sea-beans, burning-beans, and horse eye-beans (Gunn et al. 1976).

Mucuna: *M. pruriens* (C. Linnaeus) A.-P. de Candolle
(*C-E*), *M. spp.* (*A-B*). *A*, Fruits ($\times 0.5$); *B*, seeds ($\times 1.1$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 2$).



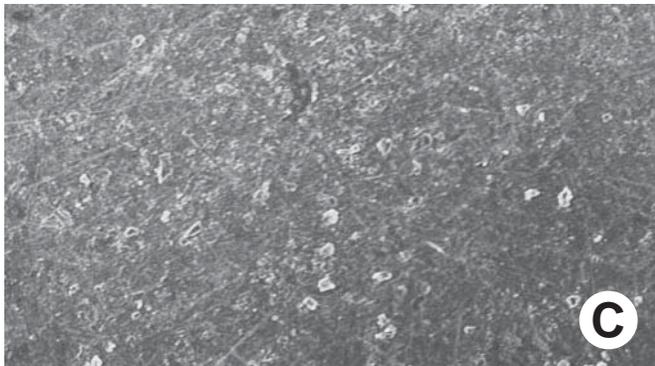
E



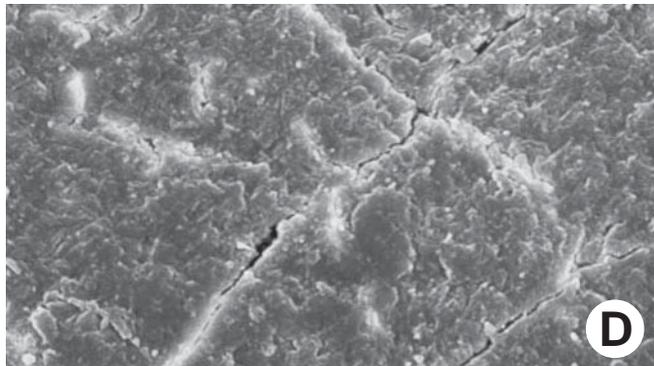
B



A



C



D

Genus: *Butea* W. Roxburgh ex C.L. von Willdenow

Phylogenetic Number: 10.04.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

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

Fruit a legume; unilocular; 10–18 × 3–5.3 × 0.4–0.6 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; flattened; without beak; rounded to truncate at apex; apex oblique with longitudinal axis of fruit; tapered to rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous and leathery; seed chambers externally visible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas (especially dorsally) or wing. Fruit wing 1; 30–53 mm wide (and 90–110 mm long); samaroid; basal. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; tan; pubescent and indurate; with 1 type of pubescence; pilose to tomentose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; reticulately veined; not tuberculate; exfoliating in part; without cracks. Mesocarp thin; surface not veined; 3-layered; without balsamic vesicles; without fibers; with solid layer over spongy layer over solid layer; coriaceous. Endocarp dull; mottled; tan; with mottling (dark and fine); with brown overlay; smooth; nonseptate; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with or oblique to fruit length. Funiculus measured; 4 mm long; thick; straight. Aril absent.

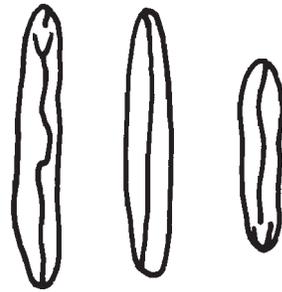
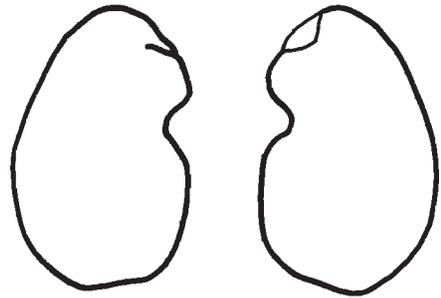
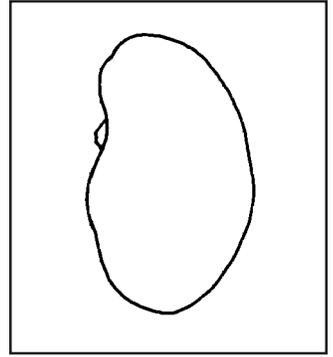
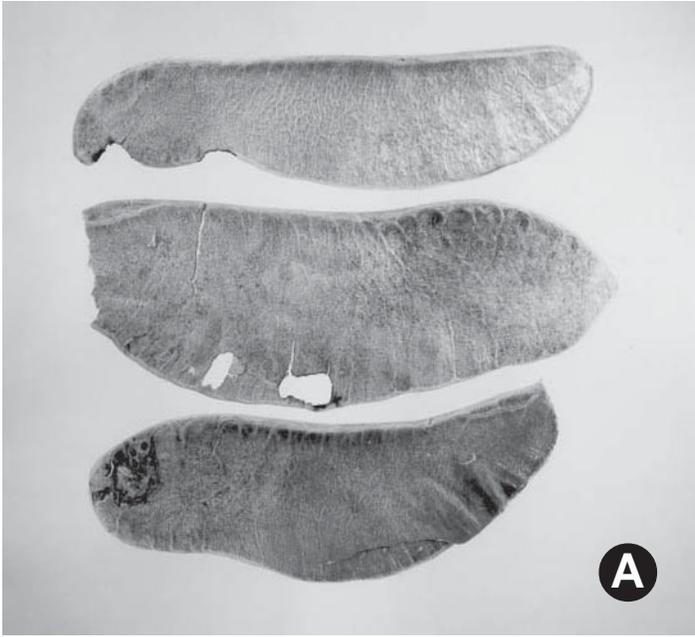
Seed 24–38 × 19–27 × 5–6 mm; not overgrown; not angular; asymmetrical; irregularly reniform; flattened; with surface wrinkled; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; reddish brown; with brown (dark) overlay; glabrous; not smooth; with elevated features; wrinkled or wrinkled and warty; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; color

of testa; raised. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.5–2.5 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within halo. Hilum halo color darker than testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis right angled or oblique; perpendicular or oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

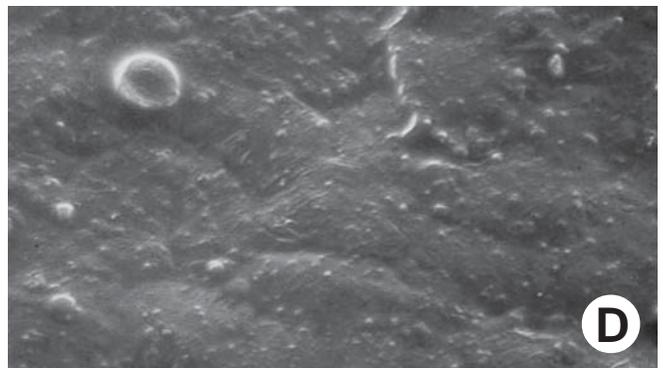
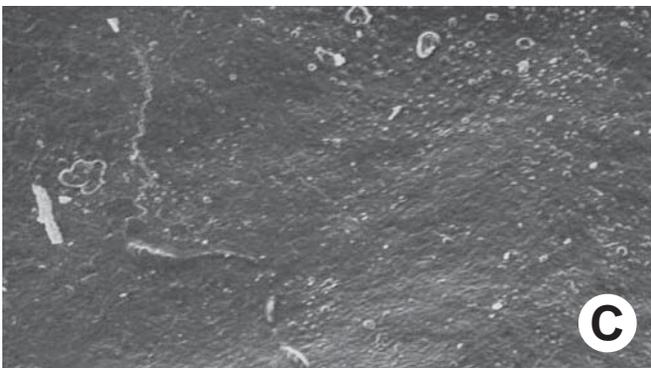
Distribution: India.

Notes: *Butea* was revised by Sanjappa (1987), who recognized two species, not the four species of Lackey (1981b). Ridder-Numan (1995) and Ridder-Numan and Ham (1997) considered this genus to be closely related to *Meizotropis* (10.06) and *Spatholobius* (10.05) and to *Kunstleria* in Millettieae (7).

Butea: *B. monosperma* (J.B.A.P.M. de Lamarck) P.H.W. Taubert (C–E), *B. spp.* (A–B). A, Fruits (× 0.4); B, seeds (× 1.2); C–D, testa (× 50, × 1000); E, embryos (× 1).



E



Genus: *Spatholobus* J.C. Hasskarl

Phylogenetic Number: 10.05.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

Species Studied—Species in Genus: 9 spp.—15 spp.

Fruit a legume; unilocular; 4–15 × 1.3–4.5 × 0.4–0.7 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; samaroid; when asymmetrical with both sutures unequally curved; not inflated; flattened; without beak; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; leathery and chartaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas (especially dorsally) or wing. Fruit wing 1; 13–45 mm wide (and 80–105 mm long); samaroid; basal. Fruit substipitate to stipitate; with the stipe up to 6 mm long. Fruit indehiscent. Epicarp dull; monochrome; brown or tan; glabrous to pubescent but soon deciduous; with 1 type of pubescence; pilose; with pubescence golden to brown; 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, reticulately veined, or irregularly veined; not tuberculate; sometimes dotted; not exfoliating; without cracks. Mesocarp present (on seed chamber); thin; surface not veined; 1- or 2-layered; without balsamic vesicles; with or without fibers; solid; with fibers embedded in mealy tissue over solid layer; with vitreous layer over solid layer; coriaceous or chartaceous. Endocarp dull; monochrome or mottled; brown or tan; with mottling over seed chambers; with brown overlay (darker near margins of seed chamber); fibrous; nonseptate; coriaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus measured; 1 mm long; flattened; triangular. Aril absent.

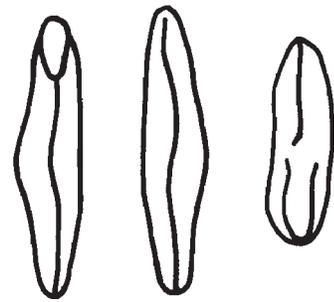
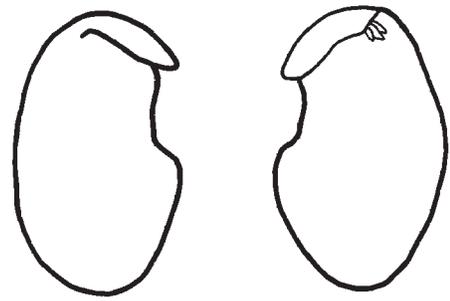
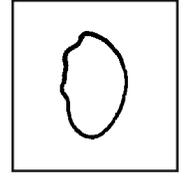
Seed 18.6–32 × 11–23 × 4–6.7 mm; not overgrown; not angular; asymmetrical; variously irregular; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not

modified by a bloom; colored; monochrome; dark brown; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; color of or darker than testa; black; raised. Hilum visible or partially 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; larger than punctiform; 2.5–4.6 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within rim. Hilum rim color of testa. Lens not discernible. Endosperm absent. Cotyledons not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

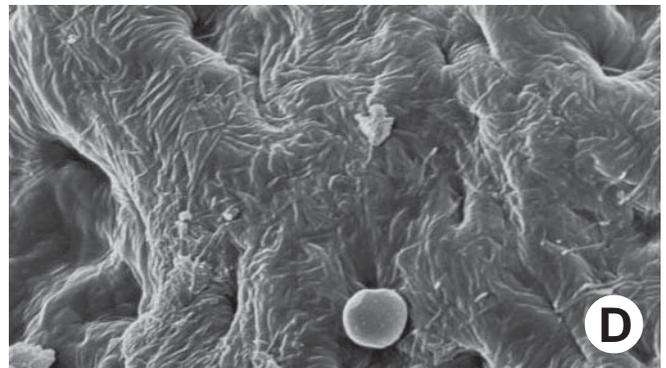
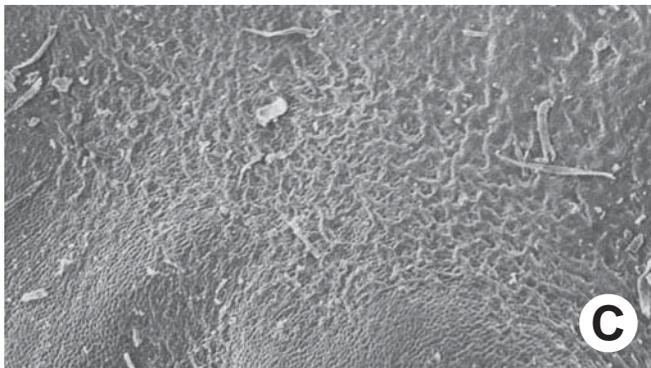
Distribution: Tropical Asia.

Notes: Ridder-Numan and Wiriadinata (1985) monographed *Spatholobus*, and Ridder-Numan (1992) added a new species and made some other revisions. Using cladistic methodology, Ridder-Numan (1996) presented an extensive analysis of its biogeography. Ridder-Numan (1995) and Ridder-Numan and Ham (1997) proposed that this genus was closely related to *Butea* (10.04) and *Meizotropis* (10.06) and to *Kunstleria* in Millettieae. They considered *Spatholobus* to be intermediate in its characteristics between Phaseoleae and Millettieae and suggested that its position was either basal in Phaseoleae or in the transition zone between the two tribes.

Spatholobus: *S. suberectus* D.B. Dunn (C–E), *S. spp.* (A–B). A, Fruits (× 0.6); B, seeds (× 1.6); C–D, testa (× 50, × 1000); E, embryos (× 2).



E



Genus: *Meizotropis* J.O. Voigt

Phylogenetic Number: 10.06.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

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

Fruit a legume; unilocular; $5-9 \times 2-4.3 \times$ up to 0.8 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregular or samaroid; when asymmetrical with both sutures unequally curved; not inflated; flattened; without beak; rounded at apex; apex oblique with longitudinal axis of fruit; rounded to truncate at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous and leathery; seed chambers externally visible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas (especially dorsally) or wing. Fruit wing 1; 28–35 mm wide (and 30–60 mm long); samaroid; basal. Fruit stipitate (from literature); with the stipe 5–6 mm long (from literature). Fruit apparently indehiscent. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate or pubescent but soon deciduous (from literature); with 1 type of pubescence; velutinous; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; irregularly veined; not tuberculate; knobbed; not exfoliating; with or without cracks; cracking irregular. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with spongy layer over solid layer; coriaceous. Endocarp dull; monochrome or mottled; brown or tan; with mottling over seed chambers; with brown overlay; smooth; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp. Seed 1 (1–2 in literature); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2 mm long; of 1 length only; flattened; straight. Aril dry; 2-lipped rim-aril; entire; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; tan.

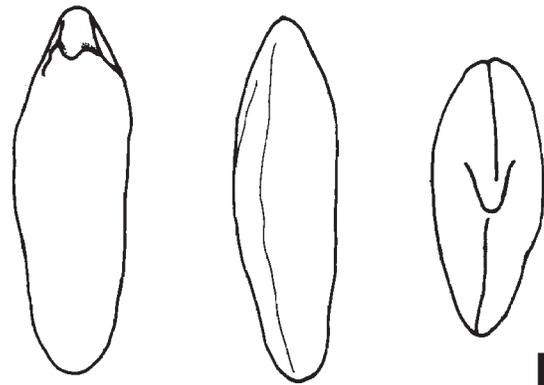
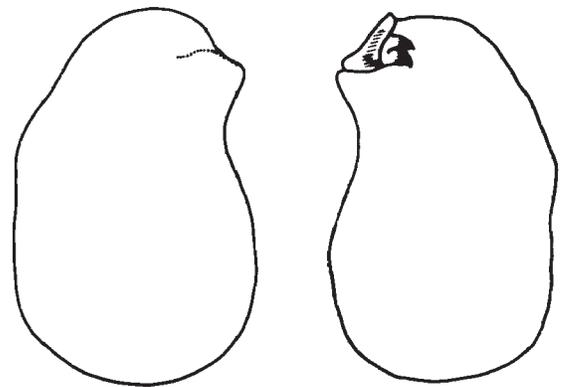
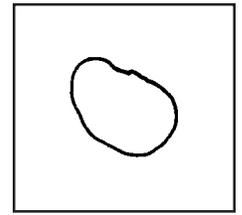
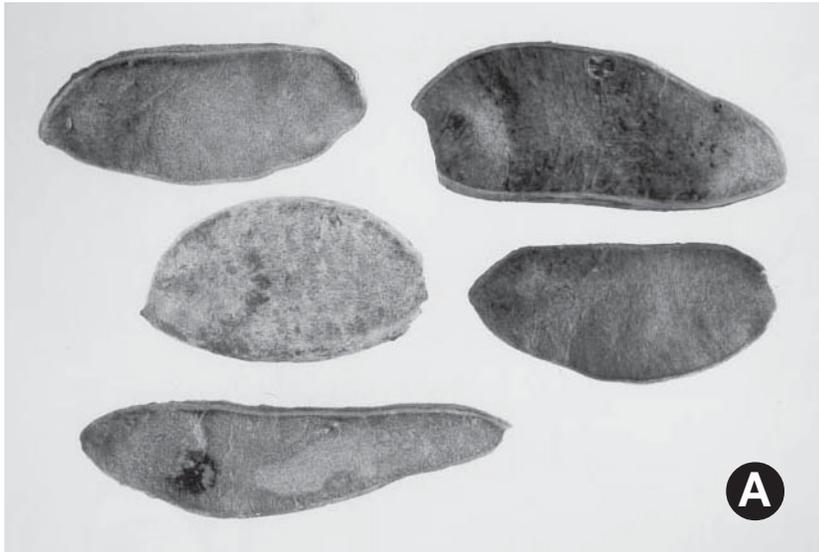
Seed 19.5 (17–22 from literature) \times 16.4 (10–17 from literature) \times 7 mm; not overgrown; not angular; asymmetrical; reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; without

hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; raised. Hilum visible; without faboid split; larger than punctiform; 1.8 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 straight; linear; not in groove of raphe; confluent with hilum; recessed; same color as testa; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; orange; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed.

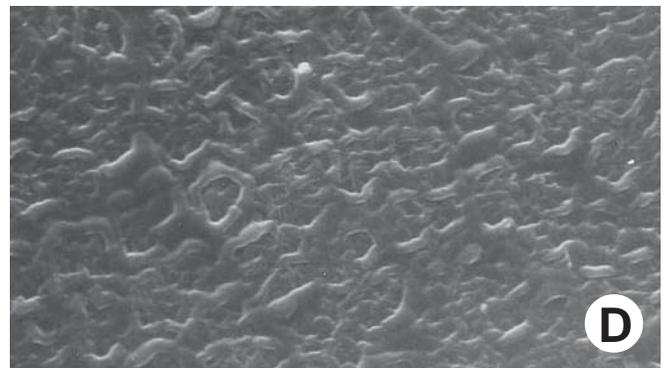
Distribution: India to Burma.

Notes: Sanjappa (1987) monographed the genus, which was not recognized by Lackey (1981b). It was inserted in phylogenetic order following Polhill (1994b). Ridder-Numan (1995) and Ridder-Numan and Ham (1997) considered this genus to be closely related to *Butea* (10.04) and *Spatholobius* (10.05) and to *Kunstleria* in Millettieae (7).

Meizotropis: *M. buteiformis* J.O. Voigt (B–E), *M. spp.* (A). A, Fruits ($\times 0.7$); B, seed ($\times 4.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



E



Genus: *Apios* P.C. Fabricius

Phylogenetic Number: 10.07.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

Species Studied—Species in Genus: 3 spp.—5 spp.

Fruit a legume; unilocular; $5.8\text{--}14.5 \times 0.6\text{--}0.8 \times 0.4\text{--}0.6$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to slightly curved; not plicate; not twisted; symmetrical to asymmetrical; linear (or nearly so) or moniliform (slightly); when asymmetrical with both sutures parallelly curved; not inflated; terete; without or with beak; straight or coiled; with solid beak the same color and texture as fruit; long tapered at apex to tapered at apex; apex aligned to oblique (slightly) with longitudinal axis of fruit; long tapered or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown, green, or tan; with brown (dark) overlay; with mottling over seed chambers; 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; with elevated features (sometimes); irregularly veined; not tuberculate; lenticular; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome or mottled; white; with mottling over seed chambers; with brown overlay; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 3–18; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; $0.5\text{--}1.5$ mm long; of 1 length only; flattened; curved or triangular. Aril dry; tongue-aril or 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-

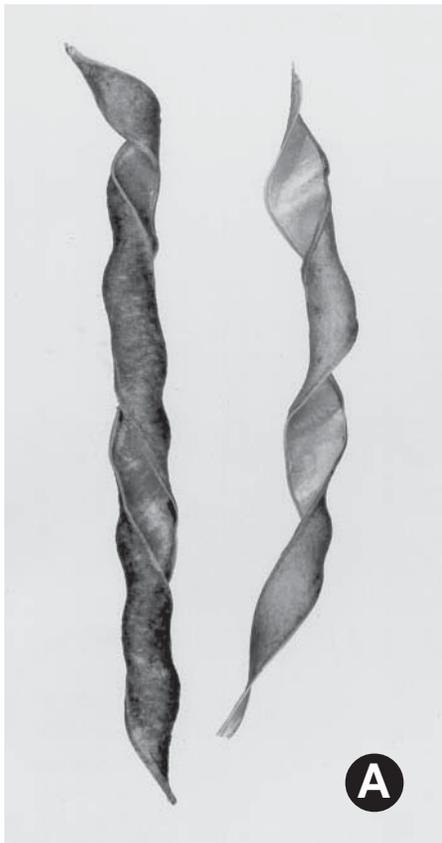
like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; brown or brown and tan.

Seed $6.4\text{--}8.3 \times 4.5\text{--}5.4 \times 2.8\text{--}6$ mm; not overgrown; angular or not angular; symmetrical or asymmetrical; rectangular to ovate to obovate or reniform; terete or compressed; with surface smooth; without or with 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; brown to reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens to base of seed and terminating, from hilum to near base of seed and terminating, or from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; raised or raised and recessed. Hilum visible to partially concealed to fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; $1.2\text{--}1.5$ mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; recessed; within rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; up to 1.2 mm long; with margins straight; linear; not in groove or in groove of raphe; confluent with hilum; recessed or mounded; same color as testa; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or tan; inner face flat or concave; glabrous around base of radicle. Embryonic axis nearly straight or oblique; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular or linear; lobe tip straight or curved; deflexed and parallel to cotyledon length, deflexed and parallel to cotyledon width, or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary or moderately developed; glabrous.

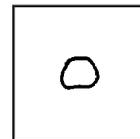
Distribution: North America and Asia.

Notes: Lackey (1981b) commented that this genus is very close to *Cochlianthus* (10.08) and that the two genera are possibly congeneric. Our fruit and seed data do not support Lackey's conclusions. Woods (1988) revised both *Apios* and *Cochlianthus*, and his distributions and species counts were used. He concluded that the two genera are separate but closely related. *Apios americana* produces sweet, starchy tubers, which were eaten by North American native peoples (National Academy of Sciences 1979, Schery 1972). The tubers have a protein content of 17.5 percent.

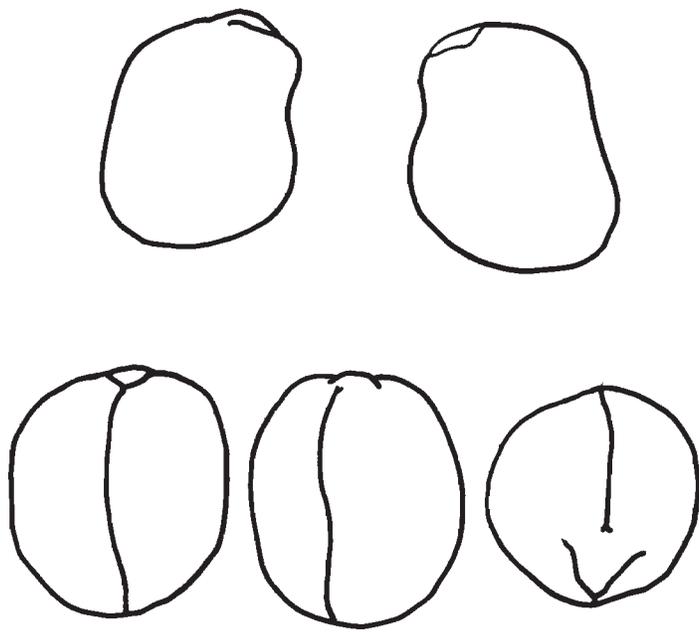
Apios: *A. americana* F.C. Medikus (*A, C-E*), *A. spp.* (*B*).
A, Fruits ($\times 1.7$); *B*, seeds ($\times 4.8$); *C-D*, testa ($\times 50$,
 $\times 1000$); *E*, embryos ($\times 6$).



A



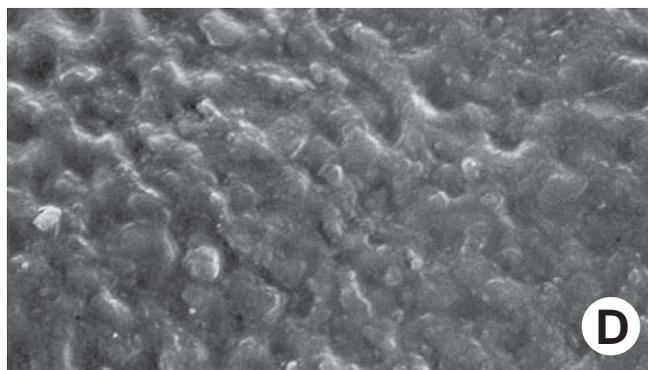
B



E



C



D

Genus: *Cochlianthus* G. Bentham

Phylogenetic Number: 10.08.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

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

Fruit a legume; unilocular; $8.1 \times 1 \times 0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; slightly 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; 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 slightly constricted along both margins; 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; active; with valves twisting. Replum invisible. Epicarp pubescent and indurate; with 1 type of pubescence; very dense tomentose; with pubescence gray-brown or brown (dark); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not tuberculate. Mesocarp thin to trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; mottled; brown; with mottling (dark); with black overlay; fibrous; with hairs scattered over endocarp; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 6; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5 mm long; of 1 length only; flattened; triangular. Aril dry; 2-lipped rim-aril; entire; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; ivory.

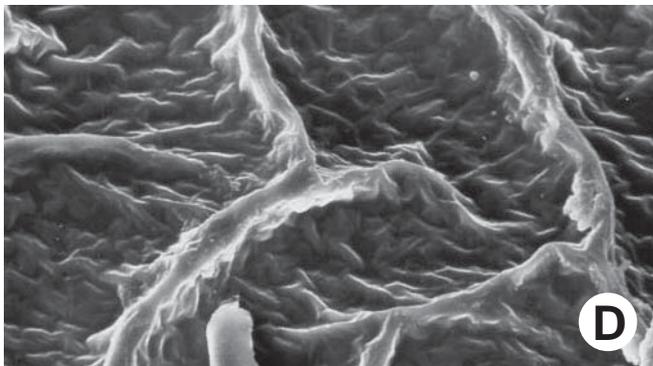
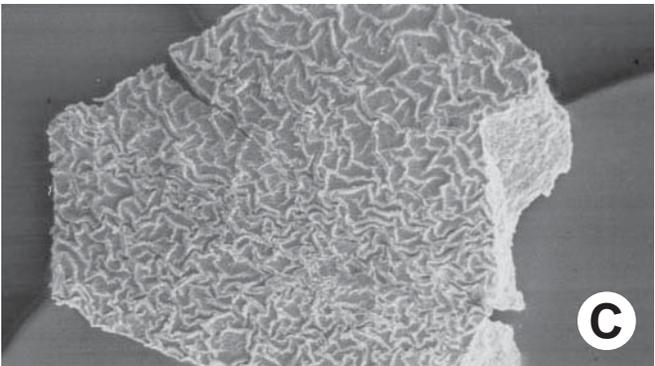
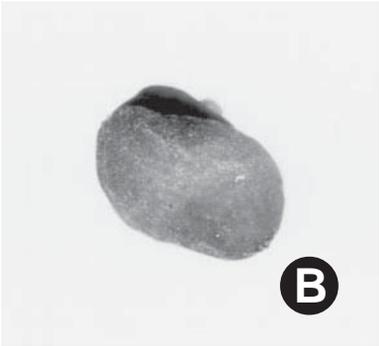
Seed $8.8 \times 7.6 \times 3.5$ mm; not overgrown; angular; asymmetrical; irregular; compressed; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; black; glabrous; smooth;

chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within halo. Hilum halo color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; lighter 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; partially concealing radicle; notched at 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 right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Himalayas and southwestern China (Yunnan province).

Notes: Lackey (1981b) noted that *Cochlianthus* is “a very close relative of *Apios* [10.07], possibly congeneric.” Our fruit and seed data do not support Lackey’s conclusions. Woods (1988) revised both *Cochlianthus* and *Apios*, and his distributions and species counts were used. He concluded that the two genera are separate but closely related. One fruit and seed were studied, and the seed was immature—it did not have a developed embryo or cotyledons.

Cochlianthus: *C. gracilis* G. Bentham (A–D). A, Fruit ($\times 1.8$); B, seed ($\times 10.8$); C–D, testa ($\times 50$, $\times 1000$).



Genus: *Rhodopis* I. Urban

Phylogenetic Number: 10.09.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

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

Fruit a legume; unilocular; 11–15 × 1.2–1.7 × 0.3–0.4 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; essentially linear; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves enrolling. Replum invisible. Epicarp dull; monochrome; dirty brown; pubescent but soon deciduous; with hairs appressed; with 1 type of pubescence; with pubescence brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; faintly veined; irregularly veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; brown or tan; smooth; with hairs scattered over endocarp; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part (between seed chambers); remaining fused to mesocarp and epicarp; entire. Seeds 11–18; length oblique to fruit length; touching or neither overlapping nor touching; in 1 series. Funiculus measured; 1.5–2 mm long; of 1 length only; flattened; slightly curved or triangular. Aril dry; 2-lipped rim-aril; fimbriate; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

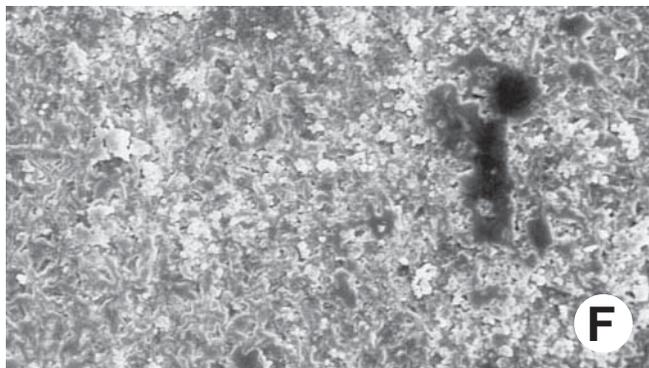
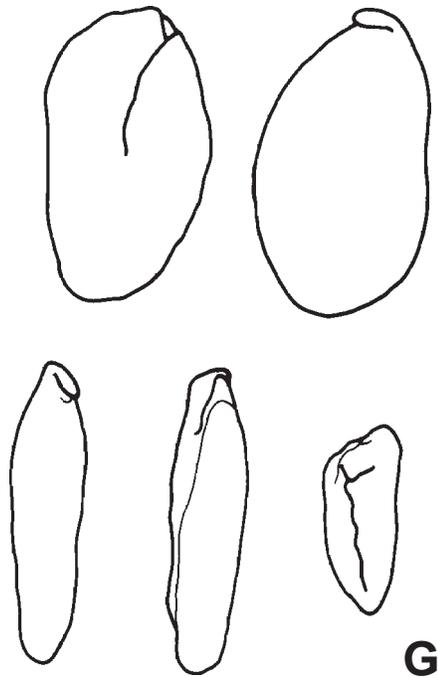
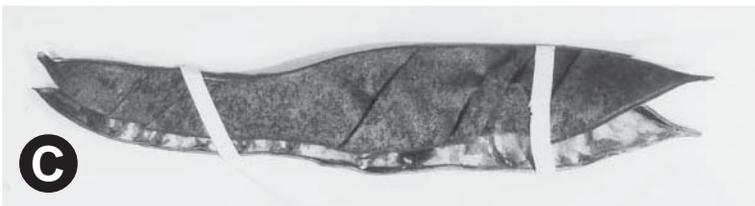
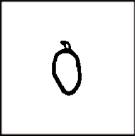
Seed 4 × 3.5 × 1.8 mm; not overgrown; not angular; asymmetrical; irregular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa

not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.4 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; within halo. Lens halo color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; 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 right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: West Indies.

Notes: Lackey (1981b) recognized one species in this genus, but is a species in Haiti, *Rhodopis planisiliqua* I. Urban, different from a species known only from the type locality in the Dominican Republic, *R. lowdenii* W.S. Judd? Our observations were made only from limited material of *R. lowdenii* and some immature fruits of *R. planisiliqua*. Thomas Zanoi (Jardín Botánico Nacional Dr. Rafael M. Moscoso (Dominican Republic)) supplied the loan of *R. lowdenii*. *Neorudolphia* (10.10) was recognized as a segregate of *Rhodopis* (Lackey 1981b); their fruits and seeds are similar.

Rhodopis: *R. lowdenii* W.S. Judd (A, B, G), *R. planisiliqua* (C. Linnaeus) I. Urban (C–F). A–C, fruits (× 0.4, × 0.8, × 0.8); D, seeds (× 6); E–F, testa (× 50, × 1000); G, embryos (× 4).



Genus: *Neorudolphia* N.L. Britton

Phylogenetic Number: 10.10.

Tribe: Phaseoleae.

Subtribe: Erythrinae.

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

Fruit a legume; unilocular; 6–12 × 1–1.7 × 0.5 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; without beak; tapered 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 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; straight; eglandular; without spines; smooth; not veined; not tuberculate; exfoliating in part; with cracks; cracking oblique to fruit length. Mesocarp thin; surface uniformly veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; mottled; tan; with mottling over seed chambers; with brown overlay; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; partially separating from mesocarp; entire. Seeds 11; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2 mm long; of 1 length only; flattened; straight or triangular. Aril dry; rim-aril and tongue-aril; entire; covering less than 1/2 of seed; brown.

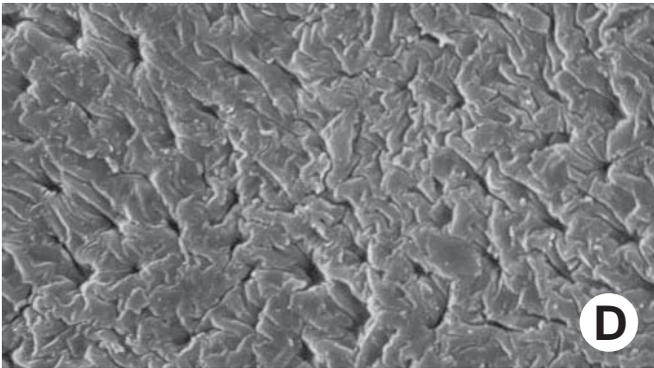
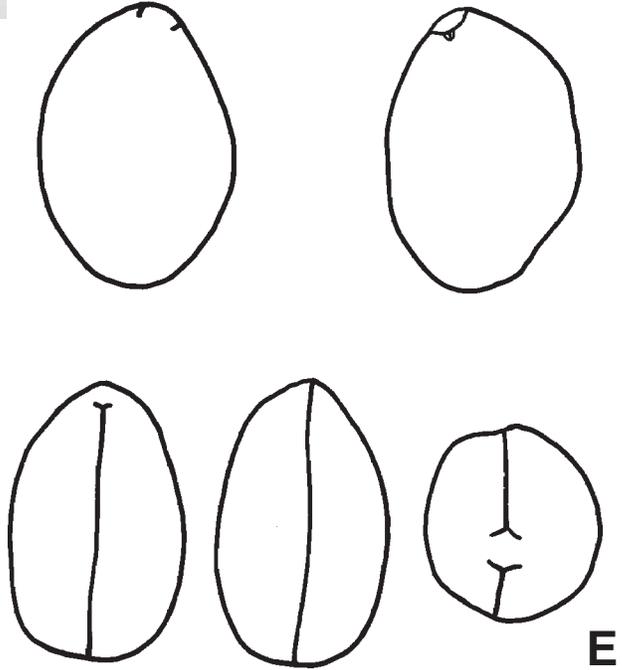
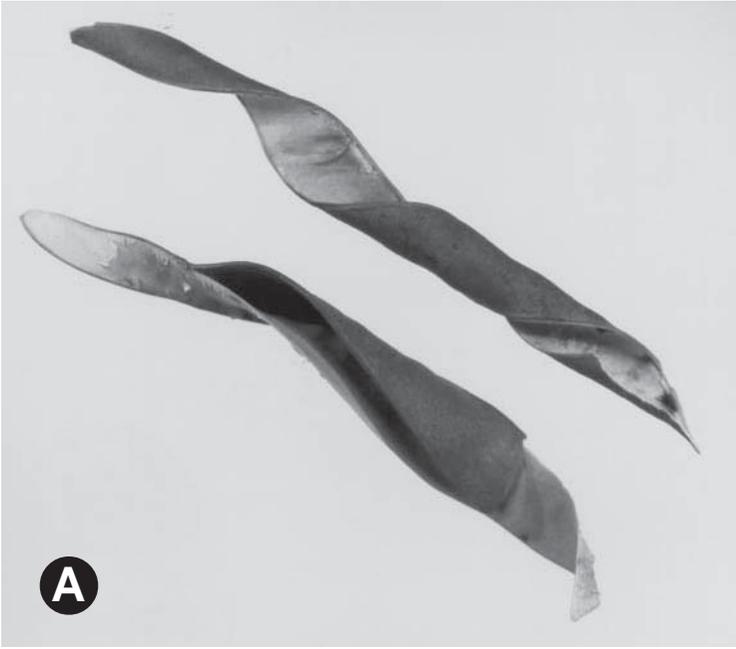
Seed 7–12 × 4.5–7 × 3.8–6.5 mm; not overgrown; angular or not angular; symmetrical; elliptic; terete to quadrangular; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; reddish brown; with brown (dark) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to near base of seed and terminating; not bifurcating; color of testa; raised. Hilum partially concealed;

concealed by aril; without faboid split; larger than punctiform; 1.4–2 mm long; with curved outline; elliptic; apical at apex of radicle tip; raised; within rim. Hilum rim color darker than testa. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: West Indies.

Notes: Lackey (1981b) noted that *Neorudolphia* is a segregate genus of *Rhodopsis* (10.09). Their fruits and seeds are similar.

Neorudolphia: *N. volubilis* (C.L. von Willdenow) N.L. Britton (A–E). A, Fruits (× 1); B, seeds (× 4.7); C–D, testa (× 50, × 1000); E, embryos (× 5).



Genus: *Ophrestia* H.M.L. Forbes

Phylogenetic Number: 10.11.

Tribe: Phaseoleae.

Subtribe: Ophrestiinae.

Species Studied—Species in Genus: 12 spp.—14 spp.

Fruit a legume; unilocular; $3-6.5 \times 0.6-1.1 \times 0.4$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; slightly asymmetrical; linear; when asymmetrical with both sutures nearly straight; not inflated; flattened; without beak; tapered or short tapered at apex; apex aligned with longitudinal axis of fruit; tapered or truncate at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally, barely visible or invisible. Fruit margin not constricted or constricted (slightly); constricted along both margins; without sulcus; plain or embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; light brown; glabrous or pubescent and indurate; with 1 type of pubescence; tomentose; 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; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; 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 parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 3 mm long; of 1 length only; flattened; triangular. Aril fleshy or dry; when fleshy hippocrepiform rim-aril; entire or crenate; covering less than 1/2 of seed; when dry rim-aril or hippocrepiform rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream to tan.

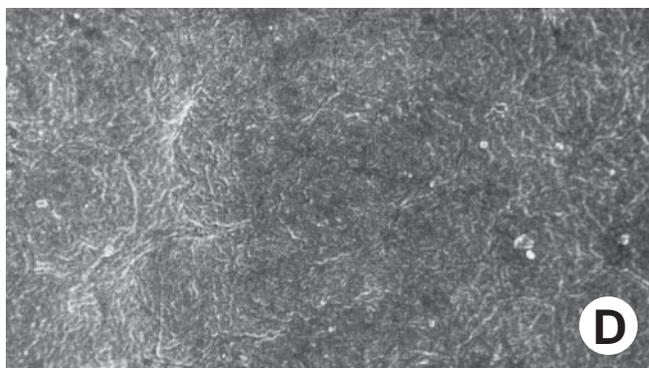
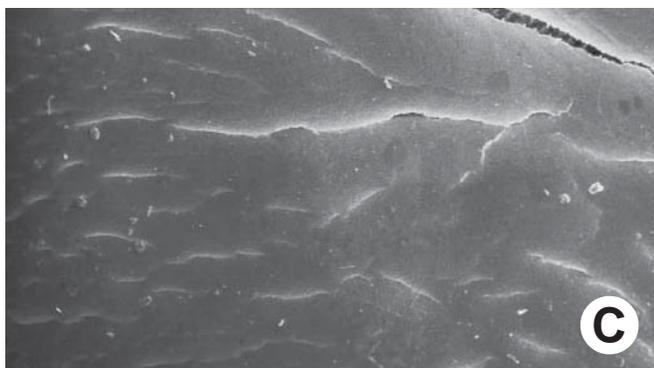
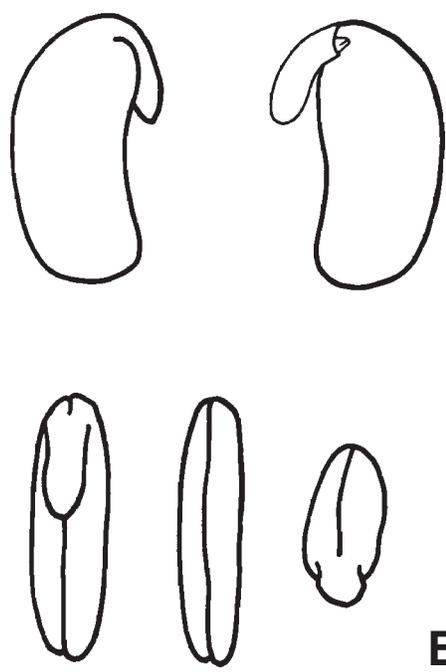
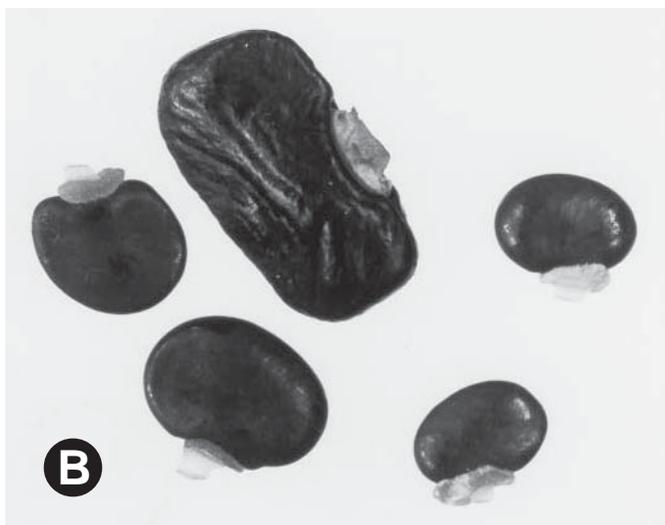
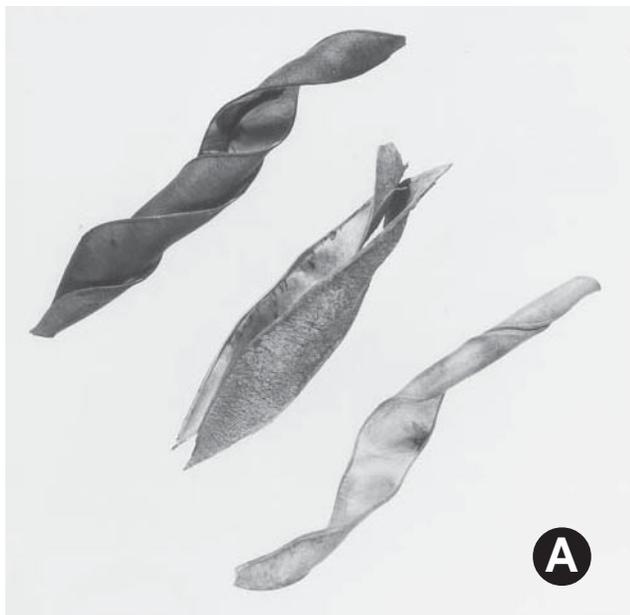
Seed $5-11 \times 3.5-6.5 \times 1.8-3.5$ mm; not overgrown; not angular or angular; asymmetrical; reniform to elliptic or rectangular (nearly); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown; with brown (lighter) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–2.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush or recessed; within rim or halo or not within corona, halo, or rim. Hilum halo color darker than testa. Hilum rim color of testa. Lens discernible; less than 0.5 mm in length; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm thin or trace; restricted to region of embryo or covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan to brown; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa and Asia.

Notes: Lackey (1981b) noted that some Asian species resemble *Cruddasia* (10.13) and some African species resemble *Pseudoeriosema* (10.12). Verdcourt (1997) described a new species from Zambia, *O. breviracemosa* B. Verdcourt, and provided a key to the five *Ophrestia* species known from Zambia.

Ophrestia: *O. radicata* (A. Richard) B. Verdcourt (C–E), *O. spp.* (A–B). A, Fruits ($\times 1.2$); B, seeds ($\times 5$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 6$).

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Genus: *Pseudoeriosema* L. Hauman

Phylogenetic Number: 10.12.

Tribe: Phaseoleae.

Subtribe: Ophrestiinae.

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

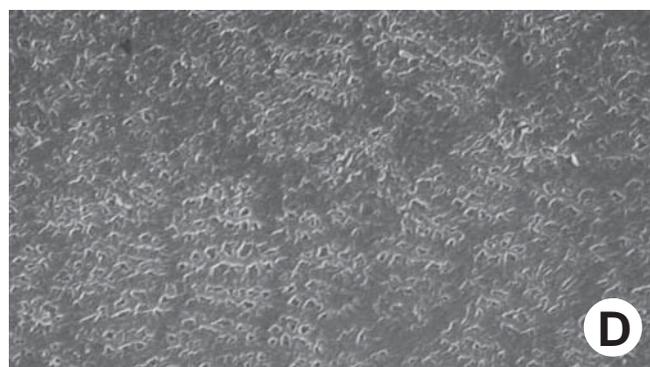
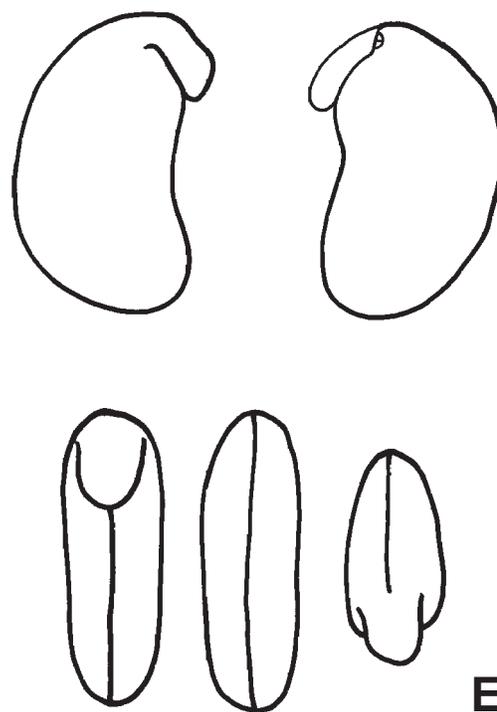
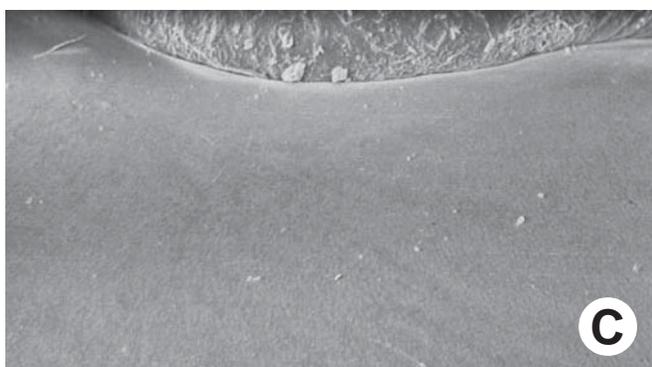
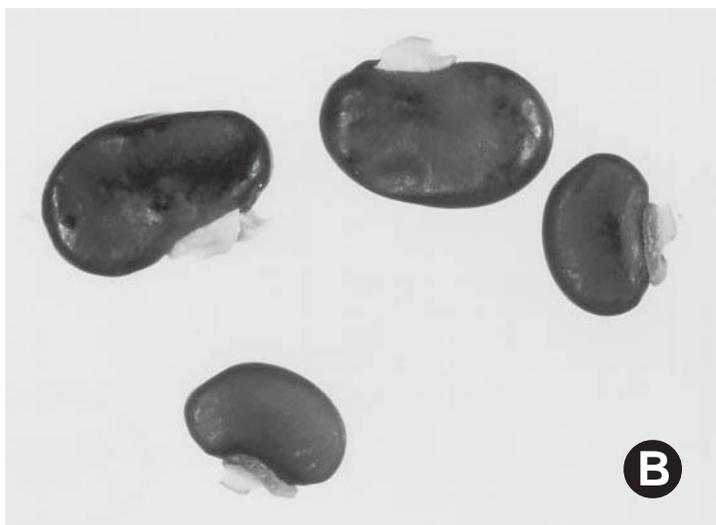
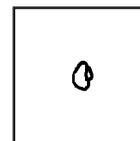
Fruit a legume; unilocular; $1.5-2 \times 0.6-0.7 \times 0.4$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical to asymmetrical (slightly); elliptic or linear; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; flattened; without or with beak (short); declined; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base to 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 dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan to brown; pubescent and indurate; with 1 type of pubescence; long sericeous; with pubescence golden to brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; papillose; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome or bichrome; tan to brown or tan and brown; smooth; subseptate; with septa thin (tissue paper-like), flexible; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length parallel with to oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; flattened; triangular. Aril dry; hippocrepiform rim-aril; entire; without tongue (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

Seed $4-8 \times 3-5 \times 2-3$ mm; not overgrown; not angular; asymmetrical; reniform to elliptic; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces.

Testa not adhering to endocarp; slightly glossy; not modified by a bloom; colored; monochrome; reddish brown to brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.5–2.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length or marginal according to radicle tip; flush to recessed; not within corona, halo, or rim or within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm thin; covering at least 1/2 of embryo but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to yellow; inner face flat; glabrous around base of radicle. Embryonic axis straight; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical Africa.

Pseudoeriosema: *P. andongense* (F.M.J. Welwitsch ex J.G. Baker) L. Hauman (*C–E*), *P. spp.* (*A–B*). *A*, Fruits ($\times 2.5$); *B*, seeds ($\times 6.1$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 8$).



Genus: *Cruddasia* D. Prain

Phylogenetic Number: 10.13.

Tribe: Phaseoleae.

Subtribe: Ophrestinae.

Species Studied—Species in Genus: 1 sp.—4 sp.

Fruit a legume; unilocular; 30–40 × 8.5–9.5 × 0.4 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; slightly asymmetrical; linear; when asymmetrical with both sutures nearly straight; not inflated; flattened; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally, barely visible; with the raised seed chambers not torulose. 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; velutinous; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; tan; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp. Seeds 3–5; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2 mm long; of 1 length only; flattened; triangular. Aril fleshy; hippocrepiform rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

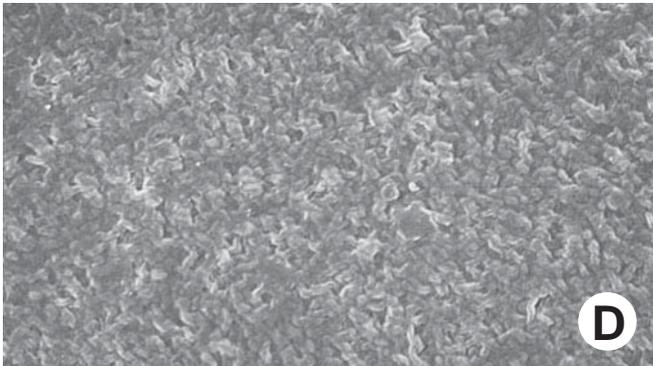
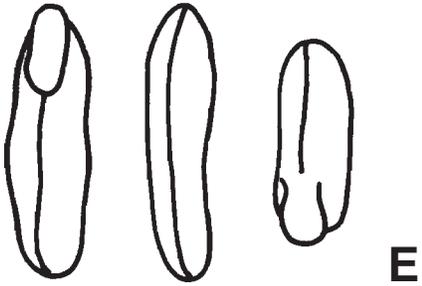
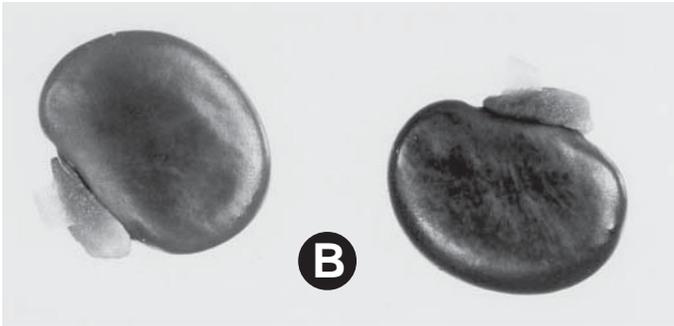
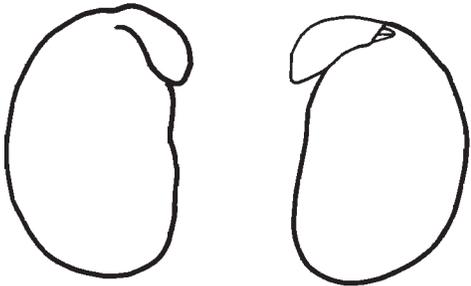
Seed 6–8 × 4–5.5 × 2–3.5 mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; with (barely) or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous.

Fracture lines absent. Rim absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim or within halo. Hilum halo color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–0.8 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm thin; covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons not smooth; dimpled once; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellowish green; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: India, Southeast Asia, and southern China.

Notes: Niyomdham (1992) described a new species of *Cruddasia*, *C. craibii* C. Niyomdham, and transferred two other species into the genus, *C. laotica* (F. Gagnepain) C. Niyomdham and *C. pinnata* (E.D. Merrill) C. Niyomdham. His species count and distribution were used. Only fruits from a single specimen were studied.

Cruddasia: *C. insignis* D. Prain (A–E). A, Fruits (× 3); B, seeds (× 7); C–D, testa (× 50, × 1000); E, embryos (× 6).



Genus: *Centrosema* (A.-P. de Candolle) G. Bentham

Phylogenetic Number: 10.14.

Tribe: Phaseoleae.

Subtribe: Clitoriinae.

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

Fruit a legume; unilocular; 6–26 × 0.3–4 × 0.1–0.5 cm; with persistent or deciduous (often when fruit mature) calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved; not plicate; not twisted; symmetrical or asymmetrical; linear (or nearly so) or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; long tapered to tapered at apex; apex oblique or aligned with longitudinal axis of fruit; tapered, long tapered, or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally invisible (sometimes demarcated by coloration). Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings present; 4 (2 wings on each valve); 1–3 mm wide; valvular; on both valves. 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; monochrome or multicolored; bichrome and mottled (centrally, paler near sutures); brown or green (brownish); with brown overlay; glabrous or pubescent and indurate; with 2 types of pubescence; pilose; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases swollen or plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; dotted or lenticular; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with solid layer over solid layer; coriaceous or chartaceous. Endocarp dull; monochrome or mottled; tan or white; with mottling (dark); with brown overlay; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds (4–)8–17; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long to measured; 1–5 mm long; of 1 length only; filiform or

thick; straight. Aril present or absent; dry; rim-aril or partial rim-aril; entire; covering less than 1/2 of seed; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

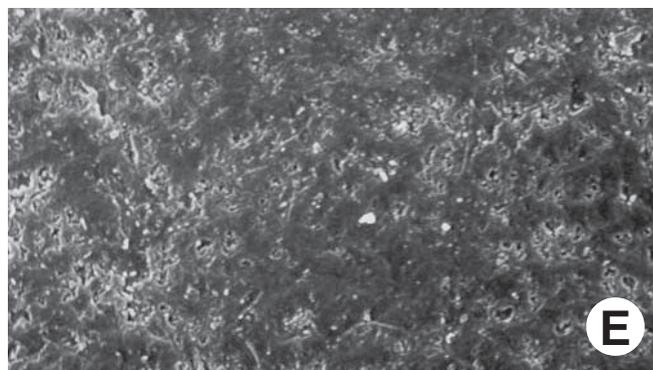
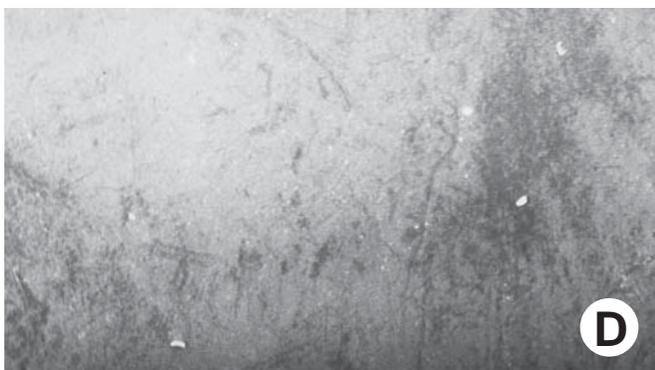
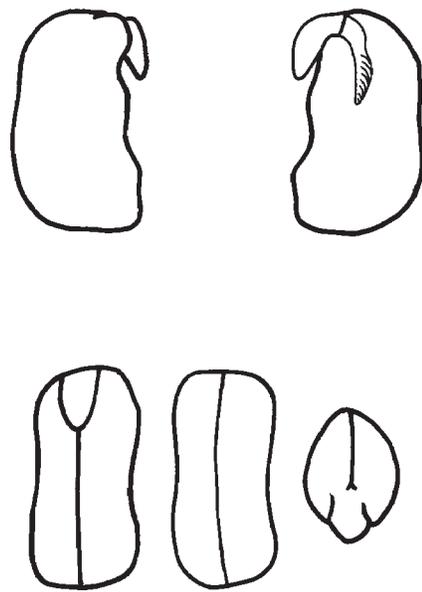
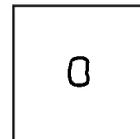
Seed 4.7–11.6 × 3–8.4 × 2–7 mm; not overgrown; not angular or angular; symmetrical; ovate, reniform, or rectangular; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull, glossy, or glaucous; not modified by a bloom; colored; monochrome; brown to reddish brown or black; glabrous; smooth; chartaceous. Fracture lines absent or present; reticulate. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 0.8–7.5 mm long; with curved or straight outline; elliptic to oval or linear; apical at apex of radicle tip to subapical to radicle tip or marginal according to radicle tip; slightly raised; not within corona, halo, or rim or within halo or rim. Hilum halo color darker than testa. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–0.8 mm long; with margins curved; circular; not in groove of raphe; adjacent to hilum; 0.5–1.3 mm from hilum; flush to mounded (slightly); dissimilar color from testa; lighter than testa; tan; within halo. Lens halo color darker than testa. 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 or partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear or bulbous; lobe tip straight; with 90-degree turn to oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Neotropics and subneotropics and cultivated in pantropics (*C. molle* van Martius ex G. Bentham).

Notes: Barbosa-Fereiro (1977) revised *Centrosema* for Brazil. Fantz (1996b) has shown that the agriculturally

important species formerly known as “*C. pubescens*” must be called *C. molle* Martius ex G. Bentham. This species is widely distributed throughout the Neotropics at locations below 500 m. The name *C. pubescens* G. Bentham applies to a poorly known species found from Mexico to western Panama at elevations of 500–2,200m.

Centrosema: *C. plumieri* (J.P.F. Turpin ex C.H. Persoon)
G. Bentham (*B*), *C. virginianum* (C. Linnaeus) G.
Bentham (*D–F*), *C. spp.* (*A, C*). *A*, Fruits ($\times 0.9$);
B, valve ($\times 0.5$); *C*, seeds ($\times 4$); *D–E*, testa ($\times 50$,
 $\times 1000$); *F*, embryos ($\times 6$).



Genus: *Periandra* C.F.P. von Martius ex G. Bentham

Phylogenetic Number: 10.15.

Tribe: Phaseoleae.

Subtribe: Clitoriinae.

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

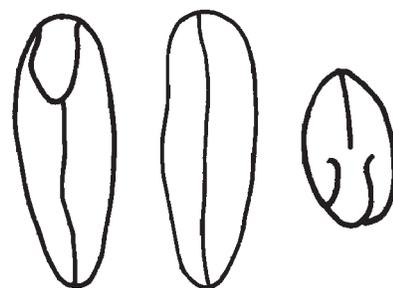
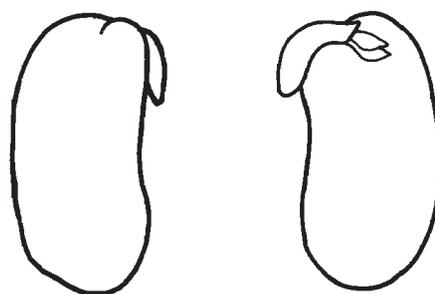
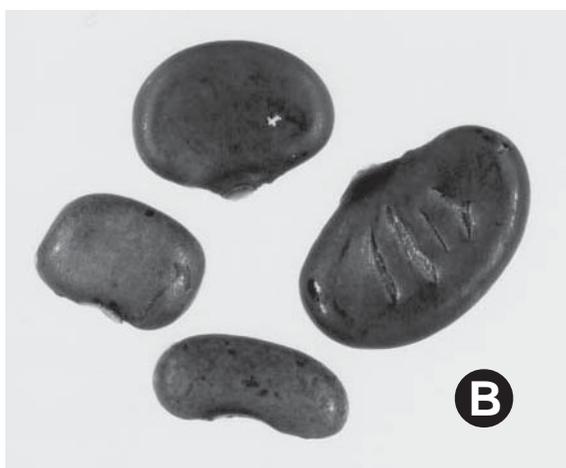
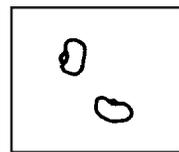
Fruit a legume; unilocular; $9-18 \times 0.4-0.8 \times 0.2-0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; symmetrical; linear; not inflated; flattened; without to with beak; straight; with papery fragile beak up to 1 cm long or solid beak the same color and texture as fruit; tapered 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 or invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit substipitate; 0.5-1 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not tuberculate; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; coriaceous. Endocarp dull; monochrome; orangish brown or white; smooth and cracked; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp and separating from mesocarp; entire. Seeds 4-11; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5-0.7 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril, tongue-aril, or 2-lipped rim-aril; entire; covering less than 1/2 of seed; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

Seed $6.6-8.1 \times 3.5-5 \times 1.8-3.3$ mm; not overgrown; not angular; symmetrical; elliptic or reniform; terete or compressed; with surface smooth; without visible

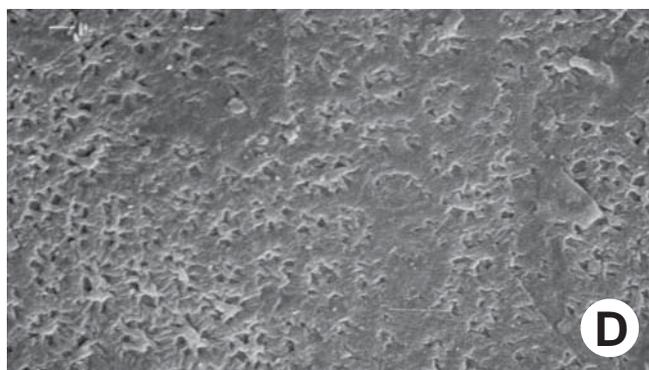
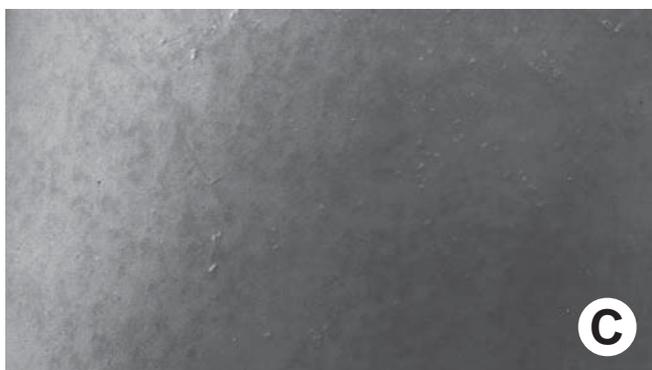
radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown; with brown (darker) overlay; glabrous; smooth or not smooth; with recessed features; pitted with small separate pits; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1.8-2.8 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; within rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 1.5 mm long; with margins straight or curved; linear or elliptic; not in groove of raphe; adjacent to hilum; 0.1-0.7 mm from hilum; recessed or flush; dissimilar color from testa; lighter or darker than testa; brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo or at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; deflexed and parallel to cotyledon length or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Santo Domingo (1 sp.) and Brazil (5 spp.).

Periandra: *P. heterophylla* G. Bentham (*C-E*), *P.* spp. (*A-B*). *A*, Fruits ($\times 1.1$); *B*, seeds ($\times 5$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



E



Genus: *Clitoria* C. Linnaeus

Phylogenetic Number: 10.16.

Tribe: Phaseoleae.

Subtribe: Clitoriinae.

Species Studied—Species in Genus: 23 spp.—59 spp.
(Fantz, personal communication, 1998).

Fruit a legume; unilocular; $3.7\text{--}33 \times 0.5\text{--}5 \times 0.2\text{--}0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; symmetrical or asymmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; tapered to short tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous to leathery; seed chambers externally visible or invisible. Fruit margin not constricted; without sulcus; embellished; with flanges or thickened sutural areas. Fruit wings absent or present (only in sect. *Neurocarpum* (A.N. Desvaux) J.G. Baker); 2; 1 mm wide; valvular; on both valves (medial, occasionally incompletely formed). Fruit nonstipitate or substipitate (only in subgen. *Clitoria*); 0.5–1 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown or greenish brown or yellow; with brown overlay; with mottling over seed chambers; glabrous or glabrate or pubescent and indurate; with 1 or 2 types of pubescence; strigose and puberulent, puberulent and villous (sparsely), or puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; blistered or scurfy; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick to thin; 3-layered; without balsamic vesicles; without fibers; with vitreous layer over 2 distinct solid layers; coriaceous. Endocarp dull; mottled; white; with mottling over seed chambers; with brown overlay; scurfy; septate to subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp;

entire. Seeds 2–11; length parallel with or transverse (seeds nearly round) to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–5 mm long; of 1 length only; thick; triangular. Aril dry; 2-lipped rim-aril or rim-aril (with tongue); entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril (smaller one on second lip); cream.

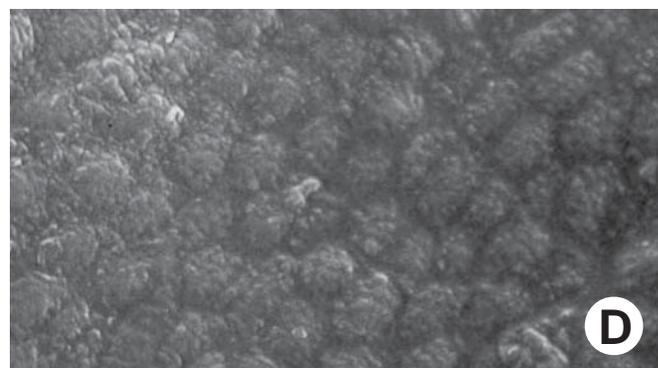
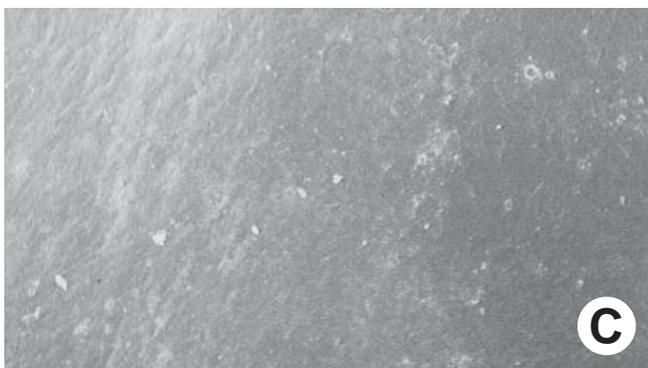
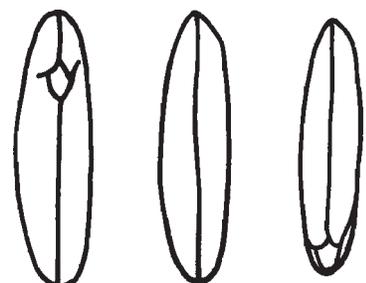
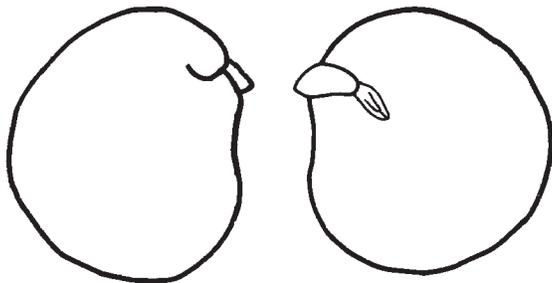
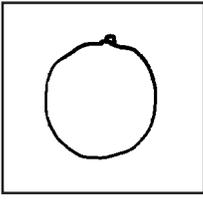
Seed $5\text{--}23 \times 4.8\text{--}22 \times 1.8\text{--}5$ mm; not overgrown; not angular or angular; symmetrical or asymmetrical (slightly); nearly circular, reniform, rhombic, or oblong; terete to compressed to flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; reddish or dark brown or green (brownish); with black overlay; glabrous; smooth; chartaceous to coriaceous (sub). Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.3 mm long; with curved outline; oval; apical at apex of radicle tip to subapical to radicle tip to apical according to radicle tip but marginal according to seed length; raised or flush; within rim. Hilum rim color of, lighter, or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–0.6 mm long; with margins curved; elliptic; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; brown to black; not within corona, halo, or rim or within halo. Lens halo color darker than testa. Endosperm present or absent; thin; restricted to region of embryo or covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; 1 thicker than the other; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed, right angled, or straight (rarely); oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear to triangular; lobe tip straight; oblique to cotyledons, deflexed and parallel to cotyledon width, with 90-

degree turn, or straight with embryonic axis (rarely); centered between cotyledons; less than 1/2 or 1/2 to nearly length of cotyledons. Plumule well to moderately developed; glabrous.

Distribution: Pantropics and North America.

Notes: *Clitoria polystachya* G. Bentham has sticky seeds, as does *Barbieria* (10.16A) (Delgado Salinas, personal communication, 1997).

Clitoria: *C. fairchildiana* R.A. Howard (*C–E*), *C. spp.*
(*A–B*). *A*, Fruits ($\times 0.4$); *B*, seeds ($\times 2.8$); *C–D*,
testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 2$).



Genus: *Barbieria* A.-P. de Candolle

Phylogenetic Number: 10.16A.

Tribe: Phaseoleae.

Subtribe: Clitoriinae.

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

Fruit a legume; unilocular; 5.5–10 × 0.5–0.6 × 0.4 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear to moniliform (slightly); not inflated; compressed; without beak; short tapered at apex; apex aligned to 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 not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate; 0.5–1 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; assumed apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over spongy layer; coriaceous. Endocarp glossy; monochrome; yellow; smooth and spongy; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; coriaceous; remaining fused to mesocarp and epicarp; entire. Seeds 3–7; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.7 mm long; of 1 length only; flattened; triangular. Aril dry; 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

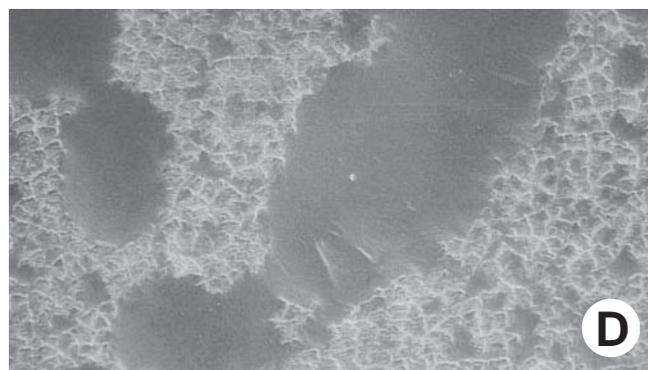
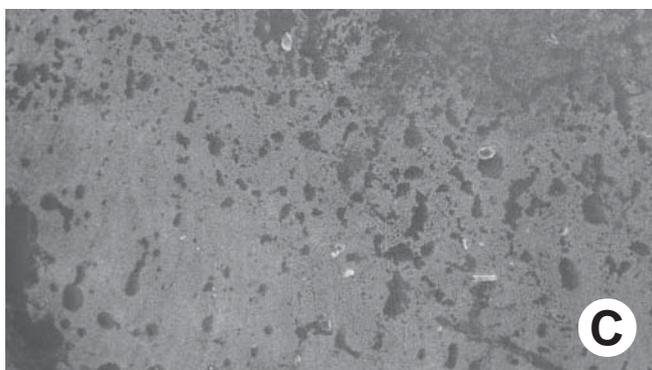
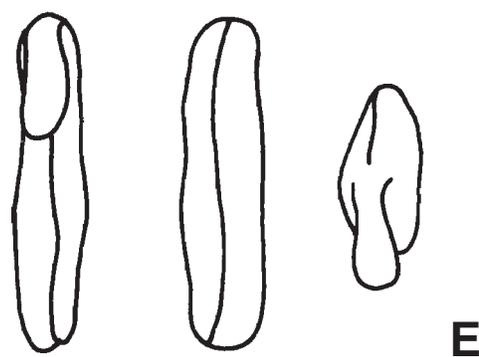
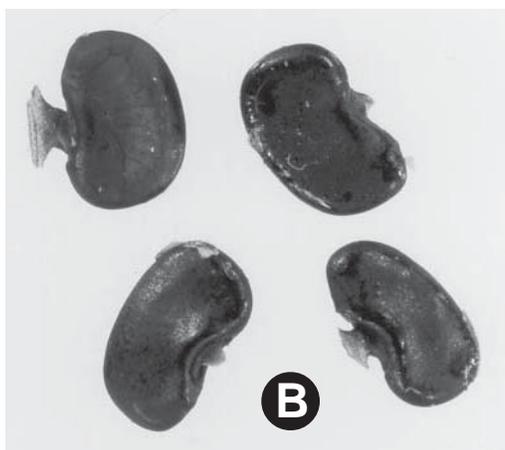
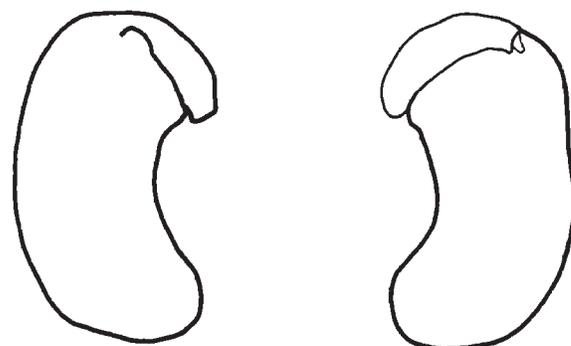
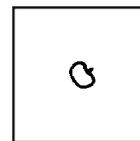
Seed 5–5.2 × 3.1–3.8 × 1.4 mm; not overgrown; angular or not angular; asymmetrical; reniform to rectangular (nearly); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to

endocarp; glossy; not modified by a bloom; colored; monochrome; black to brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1.4–1.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of or lighter than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 0.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded; same color as testa; lighter than testa; brown; not within corona, halo, or rim. Endosperm thin; covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southern Mexico to Peru, Venezuela, Brazil, and the Caribbean.

Notes: Smith and Lewis (1991) and Lackey (1981b) included the genus *Barbieria* in *Clitoria* (10.16), but Fantz (1996a) maintained it as a genus. We are following the latter author. *Barbieria* has sticky seeds, as does *Clitoria polystachya* G. Benth (10.16) (Delgado Salinas, personal communication, 1997).

Barbieria: *B. pinnata* (C.H. Persoon) H.E. Baillon (A–E). A, Fruits (× 1.7); B, seeds (× 5.8); C–D, testa (× 50, × 1000); E, embryos (× 10).



Genus: *Dioclea* K.S. Kunth

Phylogenetic Number: 10.18.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

Species Studied—Species in Genus: 13 spp.—30 spp.

Fruit a legume; unilocular; 11.5–30 × 3.5–6 × 2 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; linear or moniliform; when asymmetrical with 1 straight and 1 curved suture, both sutures unequally curved, or both sutures nearly straight; widest near middle or D-shaped; not inflated; compressed; without beak; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to leathery to ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain and embellished, plain, or embellished. Fruit wings present or absent; 2 or 4 (one wing on each valve, two wings on upper suture, or two wings on both sutures); 1–5 mm wide; valvular or sutural; on both valves; on 1 or both sutures. Fruit stipitate or nonstipitate; with the stipe up to 30 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown, black, or yellow; with brown overlay; with mottling over seed chambers; glabrous, pubescent and indurate, or pubescent but soon deciduous; with 1 type of pubescence; puberulent, tomentose, or sericeous; 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; veined or not veined; reticulately veined; not tuberculate; wrinkled; exfoliating in part; with cracks; cracking oblique to fruit length. Mesocarp thick or thin; surface uniformly veined; 2-layered; without balsamic vesicles; with fibers present or without fibers; with fibers over solid layer; with vitreous layer over solid layer; ligneous or coriaceous. Endocarp dull; monochrome or mottled; brown, white, or yellow; with mottling (dark); with brown overlay; cracked or smooth and hairy; with hairs surrounding seed chambers; subseptate or nonseptate;

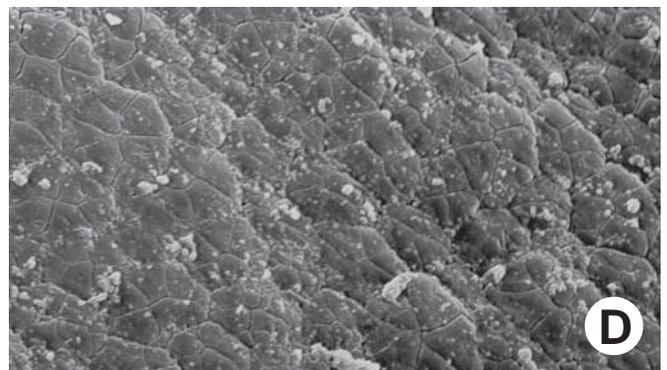
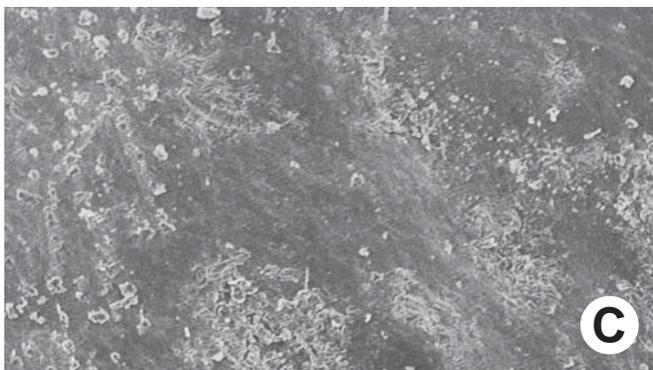
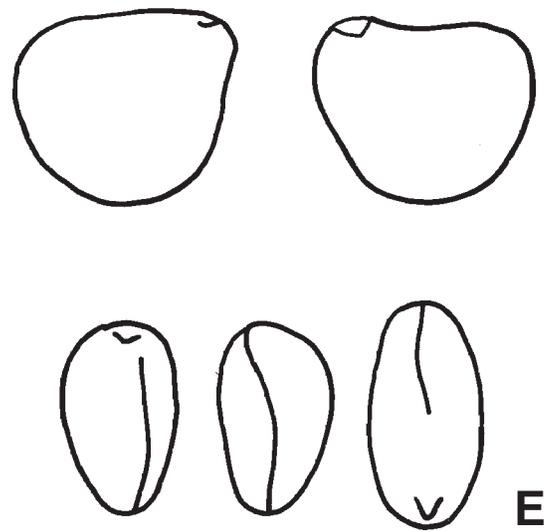
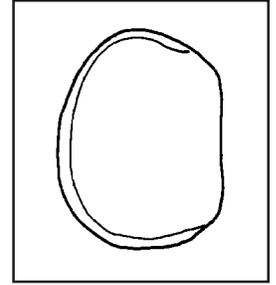
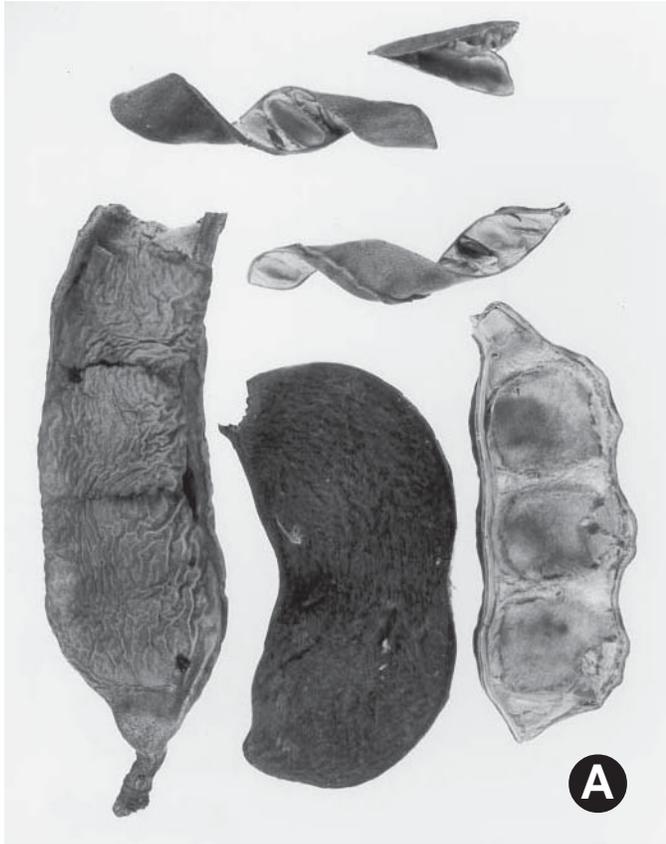
with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; separating from mesocarp; entire. Seeds (1–)3–13; length oblique or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2–50 mm long; of 1 length only; thick; curved or triangular. Aril dry; rim-aril and tongue-aril, 2-lipped rim-aril, or rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; ivory to tan.

Seed 7.5–27 × 5.3–24.5 × 3.4–15 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; oblong or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; reddish brown or tan; with brown overlay; glabrous; smooth; chartaceous or osseous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2–80 mm long; with curved or straight outline (around 3 sides of seed); elliptic or linear; apical according to radicle tip but marginal according to seed length; flush; within rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.6–1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; similar color as testa; darker than testa; brown; within rim or within halo. Lens halo color darker than testa. Lens rim color darker than testa. Endosperm thin; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over or notched at radicle; without lobes; with the interface division terminating at base of radicle; without or with 1 margin recessed; recessed on side opposite from radicle; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; parallel, oblique, or perpendicular to length of seed. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed or rudimentary; glabrous.

Distribution: Pantropics.

Notes: *Dioclea multiflora* (J. Torrey & A. Gray) C.T. Mohr has been placed in the genera *Dolichos* (10.64) and *Galactia* (10.27) at different times (Maxwell 1979), and was also segregated as the monotypic genus *Lackeya* R.H. Fortunato, L.P. de Queiroz & G.P. Lewis, as *L. multiflora* (J. Torrey & A. Gray) R.H. Fortunato, L.P. de Queiroz & G.P. Lewis (Fortunato et al. 1996). Pending further evaluation of its status, we have chosen to include it in *Dioclea*.

Dioclea: *D. reflexa* J.D. Hooker (C–E), *D. spp.* (A–B). A, Fruits ($\times 0.5$); B, seeds ($\times 1.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 1$).



Genus: *Cymbosema* G. Benth

Phylogenetic Number: 10.19.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

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

Fruit a legume; unilocular; $4.4-6 \times 1.8-2.2 \times 0.4-0.7$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical or symmetrical; oblong or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; declined; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique with longitudinal axis of fruit; rounded or short tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin constricted or not constricted; slightly constricted only on 1 margin; without sulcus; embellished; with ridges. 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; monochrome; brown; pubescent and indurate; with 1 type of pubescence; sericeous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thin; 2-layered; without balsamic vesicles; with fibers; with fibers over solid layer (resembling tomentose layer where endocarp exfoliates); coriaceous. Endocarp dull; monochrome; brown; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 2–5; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 10–15 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; crenate; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; tan.

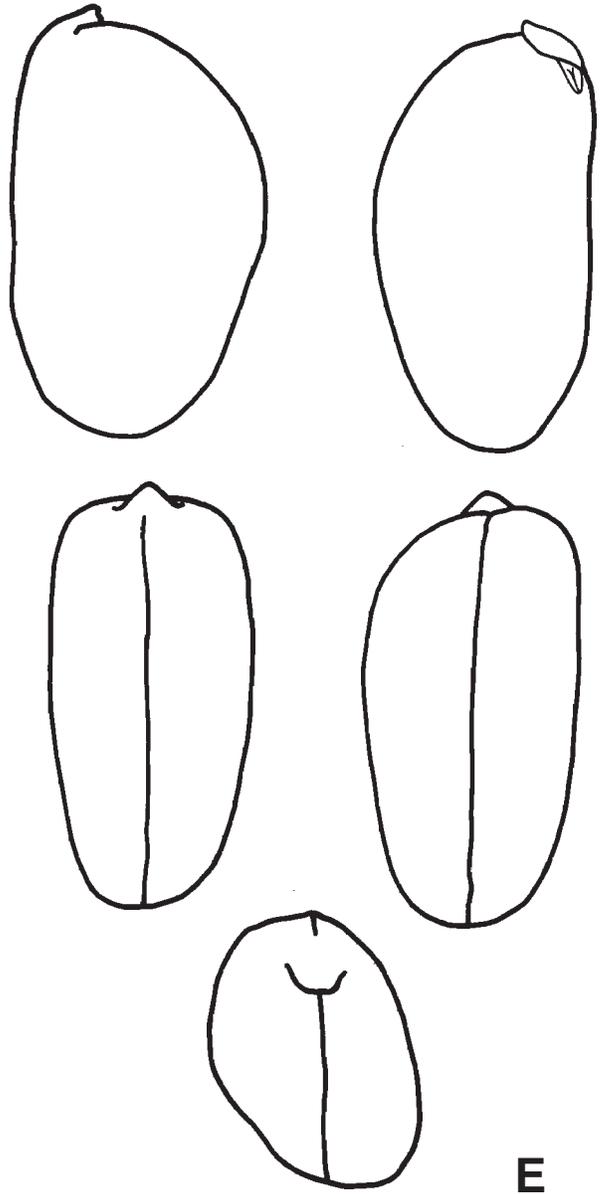
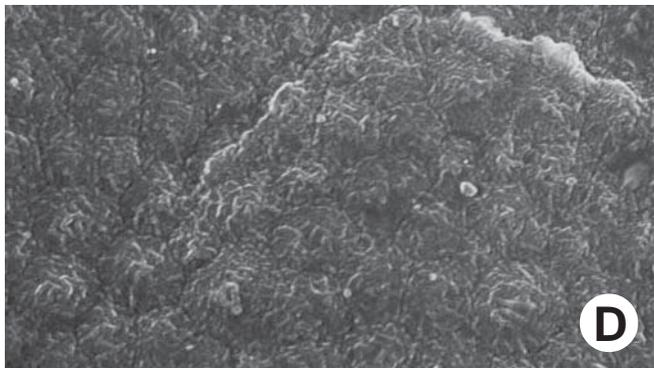
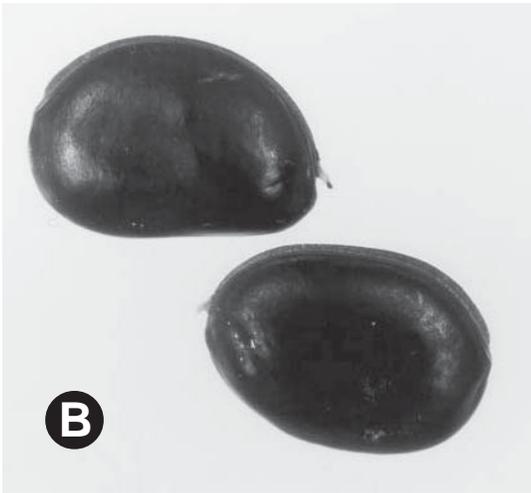
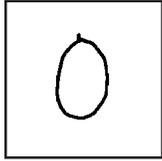
Seed 10–14 × 6–8.5 × 4–5.6 mm; not overgrown; not angular; symmetrical; oblong to ovate or reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus;

without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth; coriaceous. Fracture lines concentric. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 13–13.2 mm long; with straight outline; linear; marginal according to radicle tip; raised; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–0.8 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; dark brown; not within corona, halo, or rim. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Mexico, Central America, and South America reaching to Brazil (Amazonia).

Notes: Maxwell (1970) monographed *Cymbosema*.

Cymbosema: *C. roseum* G. Benth (A–E). A, Fruits (× 1.6); B, seeds (× 3.5); C–D, testa (× 50, × 1000); E, embryos (× 5).



Genus: *Cleobulia* C.F.P. von Martius ex G. Bentham

Phylogenetic Number: 10.20.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

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

Fruit a legume; unilocular; 6–10 × 1.5–2.3 × 0.2–0.5 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; oblong, harp-shaped, or irregular; when asymmetrical with 1 straight and 1 curved suture, both sutures unequally curved, or both sutures nearly straight; widest near apex; not inflated; compressed; without beak; truncate or blunt at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; slightly constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. 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; monochrome; brown; pubescent and indurate; with 1 type of pubescence; puberulent to tomentose; with pubescence golden or brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; not veined; not tuberculate; with or without cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; subligneous. Endocarp dull; monochrome; yellow; smooth and floury-filamentous; nonseptate; exfoliating in part; remaining fused to mesocarp and epicarp. Seeds 6–7; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 10.5 mm long; of 1 length only; flattened; curved. Aril dry; partial rim-aril; fimbriate; cream or brown (dark).

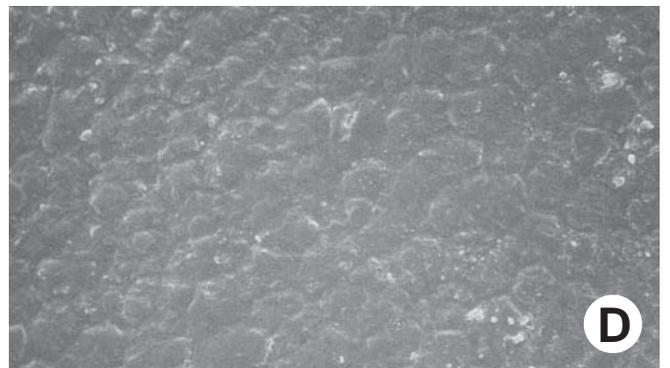
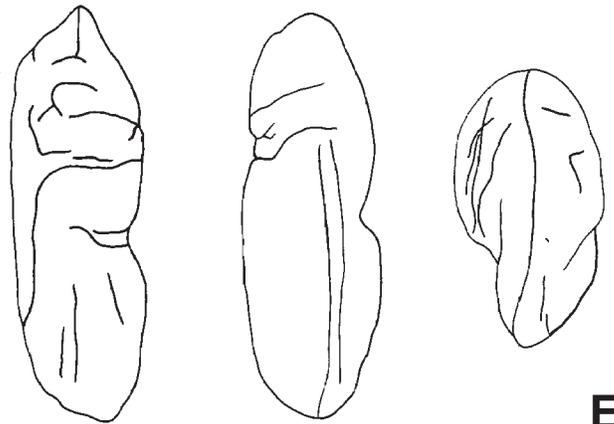
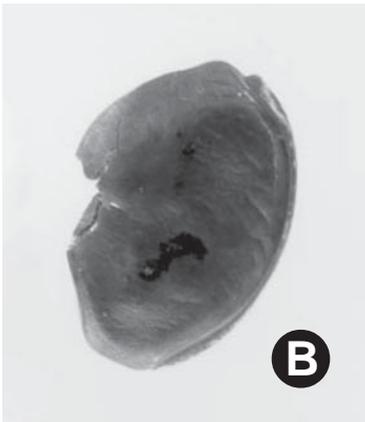
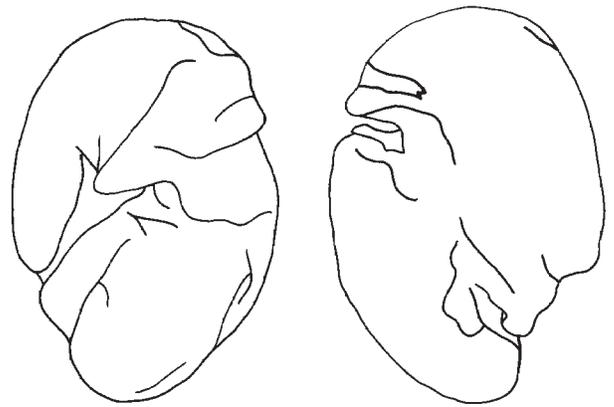
Seed 8.4 × 6 × 2.5 mm; not overgrown; not angular; symmetrical; ovate or reniform (Maxwell 1977); compressed; with surface smooth; without or with (rarely) visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not

adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; brown; 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 lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 6–8.5 mm long; with straight outline; linear; marginal according to radicle tip; slightly raised; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.6 mm long; with margins straight; wedge-shaped; 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 not smooth; convoluted; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched; similar at apex; completely concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan to brown; inner face flat and wavy (in different areas); glabrous around base of radicle. Embryonic axis straight; almost perpendicular to length of seed; with a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Brazil.

Notes: Maxwell (1977) prepared a résumé of the genus. The two studied seeds were immature.

Cleobulia: *C. leiantha* G. Bentham (*E*), *C. multiflora* C.F.P. von Martius ex G. Bentham (*B–D*), *C. spp.* (*A*). *A*, Fruits (× 1.1); *B*, seed (× 5.1); *C–D*, testa (× 50, × 1000); *E*, embryos (× 9).



Genus: *Canavalia* A.-P. de Candolle

Phylogenetic Number: 10.21.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

Species Studied—Species in Genus: 23 spp.—50 spp.

Fruit a legume; unilocular; 7–40 × 1.5–6 × 0.7–3 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated or inflated (slightly, from literature); compressed to terete; without or with beak; straight or declined; with solid beak the same color and texture as fruit; tapered or short tapered 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 or ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas or thickened sutural areas and wings. Fruit wings present or absent; 2 or 4 (one wing on each valve, sometimes two wings on upper suture); 1–1.5 mm wide; valvular or valvular and sutural; on both valves; on 1 suture. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; tan or brown; with brown overlay; glabrous or pubescent and indurate; with 1 type of pubescence; pilose; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; veined or not veined; transversely veined relative to fruit length; not tuberculate; wrinkled; exfoliating in part or not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with vitreous layer over solid layer; subligneous to coriaceous. Endocarp dull; monochrome or mottled; tan to white; with mottling (dark); with brown overlay; scurfy and smooth (over seed chambers) or floury-filamentous; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 3–15; length oblique or transverse to fruit length; neither overlapping nor touching or touching; in 1 series.

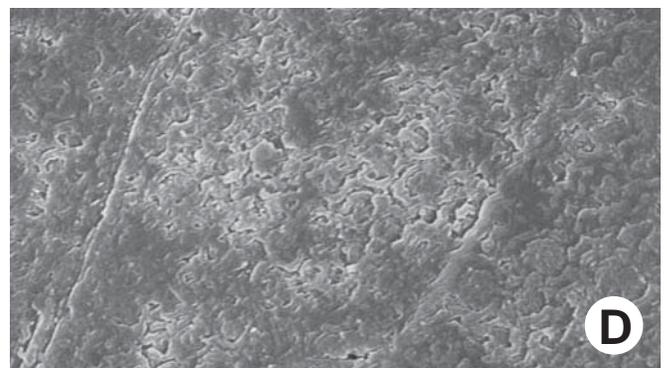
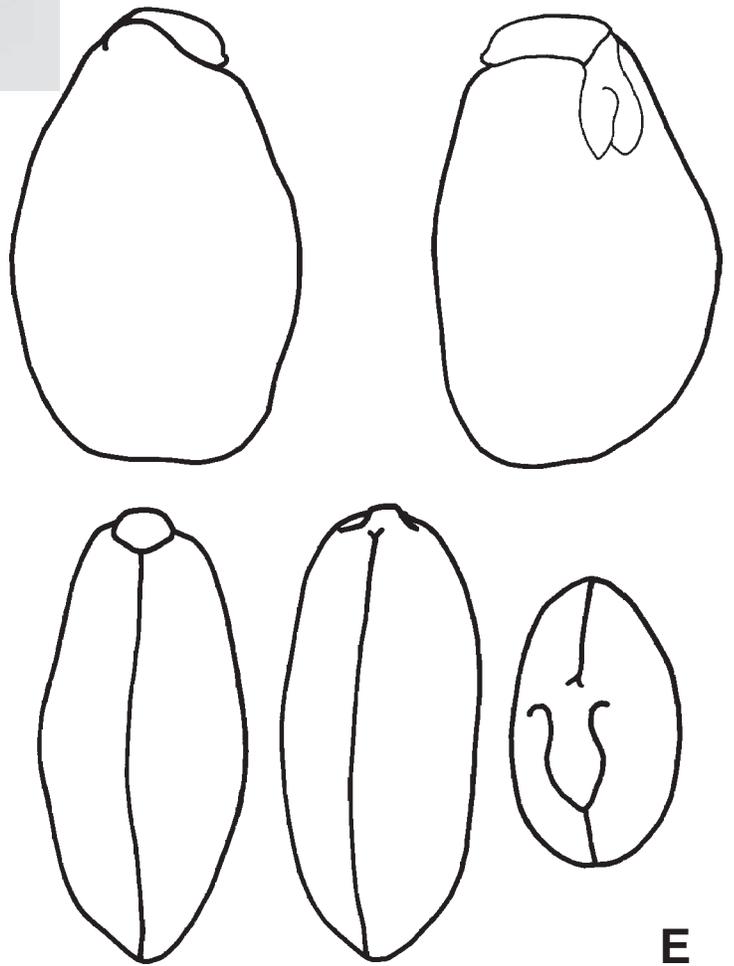
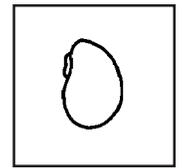
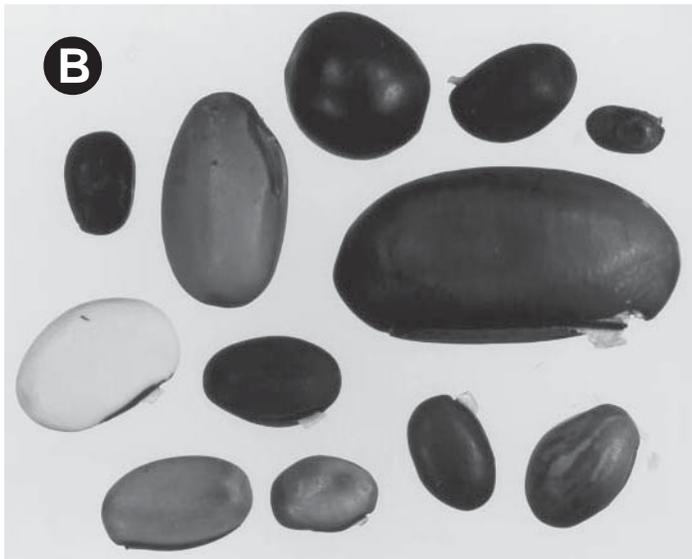
Funiculus measured; 5–30 mm long; of 1 length only; thick; straight or triangular (long). Aril dry; rim-aril and tongue-aril, rim-aril, or 2-lipped rim-aril; entire or fimbriate; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

Seed 7–48 × 5–25 × 2–21 mm; not overgrown; not angular; symmetrical or asymmetrical (slightly); elliptic to oblong or ovate; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent or frequent mottles; brown to reddish brown or ivory; with brown (dark) overlay; glabrous; smooth; coriaceous or osseous. Fracture lines absent. Rim absent. Raphe not visible or visible; from lens to base of seed and terminating; not bifurcating; darker than testa; dark brown; raised. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 5–35 mm long; with straight outline; linear; marginal according to radicle tip; flush or raised (slightly); not within corona, halo, or rim or within rim. Hilum rim color of or darker than testa. Lens discernible or not discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; not within corona, halo, or rim or within rim. Lens rim color darker than testa. Endosperm absent or present; trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin not entire 180 degrees from base of radicle; notched; similar at apex; partially concealing radicle; split over or notched at radicle; with or without lobes; with lobes not touching, touching (auriculate), or overlapping; without or with basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or linear; lobe tip straight or curved; oblique to cotyledons, with 90-degree turn, or straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Pantropical.

Notes: Sauer (1964) monographed *Canavalia* and illustrated its seeds. Adema (1997) reviewed the nine Malesian species, and illustrated the fruits for five of them.

Canavalia: *C. septentrionalis* J. Sauer (*C–E*), *C. spp.* (*A–B*).
A, Fruits ($\times 0.3$); B, seeds ($\times 1.1$); C–D, testa ($\times 50$,
 $\times 1000$); E, embryos ($\times 5$).



Genus: *Macropsyчанthus* H.A.T. Harms & C.A.G.
Lauterbach

Phylogenetic Number: 10.22.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

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

Fruit a legume; unilocular; 12.5–20 (from literature) × 4.3–5.5 (from literature) × 1.6–2.5 (from literature) cm; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed (from literature); with beak (from literature); with solid beak the same color and texture as fruit (from literature); long tapered or rounded at apex (from literature); 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. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Epicarp dull; monochrome; brown; assumed pubescent and indurate; with 1 type of pubescence; sericeous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not veined; not tuberculate. Seeds 2–5 (from literature). Aril dry; narrow rim-aril; entire; covering less than 1/2 of seed; cream.

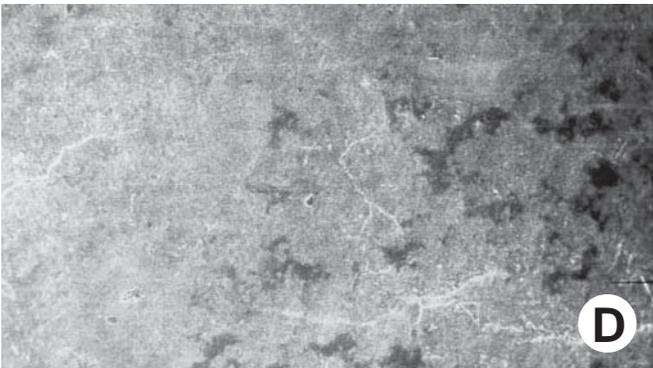
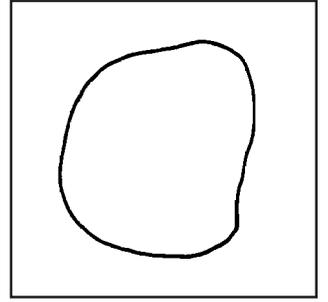
Seed 25–30 (from literature) × 20–30 (from literature) × 10–18 (from literature) mm; not overgrown; angular; symmetrical; D-shaped or rectangular (nearly); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without or with umbo on seed faces; with umbo on both faces of seed. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; mottled; reddish brown; with brown overlay; glabrous; smooth or not smooth; with elevated features; wrinkled or tuberculate (from literature); osseous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 67–80 mm long; with straight outline (around 3/4 of seed); linear; marginal according to radicle tip; raised; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 2 mm long; with margins straight; linear;

not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; 1 thicker (slightly) than the other; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: New Guinea, Philippines, and Micronesia.

Notes: Lackey (1981b) noted “scarcely distinguishable from *Dioclea*” (10.18). The fruits and seeds of the two genera are very similar. Partial fruit data taken from young fruits of *Macropsyчанthus lauterbachii* H.A.T. Harms ssp. *glabricalyx* Verdcourt (isotype at U.S. National Herbarium, Smithsonian Institution).

Macropsyчанthus: *M. dolichobotrys* L.B. Holthuis (C–E), *M. mindanaensis* E.D. Merrill (A), *M. spp.* (B). A–B, Fruit (× 1, × 0.5); C, seeds (× 1.4); D–E, testa (× 50, × 1000).



Genus: *Camptosema* W.J. Hooker & G.A.W. Arnott

Phylogenetic Number: 10.24.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

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

Fruit a legume; unilocular; (4–)5–15 × 0.6–1.4 × 0.2–0.3 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; with solid beak the same color and texture as fruit; tapered at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate or stipitate (rarely); with the stipe 5–7 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; black; pubescent and indurate; with 1 type of pubescence; puberulent, velutinous, or sericeous; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose or scaly; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome or mottled; brown; with brown overlay; smooth and floury-filamentous; septate or nonseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating or exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 3–14; length transverse to fruit length (some round); neither overlapping nor touching; in 1 series. Funiculus measured; 1–2 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril or tongue-aril; entire; covering less than 1/2 of seed; tan.

Seed (4.5–)8–9.6 × 5.5–7.2 × 2.3–6 mm; not overgrown; not angular; symmetrical; elliptic or ovate; terete or

compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; 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; larger than punctiform; 1.5–2.8 mm long; with curved outline; oval; subapical to or marginal according to radicle tip; recessed; within rim and halo. Hilum halo color lighter than testa. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 0.8(–2) mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; darker than testa; dark brown; not within corona, halo, or rim. Endosperm thin or trace; restricted to region or covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled; oblique to perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: South America.

Notes: Burkart (1970) revised the four species of Argentine *Camptosema*.

Camptosema: *C. rubicundum* W.J. Hooker & G.A.W.

Arnott (*C–E*), *C. spp.* (*A–B*). *A*, Fruits (× 1.4); *B*, seeds (× 5.3); *C–D*, testa (× 50, × 1000); *E*, embryos (× 5).

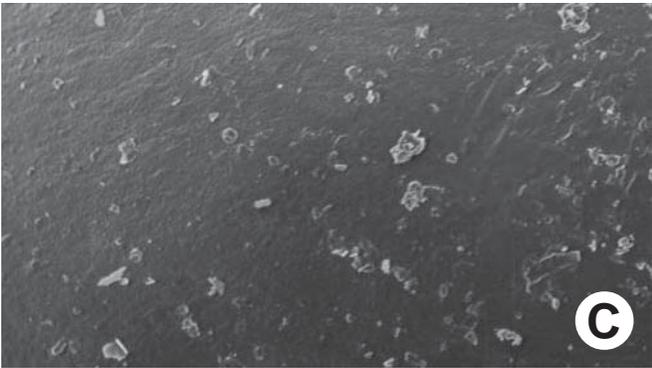
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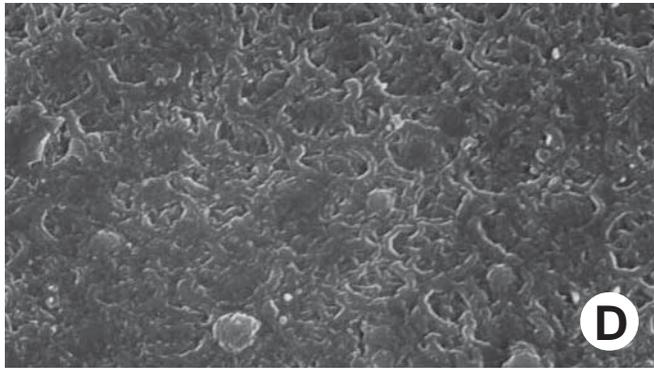
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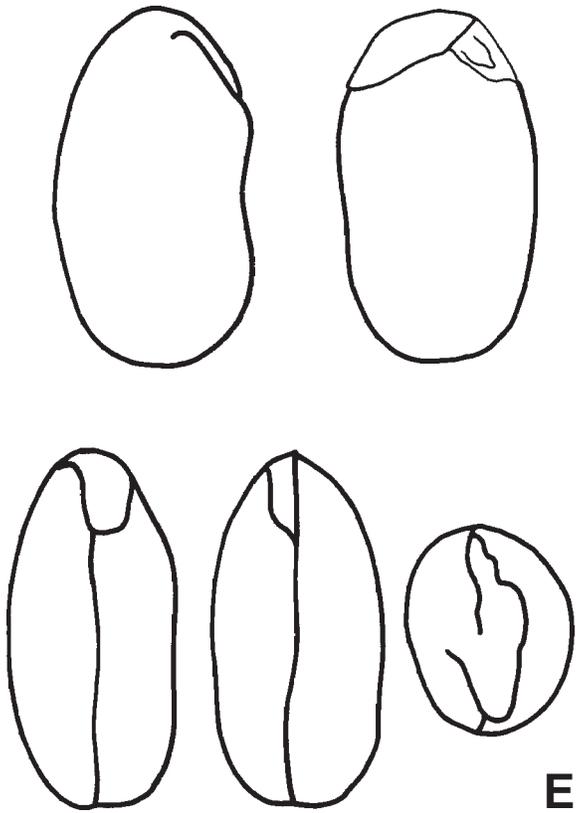
B



C



D



E

Genus: *Cratylia* C.F.P. von Martius ex G. Bentham

Phylogenetic Number: 10.25.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

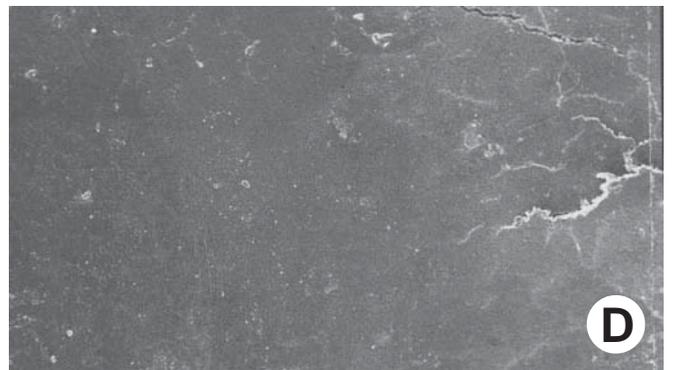
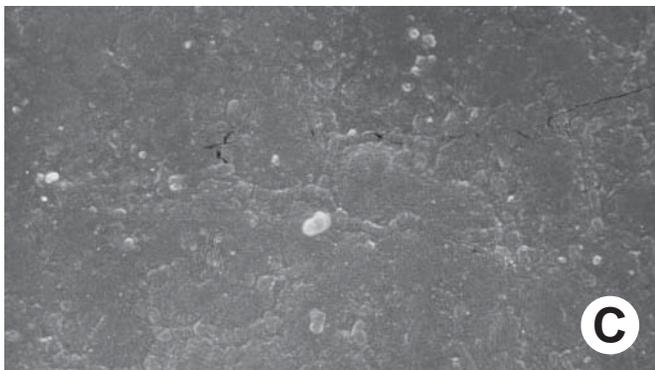
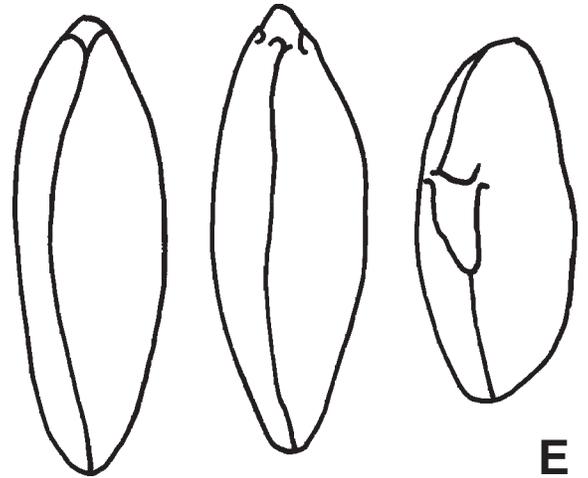
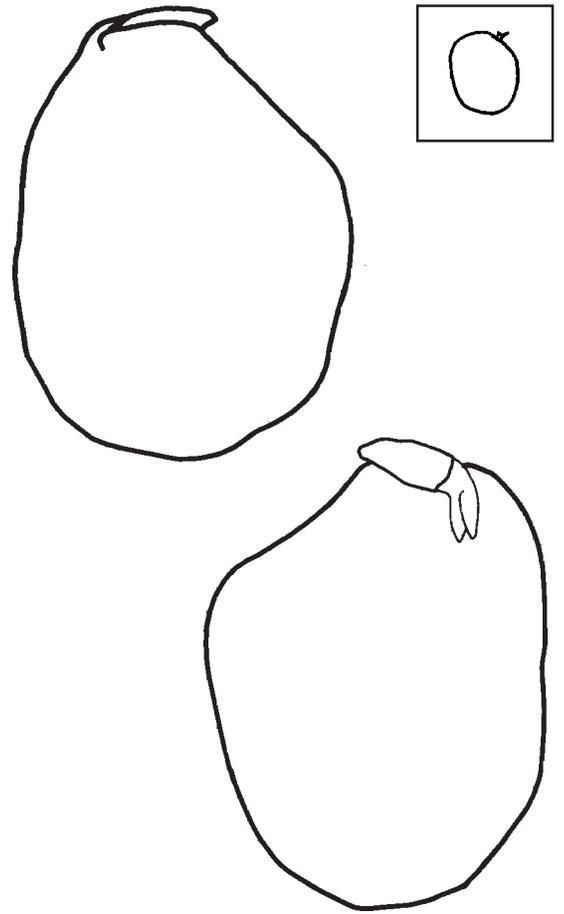
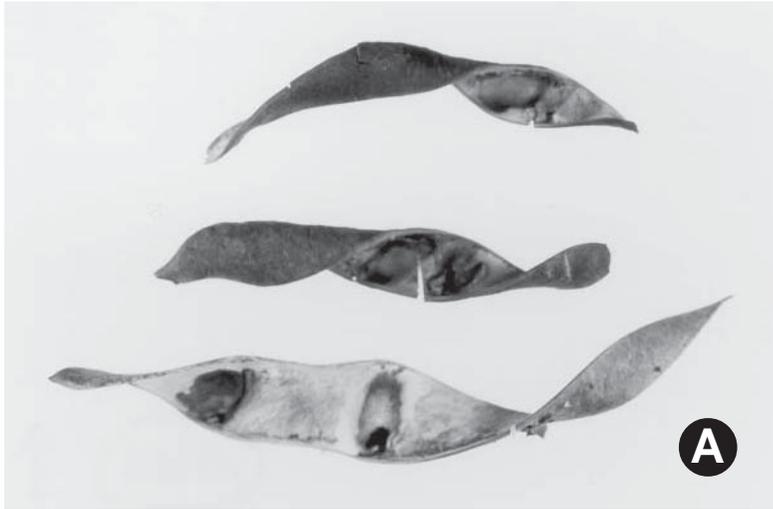
Species Studied—Species in Genus: 2 spp.—5 spp.

Fruit a legume; unilocular; 6–18 × 1.3–2 × 0.3–0.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without or with beak; straight or declined; with solid beak the same color and texture as fruit; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; puberulent or velutinous; with pubescence golden to white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; irregularly veined; not tuberculate; scurfy; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thin; 2- or 3-layered; without balsamic vesicles; without fibers; with solid or spongy layer over solid layer or vitreous layer or solid layer over 2 distinct solid layers; coriaceous. Endocarp dull; beneath seeds monochrome and mottled (between); tan; with mottling above and below seed chambers; with brown or gray overlay; beneath seeds smooth, scurfy, and cracked (the last two between seeds); subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; separating from mesocarp. Seeds 4–10; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 2 mm long; of 1 length only; flattened; straight. Aril dry; tongue-aril; entire; covering less than 1/2 of seed; tan.

Seed 9 × 3 × 4 mm; not overgrown; not angular; asymmetrical; nearly circular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with infrequent mottles; brown; with brown (dark) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 2.5 mm long; with curved outline; elliptic; subapical to radicle tip; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.8 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; brown; not within corona, halo, or rim. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; 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 right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: South America.

Cratylia: *C. mollis* C.F.P. von Martius ex G. Bentham (C–E), *C. spp.* (A–B). A, Fruits (× 0.7); B, seeds (× 2.8); C–D, testa (× 50, × 1000); E, embryos (× 5).



Genus: *Collaea* A.-P. de Candolle

Phylogenetic Number: 10.26.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

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

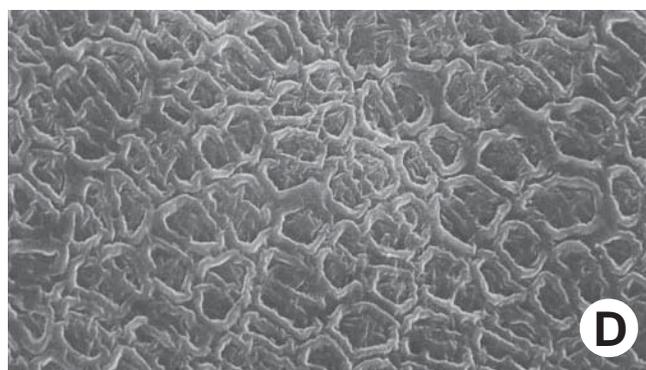
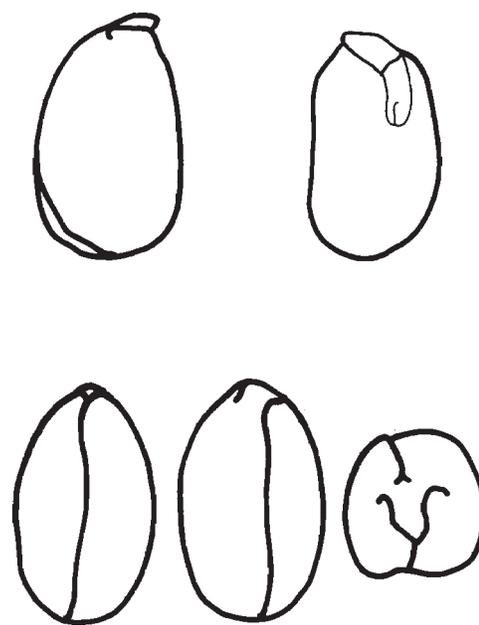
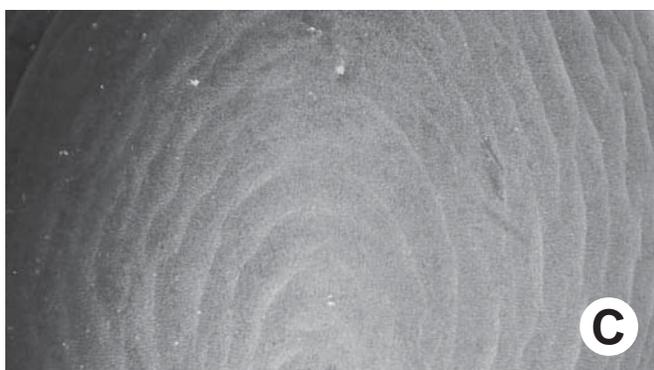
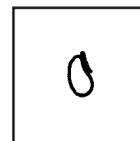
Fruit a legume; unilocular; 4.2–13 × 0.5–1 × 0.2–0.3 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical or asymmetrical; linear; when asymmetrical with both sutures nearly straight; not inflated; compressed; without or with beak; straight; with solid beak the same color and texture as fruit; tapered to short tapered at apex; apex oblique with longitudinal axis of fruit; tapered or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible or invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; velutinous or sericeous; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with spongy layer over solid layer; coriaceous to chartaceous. Endocarp dull; mottled; brown or tan; with mottling over seed chambers; with brown overlay; scurfy; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 6–14; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 6 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril; entire to crenate; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; tan.

Seed 7–8.8 × 5–5.8 × 3.5–5 mm; not overgrown; not angular; symmetrical; oblong to ovate; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; reddish brown; with brown (dark) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 4–5 mm long; with straight outline; linear; subapical to radicle tip; raised; within rim or halo. Hilum halo color darker than testa. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7–1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; lighter than testa; tan; within halo. Lens halo color darker than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: South America.

Notes: Generic delimitation follows Burkart (1971).

Collaea: *C. speciosa* (J.L.A. Loiseleur-Deslongchamps) A.-P. de Candolle (*C-E*), *C. spp.* (*A-B*). *A*, Fruits (× 1.2); *B*, seeds (× 4.6); *C-D*, testa (× 50, × 1000); *E*, embryos (× 5).



Genus: *Galactia* P. Browne

Phylogenetic Number: 10.27.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

Species Studied—Species in Genus: 18 spp.—50 spp.

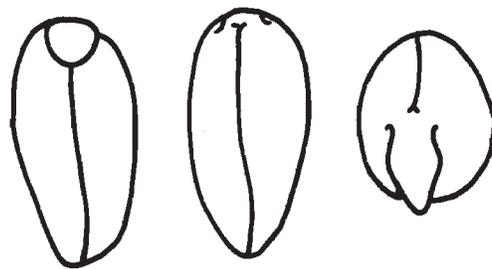
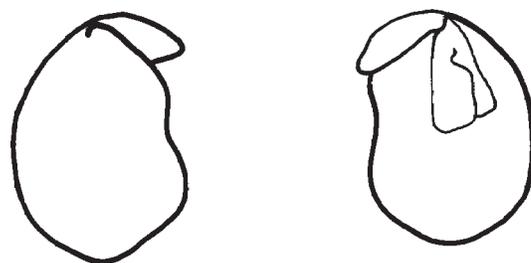
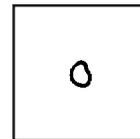
Fruit a legume; unilocular; 2.5–8 × 0.4–1.2 × 0.1–0.3 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed or flattened; without beak; tapered or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally invisible or visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; with mottling over seed chambers; pubescent and indurate or pubescent but soon deciduous; with 1 or 2 types of pubescence; densely tomentose, velutinous, sericeous, or tomentose and villous; with pubescence white or golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; brown to tan; cracked; with hairs scattered over endocarp; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating; separating from mesocarp; entire. Seeds 5–10; length parallel or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 4 mm long; of 1 length only; filiform; curved or triangular. Aril dry; 2-lipped rim-aril; entire; covering less than 1/2 of seed; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; tan.

Seed 3.5–7.8 × 2.6–4.5 × 1.7–3.7 mm; not overgrown; not angular; symmetrical or asymmetrical; D-shaped, elliptic, ovate, or reniform; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent or infrequent mottles; brown, orange (brownish), or tan; with brown or tan overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–4.5 mm long; with curved or straight outline; elliptic; linear; apical according to radicle tip but marginal according to seed length; raised; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 0.7 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown or red; within halo. Lens halo color of or darker than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire or not entire 180 degrees from base of radicle; slightly notched; similar at apex; partially concealing radicle; split 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 right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear or triangular; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

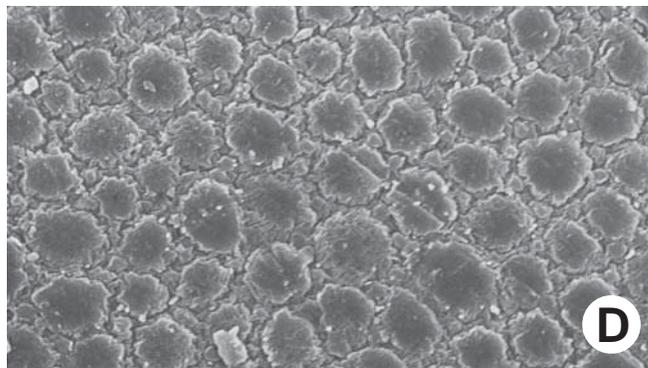
Distribution: Pantropics, pansubtropics, and temperate southern United States.

Notes: Burkart (1971) monographed the *Galactia* species of South America.

Galactia: *G. jussiaeana* K.S. Kunth (C–E), *G. spp.* (A–B). A, Fruits (× 1.4); B, seeds (× 3.4); C–D, testa (× 50, × 1000); E, embryos (× 8).



E



Genus: *Herpyza* C. Wright

Phylogenetic Number: 10.28.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

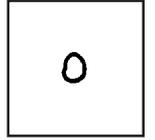
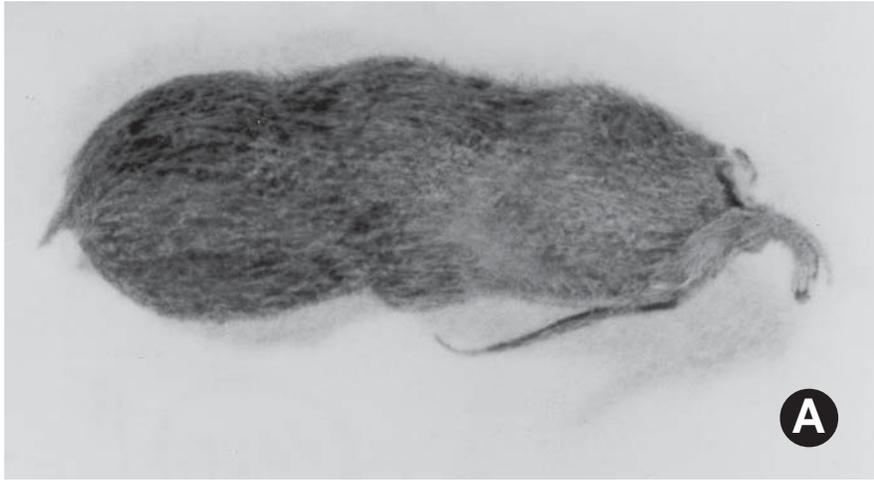
Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; 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. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Epicarp dull; multicolored; mottled; green; with brown overlay; assumed pubescent and indurate; with 2 types of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; eglandular; without spines; not tuberculate. Endocarp septate (from Lewis); with septa eglandular. Seeds 1, 2, or 3 (from Lewis).

Distribution: Cuba.

Notes: Lackey (1981b) noted that *Herpyza* is “very poorly known.” Lewis (1988) published fruit-seed illustrations that were drawn from the type: “1865, Wright 2325 (Royal Botanic Gardens, Kew).” Urban (1908) also published a fruit-seed illustration. A single immature fruit of *H. grandiflora* C. Wright was studied.

Herpyza: *H. grandiflora* C. Wright (A–B). A, Fruit ($\times 6.2$); B, seed ($\times 8.8$).



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

Phylogenetic Number: 10.29.

Tribe: Phaseoleae.

Subtribe: Glycininae.

Species Studied—Species in Genus: 2 spp.—5 spp.

Fruit a legume; unilocular; $2.3\text{--}2.8 \times 0.7\text{--}1 \times 0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; lanceolate or linear; when asymmetrical with both sutures nearly straight; not inflated; compressed; without or with beak; straight or declined; with solid beak the same color and texture as fruit; tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan to brown; pubescent and indurate; with 1 type of pubescence; sericeous; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating or exfoliating in part (rarely); without cracks. Mesocarp thin; 2-layered; without balsamic vesicles; without fibers; with vitreous layer or spongy layer over solid layer; coriaceous. Endocarp dull; mottled or bichrome; white or white and brown (over seed chambers); with mottling over seed chambers; with yellow overlay; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–2; length oblique or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1.5–3 mm long; of 1 length only; flattened; straight or triangular. Aril dry; rim- and tongue-aril; entire; cream.

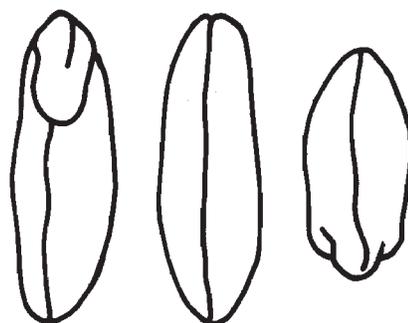
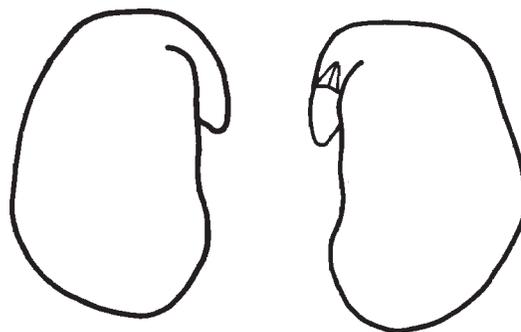
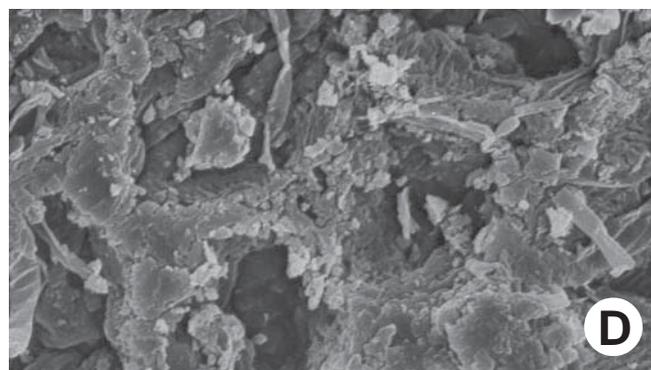
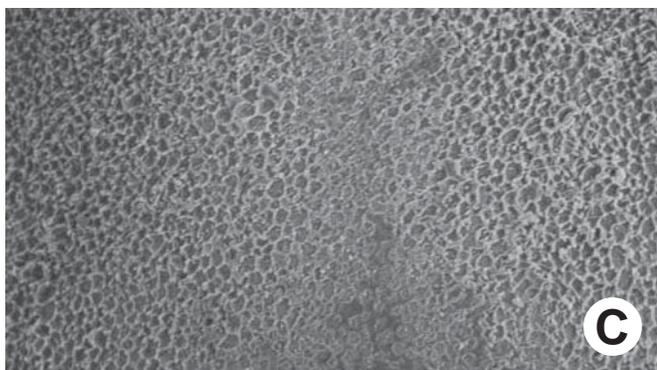
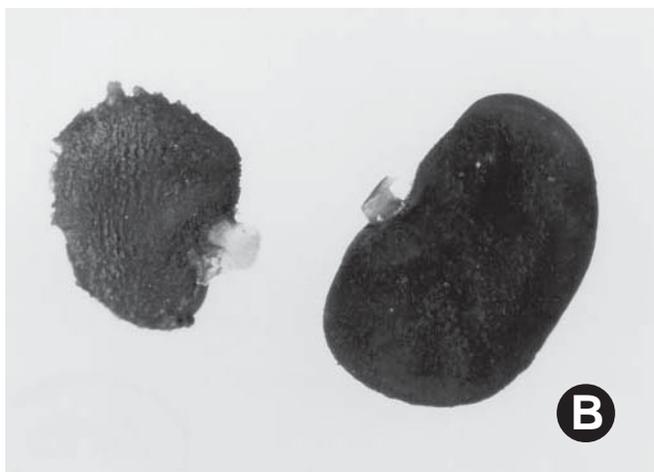
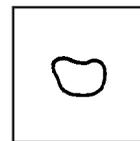
Seed $8.5\text{--}9.5 \times 6.5\text{--}7.5 \times 3\text{--}3.2$ mm; not overgrown; not angular; asymmetrical; irregularly reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not

modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with recessed features or recessed and elevated features; wrinkled; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.3–1.5 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within halo. Hilum halo color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 1 mm long; with margins curved; elliptic; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; 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; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis straight; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Southern tropical Africa.

Notes: Pauwels (1983) revised the genus and accepted four species. We used his geographic distribution but Lackey's (1981b) species count.

Eminia: *E. antennulifera* (J.G. Baker) P.H.W. Taubert (C–E), *E. spp.* (A–B). A, Fruits ($\times 2.1$); B, seeds ($\times 5.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



E

Genus: *Pseudeminia* B. Verdcourt

Phylogenetic Number: 10.30.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

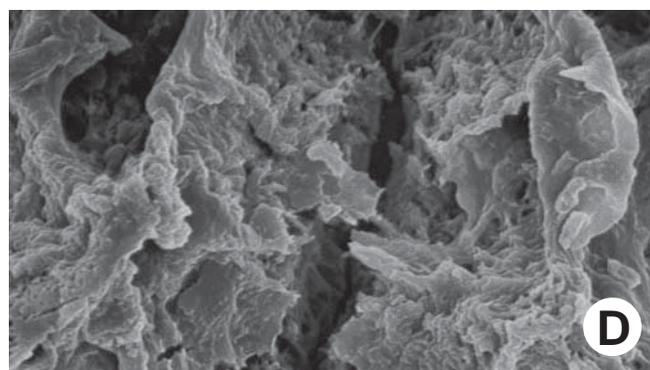
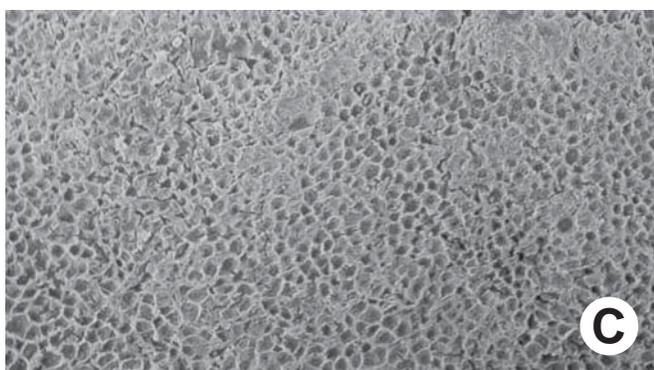
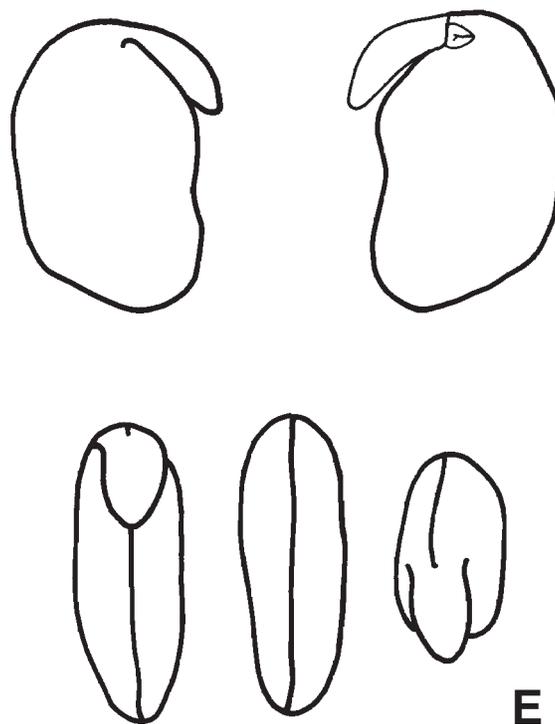
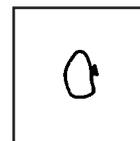
Fruit a legume; unilocular; $1.8\text{--}2.5 \times 0.7\text{--}0.9 \times 0.3\text{--}0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved suture; slightly narrowest near middle, B-shaped; not inflated; compressed; with beak (short); straight; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned or 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 visible; with the raised seed chambers not torulose. Fruit margin slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; sericeous; with pubescence golden or gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; mottled; tan; with mottling over seed chambers; with brown overlay; scurfy and smooth; subseptate; with septa thin (tissue paper-like), flexible; 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 measured; 0.5–1 mm long; of 1 length only; flattened; straight. Aril dry; rim- and tongue-aril; entire; cream.

Seed $6.5\text{--}9.5 \times 5\text{--}7 \times 3\text{--}3.7$ mm; not overgrown; not angular; asymmetrical; irregularly reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent

mottles; brown; with black overlay; glabrous; not smooth; with elevated features; rugose; coriaceous. Fracture lines absent. Rim absent. Raphe from hilum through lens and base of seed to point opposite hilum; not bifurcating; darker than testa; black; raised. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.6 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within corona or not within corona, halo, or rim. Hilum corona color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1.4 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; dark brown; within corona or not within corona, halo, or rim. Lens corona color darker than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; pale yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Africa.

Pseudeminia: *P. comosa* (J.G. Baker) B. Verdcourt (A–E). A, Fruits ($\times 1.8$); B, seeds ($\times 6.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Pseudovigna* (H.A.T. Harms) B. Verdcourt

Phylogenetic Number: 10.31.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $2.2\text{--}3.2 \times 0.7\text{--}0.8 \times 0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; oblong; not inflated; compressed; with beak (short); declined; with solid beak the same color and texture as fruit; blunt 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 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; monochrome; brown; pubescent and indurate; with 3 types of pubescence; tomentose; with pubescence white and brown; with long appressed brown hairs and short and shorter white hairs intermixed; with pubescence uniformly distributed; with simple hairs; stiff and pliable; with hair bases swollen and plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; tan; fibrous; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; 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 measured; $0.5\text{--}0.7$ mm long; of 1 length only; flattened; straight. Aril dry; rim- and tongue-aril or 2-lipped rim-aril; fimbriate or entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; cream.

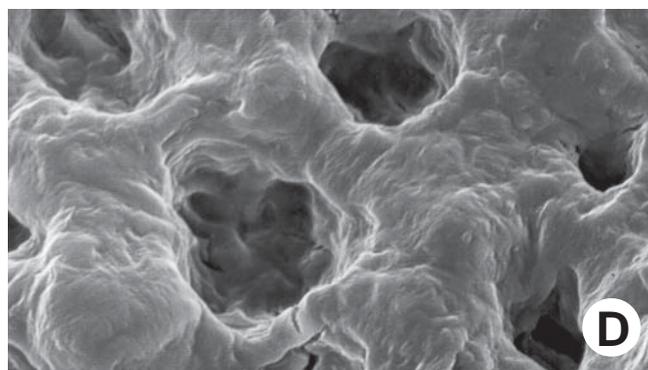
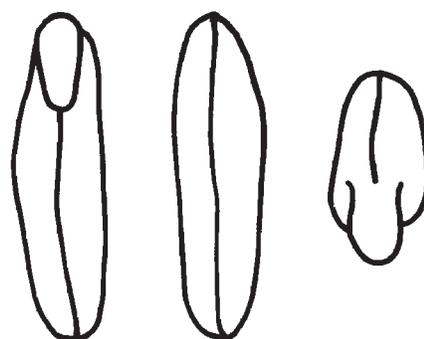
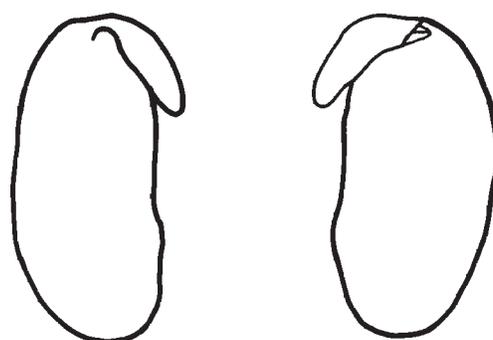
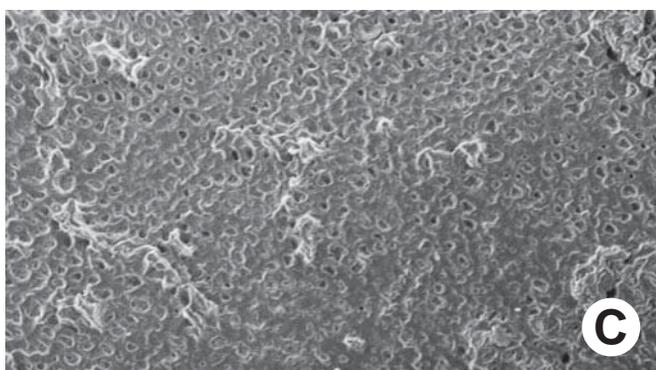
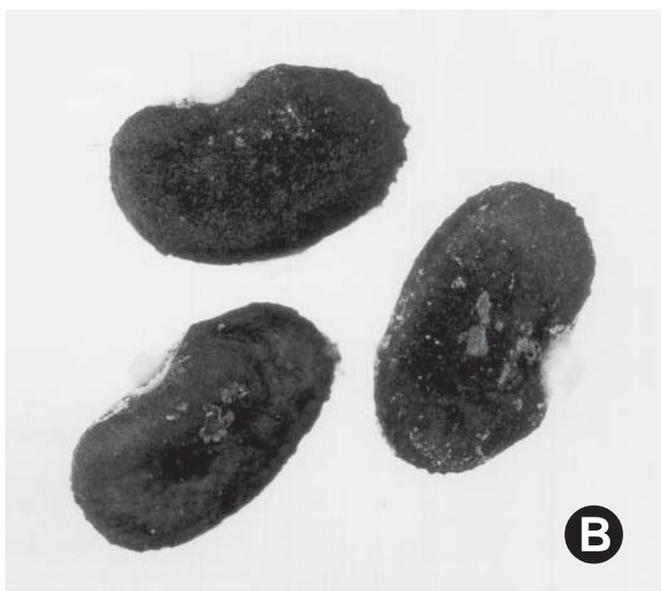
Seed $6.1\text{--}10.5 \times 4.4\text{--}6.3 \times 2.8\text{--}3.5$ mm; not overgrown; not angular; symmetrical or asymmetrical; regularly to irregularly reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without

hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with elevated features; reticulate; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible or visible; from hilum to near base of seed and terminating; not bifurcating; color of testa; raised. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; $1.6\text{--}2.6$ mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within corona or not within corona, halo, or rim. Hilum corona color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; dark brown; within corona or not within corona, halo, or rim. Lens corona color darker than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at 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 oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical and western Africa.

Pseudovigna: *P. argentea* (C.L. von Willdenow) B. Verdcourt (A–E). A, Fruits ($\times 2.5$); B, seeds ($\times 6.2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).

3



Genus: *Pueraria* A.-P. de Candolle

Phylogenetic Number: 10.32.

Tribe: Phaseoleae.

Subtribe: Glycininae.

Species Studied—Species in Genus: 7 spp.—16 spp.

Fruit a legume; unilocular; $1.5\text{--}13 \times 0.3\text{--}1.2 \times 0.3\text{--}0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical or asymmetrical; linear, moniliform, or falcate; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; narrowest near middle, B-shaped; not inflated; flattened or compressed; with beak; straight; with solid beak the same color and texture as fruit; long tapered, tapered, short tapered, or rounded at apex; apex aligned or oblique with longitudinal axis of fruit; tapered, short tapered, or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins or only on 1 margin; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; black or brown; glabrous or pubescent and indurate; with hairs erect or appressed; with 1 or 2 types of pubescence; pilose, puberulent, or velutinous; with pubescence brown; with pubescence uniformly distributed; with simple hairs or simple and complex hairs; with bristle-like hairs; pliable; with hair bases swollen or plain; retrorse and straight; straight at apex; eglandular; without spines; smooth or not smooth; with elevated features; veined or not veined; irregularly veined; not tuberculate; striate or wrinkled; not exfoliating; without cracks. Mesocarp present or absent; thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous to chartaceous. Endocarp dull to glossy; monochrome; tan; smooth; septate to nonseptate; with septa thin (tissue paperlike), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp or separating from mesocarp (partially); remaining fused to epicarp; entire.

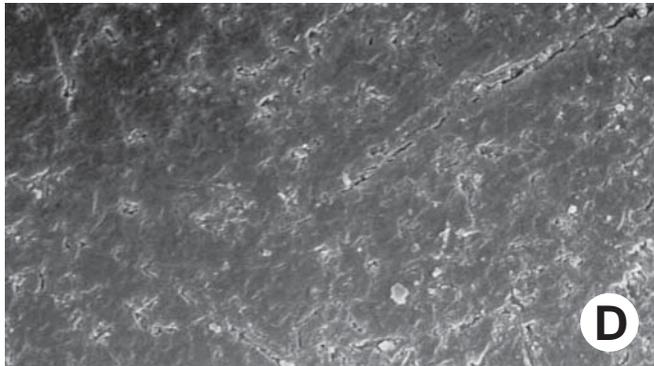
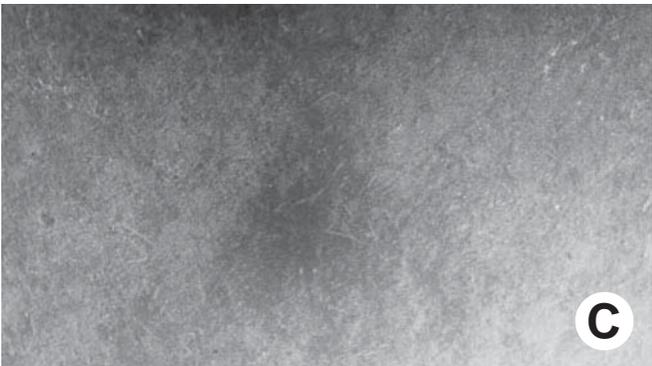
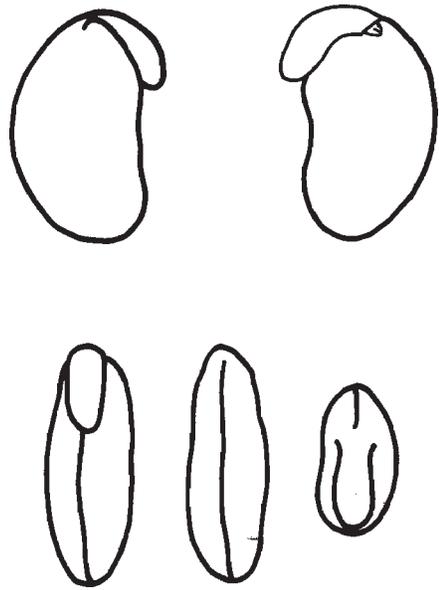
Seeds (1–)5–20; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril or rim- and tongue-aril; entire; cream.

Seed 2–3 or 7–9 \times ca. 1.5 or 5–6 \times 1 or 2.5–3 mm; not overgrown; not angular; symmetrical or asymmetrical; oblong or reniform (irregularly); terete to compressed; with surface smooth; with (slightly) 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 or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; black or brown; with black overlay; glabrous; smooth or not smooth; with elevated or recessed features; minutely tuberculate; pitted with small separate pits; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.6–1.5 mm long; with curved outline; circular to elliptic to oval; marginal according to radicle tip; recessed; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1.7 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; similar color as testa; darker than testa; brown; within corona. Lens corona color darker than testa. Endosperm thick to trace; covering entire embryo or restricted to region of embryo; adnate to testa or embryo. Cotyledons not smooth; 1–3 grooves on each face; outer face of 1 cotyledon flat and other cotyledon convex or both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to yellow to green; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Asia and two species widely distributed in the subtropics.

Notes: Van der Maesen (1985, 1994) monographed *Pueraria*, and his species number is used, not the 20 species of Lackey (1981b).

Pueraria: *P. montana* (J. de Loureiro) E.D. Merrill var.
lobata (C.L. von Willdenow) L.J.G. Maesen & S.
Almeida (*C-E*), *P. spp.* (*A-B*). *A*, Fruits ($\times 1$); *B*, seeds
($\times 6.4$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 6$).



Genus: *Nogra* E.D. Merrill

Phylogenetic Number: 10.33.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $5.5\text{--}6 \times 0.6 \times 0.3\text{--}0.4$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; short tapered 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 (slightly). 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan; pubescent and indurate; with 1 type of pubescence; pilose; with pubescence brown; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases swollen; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; papillose (associated with hairs); not exfoliating; without cracks. Mesocarp thin; 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 9–10; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1 mm long; of 1 length only; flattened; triangular. Aril dry; rim- and tongue-aril; entire; cream.

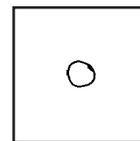
Seed $4.9 \times 4.3 \times 2.8$ mm; not overgrown; not angular; asymmetrical; nearly, irregularly circular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; not smooth; with elevated features; powdery and not rubbing off; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and base of seed to point opposite hilum; not

bifurcating; color of testa; flush. Hilum fully concealed; concealed by funicular remnant and aril; without faboid split; larger than punctiform; 1.2 mm long; with curved outline; elliptic; marginal according to radicle tip; flush; within halo. Hilum halo color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; orange; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Asia.

Notes: Lackey (1981b) noted that *Nogra filicaulis* (Kurz) E.D. Merrill “is surely not congeneric” with *N. grahamii* Merrill and *N. dalzellii* (Baker) E.D. Merrill which have a “superficial similarity, but probably represent independent lines arising from a *Pueraria*-like stock.”

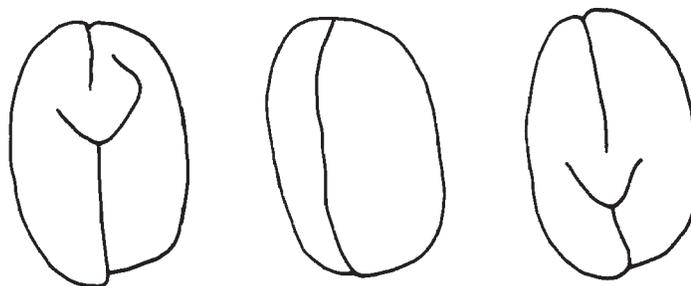
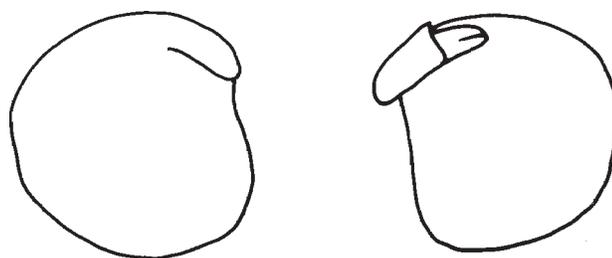
Nogra: *N. dalzellii* (E.G. Baker) E.D. Merrill (A–E). A, Fruits ($\times 1.9$); B, seeds ($\times 8.4$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



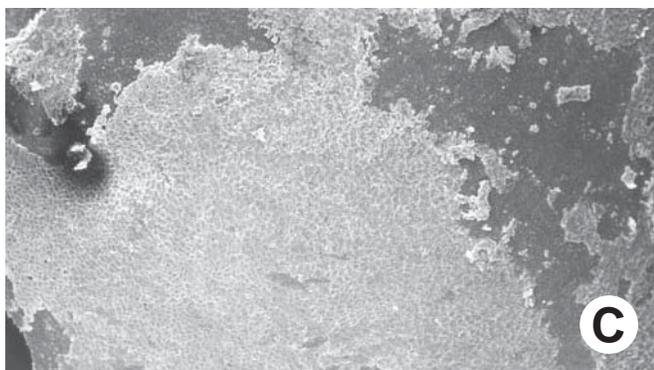
A



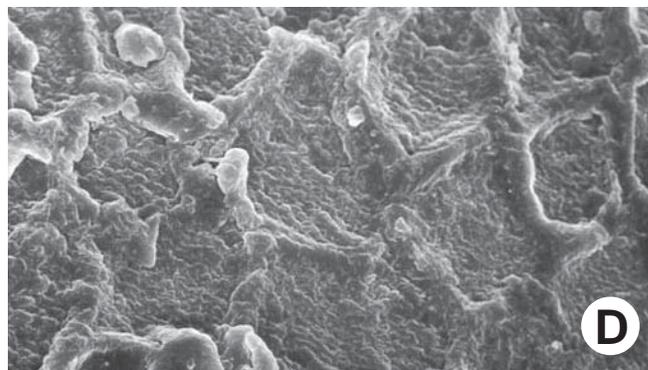
B



E



C



D

Genus: *Sinodolichos* B. Verdcourt

Phylogenetic Number: 10.34.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $5-6 \times 0.6-0.75 \times 0.3-0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; symmetrical to asymmetrical (slightly); linear, moniliform, or falcate (slightly); when asymmetrical with both sutures parallelly curved; not inflated; compressed; without beak; short tapered to rounded at apex; apex aligned with longitudinal axis of fruit; short tapered to 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 dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; dark brown; pubescent and indurate; with 2 types of pubescence; sericeous; with pubescence golden; with pubescence uniformly distributed; with simple and complex hairs; with bristle-like hairs; pliable; with hair bases plain; straight; straight at apex; glandular; with glandular dots; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; glandular dotted and papillose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; mottled; brown; with mottling over seed chambers; with brown and tan overlay; scurfy and floury-filamentous; with hairs scattered over endocarp; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 7–10; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–0.7 mm long; of 1 length only; flattened; triangular. Aril dry; rim- and tongue-aril; entire; cream.

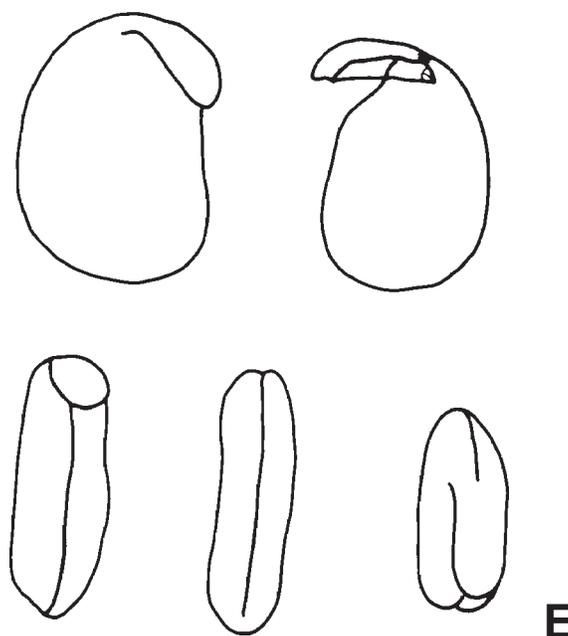
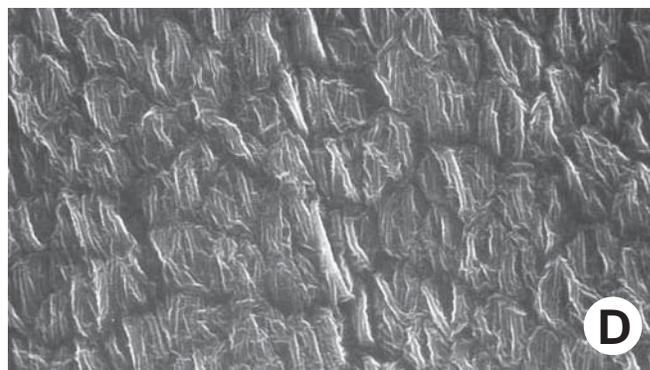
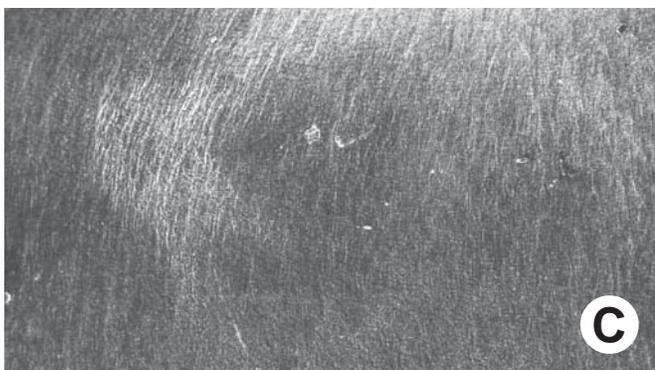
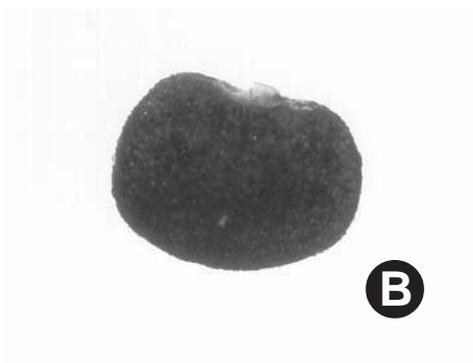
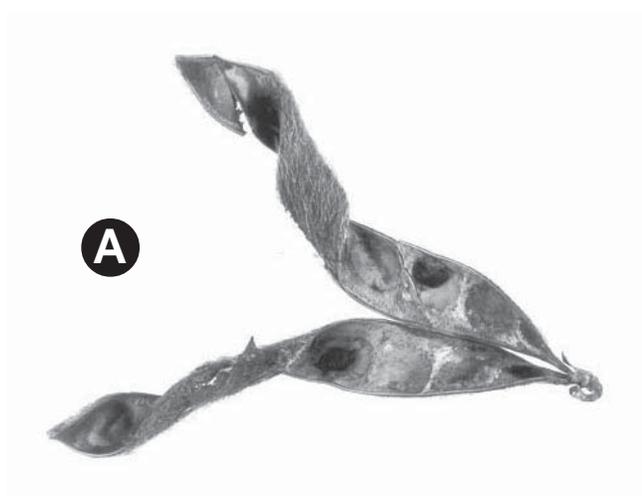
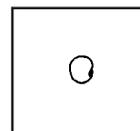
Seed $4-5.8 \times 2.9-4.6 \times 2-2.4$ mm; not overgrown; not angular; symmetrical or asymmetrical; regularly or irregularly reniform; compressed; with surface smooth;

without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; reddish brown; with brown (dark) overlay; glabrous; not smooth; with elevated features; reticulate; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.7–1.9 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within corona. Hilum corona color darker than testa. Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; ca. 0.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; within corona. Lens corona color darker than testa. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Asia.

Notes: Lackey (1981b) noted, “a poorly known genus. It is possibly congeneric with *Glycine*” (10.35). Their fruits and seeds are similar.

Sinodolichos: *S. lagopus* (S.T. Dunn) B. Verdcourt (A–E). A, Fruits ($\times 1$); B, seed ($\times 8.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 11$).



Genus: *Glycine* C.L. von Willdenow

Phylogenetic Number: 10.35.

Tribe: Phaseoleae.

Subtribe: Glycininae.

Species Studied—Species in Genus: 3 spp.—9 spp.

Fruit a legume; unilocular; $1.5-7 \times 0.3-1.5 \times 0.2-0.8$ cm; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear, falcate to moniliform (slightly), or irregular; when asymmetrical with both sutures unequally or parallelly curved; not inflated; compressed; without or with beak; straight or declined; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted (rarely); constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan to brown (dark); pubescent and indurate; with 1 type of pubescence; puberulent to sericeous; with pubescence golden to gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases swollen or plain; eglandular; smooth; not veined or veined; irregularly veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous to chartaceous. Endocarp dull; monochrome; brown to tan to white; smooth; septate or subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating or exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 2–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; 0.5 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril or 2-lipped rim-aril; entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream, tan, or white.

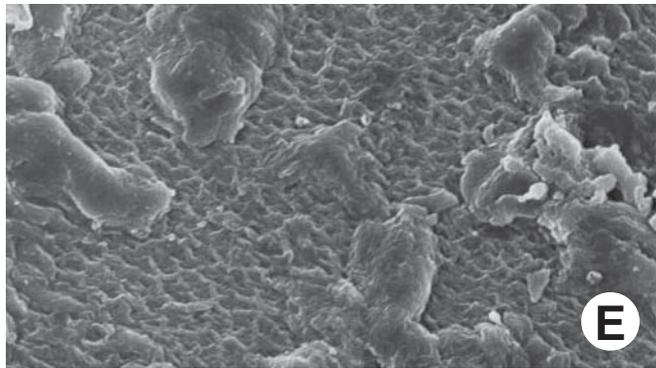
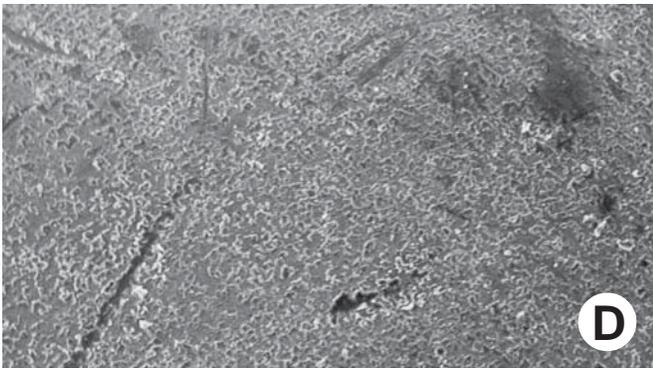
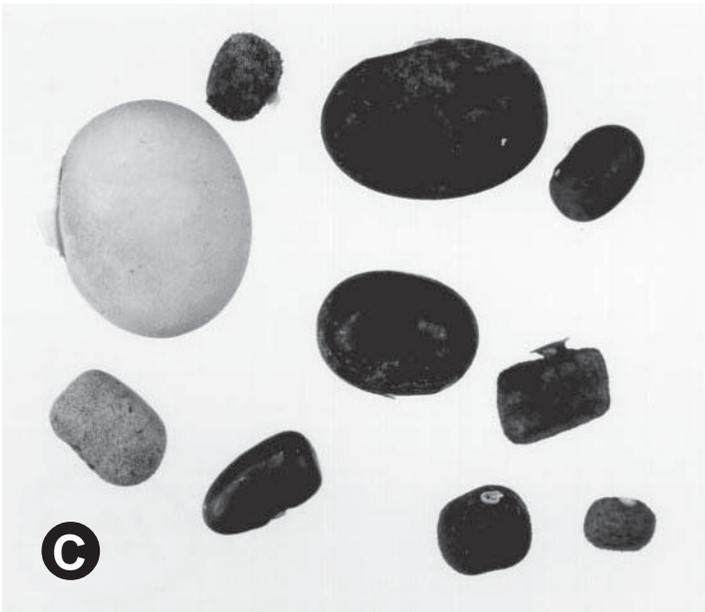
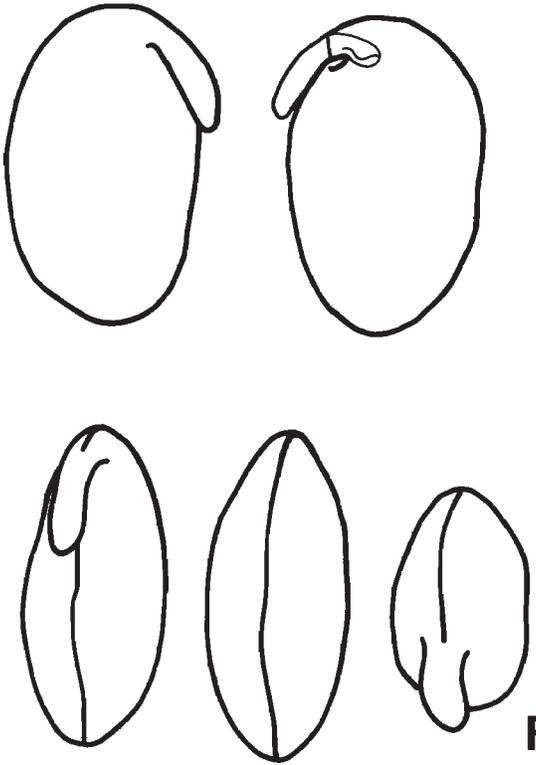
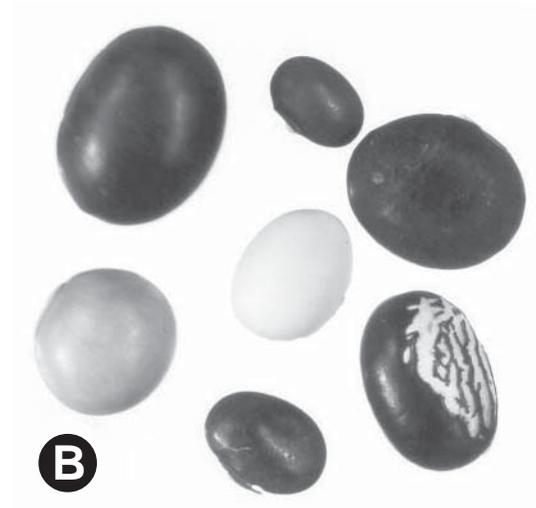
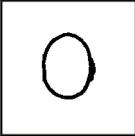
Seed $2-15.2 \times 1.8-10.2 \times 1-7$ mm; not overgrown; angular or not angular; symmetrical or asymmetrical; elliptic, oblong, ovate, quadrangular, rectangular, or reniform; compressed; with surface smooth; without or with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified or modified by a bloom; colored or clear; monochrome or mottled; with frequent mottles; brown to cream to tan to yellow; with brown overlay; glabrous; not smooth or smooth; with elevated features; reticulate, tuberculate, or papillate; coriaceous to chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with or without faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.4–5.8 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush or recessed; within rim or corona or not within corona, halo, or rim. Hilum corona color darker than testa. Hilum rim color of testa. Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; up to 1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded or recessed; same or similar color as testa; lighter or darker than testa; brown to tan; within rim or not within corona, halo, or rim. Lens rim color of, lighter than, or darker than testa. Endosperm thin or trace; covering entire embryo or restricted to region of embryo; adnate to testa or embryo. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to yellow to tan; inner face flat; glabrous around base of radicle. Embryonic axis straight to oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons to 1/2 to nearly length of cotyledons. Plumule well developed; glabrous.

Distribution: Asia, Australia, Oceania, and widely cultivated.

Notes: Lackey (1981b) commented that *Sinodolichos* (10.34) is possibly congeneric with *Glycine*. *Glycine*

max, the soybean, is the most valuable grain legume with a worldwide production of 123.6 million metric tons in 1995 (American Soybean Association 1997, Duke 1981, Maesen and Somaatmadja 1989, Schery 1972). Soybean is valuable because the seed is 13–25 percent oil, 30–50 percent protein, and 14–24 percent carbohydrate (Schery 1972).

Glycine: *G. max* (C. Linnaeus) E.D. Merrill (*B, D-F*), *G.*
spp. (*A, C*). *A*, Fruits ($\times 1.4$); *B-C*, seeds ($\times 2.5$,
 $\times 5.2$); *D-E*, testa ($\times 50$, $\times 1000$); *F*, embryos ($\times 3$).



Genus: *Teramnus* P. Browne

Phylogenetic Number: 10.36.

Tribe: Phaseoleae.

Subtribe: Glycininae.

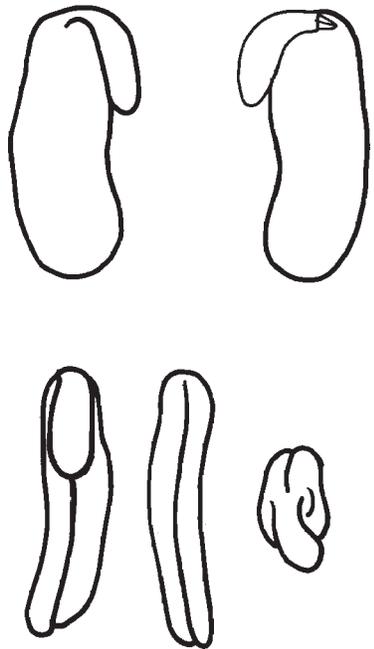
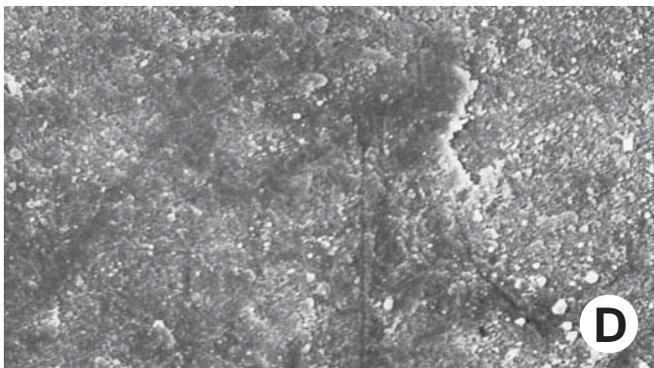
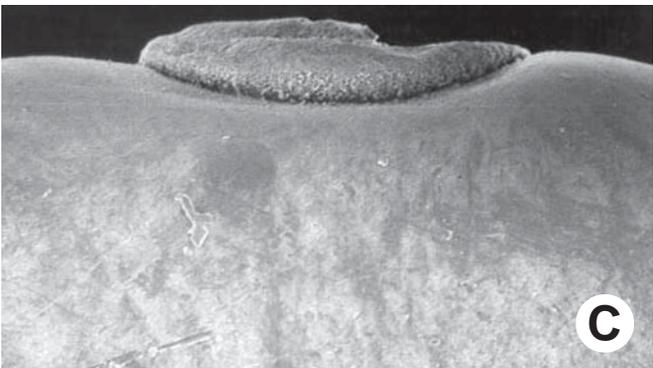
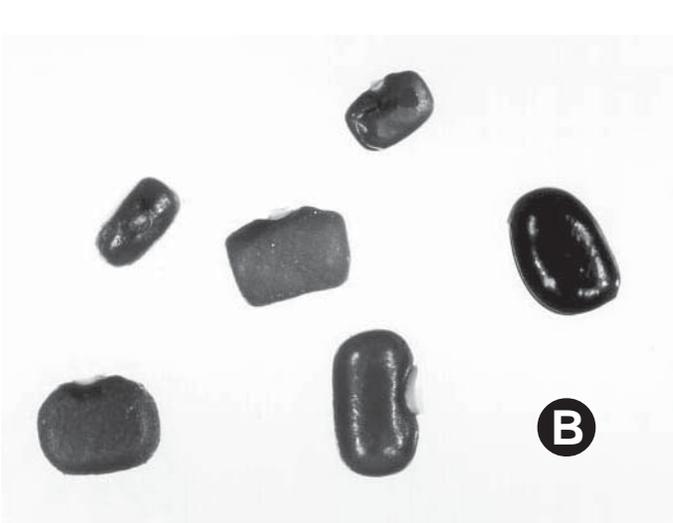
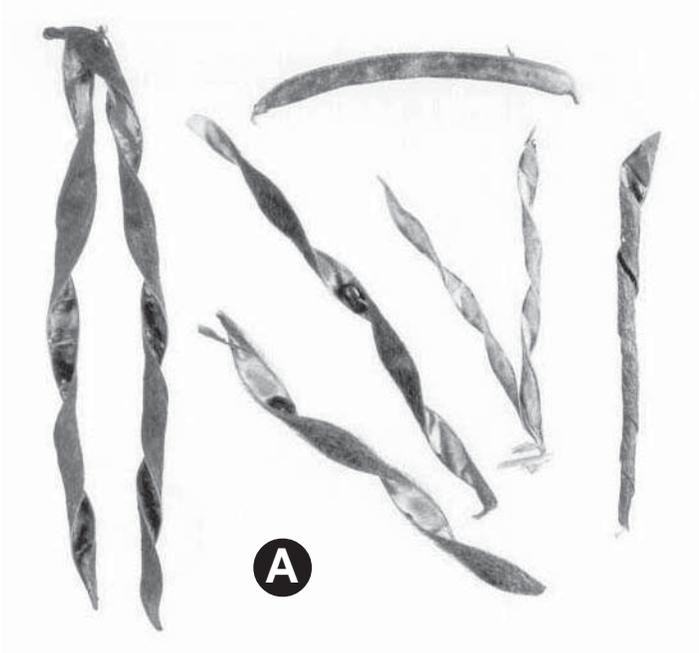
Species Studied—Species in Genus: 7 spp.—8 spp.

Fruit a legume; unilocular; $2.5\text{--}5 \times 0.2\text{--}0.4 \times 0.1\text{--}0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; tapered at apex; apex oblique to 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; chartaceous; seed chambers externally visible (slightly) or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown or tan; with brown overlay; with mottling over seed chambers; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; velutinous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; papillose and rugose; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome; brown to tan; smooth; septate or subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 6–11; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; triangular. Aril slightly fleshy or dry; when fleshy 2-lipped rim-aril; entire; covering less than 1/2 of seed; when dry 2-lipped rim-aril; entire; covering less than 1/2 of seed; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed $2.8\text{--}5.5 \times 1.6\text{--}3.3 \times 1.2\text{--}3.3$ mm; not overgrown; not angular; symmetrical; oblong to reniform; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; glossy to dull or glaucous; not modified or modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines present or absent; transverse. Rim absent. Wings absent. Raphe barely visible or not visible; from hilum through lens and base of seed to point opposite hilum; not bifurcating; lighter than testa; brown; flush. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.6–1.4 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of or darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; adjacent to hilum; flush; similar color as testa; darker than testa; brown; within corona or not within corona, halo, or rim. Lens corona color darker than testa. Endosperm thick; covering entire embryo; adnate to testa or embryo. Cotyledons not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without or with 1 margin recessed; recessed on same side as radicle; white to yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; with 90-degree turn; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Pantropics.

Teramnus: *T. uncinatus* (C. Linnaeus) O.P. Swartz (*C–E*), *T. spp.* (*A–B*). *A*, Fruits ($\times 1.4$); *B*, seeds ($\times 6.2$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 8$).



Genus: *Diphyllarium* F. Gagnepain

Phylogenetic Number: 10.37.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $6.3-8 \times 0.7 \times 0.3-4$ cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; slightly asymmetrical; nearly linear; when asymmetrical with both sutures nearly straight; not inflated; flattened; without beak; 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; leathery; seed chambers externally visible (barely). Fruit margin slightly constricted along both margins; without sulcus; embellished; with ridges. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; drying dark brown to black; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; slightly rugose; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; dark brown to black; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 7–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1.5 mm long; of 1 length only; flattened; triangular. Aril dry; rim- and tongue-aril; entire; covering less than 1/2 of seed; cream.

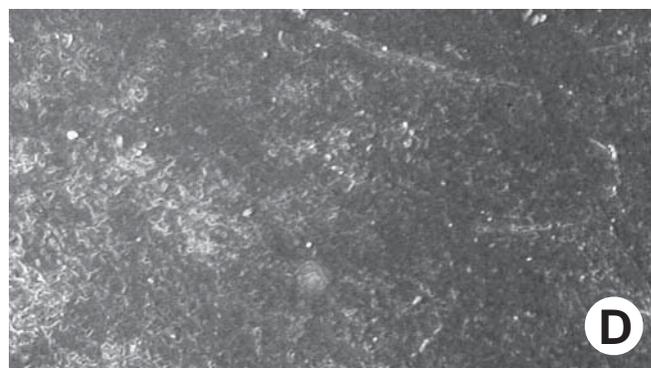
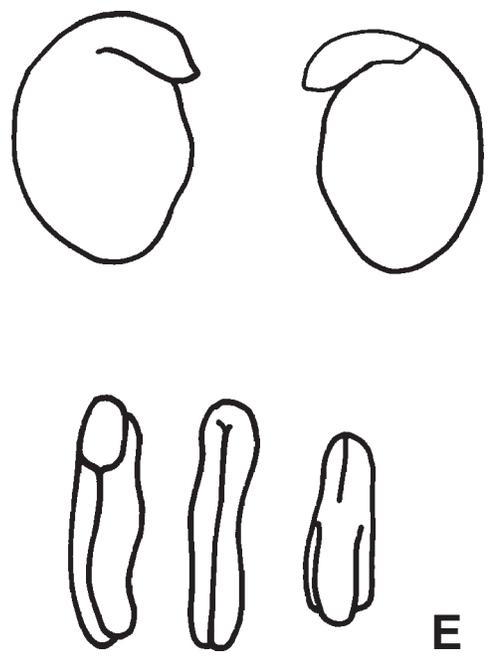
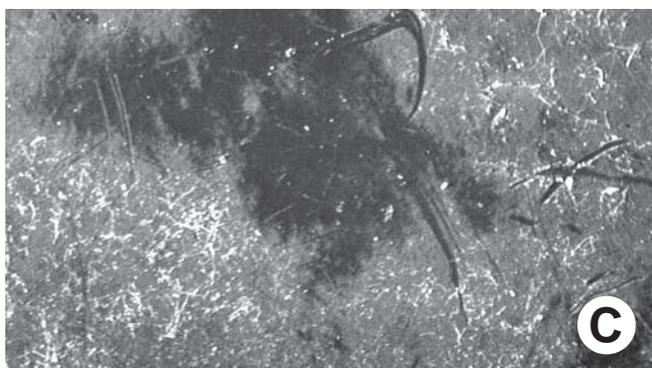
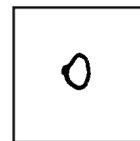
Seed $6.2 \times 5 \times 2.5$ mm; not overgrown; not angular; asymmetrical; elliptic; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with infrequent mottles; dark brown; with brown (lighter) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum;

larger than punctiform; 1.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; not within corona, halo, or rim. Endosperm absent. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split 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 oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Indochina.

Notes: Fruits studied were immature and from the same specimen.

Diphyllarium: *D. mekongense* F. Gagnepain (A–E). A, Fruits ($\times 1.4$); B, seeds ($\times 7.5$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Mastersia* G. Bentham

Phylogenetic Number: 10.38.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; 8–14 × 2.4–3 × 0.3–0.4 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; falcate or linear; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; flattened; with beak (short); declined; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded to tapered at base; base aligned to oblique (slightly) 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. Fruit margin not constricted; without sulcus; embellished. Fruit wings 1 or 2; 1–2 mm wide; sutural; on 1 or both sutures. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp glossy; monochrome; drying dark brown to black or black to yellow (reddish) to green (lighter in life); glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; exfoliating in part or not exfoliating; with cracks; cracking transverse to fruit length. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp glossy; streaked; brown; with brown (various shades) overlay; smooth; subseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–20; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 5 mm long; of 1 length only; filiform; contorted. Aril dry; rim- and tongue-aril; fimbriate; tan.

Seed 6.3 × 3.4 × 1.5 mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark reddish brown; glabrous; smooth; coriaceous. Fracture lines absent.

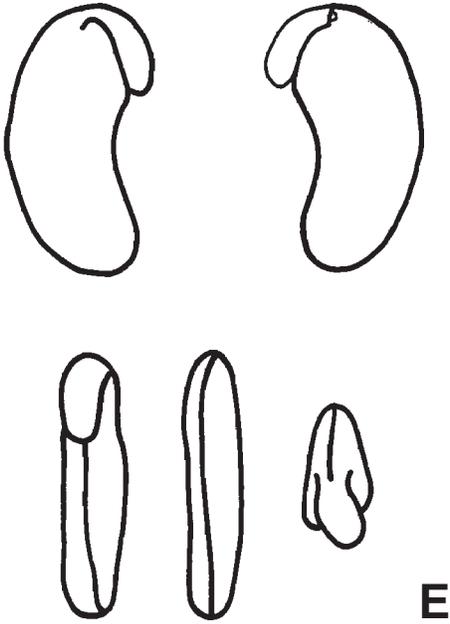
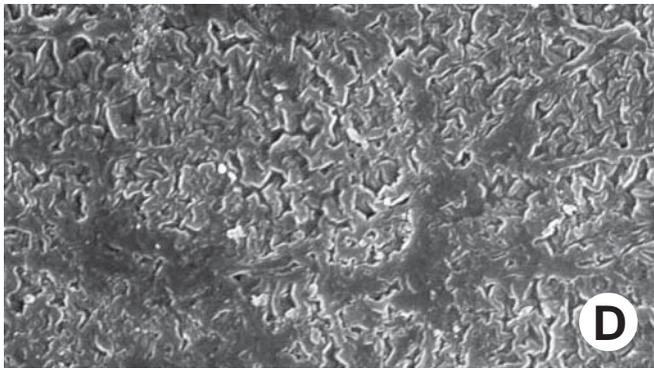
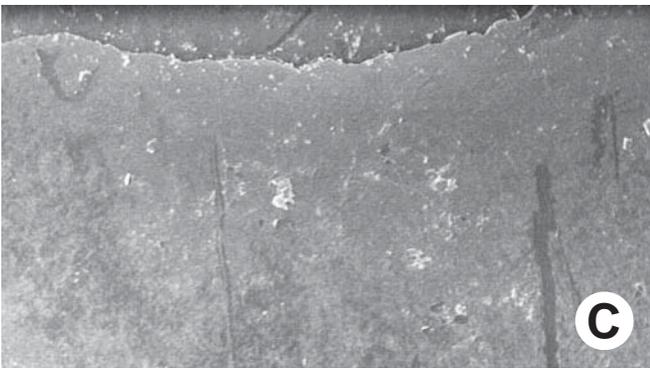
Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1 mm long; with curved outline; circular; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; within halo. Lens halo color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; brown; inner face flat. Embryonic axis straight; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Indomalaysia.

Notes: Lackey (1981b) noted that *Mastersia* resembles *Shuteria* (10.41), “especially in its seeds.” Welzen and Hengst (1984) monographed *Mastersia*. Only one immature seed was studied internally.

Mastersia: *M. bakeri* (S.H. Koorders) C.A. Backer (C–E), *M. spp.* (A–B). A, Fruits (× 0.9); B, seeds (× 7.7); C–D, testa (× 50, × 1000); E, embryos (× 6).

G



Genus: *Teyleria* C.A. Backer

Phylogenetic Number: 10.39.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $3-4 \times 0.4-0.5 \times 0.2-0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear or falcate (slightly); when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight; with solid beak the same color and texture as fruit; short tapered to rounded at apex; apex oblique with longitudinal axis of fruit; short tapered to rounded 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 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; dark brown; 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; with elevated features; not veined; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. 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 6–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril slightly fleshy; 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

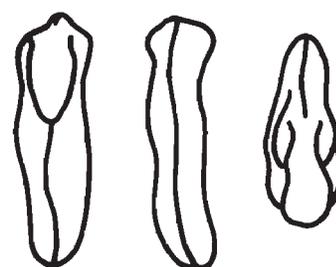
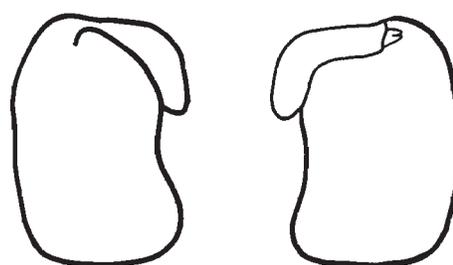
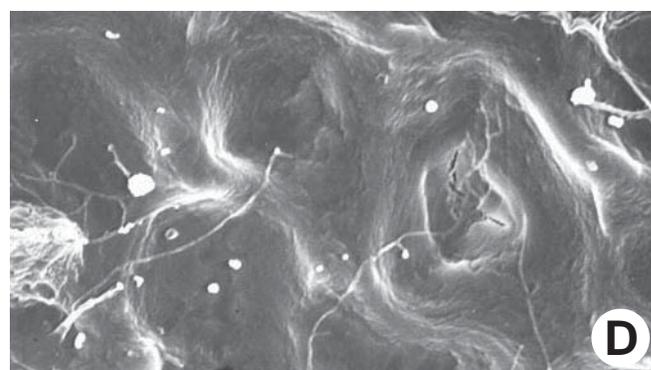
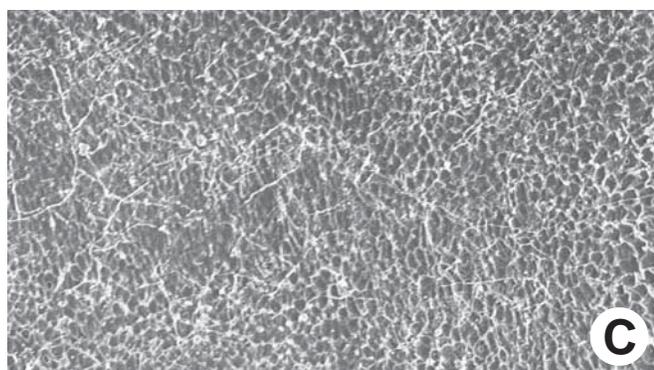
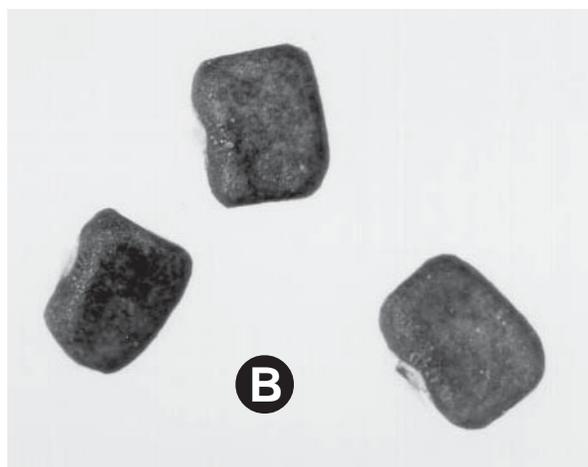
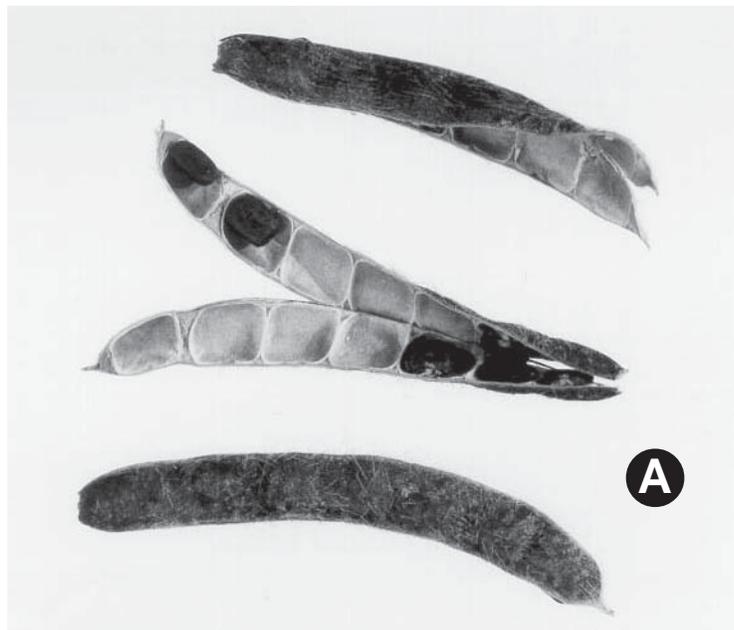
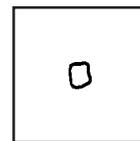
Seed $3-4.6 \times 2.8-3.7 \times 1.4-2$ mm; not overgrown; angular or not angular; symmetrical; oblong to rectangular; compressed; with surface smooth; without visible

radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering (few) to endocarp; dull; not modified or modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown; with brown (dark) overlay; glabrous; not smooth; with elevated features; reticulate. Fracture lines present or absent; transverse. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.8–1.1 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim or corona. Hilum corona color darker than testa. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; within rim or corona. Lens corona color darker than testa. Lens rim color darker than testa. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at 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 oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; with 90-degree turn or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Asia.

Notes: Van der Maesen (1986) provided an abbreviated treatment of *Teyleria* in his monograph of *Pueraria* (10.26), and we are using his species count and not that of Lackey (1981b).

Teyleria: *T. koordersii* (C.A. Backer) C.A. Backer (A–E). A, Fruits ($\times 2.1$); B, seeds ($\times 7.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



E

Genus: *Neonotonia* J.A. Lackey

Phylogenetic Number: 10.40.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $1.5\text{--}3.5 \times 0.2\text{--}0.6 \times 0.2\text{--}0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; slightly moniliform to linear (nearly); when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; compressed; without or with beak; straight; with solid beak (short) the same color and texture as fruit; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous (sub); seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin slightly constricted to constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; sericeous to tomentose; with pubescence golden, tan, or brown; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined or veined; transversely veined relative to fruit length; not tuberculate; sparsely papillose; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome; tan to white; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–10; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–1 mm long; of 1 length only; flattened; triangular. Aril dry; rim- and tongue-aril; entire; white.

Seed $4.6\text{--}5.6 \times 2.5\text{--}4 \times 2.2\text{--}2.7$ mm; not overgrown; not angular; asymmetrical; reniform to rectangular (nearly); compressed; with surface smooth; without visible

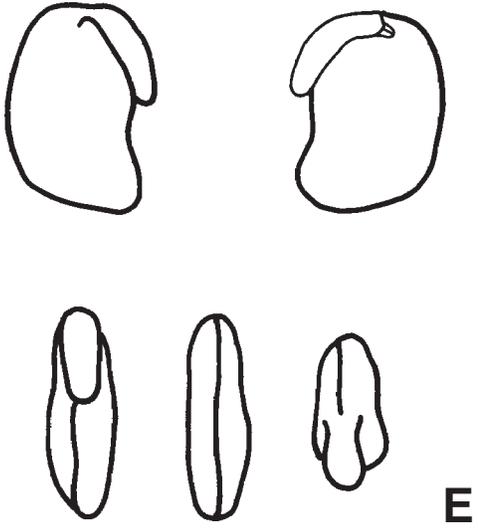
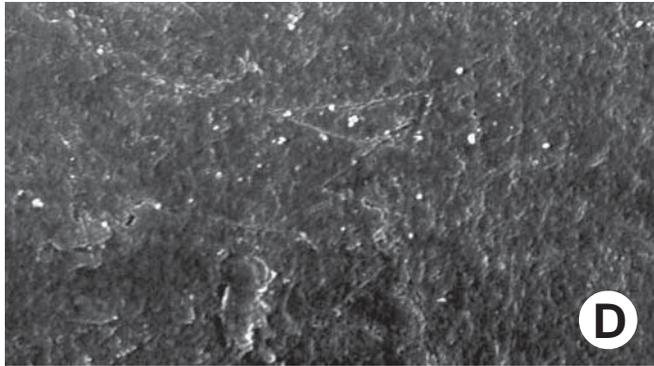
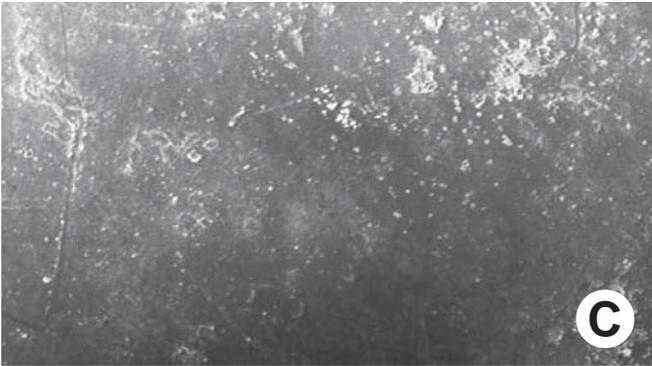
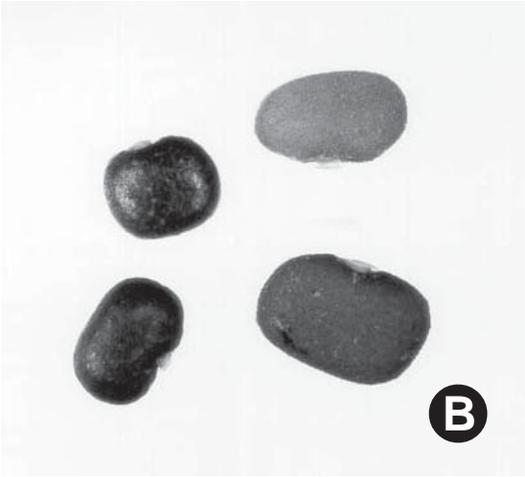
radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth or smooth; with elevated features; powdery and not rubbing off; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; without faboid split; larger than punctiform; 0.7–1 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within halo. Hilum halo color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; up to 0.9 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; within halo. Lens halo color darker than testa. Endosperm thin; covering entire embryo, restricted to region of embryo, or covering at least 1/2 of embryo, but not entire embryo; adnate to testa. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split 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 straight; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa to Asia.

Notes: Isely (Isely et al. 1980) described the second species of this genus.

Neonotonia: *N. verdcourtii* D. Isely (C–E), *N. wightii* (G.A.W. Arnott) J.A. Lackey (A–B). A, Fruits ($\times 3$); B, seeds ($\times 7.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 6$).

0



Genus: *Shuteria* R. Wight & G.A.W. Arnott

Phylogenetic Number: 10.41.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $3-5 \times 0.4-0.5 \times 0.2-0.3$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical or asymmetrical; linear or falcate (slightly); when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak (very short); straight; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique with longitudinal axis of fruit; short tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible (barely); with the raised seed chambers not torulose. 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; monochrome or multicolored; mottled; orangish brown to dark brown; with brown overlay; pubescent and indurate; with 1 type of pubescence; pilose to puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; irregularly veined; not tuberculate; papillose; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp absent. Endocarp dull; monochrome; brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 4–11; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; up to 0.6 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril or 2-lipped rim-aril; entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

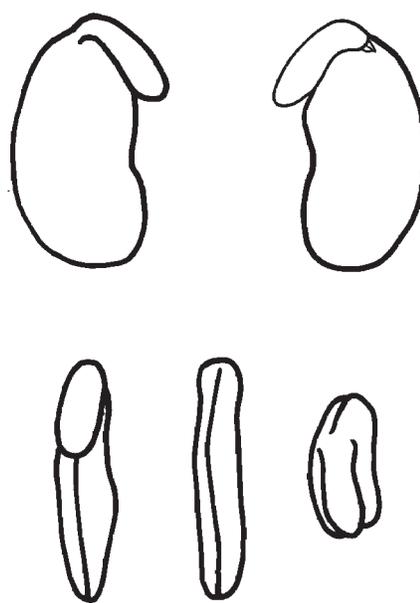
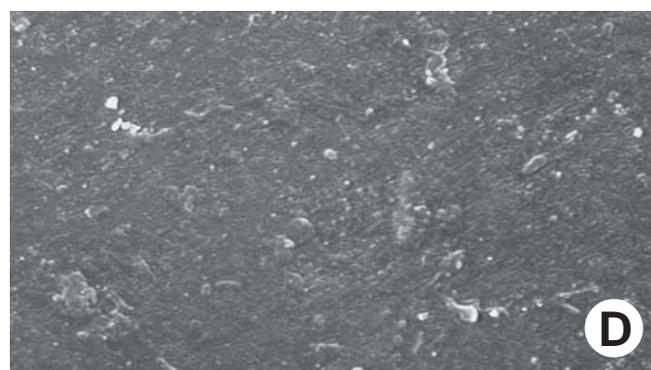
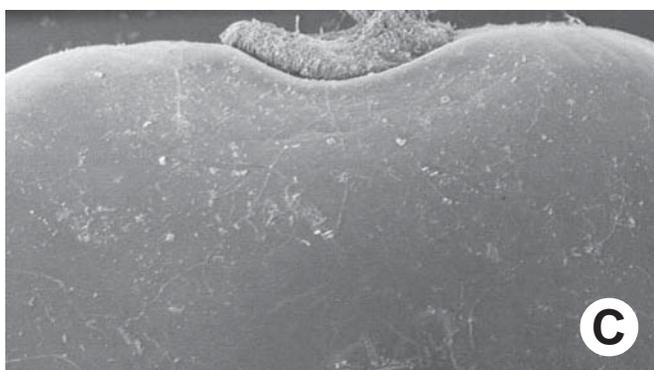
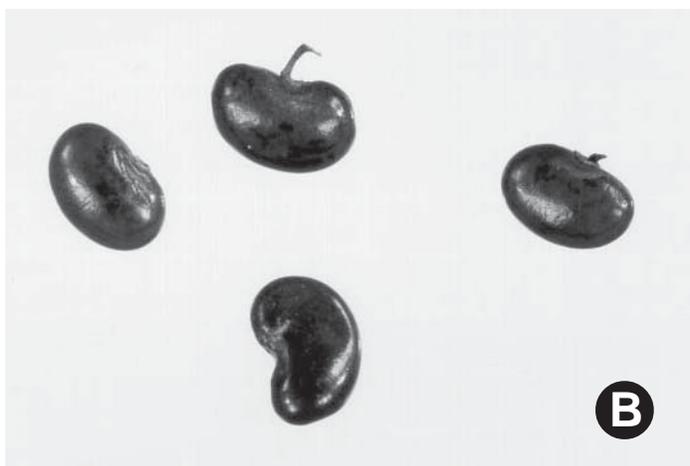
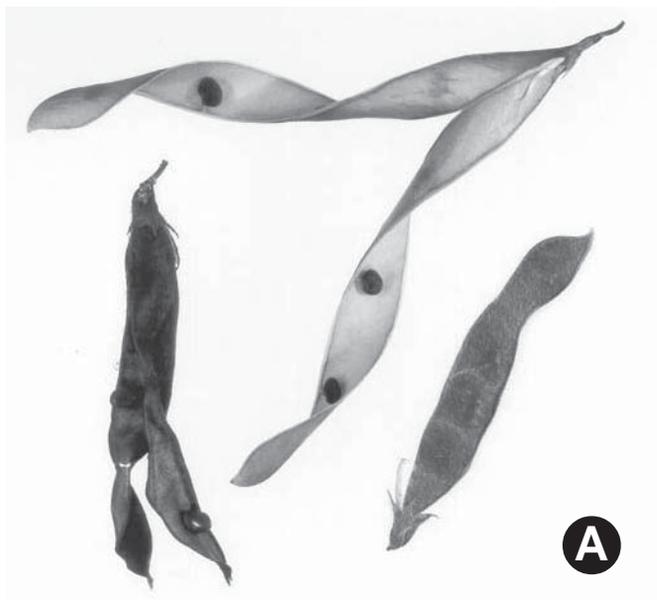
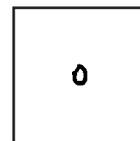
Seed $2.7-5 \times 1.7-3 \times 1.4-2.5$ mm; not overgrown; not angular; symmetrical or asymmetrical; reniform; terete to compressed; with surface smooth; with or without visible radicle and cotyledon lobes; without external

groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; not smooth; with recessed features; striate or pitted with small separate pits; coriaceous to chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.4 mm long; with curved outline; circular to elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim or corona. Hilum corona color darker than testa. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–0.7 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; similar color as testa; darker than testa; brown; within rim or corona. Lens corona color darker than testa. Lens rim color darker than testa. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons smooth or not smooth; 1–3 grooves on each face; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Indomalaysia.

Notes: Van Thuan (1972) revised this genus. Lackey (1981b) commented that *Shuteria* resembles *Mastersia* (10.38), “especially in its seeds.”

Shuteria: *S. involcrata* (N. Wallich) R. Wright & G.A.W. Arnott (C–E), *S. spp.* (A–B). A, Fruits ($\times 1.7$); B, seeds ($\times 7.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Dumasia* A.-P. de Candolle

Phylogenetic Number: 10.42.

Tribe: Phaseoleae.

Subtribe: Glycininae.

Species Studied—Species in Genus: 4 spp.—8 spp.

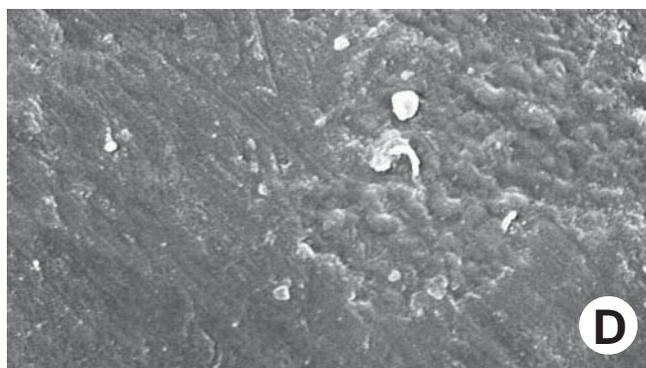
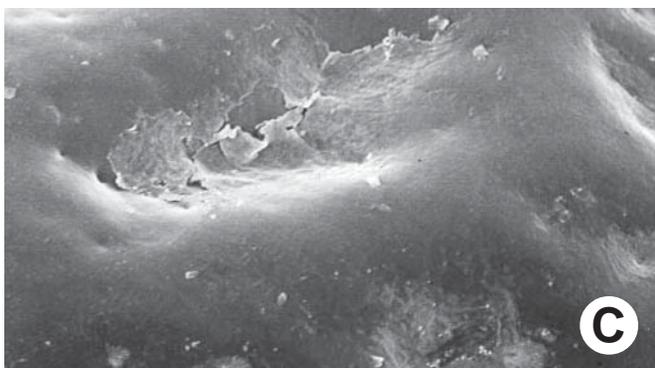
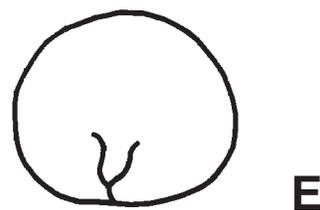
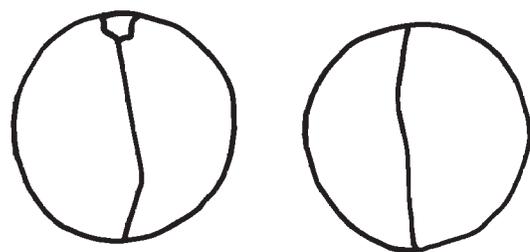
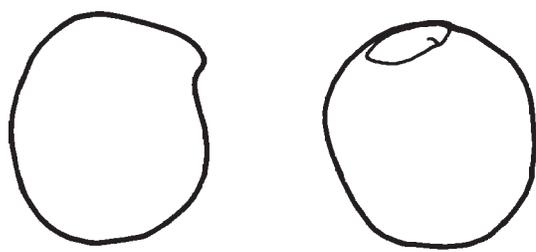
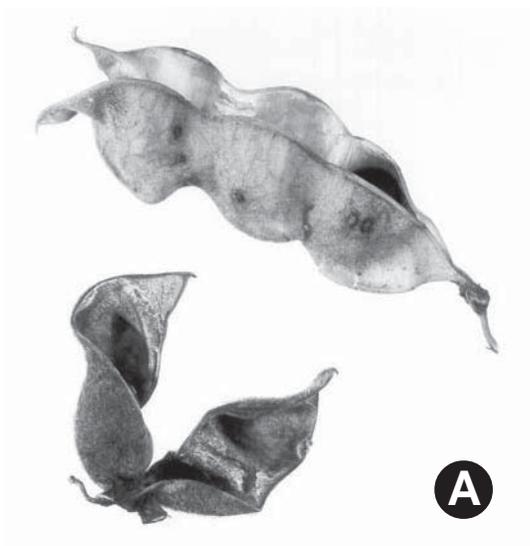
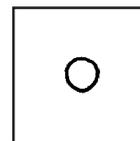
Fruit a legume; unilocular; $1.3\text{--}2.9 \times 0.7\text{--}0.8 \times 0.4\text{--}0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; moniliform; when asymmetrical with both sutures parallelly curved; not inflated; compressed to terete; with beak (short); declined; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves reflexing. Replum invisible. Epicarp dull; monochrome; dark brown to tan; pubescent and indurate or pubescent but soon deciduous; with 1 type of pubescence; pilose or sericeous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; irregularly veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; monochrome; tan; smooth; nonseptate; 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 measured; $0.5\text{--}0.7$ mm long; of 1 length only; flattened; triangular. Aril dry; rim- and tongue-aril or rim-aril; entire; brown.

Seed $6.5\text{--}7.5 \times 5\text{--}6.3 \times 4.5\text{--}6$ mm; not overgrown; not angular; symmetrical; elliptic or ovate; terete; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glaucous; modified by a bloom; colored; monochrome; black to brown (dark); glabrous; smooth; coriaceous. Fracture

lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating; not bifurcating; color of testa; black or brown; recessed. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; $1\text{--}2.2$ mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; $0.5\text{--}1$ mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; black or brown; within corona or not within corona, halo, or rim. Lens corona color darker than testa. Endosperm thin or trace; covering entire embryo or restricted to region of 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; partially concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; white or tan; inner face concave; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa and Asia.

Dumasia: *D. truncata* P.F.B. von Siebold & J.G. Zuccarini (C–E), *D. villosa* A.-P. de Candolle (A), *D. spp.* (B). A, Fruits ($\times 2.5$); B, seeds ($\times 7.1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Cologania* K.S. Kunth

Phylogenetic Number: 10.43.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $2-6 \times 0.3-0.6 \times 0.2-0.4$ cm; without orifice formed by curving of fruit or fruit segments; straight to curved; not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened to terete; with beak (short); declined; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; tapered or long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to chartaceous; seed chambers externally invisible or visible (slightly); with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan to brown (dark); pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; puberulent or tomentose; with pubescence golden or gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; monochrome; tan to white; scurfy, smooth, or cracked; septate or subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–14; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; triangular. Aril dry; rim- and tongue-aril; entire; brown to cream.

Seed $2.7-5.2 \times 2-3.5 \times 1.7-3$ mm; not overgrown; angular or not angular; symmetrical or asymmetrical; oblong, ovate, rectangular, reniform, or trapezoid; terete; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between

radicle and cotyledon lobes; with shallow or without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown, tan, or yellow; with black overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially or fully concealed; concealed by aril; with or without faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–1 mm long; with curved outline; circular, elliptic, or oval; apical according to radicle tip but marginal according to seed length; flush; within corona. Hilum corona color lighter or darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; linear or elliptic; not in groove of raphe; confluent with hilum; flush; same or similar color as testa; darker than testa; brown; within corona. Lens corona color darker than testa. Endosperm thick to 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; white, yellow, or tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

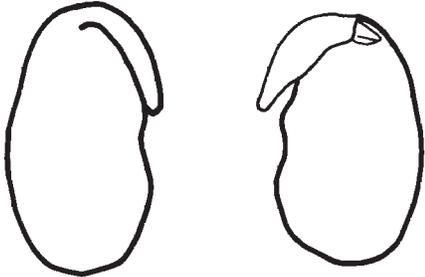
Distribution: Mexico, Central and South America.

Cologania: *C. ovalifolia* K.S. Kunth (C–E), *C. spp.* (A–B). A, Fruits ($\times 2.4$); B, seeds ($\times 7.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).

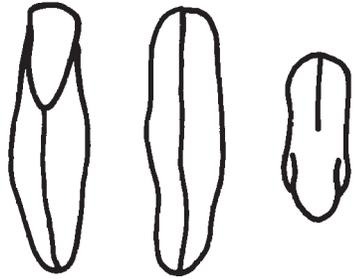
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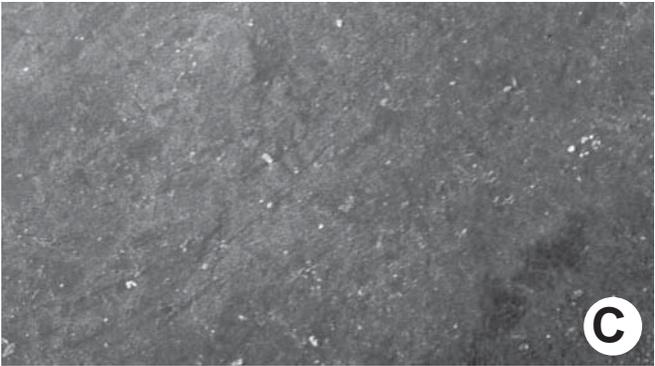
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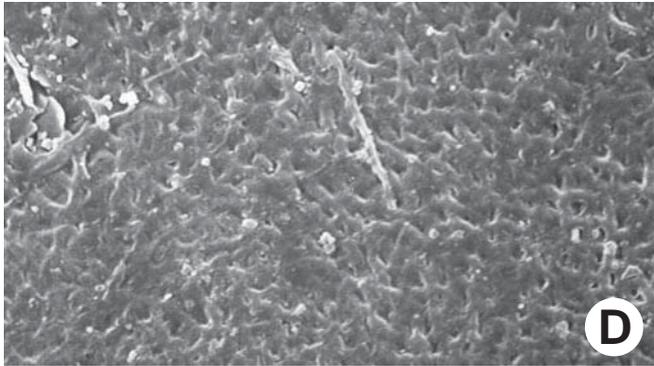
B



E



C



D

Genus: *Amphicarpaea* S. Elliott ex T. Nuttall

Phylogenetic Number: 10.44.

Tribe: Phaseoleae.

Subtribe: Glycininae.

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

Fruit a legume; unilocular; $1.5\text{--}3.8 \times 0.5\text{--}1.1 \times 0.2\text{--}0.8$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved or straight; not plicate; not twisted; asymmetrical or symmetrical; oblong or falcate; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed; with or without beak; straight; with solid beak the same color and texture as fruit; tapered or rounded at apex; apex aligned with longitudinal axis of fruit; tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible to invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with ridges. Fruit wings absent. Fruit substipitate; with the stipe 2–4 mm long. Fruit with all layers dehiscent (aboveground fruits) or indehiscent (belowground fruits); splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan or brown; with brown overlay; with mottling over seed chambers; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent [along sutural ridges (aboveground fruits) or all over (belowground fruits)]; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp present (aboveground fruits) or absent (belowground fruits); thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp present (aboveground fruits) or absent (belowground fruits); dull; monochrome; tan; smooth or cobwebby; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp or to epicarp; entire. Seeds 1–3; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–0.8 mm long; of 1 length only; flattened;

triangular. Aril present or absent; dry; 2-lipped rim-aril; entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; cream.

Seed $4\text{--}16 \times 4\text{--}11.3 \times 1.5\text{--}7.4$ mm; not overgrown or overgrown, 1 seed filling entire fruit cavity; not angular; symmetrical; reniform or ovate; compressed; with surface smooth or ridged; without or with 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; mottled; brown (or reddish brown); with brown (dark) overlay; glabrous; smooth or not smooth; with elevated features; wrinkled; coriaceous or chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with or without faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim or within rim. Lens rim color darker than testa. Endosperm absent or present; trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; not sufficiently folded for inner face to touch itself; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan or white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; narrowly triangular; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

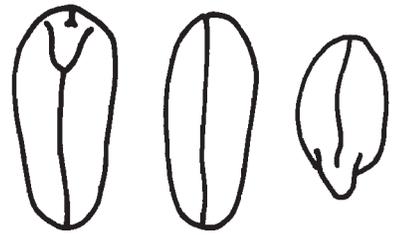
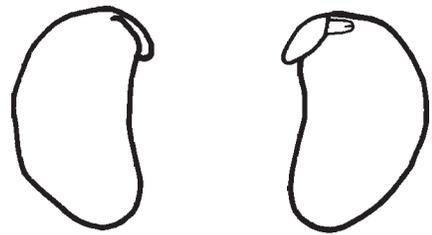
Distribution: North America, Africa, and Asia.

Notes: Turner and Fearing (1964) monographed *Amphicarpaea*. *Amphicarpaea bracteata* has heteromorphic seeds with large, underground, single-seeded

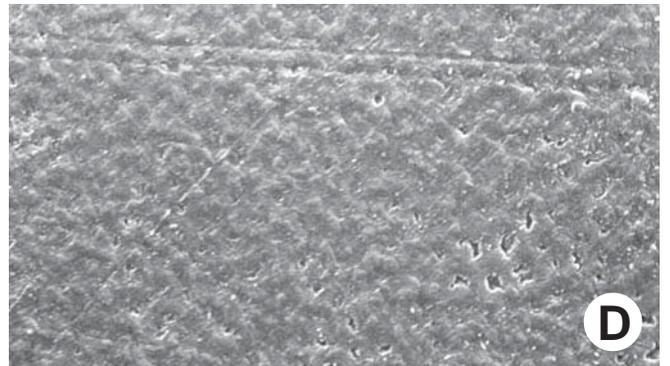
fruits and aerial, 1-3-seeded fruits. The spelling of this genus, *Amphicarpaea*, has been conserved against '*Amphicarpa*' (Greuter et al. 1994).

Amphicarpaea: *A. bracteata* (C. Linnaeus) M.L. Fernald
(*C-E*), *A. spp.* (*A-B*). *A*, Fruits ($\times 2.6$); *B*, seeds
($\times 3.8$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 6$).

0



E



Genus: *Calopogonium* A.N. Desvaux

Phylogenetic Number: 10.45.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

Species Studied—Species in Genus: 5 spp.—8 spp.

Fruit a legume; unilocular; $1.5\text{--}12 \times 0.3\text{--}1 \times 0.2\text{--}0.5$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; without beak; tapered or short tapered at apex; apex aligned with longitudinal axis of fruit; tapered or truncate at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves revolute. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (darker) overlay; pubescent and indurate or pubescent but soon deciduous; with 1 type of pubescence; puberulent, velutinous, or sericeous; with pubescence golden; with pubescence uniformly distributed or denser near sutures, sparse centrally; with simple hairs; pliable; with hair bases swollen or plain; eglandular; smooth or not smooth; with elevated features; not veined; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous or chartaceous. Endocarp dull; monochrome or mottled; tan; with mottling over seed chambers; with green overlay; smooth and floury-filamentous; septate to subseptate; with septa thin (tissue paper-like), flexible to thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–11; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry; rim-, tongue-, or partial rim-aril; entire or fimbriate; covering less than 1/2 of seed; cream to tan.

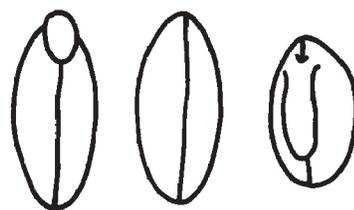
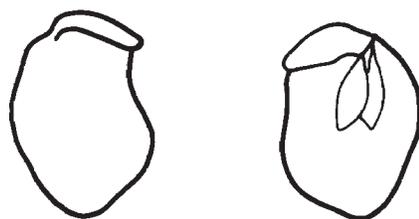
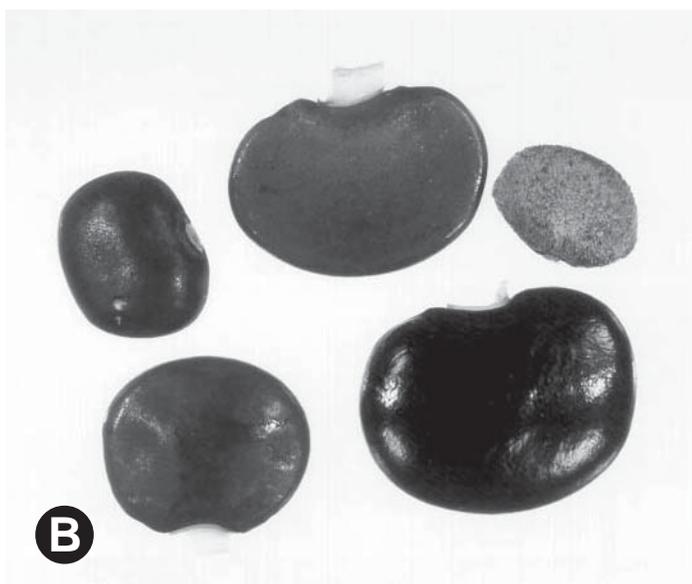
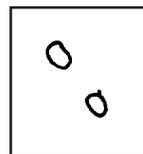
Seed $4.2\text{--}8 \times 2.6\text{--}5 \times 2\text{--}3$ mm; not overgrown; angular or not angular; symmetrical; ovate, rectangular, or

reniform; compressed; 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; with frequent mottles; brown, tan, or yellow; with brown overlay; glabrous; smooth; coriaceous or chartaceous. Fracture lines absent or present (rarely); transverse. Rim absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–2 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within rim and halo, within rim, or within halo. Hilum halo color darker than testa. Hilum rim color of or darker than testa. Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; 0.4–0.6 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded or flush; same color as or dissimilar color from testa; darker than testa; black or brown; within rim or halo. Lens halo color darker than testa. Lens rim color of or darker than testa. Endosperm thin; covering entire embryo or restricted to region of 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; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan or green (rarely); inner face flat; glabrous around base of radicle. Embryonic axis right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

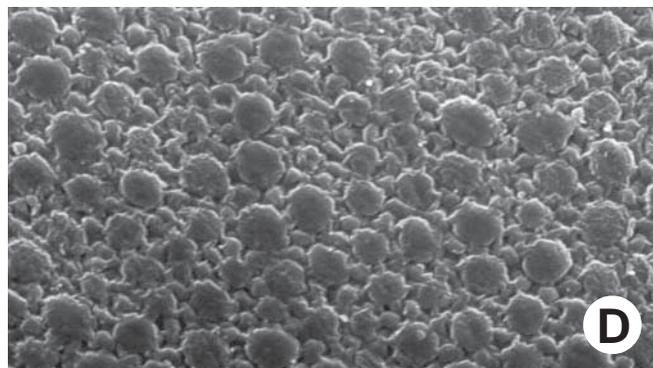
Distribution: New World tropics; cultivated as a cover crop (*C. mucunoides* A.N. Desvaux).

Notes: *Calopogonium* was revised for Brazil by Carvalho-Okano and Leitão filho (1985).

Calopogonium: *C. galactoides* (K.S. Kunth) W.B. Hemsley (*C-E*), *C. spp.* (*A-B*). *A*, Fruits ($\times 1.5$); *B*, seeds ($\times 6.7$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 6$).



E



Genus: *Pachyrhizus* A. Richard ex A.-P. de Candolle

Phylogenetic Number: 10.46.

Tribe: Phaseoleae.

Subtribe: Diocleinae.

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

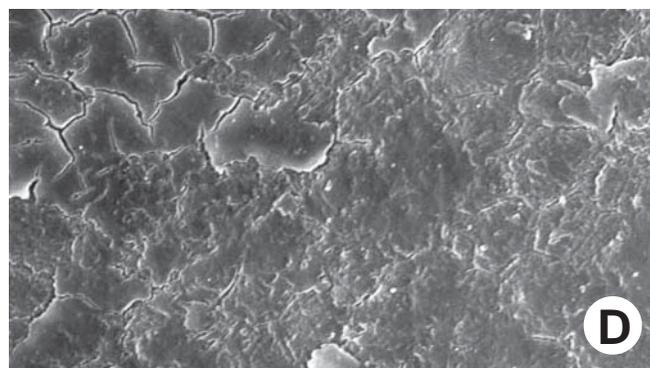
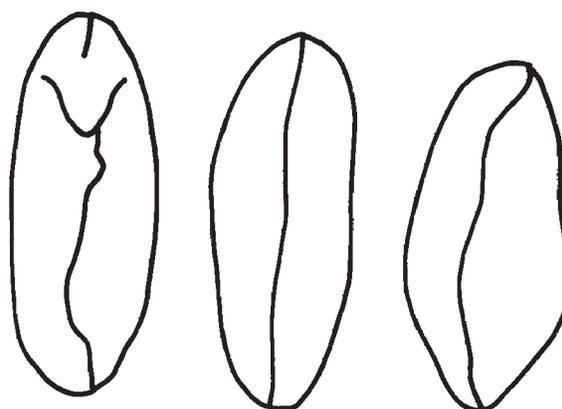
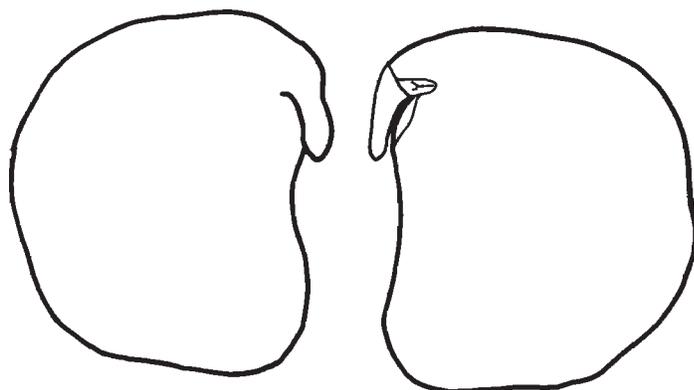
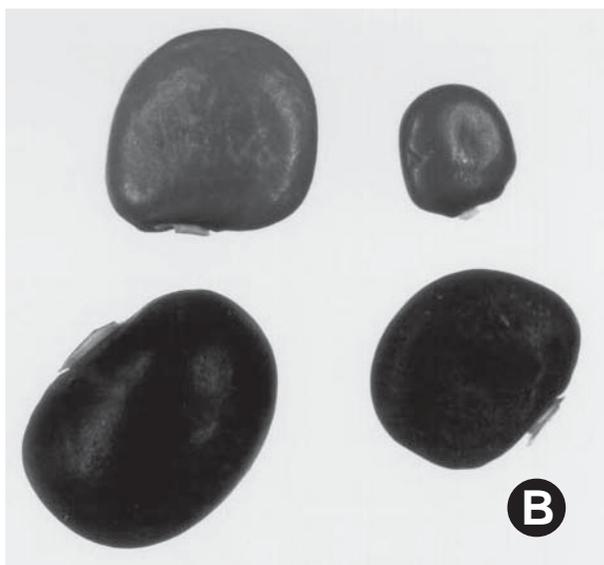
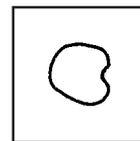
Fruit a legume; unilocular; $6\text{--}25.5 \times 0.8\text{--}2.8 \times 0.3\text{--}0.6$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical or symmetrical; linear; when asymmetrical with both sutures parallelly curved; not inflated; compressed to terete; without beak; tapered at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with flanges (narrow) or thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with black, brown, or gray overlay; pubescent and indurate or pubescent but soon deciduous; with hairs erect or appressed; with 1 type of pubescence; tomentose or sericeous (and appressed); with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with recessed features; not veined; not tuberculate; grooved; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome; tan; smooth and scurfy; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 4–12(–18); length transverse to or parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–2 mm long; of 1 length only; flattened; triangular. Aril dry; tongue-aril or 2-lipped rim-aril; entire; covering less than 1/2 of seed; cream.

Seed $9.5\text{--}15.5 \times 9\text{--}14.5 \times 4.5\text{--}6.5$ mm; not overgrown; angular or not angular; symmetrical or asymmetrical; D-shaped, quadrangular, rectangular, or reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown to reddish brown, green (olive), red (brownish), or black; glabrous; smooth or not smooth; with recessed features; pitted with small separate pits; coriaceous. Fracture lines absent or present; transverse. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 3.5–4 mm long; with curved outline; elliptic; apical at apex of radicle tip; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 2.3–2.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; dissimilar color from testa; black; within rim. Lens rim color of or darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan; inner face flat; glabrous around base of radicle. Embryonic axis straight or oblique; parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight or curved (slightly); straight with embryonic axis; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary to moderately developed; glabrous.

Distribution: Neotropics and widely cultivated.

Notes: Sørensen (1988) monographed the genus, and our species count is based on his treatment rather than that of Lackey (1981b).

Pachyrhizus: *P. erosus* (C. Linnaeus) I. Urban (C–E), *P.* spp. (A–B). A, Fruits ($\times 1$); B, seeds ($\times 3.2$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Kennedia* E.P. Ventenat

Phylogenetic Number: 10.47.

Tribe: Phaseoleae.

Subtribe: Kennediinae.

Species Studied—Species in Genus: 10 spp.—15 spp.

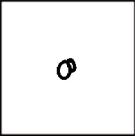
Fruit a legume; unilocular; $3-7 \times 0.7-1.2 \times 0.3-0.7$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical (or nearly symmetrical); linear; not inflated; compressed; without beak; tapered at apex; apex aligned to oblique with longitudinal axis of fruit; short tapered to tapered at base; base aligned to oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible or invisible. Fruit margin not constricted or constricted (rarely slightly); slightly constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; light to dark brown; pubescent and indurate, glabrous, or pubescent but soon deciduous; with 1 type of pubescence; tomentose or sericeous; with pubescence gray-brown or gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; drying wrinkled; not exfoliating; without cracks. Mesocarp thin; 2-layered; without balsamic vesicles; without fibers; with spongy layer over solid layer; coriaceous. Endocarp dull; monochrome or mottled; brown or tan; with mottling and mottling (dark) over seed chambers; with brown overlay; smooth; septate; with septa thin (tissue paper-like), flexible; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 4–9; length transverse or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 2.5 mm long; of 1 length only; flattened; triangular. Aril fleshy; annular (bulbous and partially extended over lens at end opposite radicle lobe, narrow at end near radicle lobe); entire to crenate; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

Seed $3.7-8.5 \times 3.8-5$ (including aril) $\times 2.8-2.9$ mm; not overgrown; not angular; asymmetrical; reniform; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown (or dark brown); with brown (darker) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2.4 mm long; with curved outline; elliptic; marginal according to radicle tip; flush; within halo. Hilum halo color darker than testa. Lens discernible (but mostly hidden by aril); equal to or greater than 0.5 mm in length; up to 1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; within halo. Lens halo color darker than testa. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin 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 oblique; oblique or parallel to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

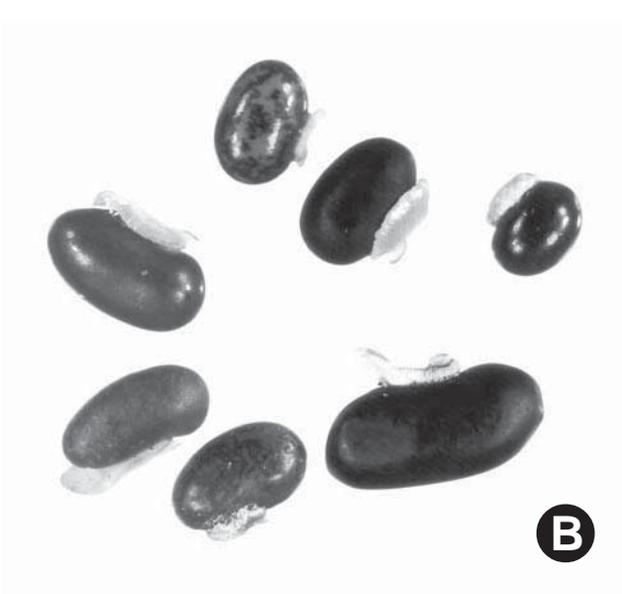
Distribution: Australia.

Notes: Berg (1979) studied the myrmecochorous dispersal of *Kennedia* and *Hardenbergia* (10.48) seeds.

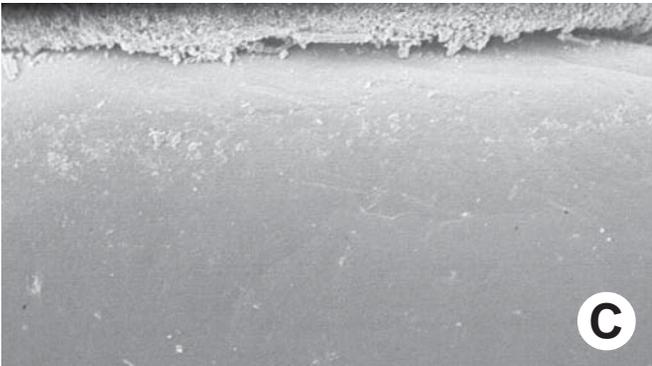
Kennedia: *K. macrophylla* (C.F.W. Meissner) G. Bentham (C–E), *K.* spp. (A–B). A, Fruits ($\times 1.4$); B, seeds ($\times 5$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



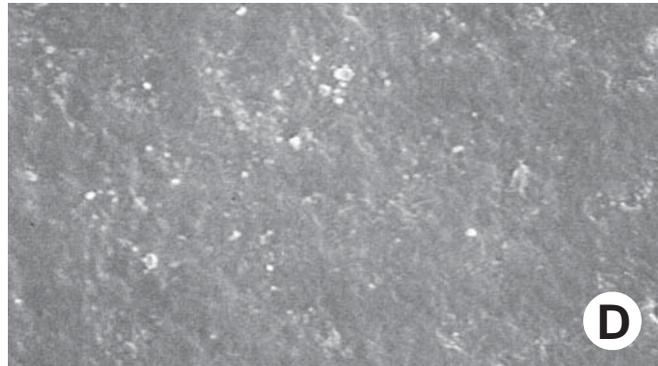
A



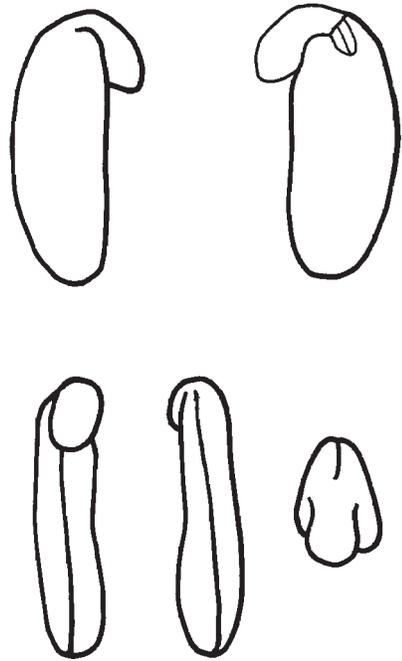
B



C



D



E

Genus: *Hardenbergia* G. Bentham

Phylogenetic Number: 10.48.

Tribe: Phaseoleae.

Subtribe: Kennediinae.

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

Fruit a legume; unilocular; 3.5–4.5 (from literature) × 0.3–1.1 (from literature) × 0.4 cm (from literature); with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; nearly linear; when asymmetrical with both sutures parallelly curved; not inflated; compressed to terete; without beak; short tapered at apex; apex aligned (nearly) with longitudinal axis of fruit; tapered to short tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown (to violet brown in literature); glabrous; eglandular; without spines; not smooth; with elevated or recessed features; not veined; not tuberculate; minutely, obliquely rugose; slitted obliquely; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; orangish brown or tan; smooth or cracked; nonseptate; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 5–6; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 2 mm long; of 1 length only; flattened; triangular. Aril fleshy; annular to 2-lipped rim-aril (with lips fused, but thinner in area of fusion); entire to crenate; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril.

Seed 5.5–9 × 2.6–4.5 × 2.5–4 mm; not overgrown; not angular; asymmetrical; elliptic to rectangular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on

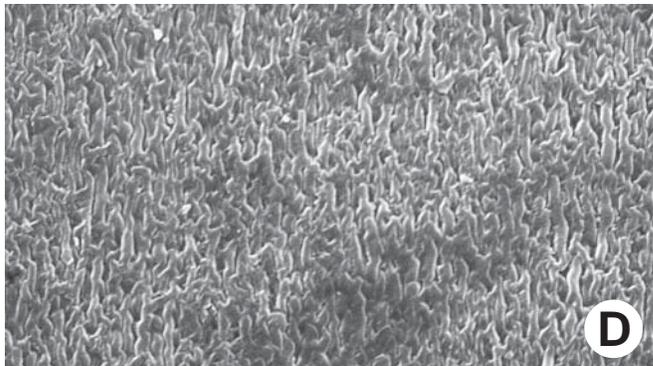
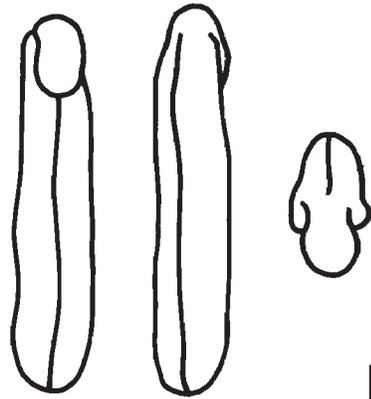
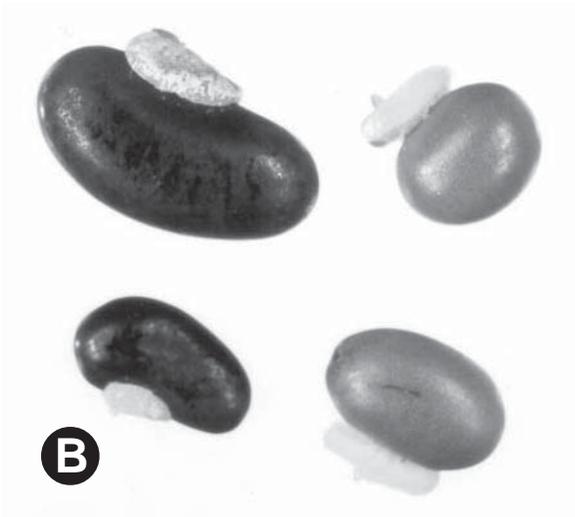
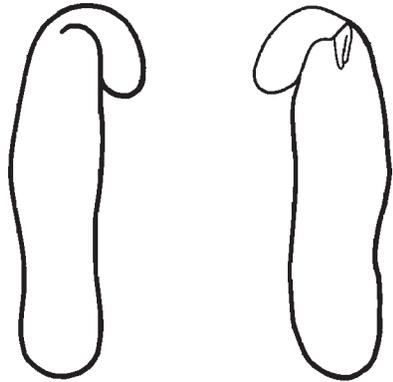
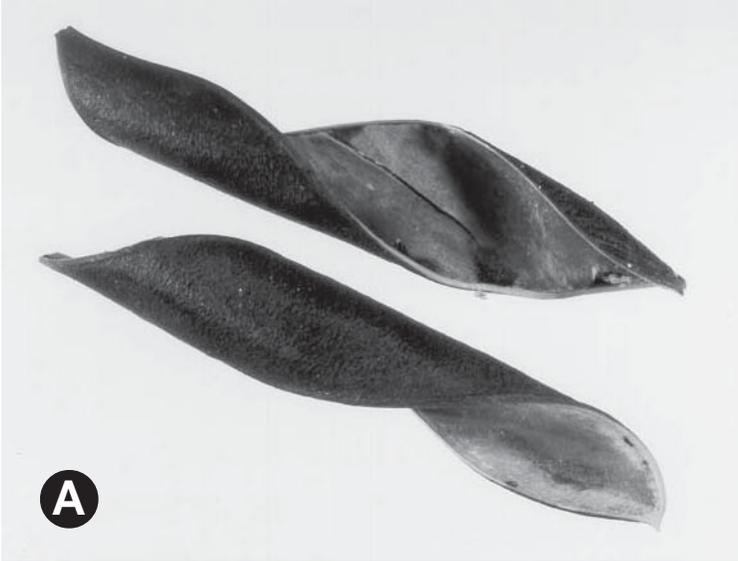
seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2.5–4 mm long; with curved outline; elliptic; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; up to 1.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; within halo. Lens halo color darker than testa. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; split over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Australia.

Notes: Berg (1979) studied the myrmecochorous dispersal of *Hardenbergia* and *Kennedia* (10.47) seeds.

Hardenbergia: *H. violacea* (G.V. Schneevogt) W.T. Stearn (A, C–E), *H. spp.* (B). A, Fruits (× 2.6); B, seeds (× 6); C–D, testa (× 50, × 1000); E, embryos (× 6).

0



Genus: *Vandasina* S. Rauschert

Phylogenetic Number: 10.49.

Tribe: Phaseoleae.

Subtribe: Kennediinae.

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

Fruit a legume; unilocular; 6–9.2 × 1.5–2 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; nearly linear; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without to with beak (short); declined; with solid beak the same color and texture as fruit; tapered to short 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 invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent but soon deciduous; with 1 type of pubescence; sericeous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; slitted obliquely; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; ligneous. Endocarp dull; mottled; tan; with mottling (dark); with brown overlay; spongy; nonseptate; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 4; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 3 mm long; of 1 length only; thick; straight. Aril fleshy; annular or 2-lipped rim-aril (with lips fused, but narrower at fusion point); crenate; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril.

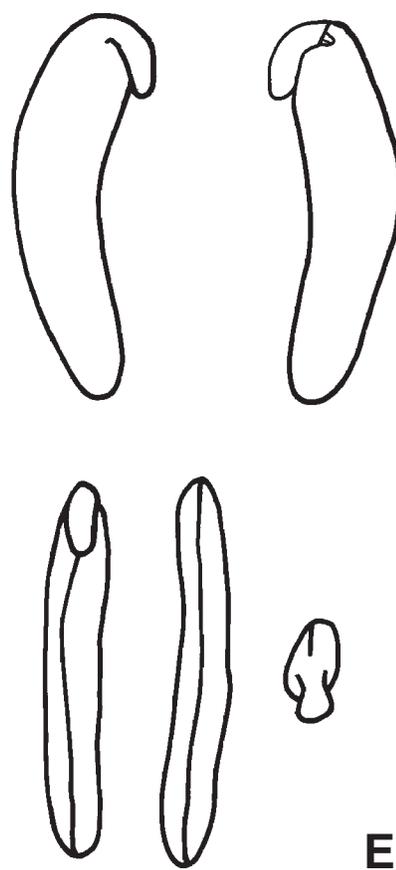
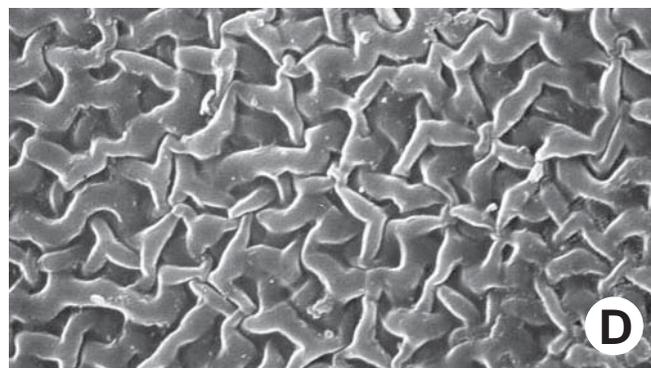
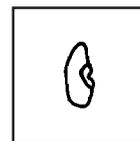
Seed 10–12 × 4.2–5.7 × 3.5–3.7 mm; not overgrown; not angular; asymmetrical; reniform to elliptic; terete to compressed (slightly); with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus;

without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 4.2–5 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; equal to or greater than 0.5 mm in length; up to 1.2 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; not within corona, halo, or rim or within halo. Lens halo color darker than testa. Endosperm thick; covering entire embryo; adnate to testa or embryo. Cotyledons not smooth; sulcate; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: New Guinea and Australia (Queensland).

Notes: The name *Vandasia* K. Domin, used by Lackey (1981b), was rejected because it is a later homonym of *Vandasia* J. Velenovsky (Gasteromycetes). Rauschert (1982) replaced it with *Vandasina*. Lackey noted that this genus is “a segregate of *Hardenbergia* (10.48) from which it differs by the larger keel.” Only two fruits were studied.

Vandasina: *V. retusa* (G. Bentham) S. Rauschert (A–E). A, Fruits (× 1.2); B, seeds (× 6.7); C–D, testa (× 50, × 1000); E, embryos (× 5).



Genus: *Dysolobium* (G. Bentham) D. Prain

Phylogenetic Number: 10.50.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; 3.5–20 × 0.8–2.3 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed to terete; without beak; tapered or short tapered 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 to ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with ridges or thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; puberulent or velutinous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose and wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; ligneous to coriaceous. Endocarp dull; monochrome; brown to tan; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–15; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–3 mm long; of 1 length only; flattened; straight or triangular. Aril dry; rim-aril and tongue-aril; entire; cream to tan.

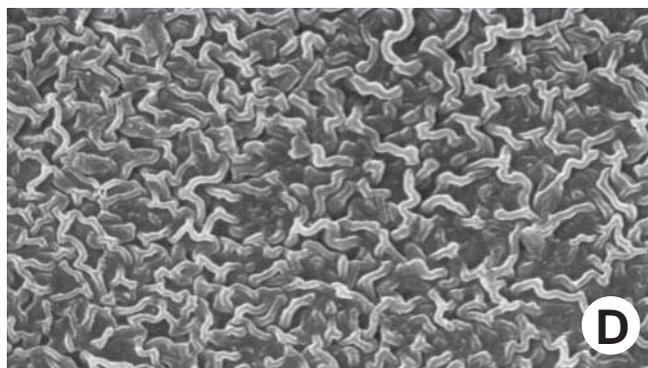
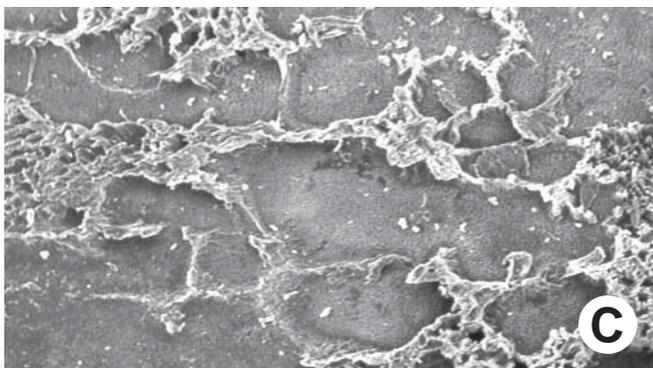
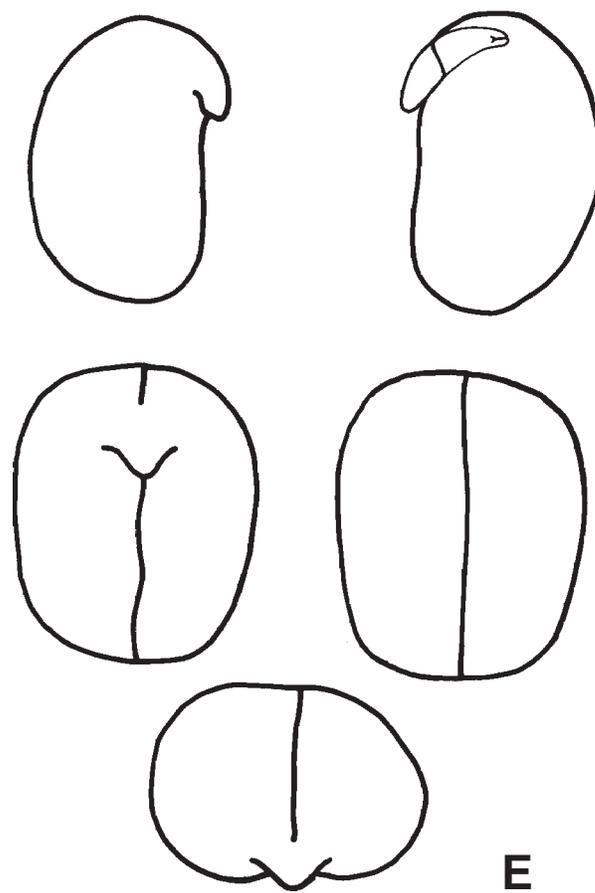
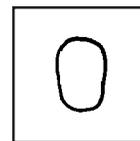
Seed 4.8–13.7 × 4.7–10 × 4.1–11 mm; not overgrown; not angular; symmetrical; circular to oblong; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth or not smooth; with elevated features; reticulate; coriaceous. Fracture lines absent. Rim absent.

Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.7–6.1 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; recessed; within rim or not within corona, halo, or rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.3–1.7 mm long; with margins straight or curved; linear; circular; not in groove of raphe; confluent with hilum; recessed; same color as testa; dark brown; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm apparently absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; orange; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Asia.

Notes: Lackey (1981b) noted “the genus resembles *Psophocarpus* [10.51] in many respects, but Maréchal et al. (1978) doubted a close natural relationship of the two genera.” Our seed and fruit data do not support Lackey’s conclusion, but rather that of Maréchal. Welzen and Hengst (1985) monographed *Dysolobium*. Only one fruit was studied; additional information was taken from Welzen and Hengst.

Dysolobium: *D. grande* (N. Wallich ex G. Bentham) D. Prain (C–E), *D. spp.* (A–B). A, Fruits (× 0.5); B, seeds (× 3.6); C–D, testa (× 50, × 1000); E, embryos (× 3).



Genus: *Psophocarpus* N.J. de Necker ex A.-P. de Candolle

Phylogenetic Number: 10.51.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

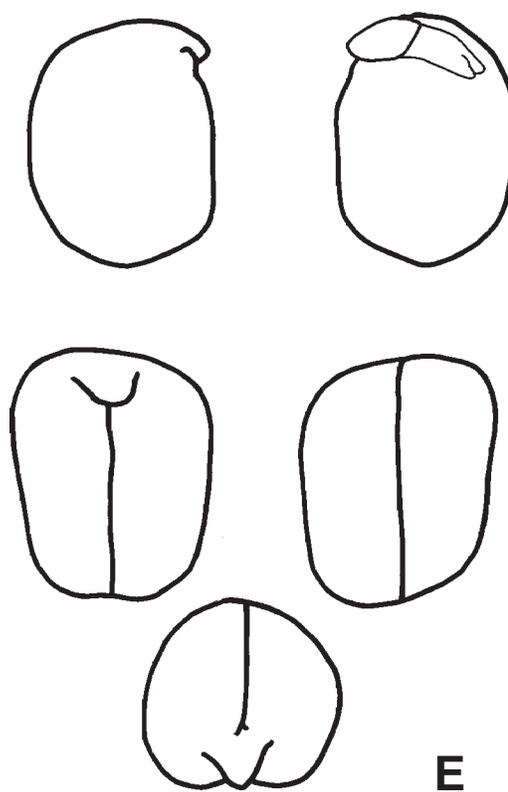
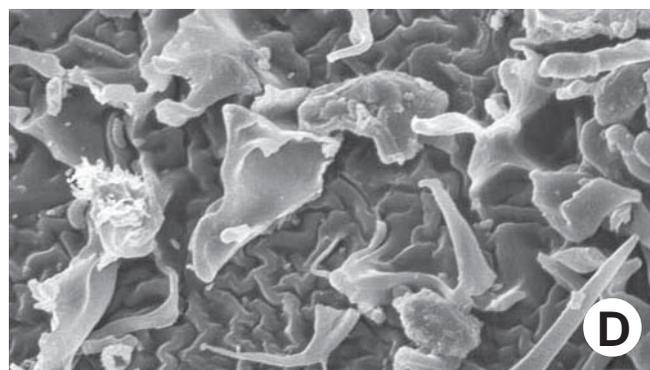
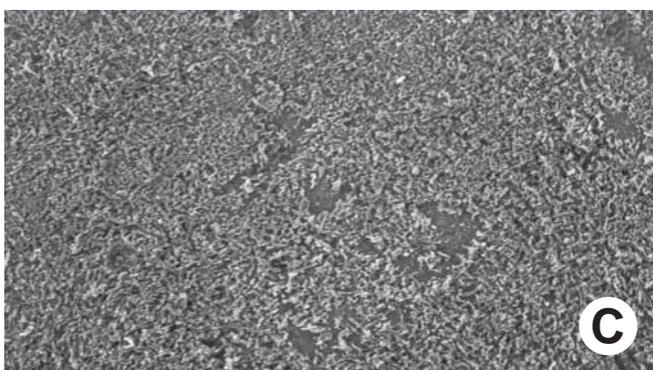
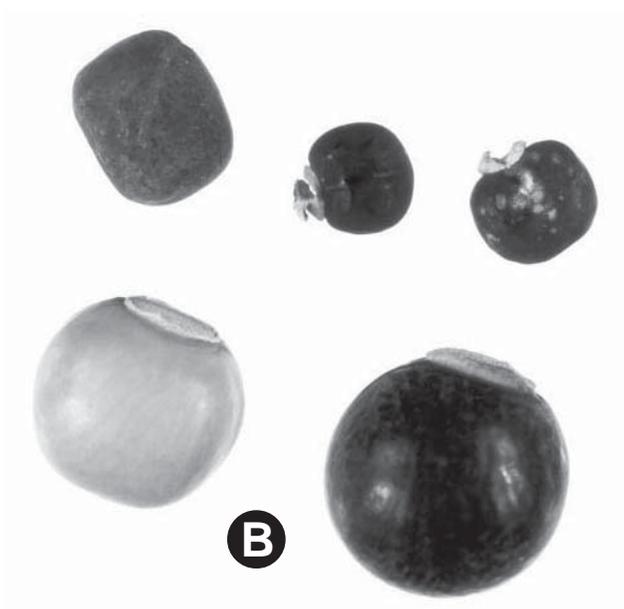
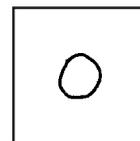
Fruit a legume; unilocular; 1.5–14(–40) (extreme limit from literature) \times 0.6–2(–3.5) \times 0.7–1.5 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear to oblong; not inflated; quadrangular; without beak; short tapered, rounded, or truncate at apex; apex aligned with longitudinal axis of fruit; rounded to truncate at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to leathery; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished. Fruit wings 4; (1–)2–6(–10) mm wide; valvular; on both valves (2 on each valve). Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; glabrous or pubescent and indurate; puberulent; with simple hairs; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; rarely warty; not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with solid layer over solid layer; subligneous to coriaceous. Endocarp dull; monochrome or bichrome; tan and brown or white and brown; cobwebby, scurfy, and smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 3–21; length parallel with or 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 present or absent; dry; 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed 3–12.5 \times 3–12.2 \times 2.5–11 mm; not overgrown; angular or not angular; symmetrical; circular, elliptic,

irregular, oblong, or ovate; terete to quadrangular to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome or mottled (from literature); black, brown, cream, white, or yellow; with brown overlay; glabrous or minutely pubescent; smooth or not smooth (rarely); with elevated features; with 1 longitudinal ridge on each face; coriaceous to chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; brown; recessed. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same or lighter color than the rest of the hilum and therefore conspicuous; larger than punctiform; 2.2–5.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; within rim or not within corona, halo, or rim. Hilum rim color of testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.8–1.8 mm long; with margins straight or curved; linear, circular, or elliptic; not in groove or in groove of raphe; confluent with hilum; mounded or flush; same or similar color as testa; darker than testa; black or brown (dark); 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; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without or with 1 margin recessed; recessed on same side as radicle; yellow; inner face flat; glabrous around base of radicle. Embryonic axis right angled or oblique; perpendicular to oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; straight with embryonic axis or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed to well developed; glabrous.

Distribution: Paleotropics.

Psophocarpus: *P. palustris* A.N. Desvaux (C–E), *P.* spp. (A–B). A, Fruits (\times 1); B, seeds (\times 3.9); C–D, testa (\times 50, \times 1000); E, embryos (\times 5).



Genus: *Physostigma* J.H. Balfour

Phylogenetic Number: 10.52.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; 5–17 × 0.5–5 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (to slightly curved); not plicate; not twisted; asymmetrical or symmetrical; fusiform, linear, or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without or with beak; straight, declined, or hooked; with solid beak the same color and texture as fruit; long tapered or tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to ligneous; seed chambers externally invisible or visible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted (slightly); constricted along both margins; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit stipitate or nonstipitate; with the stipe 5–15 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown or green; glabrate or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases swollen; eglandular; without spines; smooth or not smooth; with elevated features; veined or not veined; transversely veined relative to fruit length; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp thick or thin; surface uniformly veined; 2-layered; with balsamic vesicles; without fibers; with solid layer over solid layer; subligneous. Endocarp dull; monochrome; tan to white; cobwebby, scurfy, and smooth; nonseptate; chartaceous or osseous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–9; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–5 mm long (or longer); of 1 length only; flattened; triangular or convoluted. Aril dry; 2-lipped rim-aril (partial or whole); entire;

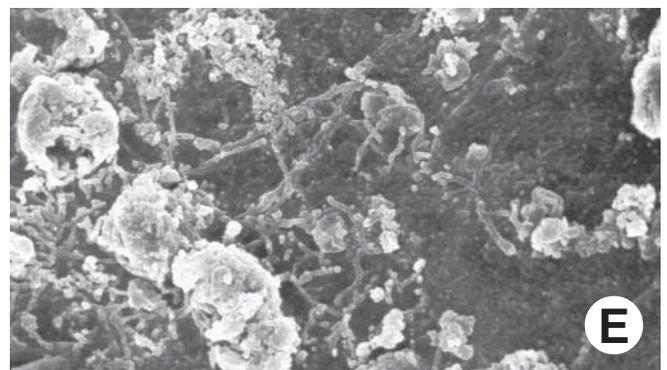
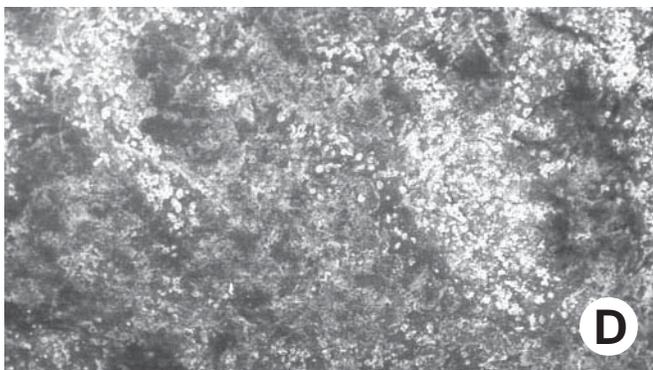
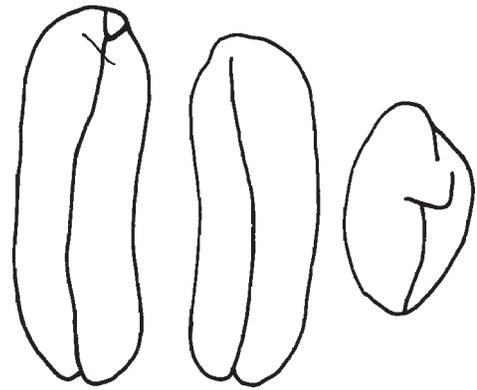
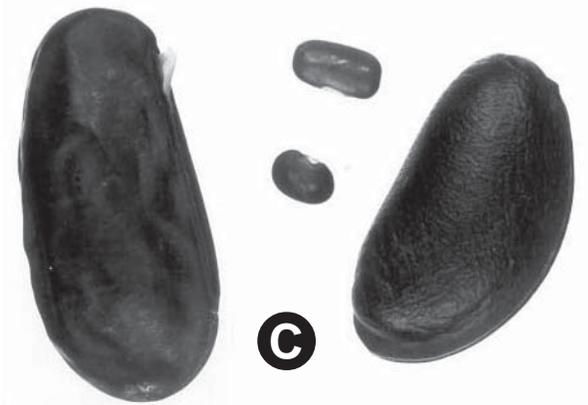
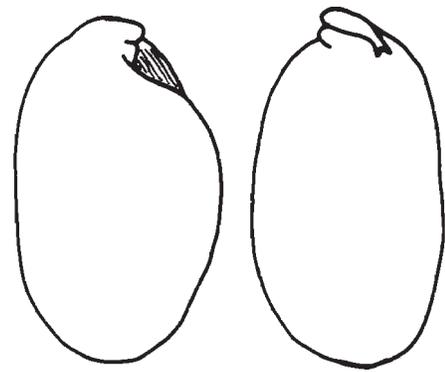
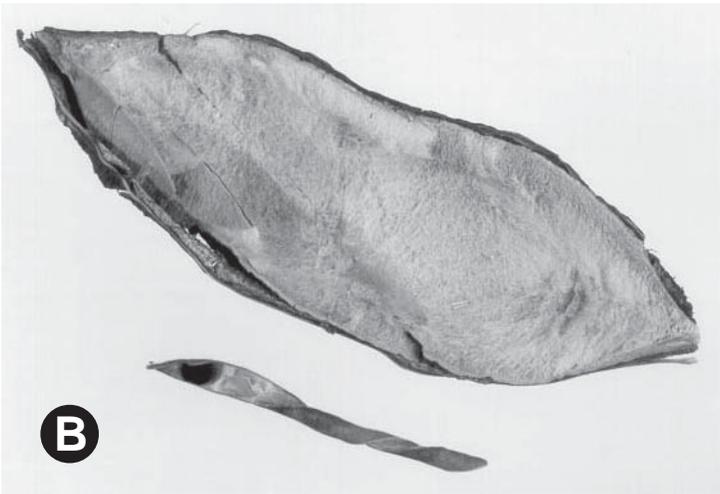
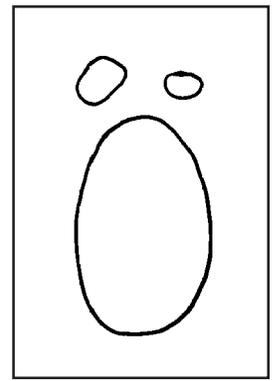
without tongue (or flap-like) on lips of 2-lipped rim-aril; cream.

Seed 5–48 × 3.5–23 × 2–18.5 mm; not overgrown; not angular; asymmetrical; nearly elliptic, irregular, or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome; dark brown or brown; glabrous; smooth or not smooth; with elevated features; reticulate to wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from lens to base of seed and terminating; not bifurcating; color of testa; brown; raised or recessed. Hilum visible or partially concealed; concealed by funicular remnant and aril, funicular remnant, or aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.4–41 mm long; with straight outline; linear; marginal according to radicle tip; flush or recessed; within rim or not within corona, halo, or rim. Hilum rim color of, lighter, or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.9–9 mm long; with margins straight or curved; linear, triangular; or circular; not in groove or in groove of raphe; confluent with hilum; flush or recessed; same or similar color as testa; darker than testa; brown; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm present or absent; 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; notched at radicle or split over radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; yellow; inner face concave or flat; glabrous around base of radicle. Embryonic axis right angled or oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; with 180-degree turn, straight with embryonic axis, or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Tropical Africa.

Notes: *Physostigma* has been divided into subgenera, in part using seed characteristics (Gillett 1966a, Maréchal et al. 1978): subgenus *Physostigma* with 2–3 ovules per locule and the seed ca. 3 cm long and subgenus *Taubertiophyton* with 7–12 ovules per locule and the seed ca. 0.5 cm long.

Physostigma: *P. venosum* J.H. Balfour (*D–F*), *P. spp.* (*A–C*). *A–B*, Fruits ($\times 0.9$); *C*, seeds ($\times 1.3$); *D–E*, testa ($\times 50$, $\times 1000$); *F*, embryos ($\times 1.5$).



Genus: *Vatovaea* E. Chiovenda

Phylogenetic Number: 10.53.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; $3.7\text{--}5 \times 0.8\text{--}1 \times 0.3\text{--}0.6$ cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened to compressed; with beak (short); straight; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique with longitudinal axis of fruit; rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible (barely); with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; tan to brown; with green overlay; pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous to chartaceous. Endocarp dull; monochrome; yellowish green; smooth; nonseptate to septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp to separating from mesocarp; entire. Seeds 3–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1–1.5 mm long; of 1 length only; flattened; triangular to anvil-shaped. Aril dry; rim-aril and tongue-aril; entire; ivory.

Seed $6\text{--}8 \times 5\text{--}7 \times 3.3\text{--}4.6$ mm; not overgrown; not angular; symmetrical; elliptic to oblong; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not

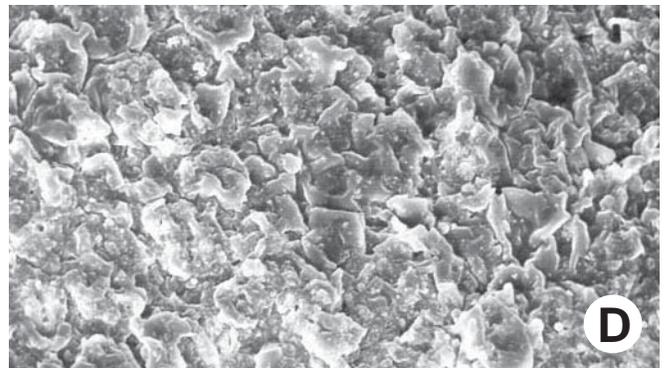
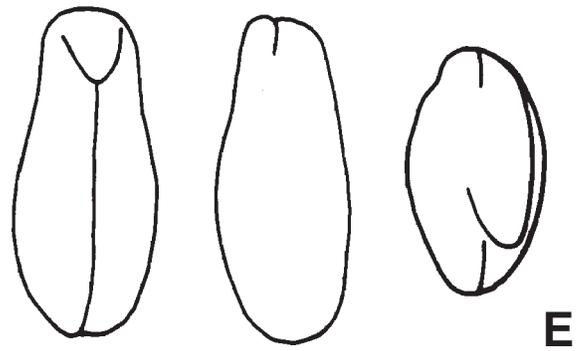
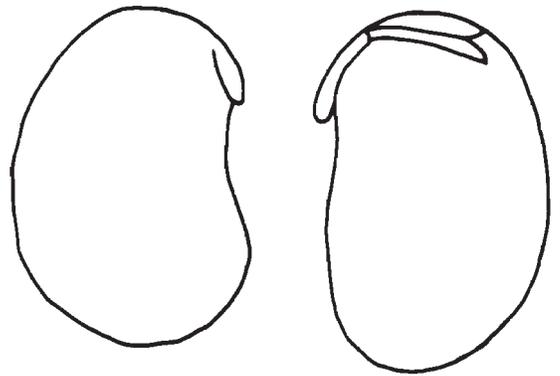
modified by a bloom; colored; mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; larger than punctiform; 0.9–1.8 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; flush; within corona. Hilum corona color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1–2 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; split over radicle; with lobes; with lobes touching (barely, auriculate); with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; yellow to tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Tropical and dry eastern Africa.

Notes: Verdcourt (1971) gave a more exact distribution for this genus.

Vatovaea: *V. pseudolablab* (H.A.T. Harms) J.B. Gillett (A–E). A, Fruits ($\times 1.9$); B, seeds ($\times 7.1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).

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Genus: *Decorsea* R. Viguier

Phylogenetic Number: 10.54.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 1 sp.—4 spp.

Fruit a legume; unilocular; 7–12 × 0.5–0.8 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without beak; 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 barely visible or invisible externally; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; assumed apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent but soon deciduous (from literature); puberulent; with simple hairs; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome; white; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–11; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 0.7 mm long; of 1 length only; flattened; curved to triangular. Aril slightly fleshy to dry; when fleshy 2-lipped rim-aril; entire; covering less than 1/2 of seed; when dry 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed 5.3–10.6 × 3.9–5.5 × 2–4.5 mm; not overgrown; not angular; symmetrical or asymmetrical; ovate to reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to

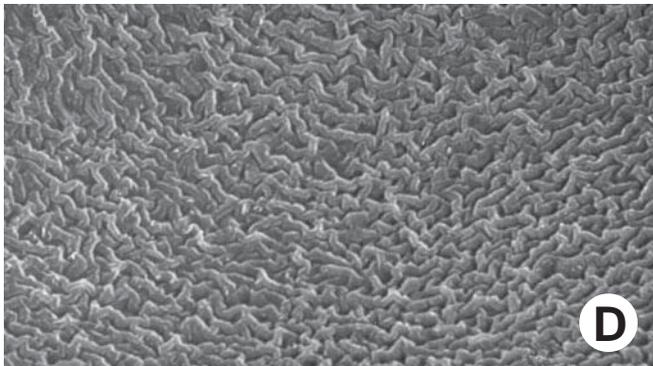
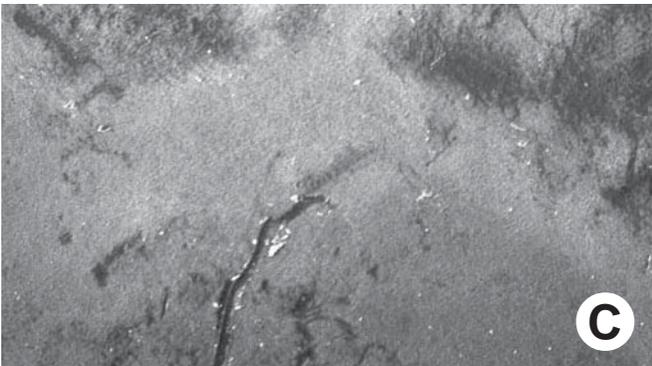
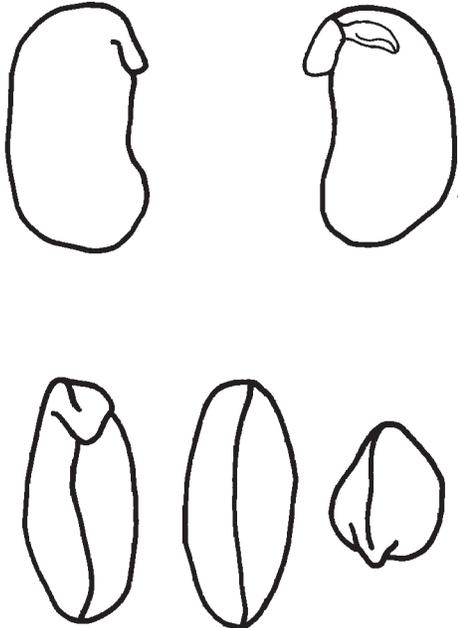
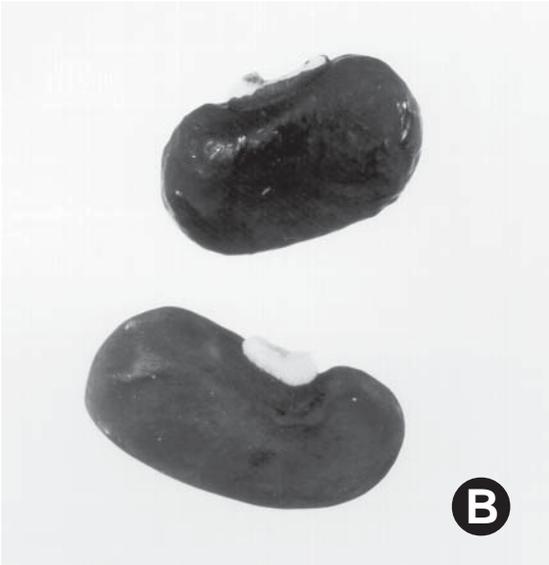
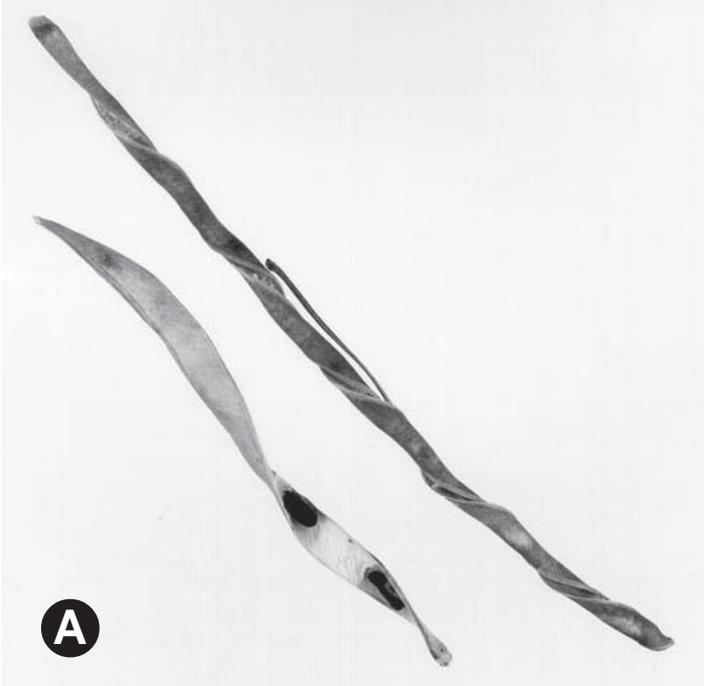
endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially or fully concealed; concealed by aril; without faboid split; larger than punctiform; 2.4–3.6 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim or corona. Hilum corona color darker than testa. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; up to 0.7 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; brown; not within corona, halo, or rim. Endosperm apparently absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; pink; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Southern and eastern Africa and Madagascar.

Notes: Verdcourt (1971) gave a more exact distribution for this genus.

Decorsea: *D. schlechteri* (H.A.T. Harms) B. Verdcourt (A–E). A, Fruits (× 1.1); B, seeds (× 6.5); C–D, testa (× 50, × 1000); E, embryos (× 5).

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

Phylogenetic Number: 10.55.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; $2.5\text{--}3.5 \times 0.9\text{--}1 \times 0.4$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened to compressed; without or with beak; declined; with solid beak the same color and texture as fruit; rounded at apex; apex oblique with longitudinal axis of fruit; rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown to tan; with brown overlay; glabrous; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; coriaceous. Endocarp dull to glossy; monochrome or mottled; tan to white; with mottling over seed chambers; with tan overlay; fibrous to 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 measured; 1–1.2 mm long; of 1 length only; flattened; triangular. Aril dry; 2-lipped rim-aril; entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

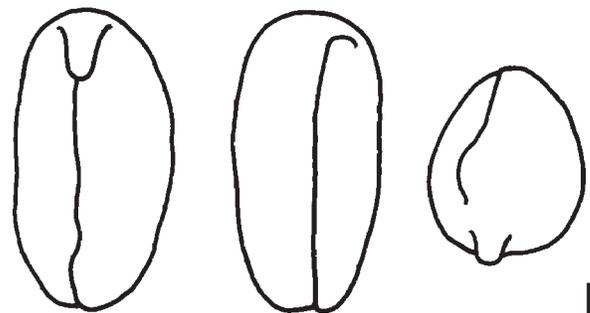
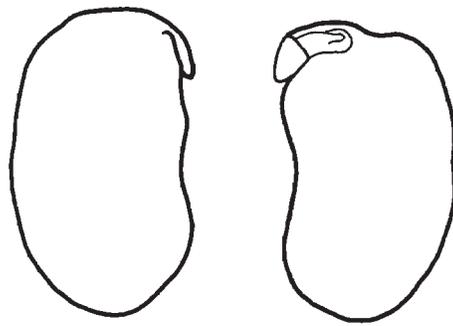
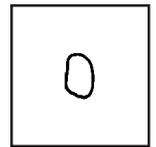
Seed $8.5\text{--}10.7 \times 6.5\text{--}9.5 \times 1.5\text{--}3.5$ mm; not overgrown; not angular; symmetrical to asymmetrical; ovate; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; mottled; with frequent or infrequent mottles; brown; with brown

(darker) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.8–3 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1–1.8 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; same color as testa; brown; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed (slightly); recessed on same side as radicle; white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

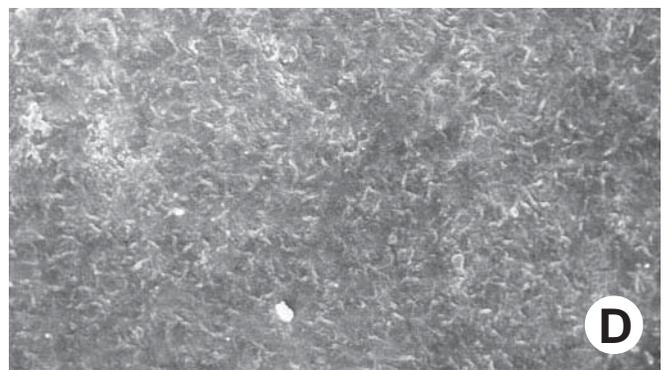
Distribution: Tropical eastern Africa.

Notes: Verdcourt (1971) gave a more exact distribution for this genus.

Spathionema: *S. kilimandscharicum* P.H.W. Taubert (A–E). A, Fruits ($\times 2.1$); B, seeds ($\times 5.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



E



Genus: *Otoptera* A.-P. de Candolle

Phylogenetic Number: 10.56.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; 7.7–10.5 × 0.5–1.1 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; without beak; long tapered at apex; apex aligned with longitudinal axis of fruit; tapered to 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; with thickened sutural areas (slightly). Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown to tan; with brown overlay; with mottling over seed chambers; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; 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; not veined; not tuberculate; wrinkled; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 2-layered; with balsamic vesicles; without fibers; with solid layer over spongy layer; coriaceous. Endocarp dull; monochrome; tan to white; fibrous and scurfy; nonseptate; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 4–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 0.6 mm long; of 1 length only; flattened; triangular. Aril dry; tiny, hippocrepiform rim-aril; entire; cream.

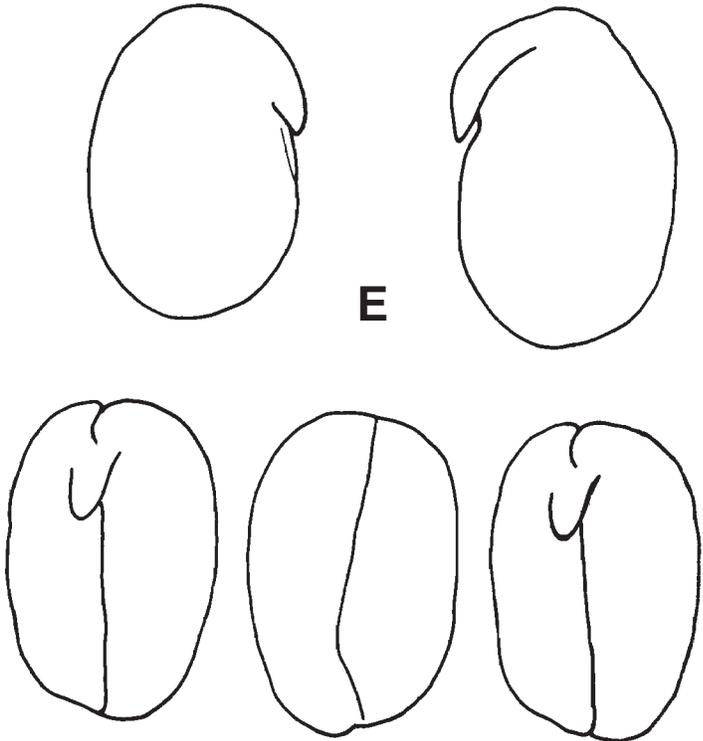
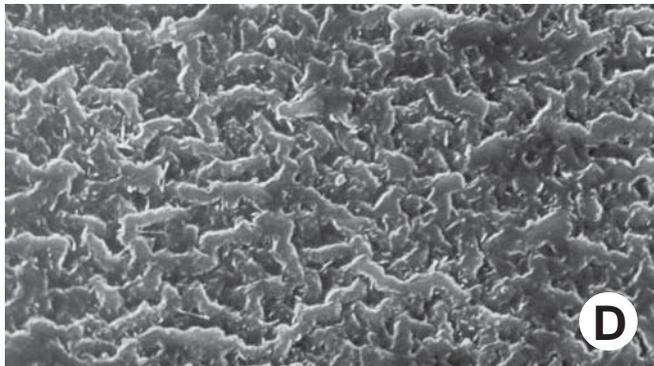
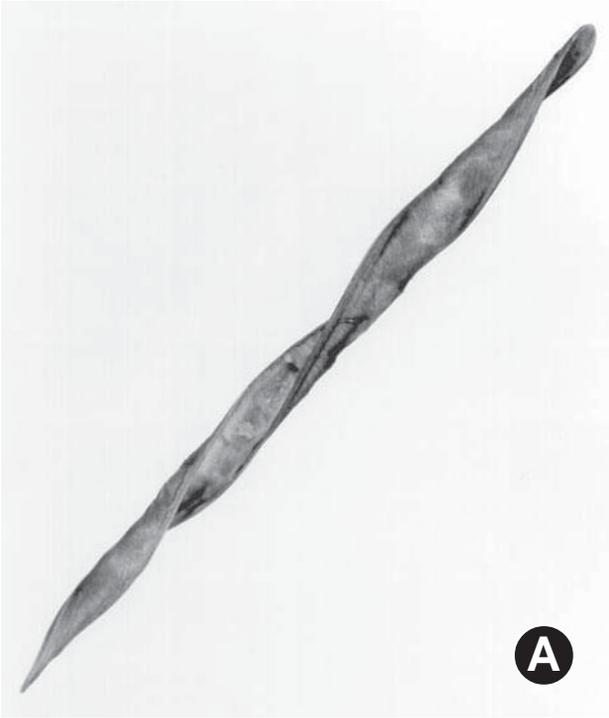
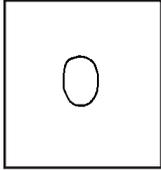
Seed 7–10 × 4.8–5.8 × 2.8–5.3 mm; not overgrown; not angular; symmetrical; elliptic to oblong; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; dark brown or brown;

with brown (darker) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; raised. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 0.7–1 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color darker than testa. Lens discernible or not discernible; equal to or greater than 0.5 mm in length; 0.8–1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; similar color as testa; lighter or darker than testa; brown; within rim. Lens rim color lighter or darker than testa. Endosperm absent. Cotyledons smooth or not smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Southern Africa.

Notes: Verdcourt (1971) gave a more exact distribution for this genus.

Otoptera: *O. burchellii* A.-P. de Candolle (A–E). A, Fruit (× 9.4); B, seeds (× 6.3); C–D, testa (× 50, × 1000); E, embryos (× 6).



Genus: *Sphenostylis* E.H.F. Meyer

Phylogenetic Number: 10.57.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 4 spp.—7 spp.

Fruit a legume; unilocular; 8.5–15 × 0.5–0.9 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; symmetrical or asymmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; flattened to compressed; without or with beak; straight to declined; with solid beak the same color and texture as fruit; long tapered to tapered at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas or ridges. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown overlay; with mottling over seed chambers; glabrous 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 swollen; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; dotted; not exfoliating; without cracks. Mesocarp thick; surface not veined; 2-layered; without balsamic vesicles; without fibers; with spongy layer over solid layer; coriaceous. Endocarp dull; monochrome or mottled; tan; with mottling (dark); with brown overlay; cobwebby and scurfy; septate; with septa thin (tissue paper-like), flexible to thicker than paper, firm; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 5–15; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; up to 0.6 mm long; of 1 length only; thick; straight. Aril dry; rim-aril and tongue-aril or hippo-crepiform rim-aril; entire; cream.

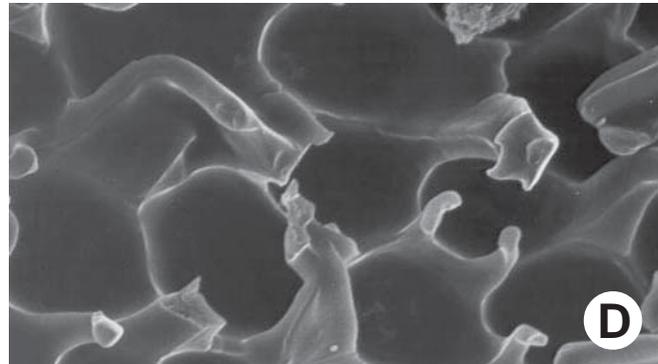
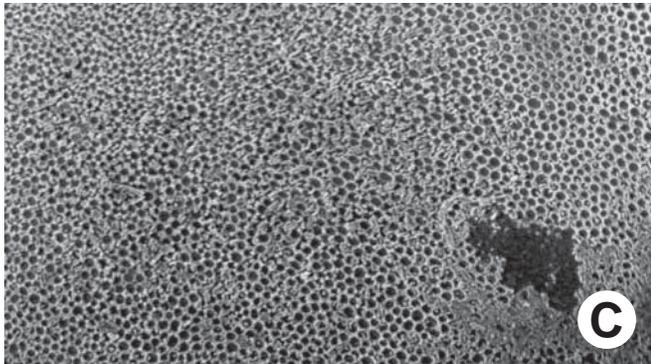
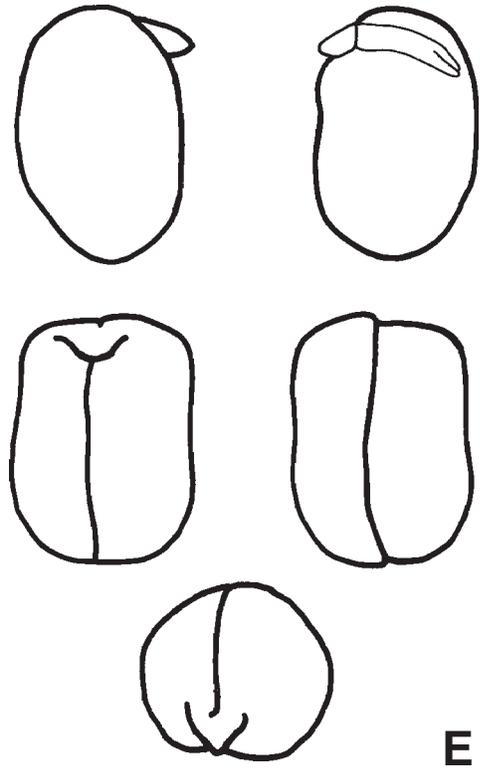
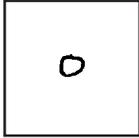
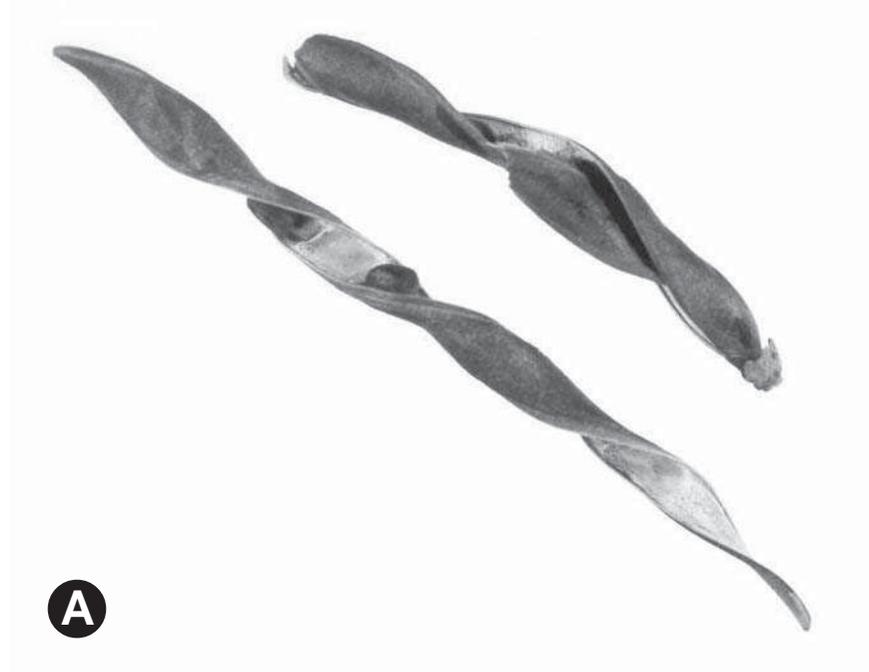
Seed 3.5–12.2 × 3–6.5 × 2–6.5 mm; not overgrown; angular or not angular; symmetrical; circular, D-shaped, or oblong; terete or compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; black to brown (or dark brown); with black or brown (darker) overlay; glabrous; smooth or not smooth; with elevated features; reticulate, rugose, or papillate; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum through lens and base of seed to point opposite hilum; not bifurcating; color of testa; brown; raised. Hilum partially or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–3 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; not within corona, halo, or rim or within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–2.2 mm long; with margins straight or curved; linear, circular, or elliptic; not in groove of raphe; confluent with hilum; mounded, flush, or recessed; same color as testa; dark brown; not within corona, halo, or rim. Endosperm present or absent; trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or pink; inner face flat; glabrous around base of radicle. Embryonic axis straight, oblique, or right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; oblique to cotyledons or deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Tropical and southern Africa.

Notes: Potter and Doyle (1994) developed phylogenetic hypotheses for *Sphenostylis* and altered the generic circumscription accordingly. Their species count and distribution were used. *Sphenostylis stenocarpa*, the African yam bean, has distinct wild and cultivated forms (Potter 1992). The cultivated type has larger fruit

with delayed dehiscence and larger seeds with smooth testa. Wild type seeds are smaller with black, waxy elaborations on the testa, also found in other species.

Sphenostylis: *S. stenocarpa* (C.F. Hochstetter ex A. Richard) H.A.T. Harms (C–E), *S. spp.* (A–B). A, Fruits (× 1.3); B, seeds (× 5.3); C–D, testa (× 50, × 1000); E, embryos (× 8).



Genus: *Nesphostylis* B. Verdcourt

Phylogenetic Number: 10.58.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; 10–15 × 0.75–0.9 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; flattened; without beak; 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; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves assumed along both sutures; assumed apical and down; assumed active; assumed with valves twisting. Epicarp pubescent and indurate; velutinous; with pubescence gray to brown; not tuberculate. Aril fleshy; hippocrepiform rim-aril (thick at connected end); entire; covering less than 1/2 of seed; brown, cream, or orange.

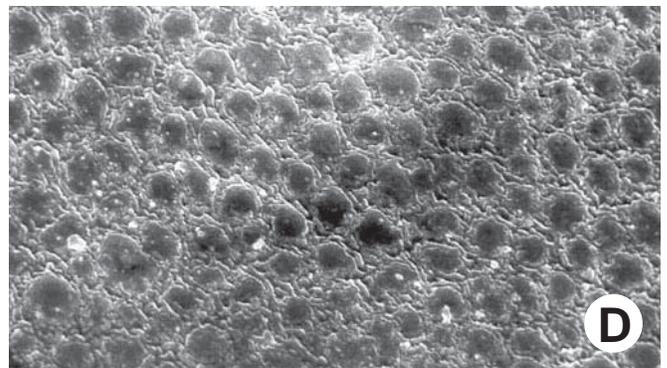
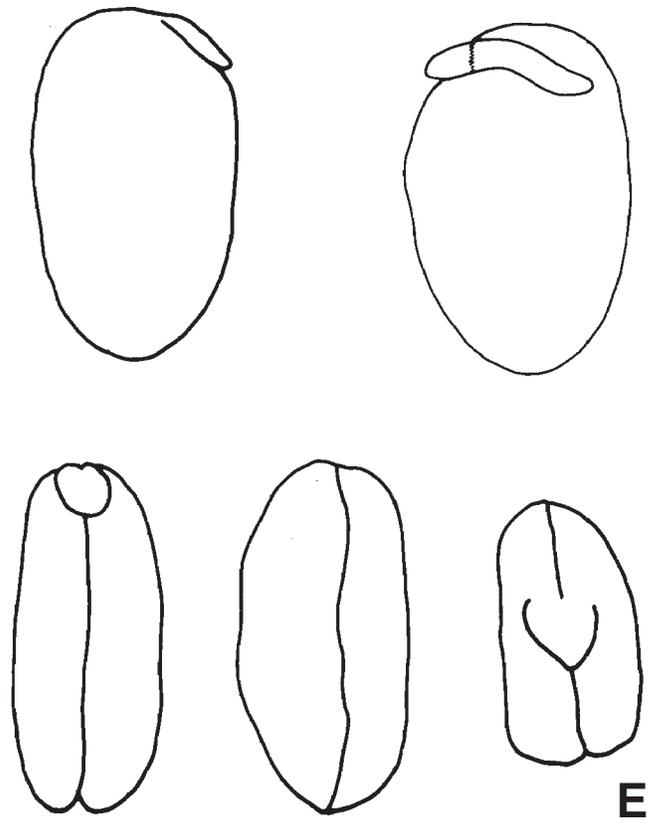
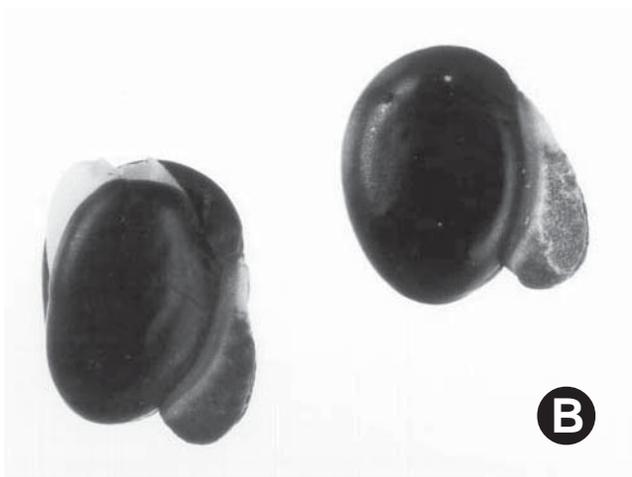
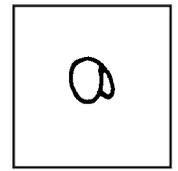
Seed 5.5–8 × 4–5 × 2.5–3.2 mm; not overgrown; not angular; symmetrical; ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; not smooth; with elevated features; wrinkled; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially to fully concealed; concealed by funicular remnant and aril; without faboid split; larger than punctiform; 5–6.3 mm long; with straight outline; linear; marginal according to radicle tip; flush; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; black to brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at

base of radicle; without margins recessed; yellowish white; inner face flat; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Africa (1 sp.), India (1 sp.), and Burma (1 sp.).

Notes: Potter and Doyle (1994) developed phylogenetic hypotheses for *Nesphostylis* and altered the generic circumscription accordingly. Their species count and distribution were used. No fruit was dissected, and only one seed was studied. Some data were taken from Verdcourt (1970a).

Nesphostylis: *N. holosericea* (J.G. Baker) B. Verdcourt (A–E). A, Fruit (× 1.1); B, seeds (× 7.2); C–D, testa (× 50, × 1000); E, embryos (× 8).



Genus: *Austrodolichos* B. Verdcourt

Phylogenetic Number: 10.59.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

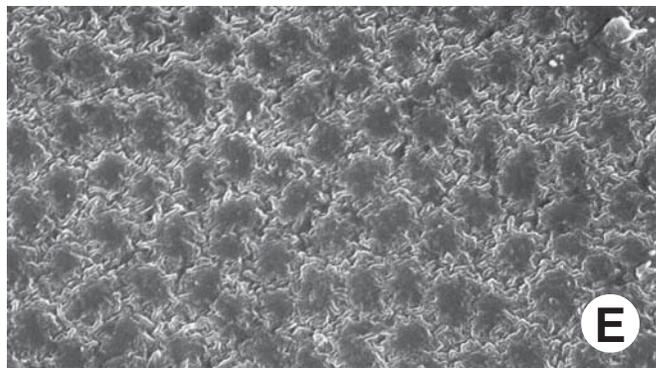
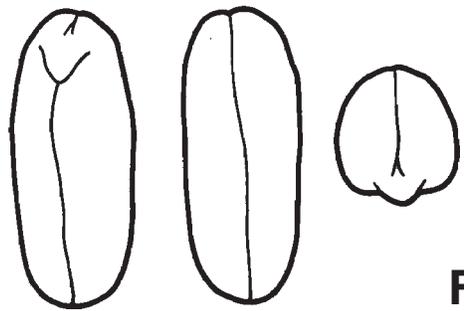
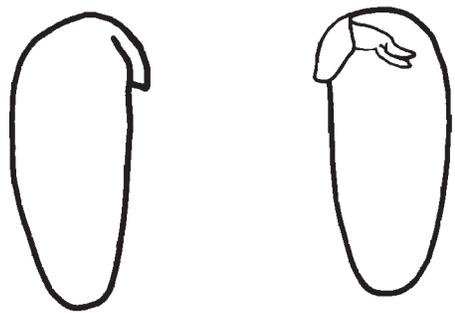
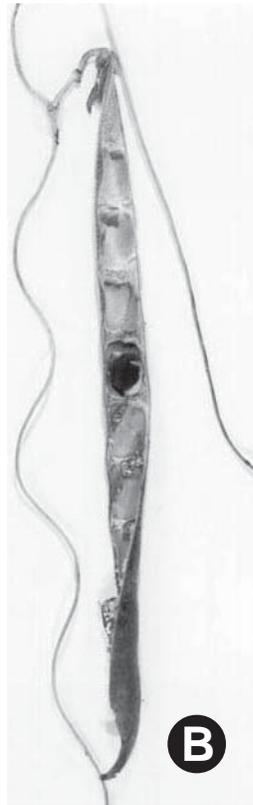
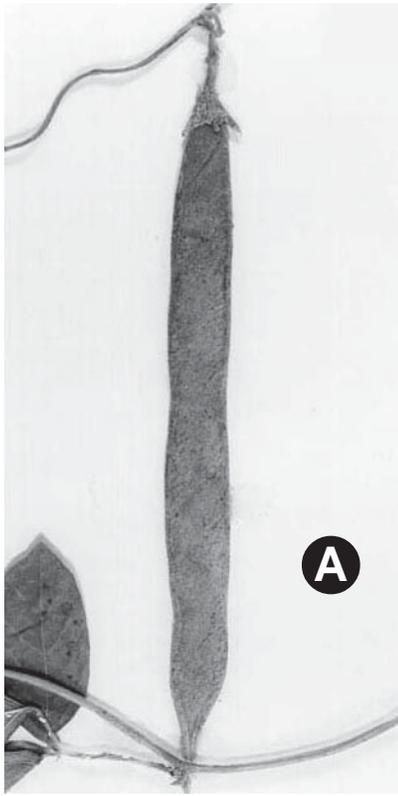
Fruit a legume; unilocular; 7.5–8 × 0.7 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed; without beak; long tapered at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligneous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscing. Dehiscence of valves along both sutures; assumed apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; dark brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence uniformly distributed; with simple hairs; with hair bases swollen; eglandular or glandular; with glandular hairs; without spines; not smooth; with elevated features; not veined; not tuberculate; papillose; not exfoliating; without cracks. Mesocarp thick; 1-layered; without balsamic vesicles; without fibers; subligneous. Endocarp dull; monochrome; tan; smooth; septate; with septa eglandular; not exfoliating. Seeds 8–9; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5 mm long; of 1 length only; thick; straight. Aril fleshy; hippocrepiform rim-aril (bulbous at base); entire; covering less than 1/2 of seed; tan.

Seed 5.2–6.4 × 3.3–4 × 2.4–2.8 mm; not overgrown; not angular; asymmetrical; ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; not smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril; without faboid split; larger than punctiform; 3–4.2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal

according to seed length; recessed; within corona. Hilum corona color darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; lighter than testa; brown; within corona. Lens corona color lighter than testa. Endosperm apparently absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellowish white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Australia.

Austrodolichos: *A. errabundus* (M. Schott) B. Verdcourt (A–F). A–B, Fruits (× 1.2, × 1.3); C, seeds (× 6.6); D–E, testa (× 50, × 1000); F, embryos (× 6).



Genus: *Neorautanenia* H. Schinz

Phylogenetic Number: 10.60.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

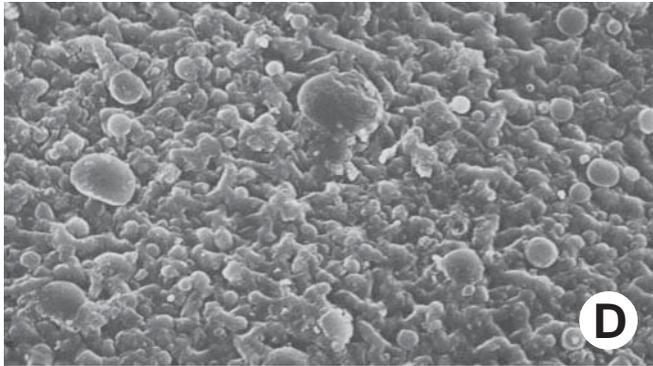
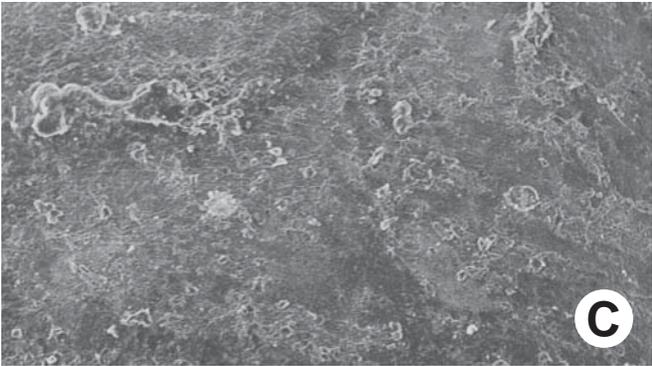
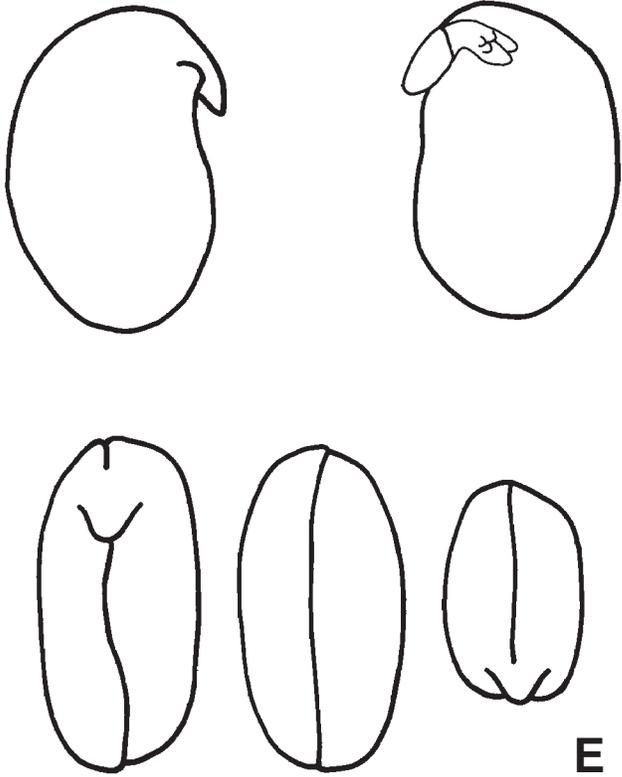
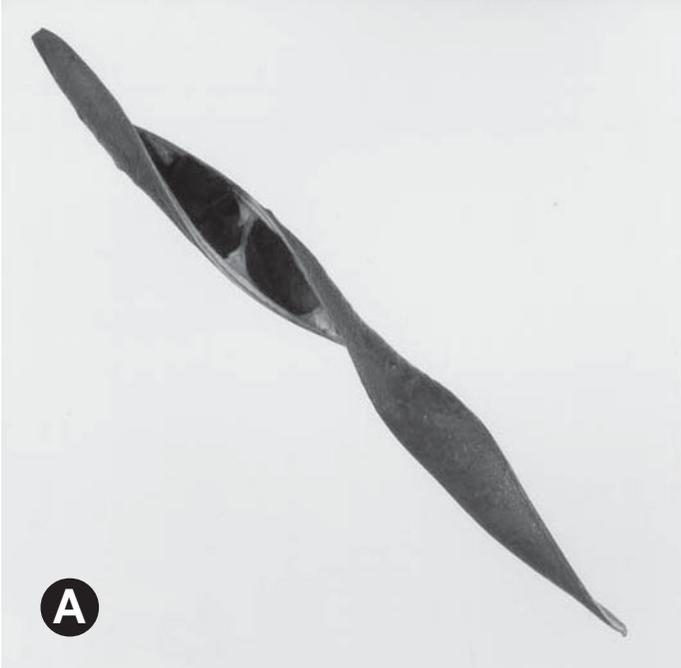
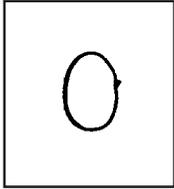
Fruit a legume; unilocular; 7.5–11.5 × 1–1.7 cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; linear; not inflated; compressed to terete; without beak; long tapered to tapered at apex; apex aligned with longitudinal axis of fruit; tapered to short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to leathery; seed chambers externally invisible to visible (slightly); with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; tan to brown; with brown overlay; with mottling over seed chambers; pubescent and indurate; with 1 type of pubescence; puberulent to velutinous (shortly); with pubescence golden to white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp thick; surface not veined; 1-layered; without or with balsamic vesicles; without fibers; solid; subligneous. Endocarp dull; monochrome or mottled; tan or white; with mottling over seed chambers; with brown overlay; cobwebby, fibrous, and scurfy; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 5–8; length parallel with or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1.5 mm long; of 1 length only; thick; straight. Aril dry; 2-lipped rim-aril or hippocrepiform rim-aril; fimbriate; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; cream.

Seed 8–14.5 × 7–11 × 4.3–7.5 mm; not overgrown; not angular or angular (slightly); symmetrical or asymmetrical; irregular to oblong to ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp; dull; not modified by a bloom; colored; monochrome; brown; glabrous; not smooth; with recessed or recessed and elevated features; wrinkled; pitted with small separate pits; 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; larger than punctiform; 2.7–4.3 mm long; with curved outline; elliptic to oval; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.7–2.8 mm long; with margins curved; ovate; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; black to brown; within rim. Lens rim color of or darker than testa. Endosperm absent. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness or 1 thicker than the other (rarely); both more or less of equal length or 1 longer than other (rarely); not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; notched at radicle; with or without lobes; with lobes not touching; with basal groin formed by lobes; with the interface division terminating at base of radicle; without or with both margins recessed; yellowish white or tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; parallel or oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately or well developed; glabrous.

Distribution: Africa.

Notes: Lackey (1981b) spelled the name of this genus '*Neurautanenia*,' but the correct spelling is *Neorautanenia*.

Neorautanenia: *N. amboensis* H. Schinz (A, C–E), *N. spp.* (B). A, Fruit (× 1); B, seeds (× 3.6); C–D, testa (× 50, × 1000); E, embryos (× 3).



Genus: *Lablab* M. Adanson

Phylogenetic Number: 10.61.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

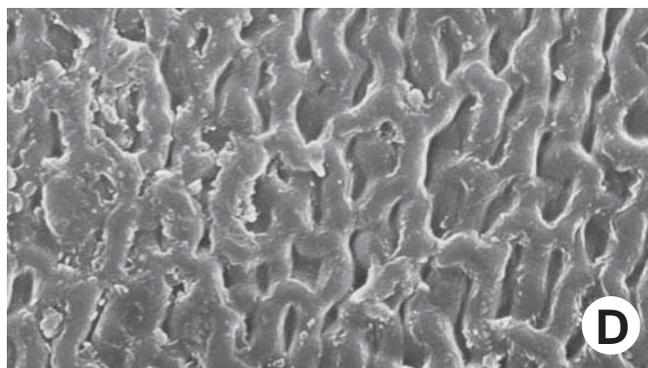
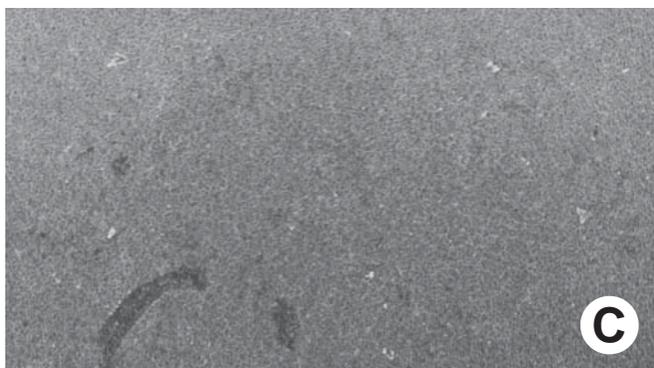
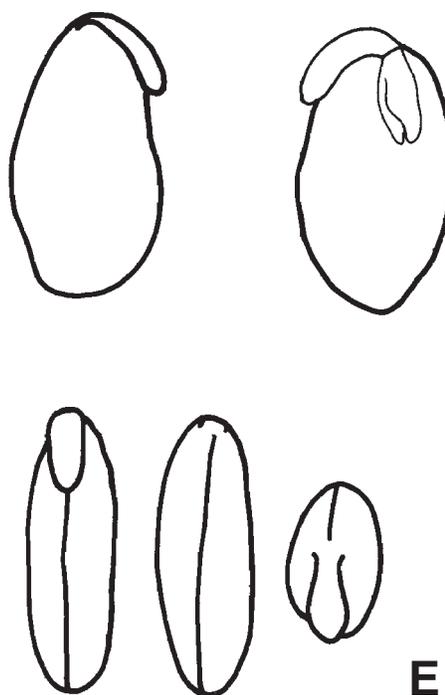
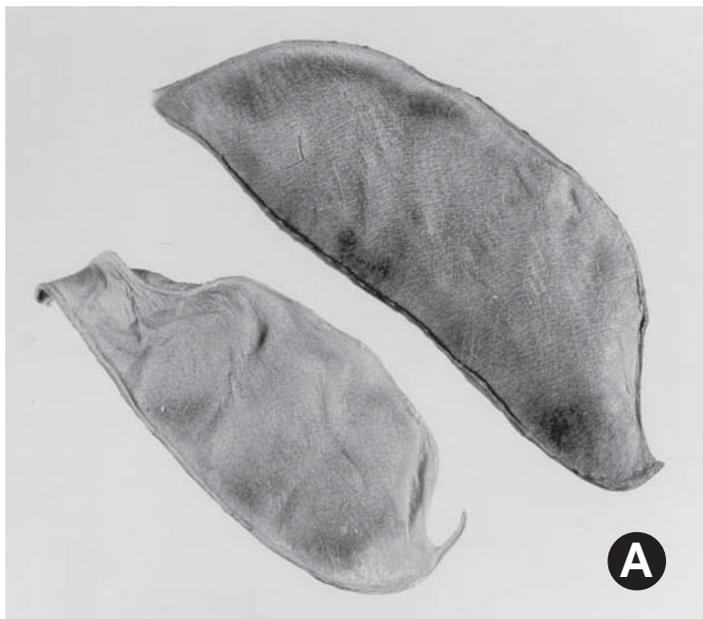
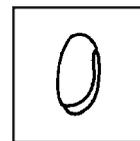
Fruit a legume; unilocular; $3.7\text{--}5 \times 1.6\text{--}1.8 \times 0.6\text{--}0.8$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; irregular; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near middle or D-shaped; not inflated; compressed; with beak; hooked; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique with longitudinal axis of fruit; tapered or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas or thickened sutural areas and prickles. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan; pubescent and indurate; with 1 type of pubescence; short puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; verrucose-rugose; not exfoliating; without cracks. Mesocarp trace; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp glossy; monochrome; tan to white; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 2–4; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 2 mm long; of 1 length only; flattened; triangular. Aril fleshy; hippocrepiform rim-aril; fimbriate; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed $8\text{--}18 \times 5.5\text{--}11.5 \times 3.8\text{--}7.5$ mm; not overgrown; not angular; asymmetrical; elliptic to irregular to ovate; nearly terete to compressed; with surface smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled; with infrequent mottles; brown or cream; with brown (darker) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril; without faboid split; larger than punctiform; 8–12.5 mm long; with straight outline; linear; marginal according to radicle tip; recessed; within corona or not within corona, halo, or rim. Hilum corona color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1.8–2 mm long; with margins straight or curved; linear or elliptic; not in groove of raphe; confluent with hilum; mounded; similar color as or dissimilar color from testa; darker than testa; brown or tan; within rim. Lens rim color of or darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan to brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Africa and widely cultivated.

Notes: This genus is grown in tropical and subtropical areas. The young pods and dried seeds are used for human food, and the whole plants for forage and green manure (Duke 1981, Maesen and Somaatmadja 1989). The plants are prolific nodulators.

Lablab: *L. purpureus* (C. Linnaeus) R. Sweet (A–E). A, Fruits ($\times 1.8$); B, seeds ($\times 2.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Alistilus* N.E. Brown

Phylogenetic Number: 10.62.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; $4.7 \times 0.7 \times 0.35$ cm; without orifice formed by curving of fruit or fruit segments; curved; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without beak; tapered at apex; apex right-angled with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible (barely); with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit substipitate; with the stipe 3 mm long. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Epicarp dull; multicolored; bichrome; brown and tan; pubescent and indurate; with 1 type of pubescence; short puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined; not tuberculate; rugose; not exfoliating; with cracks; cracking oblique to fruit length. Mesocarp present. Seeds ca. 4; length assumed parallel with fruit length; assumed neither overlapping nor touching; assumed in 1 series. Aril dry; rim- and tongue-aril; entire; cream.

Seed $6.5\text{--}8 \times 4.5\text{--}5.4 \times 1.9\text{--}2.8$ mm; not overgrown; not angular; symmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; mottled; with frequent mottles; brown; with brown (darker) overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; $2\text{--}2.3$ mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within corona. Hilum corona color darker than testa. Lens

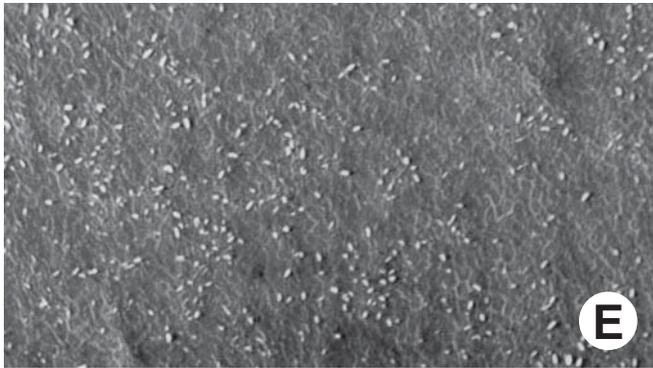
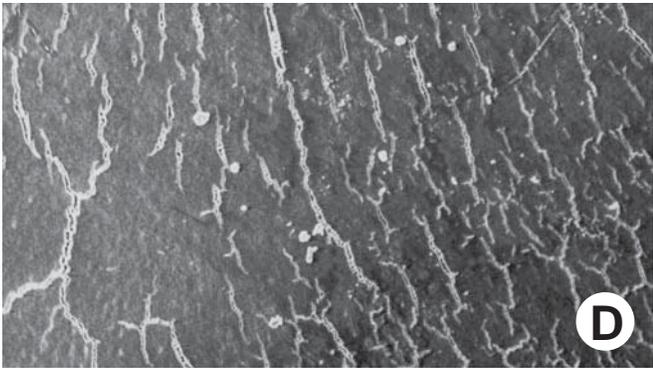
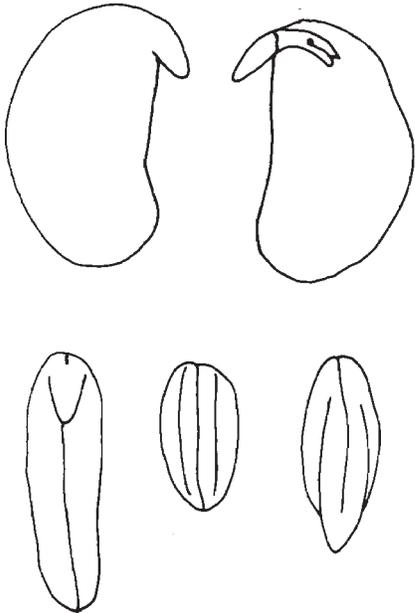
discernible; equal to or greater than 0.5 mm in length; 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; within corona. Lens corona color darker than testa. Endosperm apparently absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Southern tropical Africa and Madagascar.

Notes: Verdcourt (1981) described a new species from Madagascar, *A. magnificus* B. Verdcourt, which increased to three the number of species in this genus.

Alistilus: *A. bechuanicus* N.E. Brown (A), *A. spp.* (B–F). A–B, Fruit ($\times 2$, $\times 2.1$); C, seeds ($\times 6.8$); D–E, testa ($\times 50$, $\times 1000$); F, embryos ($\times 4.5$).

0



Genus: *Dipogon* F.M. Liebmann

Phylogenetic Number: 10.63.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

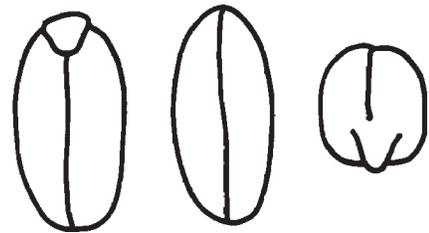
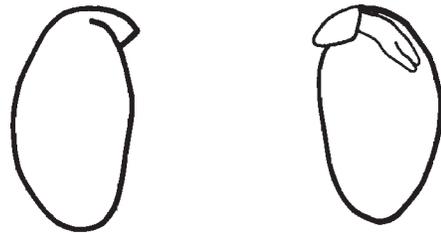
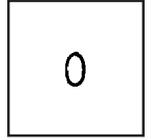
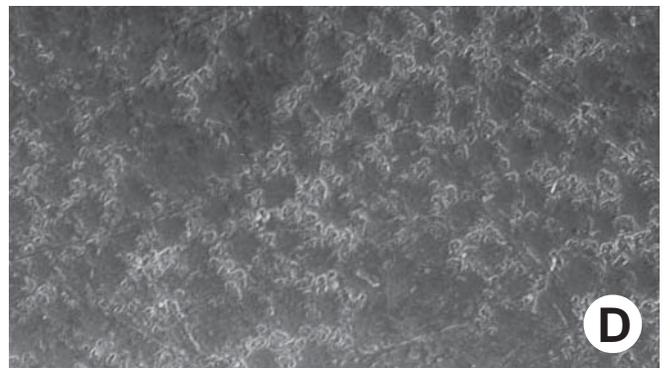
Fruit a legume; unilocular; 3–4.5 × 0.5–0.9 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; slightly falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; declined; with solid beak the same color and texture as fruit; short tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit substipitate; with the stipe 2–3 mm long. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; orange; with brown overlay; with mottling over seed chambers; glabrous; eglandular; without spines; smooth or not smooth; not veined; not tuberculate; not exfoliating; without or with cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. 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 3–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; flattened; straight. Aril fleshy; hippocrepiform rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed 4.1–7.1 × 3.5–5 × 3–3.7 mm; not overgrown; angular; symmetrical; elliptic to ovate; 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; mottled; with frequent mottles; brown;

with brown (darker) overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril; without faboid split; larger than punctiform; 3–3.8 mm long; with straight outline; linear; marginal according to radicle tip; flush; within corona. Hilum corona color darker than testa. Lens barely discernible; equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; brown; within rim. Lens rim color darker than testa. Endosperm apparently absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellowish white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: South Africa; cultivated elsewhere.

Dipogon: *D. lignosus* (C. Linnaeus) B. Verdcourt (A–E). A, Fruit (× 2.3); B, seeds (× 6.7); C–D, testa (× 50, × 1000); E, embryos (× 5).



E

Genus: *Dolichos* C. Linnaeus

Phylogenetic Number: 10.64.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

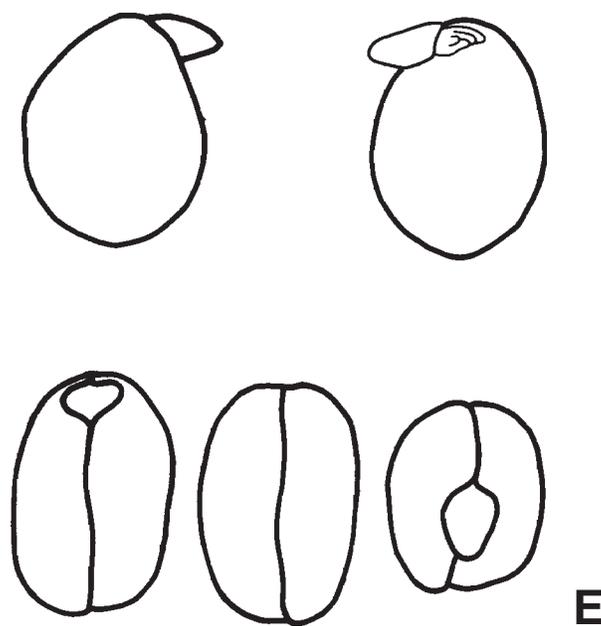
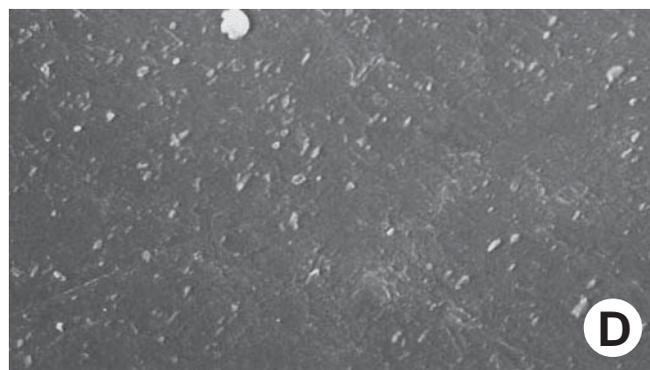
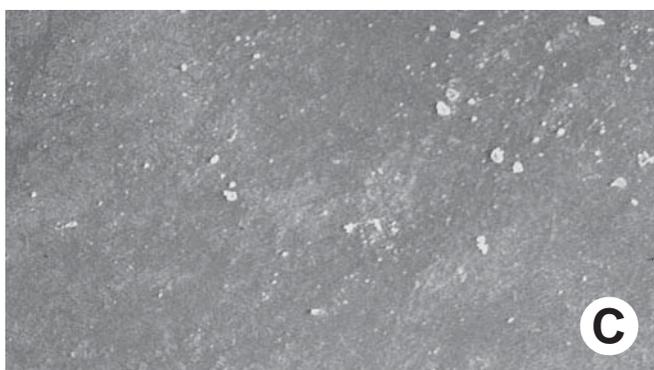
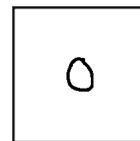
Species Studied—Species in Genus: 12 spp.—60 spp.

Fruit a legume; unilocular; 1.5–7 × 0.6–1.4 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed; with beak; declined; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned or oblique 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 or leathery; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown to tan; glabrous or pubescent and indurate; with 1 type of pubescence; pilose or puberulent; with pubescence golden; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick or thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with vitreous layer over solid layer; coriaceous. Endocarp dull; monochrome; brown to tan; smooth; septate; with septa thin (tissue paper-like), flexible or thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–11; length parallel with or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; flattened; triangular. Aril fleshy or dry; when fleshy hippo-crepiform rim-aril; entire; covering less than 1/2 of seed; when dry 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed 3.3–9.5 × 3–6.1 × 2–5 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; circular to elliptic to irregular to reniform; terete to compressed; with surface smooth; without or with 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; glossy to dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; black to brown; with brown (darker) overlay; glabrous; smooth or not smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe barely visible or not visible; from hilum through lens to base of seed and terminating; not bifurcating; darker than testa; dark brown; flush or raised (slightly). Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.8–5 mm long; with curved to straight outline; narrowly elliptic, oval (narrowly), or linear; apical according to radicle tip but marginal according to seed length; flush; within corona or not within corona, halo, or rim. Hilum corona color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–1.4 mm long; with margins straight; linear; not in groove or in groove of raphe; confluent with hilum; flush; similar color as testa; darker than testa; black to brown; within rim or corona. Lens corona color darker than testa. Lens rim color of testa. Endosperm apparently absent. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to yellow to tan (pale); inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Africa and eastern Asia.

Dolichos: *D. gululu* E.A.J. De Wildeman (*C–E*), *D.* spp. (*A–B*). *A*, Fruits (× 1.3); *B*, seeds (× 4.5); *C–D*, testa (× 50, × 1000); *E*, embryos (× 6).



Genus: *Macrotyloma* (R. Wight & G.A.W. Arnott) B. Verdcourt

Phylogenetic Number: 10.65.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 8 spp.—24 spp.

Fruit a legume; unilocular; $1.1\text{--}6 \times 0.2\text{--}1.1 \times 0.2\text{--}0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (to slightly curved); not plicate; not twisted; asymmetrical or symmetrical; linear to oblong (narrowly), ovate (geocarpic fruit), falcate, or irregular (geocarpic fruit); when asymmetrical with 1 straight and 1 curved suture (in literature) or both sutures parallelly curved, unequally curved, or nearly straight; narrowest near middle, B-shaped; not inflated; compressed; with beak; declined to hooked; with solid beak the same color and texture as fruit; tapered at apex; apex aligned, oblique, or right-angled with longitudinal axis of fruit; tapered to short tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins or constricted only on 1 margin; without sulcus; plain or embellished; with ridges. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent or indehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown or tan; with brown overlay; with mottling over seed chambers; glabrous or pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence golden to white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth or not smooth; with elevated or recessed features; veined or not veined; reticulately veined; not tuberculate; rugose to wrinkled; resinous punctate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with solid layer over spongy layer; chartaceous. Endocarp dull to glossy; monochrome or mottled; tan to white; with mottling over seed chambers; with brown overlay; fibrous to smooth; subseptate

or nonseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long to measured; up to 1 mm long; of 1 length only; flattened to thick; straight. Aril dry; rim- and tongue-aril; entire; brown to cream.

Seed $4\text{--}12 \times 1.8\text{--}8 \times 0.6\text{--}3$ mm; not overgrown; not angular to angular (slightly); symmetrical or asymmetrical; elliptic, irregular, oblong, ovate, or reniform; 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; glossy to dull; not modified by a bloom; colored or clear; monochrome or mottled; with frequent or infrequent mottles; brown to black; with brown overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible, partially concealed, 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; $0.8\text{--}3.6$ mm long; with curved or straight outline; elliptic or linear; apical according to radicle tip but marginal according to seed length; recessed; not within corona, halo, or rim or within corona or corona and halo. Hilum corona color darker than testa. Hilum halo color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; $0.8\text{--}1.5$ mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; same or similar color as testa; darker than testa; black or brown; within corona or not within corona, halo, or rim. Lens corona color darker than testa. Endosperm present or absent; trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis right angled or oblique; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip curved; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of

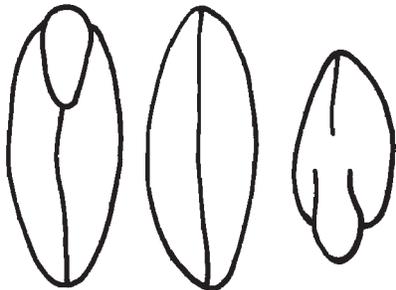
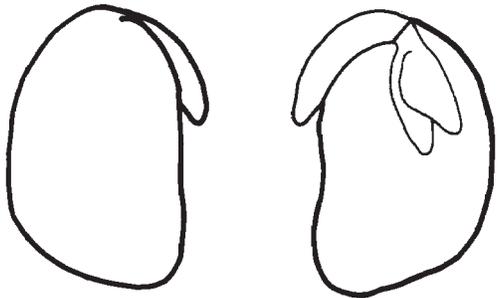
cotyledons. Plumule moderately to well developed;
glabrous.

Distribution: Africa and Asia.

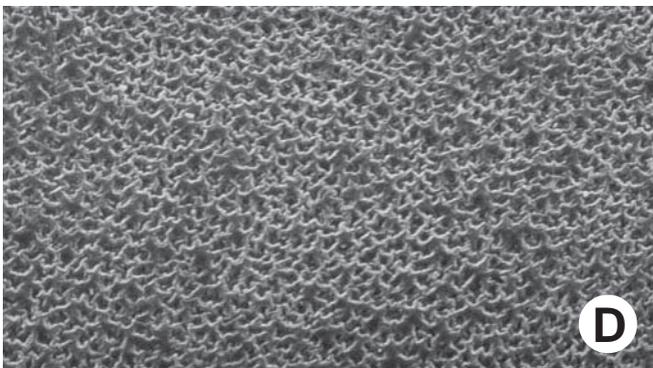
Notes: *Macrotyloma* was monographed by Verdcourt
(1982).

Macrotyloma: *M. axillare* (E.H.F. Meyer) B. Verdcourt
(*C-E*), *M. spp.* (*A-B*). *A*, Fruits ($\times 1.2$); *B*, seeds
($\times 4.5$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 6$).

0



E



Genus: *Vigna* C.G. Savi

Phylogenetic Number: 10.66.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 43 spp.—150 spp.

Fruit a legume; unilocular; 3–30(–40) × 0.3–1.6 × 0.25–1 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical or asymmetrical; linear or falcate; when asymmetrical with both sutures nearly straight; inflated or not inflated; compressed to terete; with or without beak; straight; with solid beak the same color and texture as fruit; blunt, long tapered, tapered, or short tapered at apex; apex aligned with longitudinal axis of fruit; long tapered or tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous, coriaceous, or fleshy; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain or embellished; with ridges or thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown, green, or tan; with brown overlay; with surface texture uniform; glabrous, pubescent and indurate, or pubescent but soon deciduous; with hairs appressed; with 1 type of pubescence; puberulent, sericeous, or strigose; with pubescence brown to white; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases swollen or plain; eglandular; without spines; smooth or not smooth; with recessed features; not veined; not tuberculate; minutely slitted obliquely; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with solid layer over solid layer; chartaceous or fleshy. Endocarp dull or glossy; opaque or translucent; monochrome; tan or white; smooth and pithy or smooth; without adhering pieces of testa; septate or subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–20; length parallel with or oblique to fruit length;

neither overlapping nor touching; in 1 series. Funiculus measured; 1–1.5 mm long; of 1 length only; flattened; straight or triangular (rarely). Aril fleshy or dry; when fleshy hippocrepiform rim-aril, 2-lipped rim-aril, or marginal hilar; crenate; covering less than 1/2 of seed; when dry rim-aril or rim- and tongue-aril; without tongue (or flap-like) on lips of 2-lipped rim-aril; cream.

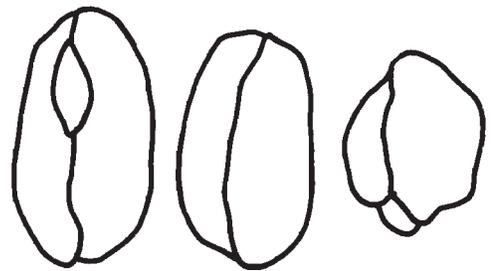
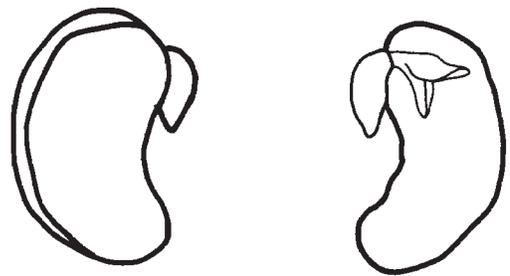
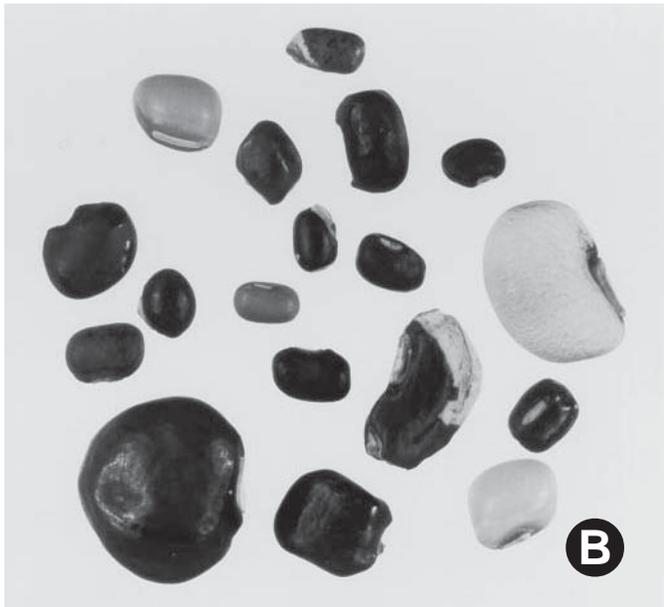
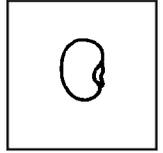
Seed 2–18 × 1–13 × 1–12 mm; not overgrown; angular or not angular; symmetrical or asymmetrical; circular, elliptic, irregular, oblong, ovate, reniform, or rhombic (irregularly); terete or compressed; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus or without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified or modified by a bloom; colored or clear (rarely); monochrome, bichrome, mottled, or streaked; with frequent or infrequent mottles; with infrequent streaks; brown, cream, red, tan, or white; with black or brown overlay; glabrous; smooth; coriaceous or chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum through base of seed and up the other side; not bifurcating; color of testa; flush and raised. Hilum visible or fully concealed; concealed by aril or funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–4 mm long; with curved or straight outline; elliptic, oval, or linear; apical according to radicle tip but marginal according to seed length; recessed; within halo or rim or not within corona, halo, or rim. Hilum halo color lighter or darker than testa. Hilum rim color of, lighter than, or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 1–2 mm long; with margins straight or curved; oblong or ovate; not in groove of raphe; confluent with hilum; mounded; same color as testa; brown or red; not within corona, halo, or rim. Endosperm present or absent; trace; not pluglike and not resembling tip of radicle; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; with both folded or not 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; partially concealing or not concealing radicle; notched at or split over radicle; with or without lobes; with lobes touching (auriculate) or not touching; with or without basal groin

formed by lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; white; inner face flat or concave; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous, linear, or triangular; lobe tip straight or curved; oblique to cotyledons or deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately or well developed; glabrous.

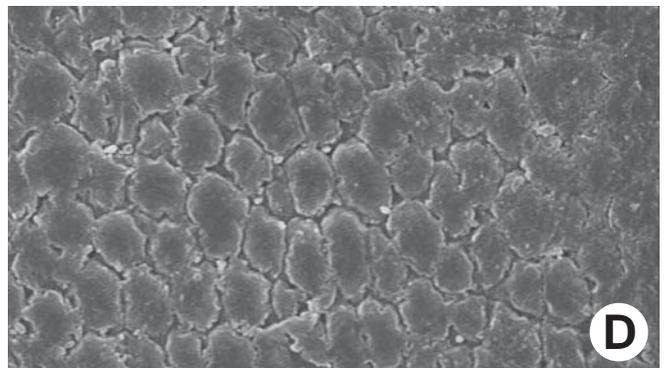
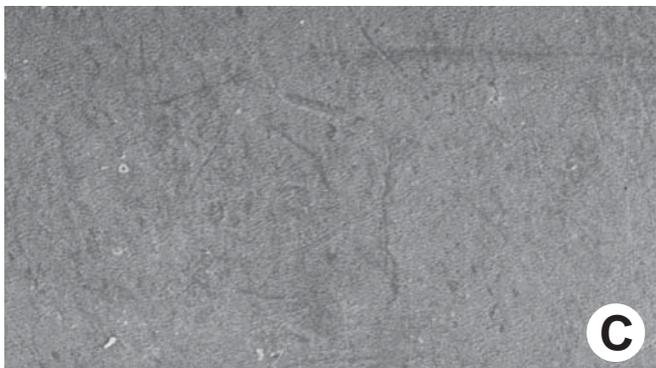
Distribution: Pantropics and widely cultivated.

Notes: Niyomdham (1992) transferred *Vigna pilosa* (J.T. Klein ex C.L. von Willdenow) J.G. Baker to the genus *Dolichovigna* B. Hayata. He considered the species to be intermediate between *Vigna* and *Dolichos* (10.64) and better placed in its own monotypic genus. We have left it in *Vigna*. Polhill (1994b) accepted *Wajira* M. Thulin (10.67) as a genus, but we have maintained it as a synonym of *Vigna*. Eight species or more of *Vigna* are cultivated, especially in the Old World (Duke 1981, Maesen and Somaatmadja 1989). The dried seeds of all cultivated species and the young pods of some species are used as human food, and some species are used as forage.

Vigna: *V. unguiculata* (C. Linnaeus) G.W. Walpers subsp. *unguiculata* (C-E), *V. spp.* (A-B). A, Fruits ($\times 1$); B, seeds ($\times 2.5$); C-D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



E



Genus: *Ramirezella* J.N. Rose

Phylogenetic Number: 10.66A.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 2 spp.—7 spp.

Fruit a legume; unilocular; 10.5–16 × ca. 1.3 × 0.3–0.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; narrowly oblong; not inflated; flattened; with beak (narrowly triangular, 17 × 3 mm, easily broken off); straight; with solid beak the same color and texture as fruit; tapered at apex; apex aligned with longitudinal axis of fruit; long tapered or tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin not constricted; with sulcus (shallow); plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down (assumed); active; with valves twisting. Replum invisible. Epicarp dull; monochrome; tan to greenish tan; with surface texture uniform; glabrous; eglandular; without spines; not smooth; with elevated or recessed features; not veined or veined (faintly); reticulately veined; not tuberculate; minutely slitted obliquely; not exfoliating; without cracks. Mesocarp thin; surface not veined; 2-layered; without balsamic vesicles; without fibers; with solid layer over solid layer; chartaceous. Endocarp dull or glossy (next to seeds); translucent or opaque (next to seeds); monochrome; white or tan; pithy, spongy and smooth (next to seeds), or smooth; without adhering pieces of testa; septate or subseptate; with septa thin (tissue paper-like), flexible; 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 measured; 2–3.6 mm long; of 1 length only; flattened; triangular. Aril dry; tongue-aril; entire; covering less than 1/2 of seed; cream.

Seed 5.5–9.5 × 3–9 × 2.5–4.5 mm; not overgrown; not angular; symmetrical; circular or elliptic; compressed or flattened (rarely); with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus;

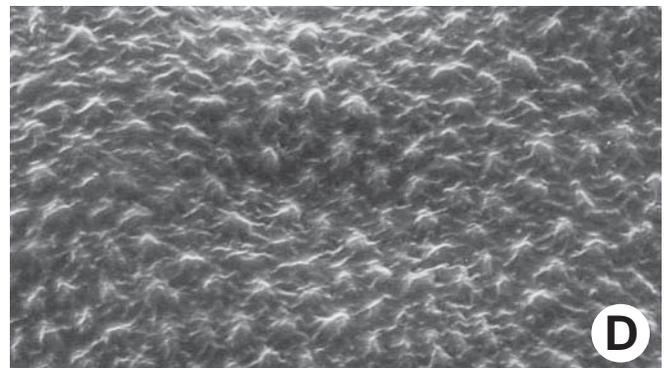
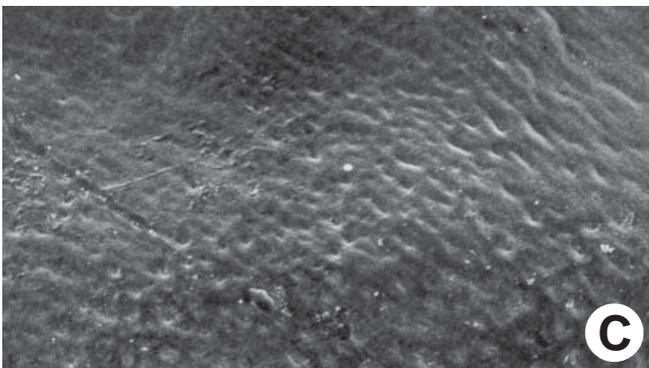
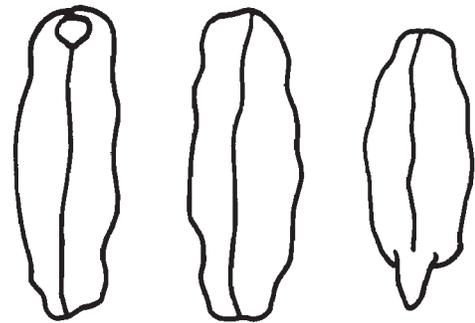
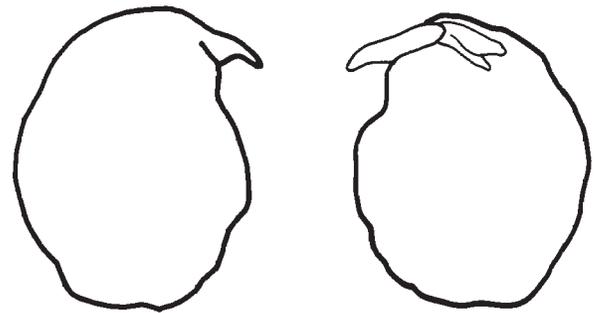
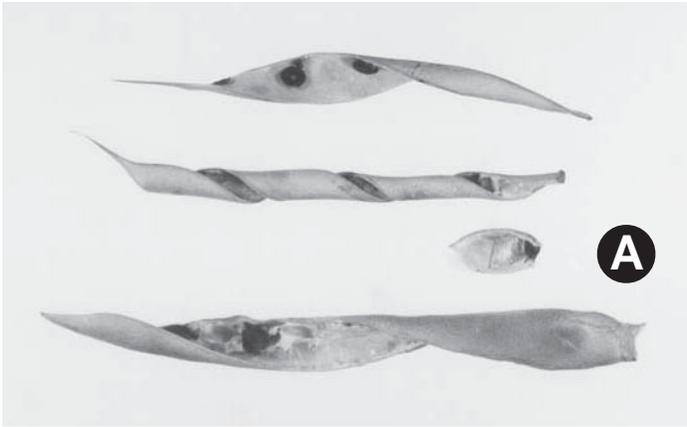
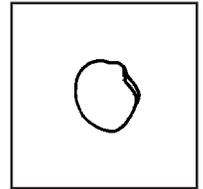
without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; dull or glossy; not modified by a bloom; colored; mottled and streaked or monochrome (rarely); with frequent streaks; dark or light brown; with dark or light brown or brown and tan overlay; glabrous; not smooth or smooth; with elevated features; wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 2–3 mm long; with straight or curved outline; narrowly oval or linear; apical according to radicle tip but marginal according to seed length; recessed; within rim (sometimes weakly developed). Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.6–1.3 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; same color as or dissimilar color from testa; darker than testa; dark brown; within rim. Lens rim color of or darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; light brown; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed.

Distribution: From Mexico to Nicaragua.

Notes: Lackey (1981b) noted that he preferred to merge *Ramirezella* into *Vigna* (10.66) and did so (Lackey 1983) without making the necessary new combinations. McVaugh (1987) also included *Ramirezella* in *Vigna* and made some of the needed combinations. Maréchal et al. (1978) maintained *Ramirezella* as a good genus separate from *Vigna*. Morphological (Ochoterena-Booth 1991, Ochoterena-Booth and Delgado Salinas 1994) and chloroplast DNA (Delgado Salinas et al. 1993) studies supported the proposition that

Ramirezella is a good genus. We agree with Maréchal et al. and not Lackey. The number of species and distribution are from Ochoterena-Booth and Delgado Salinas.

Ramirezella: R. strobilophora (B.L. Robinson) J.N. Rose
(A, C–E), *R. spp.* (B). A, Fruits ($\times 0.5$); B, seeds ($\times 6$);
C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Oxyrhynchus* T.S. Brandegee

Phylogenetic Number: 10.68.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 3 spp.—4 spp.

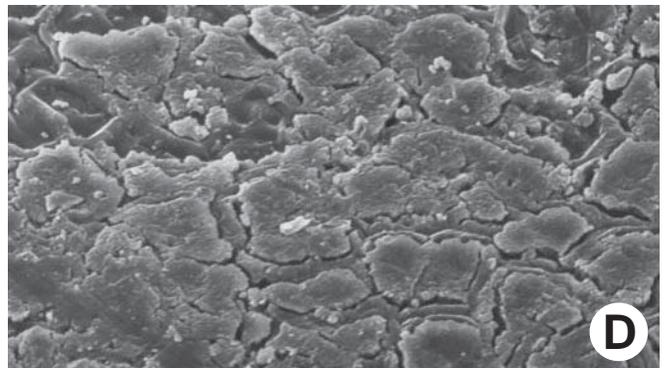
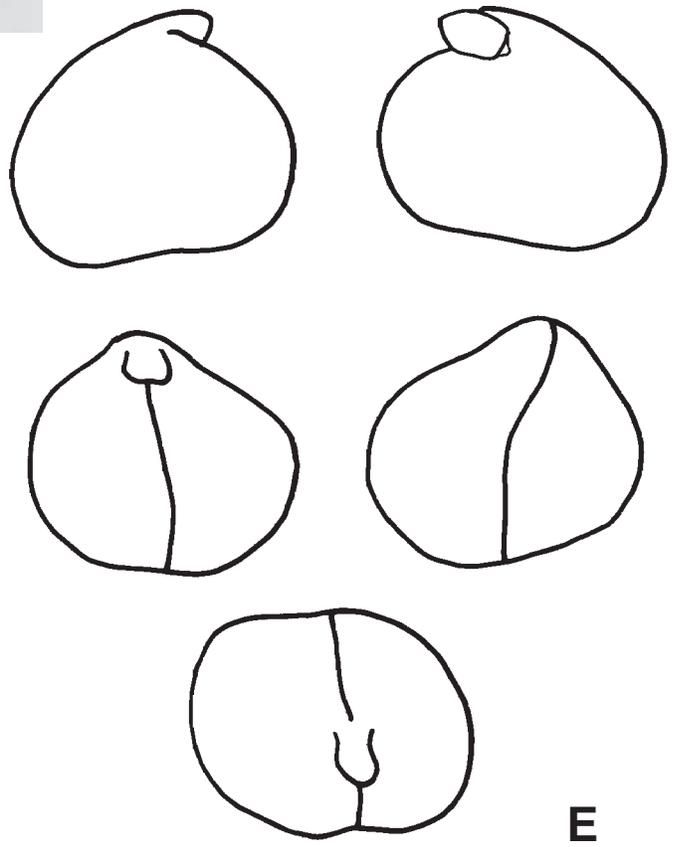
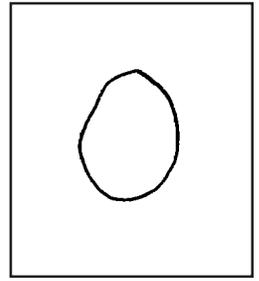
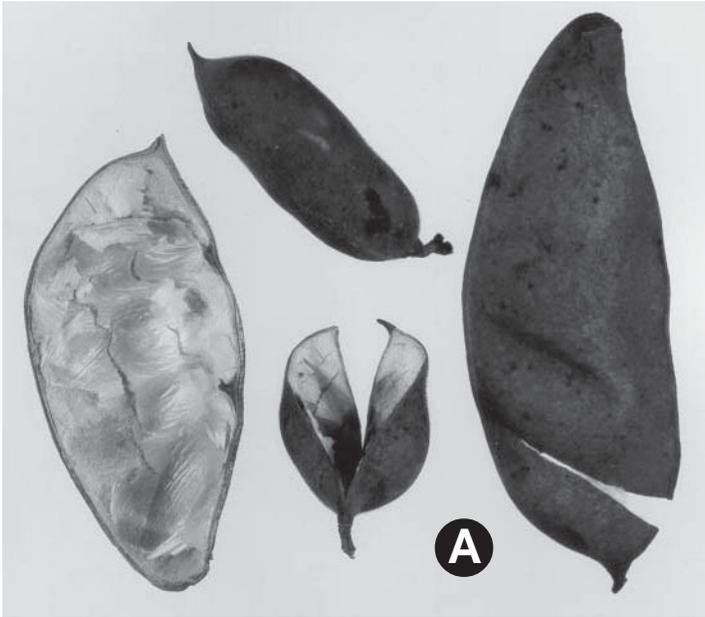
Fruit a legume; unilocular; 4–10 × 1.8–3.6 × 1.5–2.5 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; fusiform; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed or terete; with beak; straight or declined; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous or coriaceous; seed chambers externally visible or invisible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; multicolored; mottled; brown; with brown overlay; pubescent and indurate or pubescent but soon deciduous; with 1 type of pubescence; puberulent or sericeous; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome; white to tan; cobwebby, scurfy, smooth, and floury-filamentous; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 1–4; neither overlapping nor touching; in 1 series. Funiculus measured; at least 4 mm long; of 1 length only; thick; anvil-shaped. Aril present or absent; dry; 2-lipped rim-aril; entire; without tongue (or flap-like) on lips of 2-lipped rim-aril; cream.

Seed 13–20 × 13–19 × 11–18 mm; not overgrown; not angular; symmetrical; circular or elliptic (broadly); terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome; black to brown; glabrous; smooth or not smooth; with elevated features; wrinkled; coriaceous. Fracture lines present or absent; reticulate. Rim absent. Wings absent. Raphe not visible. Hilum visible, partially concealed, or fully concealed; concealed by funicular remnant or aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 13–25 mm long; with straight outline; linear; marginal according to radicle tip; flush; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 2–4 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; brown; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth or not smooth; wrinkled; both outer faces convex; both the same thickness; both more or less of equal length; with both folded or not folded; sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire or not entire 180 degrees from base of radicle; notched; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Central America (3 spp.) and New Guinea (1 sp.).

Notes: Seed alignment relative to fruit length could not be determined for this genus because the available fruits all had the seeds detached from the funiculi.

Oxyrhynchus: *O. trinervis* (J.D. Smith) V.E. Rudd (C–E), *O.* spp. (A–B). A, Fruits (× 0.8); B, seeds (× 3.1); C–D, testa (× 50, × 1000); E, embryos (× 2).



Genus: *Dolichopsis* E. Hassler

Phylogenetic Number: 10.69.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; $2.5\text{--}3.5 \times 0.8\text{--}0.9$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; reniform; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; widest near middle or D-shaped; 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; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown to tan; pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; chartaceous. 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 4–8; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2–3 mm long; of 1 length only; flattened; narrowly triangular. Aril dry; 2-lipped rim-aril; fimbriate; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; tan.

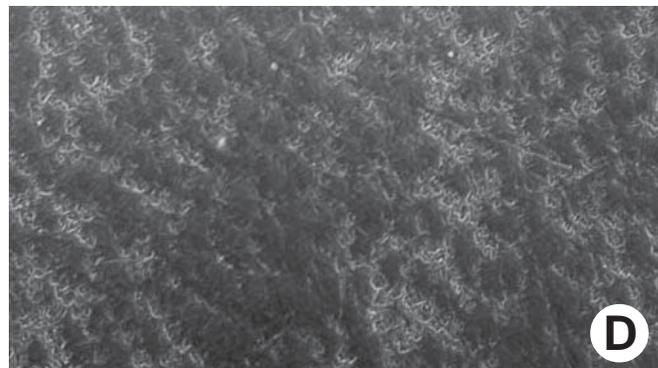
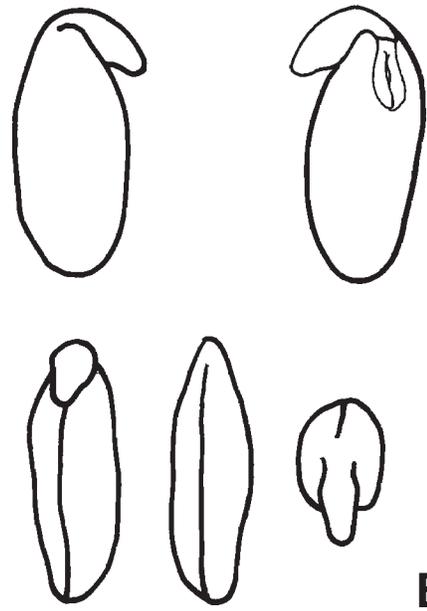
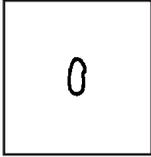
Seed $5.4\text{--}6.7 \times 2.5\text{--}3 \times 1.1\text{--}2.1$ mm; not overgrown; not angular; asymmetrical; irregularly elliptic; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on

seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; dark brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating; not bifurcating; darker than testa; black. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 3.5–4.6 mm long; with straight outline; linear; marginal according to radicle tip; recessed; within rim. Hilum rim color of or darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; same color as testa; brown; within rim. Lens rim color of or darker than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed; recessed on same side as radicle; yellow; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: South America.

Notes: Lackey (1981b) noted that “*Dolichos monticola* [C.F.P. von Martius ex G. Benth] is better placed in this genus.” Delgado Salinas and Lewis (1997) created the monotypic genus *Oryxis* A. Delgado Salinas & G.P. Lewis for *Dolichopsis monticola* (C.F.P. von Martius ex G. Benth) J.A. Lackey ex G.P. Lewis. We are not recognizing the new genus pending an expression on its status by the general botanical community.

Dolichopsis: *D. paraguariensis* E. Hassler (A–E). A, Fruits ($\times 4.3$); B, seeds ($\times 10$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Strophostyles* S. Elliott

Phylogenetic Number: 10.70.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; $4-7 \times 0.5-0.8 \times 0.3-0.5$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; symmetrical; linear; not inflated; compressed to terete; without beak; long tapered to tapered at apex; apex aligned to oblique (slightly) with longitudinal axis of fruit; tapered to rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally invisible or visible (slightly); with the raised seed chambers not torulose. Fruit margin not constricted or constricted; slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; glabrate or pubescent and indurate; with hairs (sparse) appressed; with 1 type of pubescence; 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; not veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; subcoriaceous to chartaceous. Endocarp dull; monochrome; white; cobwebby to scurfy to floury-filamentous; subseptate; osseous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 3–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry; tongue-aril or 2-lipped rim-aril (narrow); entire; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream.

Seed $7.2-10.5 \times 3.5-5.5 \times 3.7-5.2$ mm; not overgrown; angular to not angular; symmetrical; oblong to rectangular; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus;

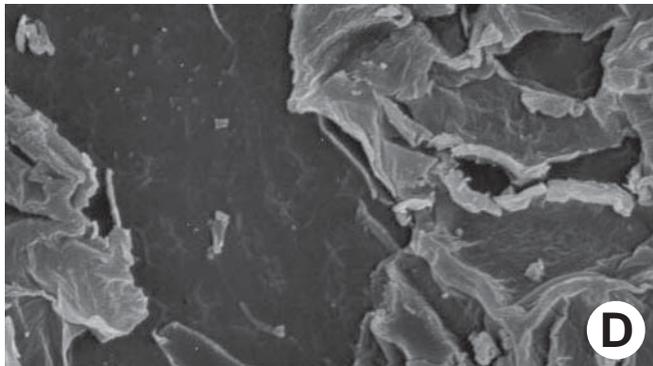
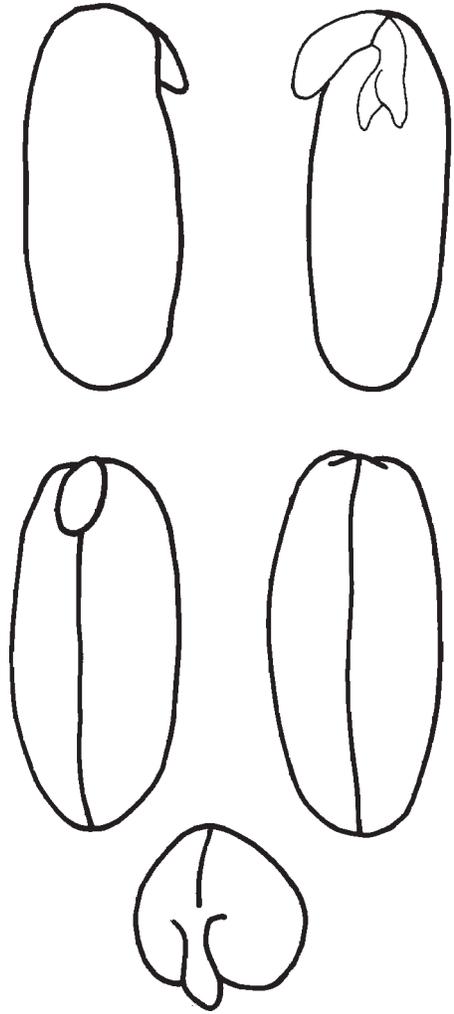
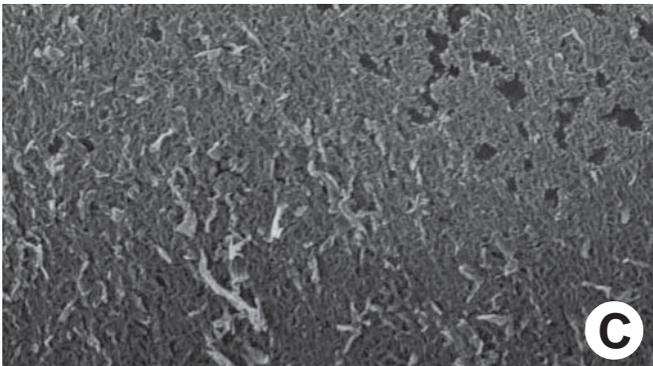
without umbo on seed faces. Testa not adhering or partially adhering to endocarp; glossy to dull; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; dark brown; with brown overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by funicular remnant; without faboid split; larger than punctiform; 4.2–6.3 mm long; with straight outline; linear; apical according to radicle tip but marginal according to seed length; raised; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.8–1 mm long; with margins straight or curved; linear or circular; not in groove of raphe; confluent with hilum; mounded; same or similar color as testa; lighter than testa; brown; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; 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 oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: North America and Mexico.

Notes: Yanful and Maun (1996) found fruits of *Strophostyles helvula* with up to eight seeds. Fragments of endocarp adhere to the testa, sometimes giving the false impression that it is pubescent.

Strophostyles: *S. helvula* (C. Linnaeus) S. Elliott (*C–E*), *S.* spp. (*A–B*). *A*, Fruits ($\times 1.2$); *B*, seeds ($\times 6.5$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).

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Genus: *Macroptilium* (G. Benth) I. Urban

Phylogenetic Number: 10.71.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 9 spp.—20 spp.

Fruit a legume; unilocular; $1.5-13 \times 0.3-0.6 \times 0.3-0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear or falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed to terete; without beak; long tapered to tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered to short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous to coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened (slightly) sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown, green, or tan; pubescent and indurate; with hairs erect or appressed; with 1 or 2 types of pubescence; pilose, puberulent, or villous; with pubescence golden, gray-brown, or white; with long and short white hairs intermixed; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous to chartaceous. Endocarp dull; monochrome; white; cobwebby to fibrous; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–27; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5 mm long; of 1 length only; flattened; triangular. Aril dry or fleshy (rarely); when fleshy hippocrepiform rim-aril; crenate; covering 1/2 to nearly all of seed; when dry rim-aril or 2-lipped rim-aril; entire; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; cream to white.

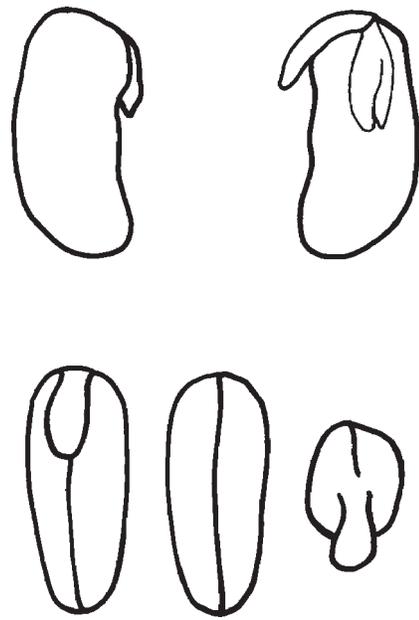
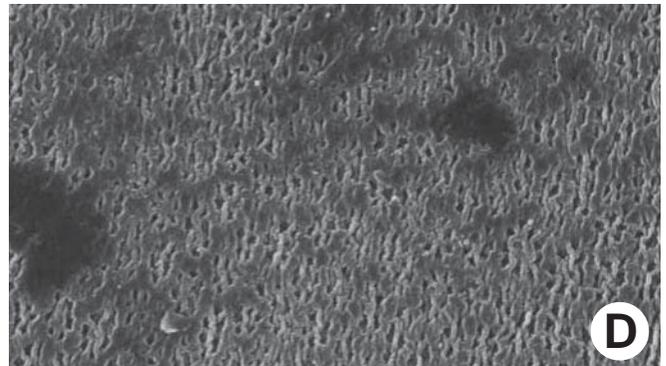
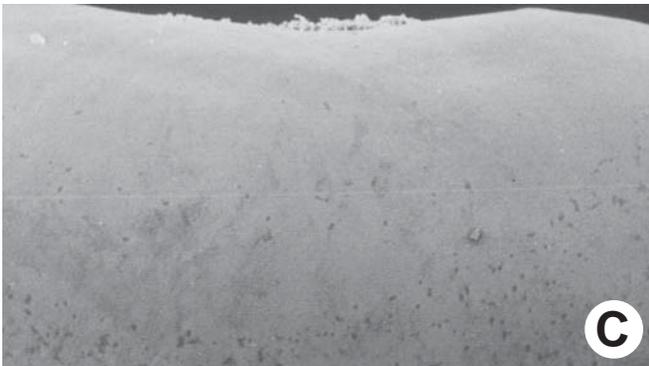
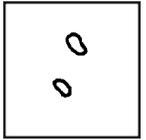
Seed $3-7 \times 2-4.5 \times 1.5-4$ mm; not overgrown; angular or not angular; symmetrical or asymmetrical; irregular, oblong, ovate, or reniform; terete to compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified or modified by a bloom; colored; monochrome or mottled; with frequent mottles; brown to black; with dark brown to black overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–4.2 mm long; with curved outline; elliptic or oval; apical according to radicle tip but marginal according to seed length; recessed; within corona or corona and halo. Hilum corona color darker than testa. Hilum halo color lighter than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; brown; within rim or not within corona, halo, or rim. Lens rim color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without or with 1 margin recessed; recessed on same side as radicle; yellowish white to white; inner face flat; glabrous around base of radicle. Embryonic axis oblique; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; with 180-degree turn to oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately or well developed; glabrous.

Distribution: Neotropics and neosubtropics; widely cultivated in tropics (*M. atropurpureum*).

Notes: *Macroptilium* was treated for Brazil by Barbosa-Fereiro (1987). Underground fruits and seeds of *M. gracile* (E.F. Poeppig ex G. Benth) I. Urban, *M. heterophyllum* (C.L. von Willdenow) R. Maréchal & J.C. Baudet, *M. panduratum* (C.F.P. von Martius ex G. Benth) R. Maréchal & J.C. Baudet, and *M. pedatum* (J.N. Rose) R. Maréchal & J.C. Baudet were not

available for study. *Macroptilium atropurpureum* (A.-P. de Candolle) I. Urban 'Sirato' is one of the most important tropical pasture legumes (Duke 1981); it is very drought resistant.

Macroptilium: *M. lathyroides* (C. Linnaeus) I. Urban (C–E),
M. spp. (A–B). A, Fruits ($\times 1.2$); B, seeds ($\times 6.7$);
C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Phaseolus* C. Linnaeus

Phylogenetic Number: 10.72.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

Species Studied—Species in Genus: 34 spp.—36 spp.

Fruit a legume; unilocular; $1-18 \times 0.2-2 \times 0.2-1.1$ cm; with persistent or deciduous 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; asymmetrical or symmetrical; linear, falcate, or irregular; when asymmetrical with both sutures parallelly curved, both sutures unequally curved, or 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; flattened to compressed to terete; without or with beak; declined or hooked; with solid beak the same color and texture as fruit; long tapered to tapered to short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; tapered or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous to chartaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain or embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; yellow to tan to brown to black, green, or red; with brown overlay; with mottling over seed chambers; glabrous, glabrate, or pubescent and indurate; with 1 or 2 types of pubescence; puberulent, pilose, strigose, or pilose and puberulent; with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable or pliable and stiff; with hair bases plain or swollen; glandular or eglandular; with glandular dots; without spines; smooth or not smooth; with elevated features; not veined; not tuberculate; dotted, wrinkled, or wrinkled and dotted; not exfoliating; without cracks. Mesocarp present or absent; thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous to chartaceous. Endocarp dull; monochrome; tan or white; smooth; septate or subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; remaining fused to epicarp; entire. Seeds $1-12(-20)$; length

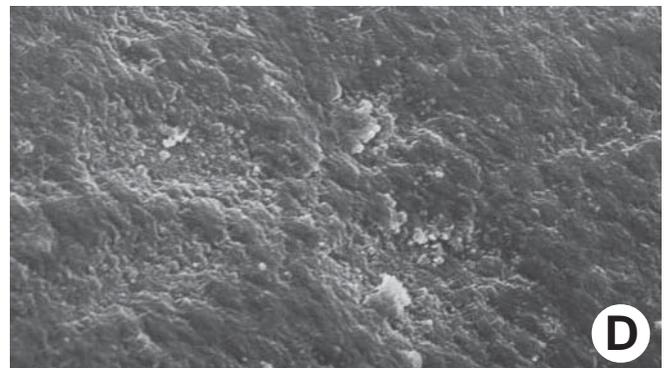
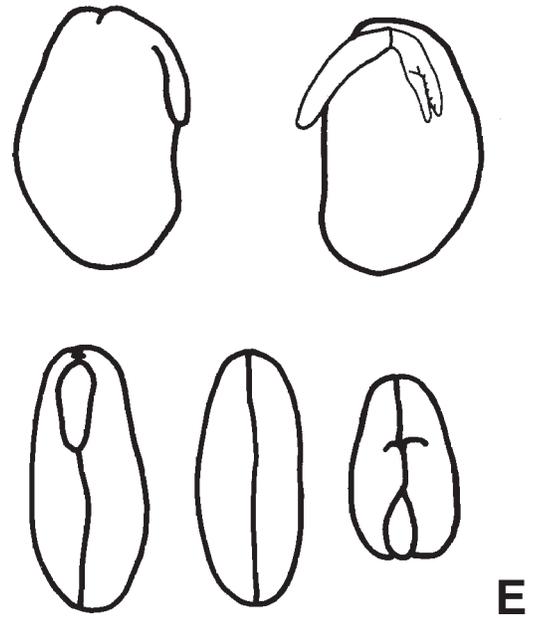
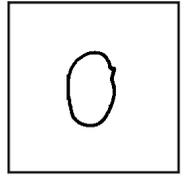
parallel with or transverse (rarely) to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; $0.5-1$ mm long; of 1 length only; flattened; straight or triangular. Aril present or absent; dry; tongue-aril; fimbriate; cream.

Seed $1.5-33 \times 1.5-20 \times 1-12$ mm; not overgrown; not angular or angular; symmetrical or asymmetrical; elliptic, reniform, trapezoid, irregular, oblong, or ovate; compressed, flattened, terete, or quadrangular; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus or without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored or clear; monochrome, mottled, or bichrome; with frequent mottles; greenish brown or reddish brown to brown, black, white, red, or brown and white; with brown, brown and tan, or black overlay; glabrous; smooth or not smooth; with elevated features; rugose or wrinkled; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe visible or not visible; from hilum to near base of seed and terminating or from hilum through base of seed and up the other side; not bifurcating; color of testa; raised or recessed. Hilum fully concealed; concealed by funicular remnant; with faboid split; larger than punctiform; $0.3-6$ mm long; with curved outline; narrowly elliptic to circular or oval (narrowly); apical according to radicle tip but marginal according to seed length; recessed, flush, or raised; within rim. Hilum rim color of or darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; $0.5-2$ mm long; with margins straight or curved; triangular or circular; not in groove of raphe; confluent with hilum; mounded; same or similar color as testa; lighter or darker than testa; black, brown, or tan; within rim or not within corona, halo, or rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire or not entire 180 degrees from base of radicle; wavy; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without or with 1 margin recessed; recessed on same side as radicle; white, yellow, or tan; inner face slightly concave or flat; glabrous around base of radicle. Embryonic axis oblique, parallel, or right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; slightly bulbous or linear; lobe tip slightly curved or straight; oblique to cotyledons; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: New World and widely cultivated.

Notes: Delgado Salinas (1985) monographed North and Central American *Phaseolus*, and his species count is used rather than that of Lackey (1981b). Delgado Salinas et al. (1988) described and illustrated the “dehiscence slit” found in *P. vulgaris* C. Linnaeus and *P. leptostachyus* G. Benth. The dehiscence slit is a short opening in the fruit suture close to the pedicel prior to full dehiscence. Seeds cannot pass through it, but females of *Zabrotes subfasciatus*, a bruchid, pass through the slit to oviposit on the first seed. Females of *Acanthoscelides obtectus* and *A. obvelatus*, also bruchids, oviposit directly through the dehiscence slit. Four species of large-seeded *Phaseolus* are commonly cultivated as human food (Duke 1981, Schery 1972): *P. acutifolius*, tepary bean; *P. coccineus* C. Linnaeus, scarlet runner bean; *P. lunatus* C. Linnaeus, lima bean; and *P. vulgaris*, bean or common bean. *Phaseolus vulgaris* is the most frequently and widely cultivated of the four, having a protein content of 17–37 percent and an average content of about 25 percent (Duke 1981, Schery 1972). The seed coat contains 4.8 percent of the protein in the seed (Werker 1997).

Phaseolus: *P. acutifolius* A. Gray (C–E), *P. spp.* (A–B). A, Fruits ($\times 0.7$); B, seeds ($\times 1$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 3$).



Genus: *Mysanthus* G.P. Lewis & A. Delgado Salinas

Phylogenetic Number: 10.72A.

Tribe: Phaseoleae.

Subtribe: Phaseolinae.

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

Fruit a legume; unilocular; 4.8–6.5 (from literature) × 0.8–1 (–1.4) (from literature) × ca. 0.5 cm; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without beak; 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; embellished; with thickened sutural areas. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; green to tan (yellowish); glabrate to pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; slightly, reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome; white; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 5–8 (from literature); length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 1 mm long; of 1 length only; flattened; straight. Aril dry; rim- and tongue-aril; entire; tan.

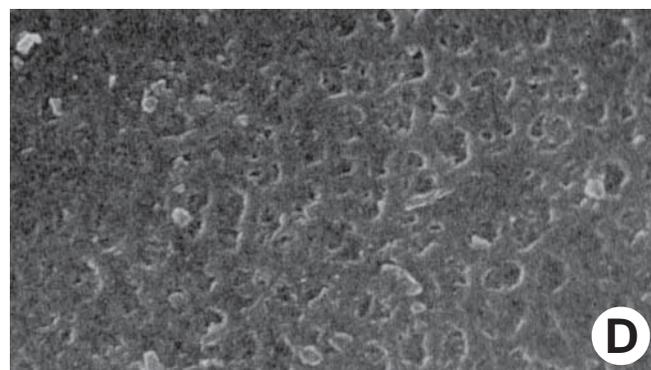
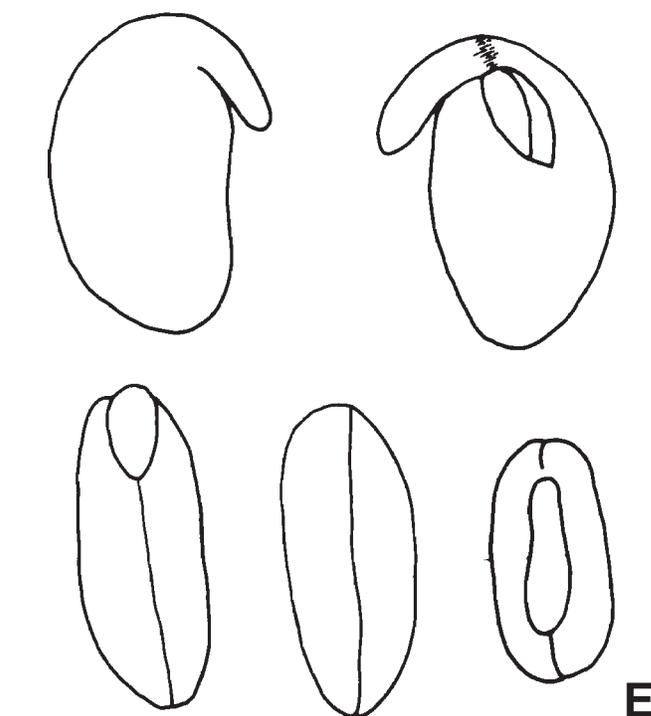
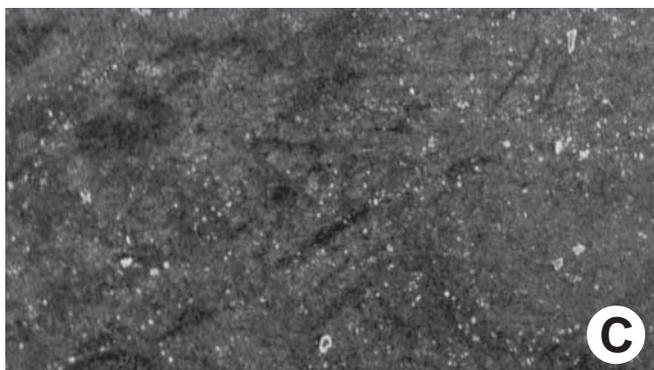
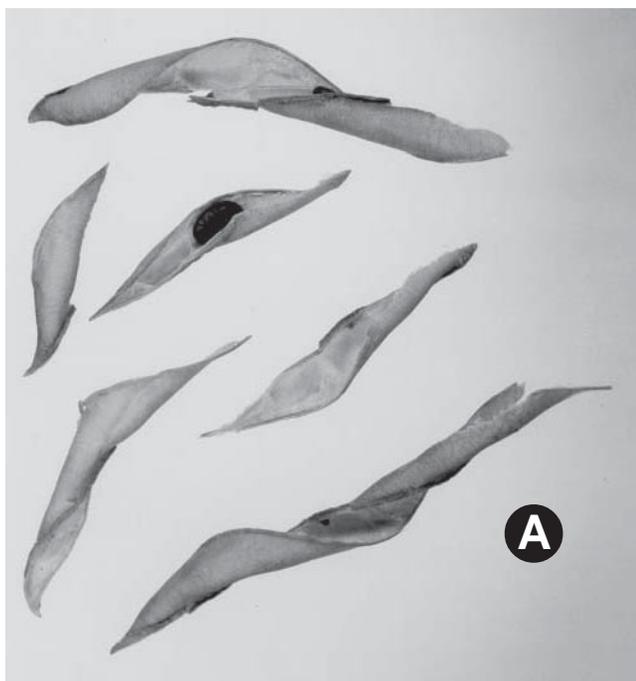
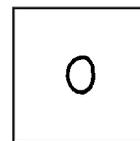
Seed 5–7 × 3.5–5 × 2–2.5 mm; not overgrown; not angular; symmetrical; elliptic to reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy to dull; not modified by a bloom; colored; mottled; with frequent mottles; reddish brown to tan; with black overlay; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible.

Hilum partially concealed; concealed by aril; without faboid split; larger than punctiform; 1.5–2 mm long; with curved outline; oval; apical according to radicle tip but marginal according to seed length; flush; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7–1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; brown or tan; within rim. Lens rim color of testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; 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 right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip curved; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Brazil in the states of Bahia and São Paulo.

Notes: *Mysanthus* was segregated from *Phaseolus* (10.72) by Lewis and Delgado Salinas (1994). Its position in subtribe Phaseolinae is uncertain (Lewis and Delgado Salinas 1994). Data from the single sample studied was supplemented from their description.

Mysanthus: *M. uleanus* (H.A.T. Harms) G.P. Lewis & A.O. Delgado Salinas var. *uleanus* (A–E). A, Fruits (× 1.6); B, seeds (× 4.4); C–D, testa (× 50, × 1000); E, embryos (× 7).



Genus: *Cajanus* A.-P. de Candolle

Phylogenetic Number: 10.73.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

Species Studied—Species in Genus: 13 spp.—31 spp.

Fruit a legume; unilocular; $1.3\text{--}9.5 \times 0.6\text{--}1.4 \times$ up to 0.25 cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; falcate, linear, moniliform, or irregular; when asymmetrical with both sutures parallelly curved, unequally curved, or nearly straight; not inflated; compressed; without or with beak; declined; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned to 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 not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent or indehiscent; splitting along sutures. Dehiscence of valves along both sutures; assumed apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown; with brown (light) overlay; with mottling over seed chambers; pubescent and indurate; with hairs appressed; with 2 or 3 types of pubescence; with pubescence golden; with pubescence uniformly distributed; with simple and glandular hairs or simple, glandular, and complex hairs; with bristle-like hairs; stiff; with hair bases swollen and plain; straight; straight at apex; glandular; with glandular dots or dots and hairs; without spines; smooth; not tuberculate; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome; white, tan, or brown; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; exfoliating in part; remaining fused to mesocarp and epicarp; entire. Seeds 2–9; length parallel with or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 1 mm long; of 1 length only; flattened; hooked. Aril present or absent; fleshy (if fleshy, also hard) or dry; when fleshy 2-lipped rim-aril or hippocrepiform rim-aril; entire;

covering less than 1/2 of seed; when dry 2-lipped rim-aril or hippocrepiform rim-aril; entire; covering less than 1/2 of seed; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril or 1 tongue or flap on 1 lip of 2-lipped rim-aril; ivory, cream, or tan.

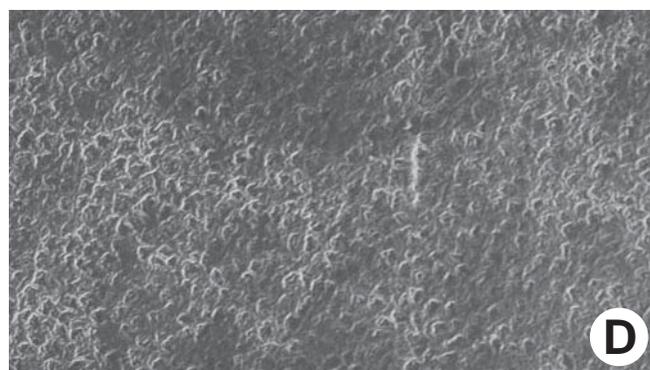
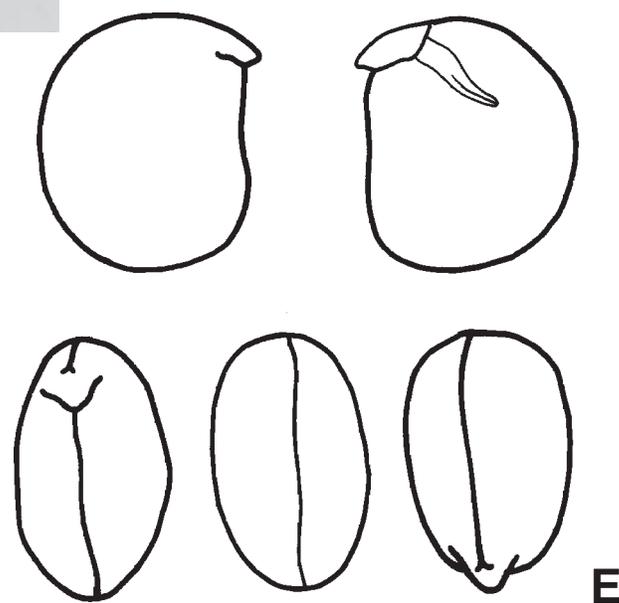
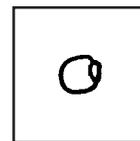
Seed $3.4\text{--}9 \times 2.8\text{--}8.5 \times 1.7\text{--}6.3$ mm; not overgrown; not angular; symmetrical; oblong to circular to reniform; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or glossy; not modified by a bloom; colored; monochrome, bichrome, mottled, or streaked (in literature); with frequent mottles; reddish brown, cream, black (nearly), gray, white, orange, or purple; with brown overlay; glabrous; smooth or not smooth; with recessed features; pitted with small separate pits; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed, fully concealed, or visible; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; up to 4.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush or raised; within rim. Hilum rim color darker than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; darker than testa; dark brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique, parallel, or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Africa throughout Asia to Australia and Oceania and cultivated (1 species).

Notes: Also included in this genus is *Atylosia* R. Wright & G.A.W. Arnott, which Van der Maesen (1986) placed in *Cajanus*. The species count is from Van der Maesen

(1986) and not Lackey (1981b). Van der Maesen discussed the relationships of *Dunbaria* and *Cajanus* (10.73), and included six species of *Dunbaria* in synonymies of various species of *Cajanus*. According to Van der Maesen, *Endomallus pellitus* F. Gagnepain and *E. spirei* F. Gagnepain are *Cajanus goensis* J.M. Dalziel. *Cajanus* is widely cultivated throughout the tropics, and 85 percent of its production is in India (Van der Maesen and Somaatmadja 1989, Purseglove 1968). On the Indian subcontinent, it is consumed mainly as dried seeds or pulse, and elsewhere it is commonly consumed as fresh seeds and pods.

Cajanus: *C. cajan* (C. Linnaeus) C.F. Millspaugh (*C–E*), *C.*
spp. (*A–B*). *A*, Fruits ($\times 1.4$); *B*, seeds ($\times 3.4$); *C–D*,
testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).



Genus: *Dunbaria* R. Wight & G.A.W. Arnott

Phylogenetic Number: 10.74.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

Group: Cajaninae.

Species Studied—Species in Genus: 4 spp.—20 spp. (Van der Maesen, personal communication, 1998)

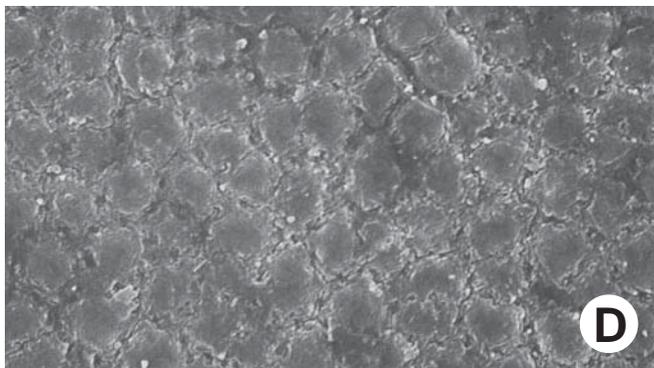
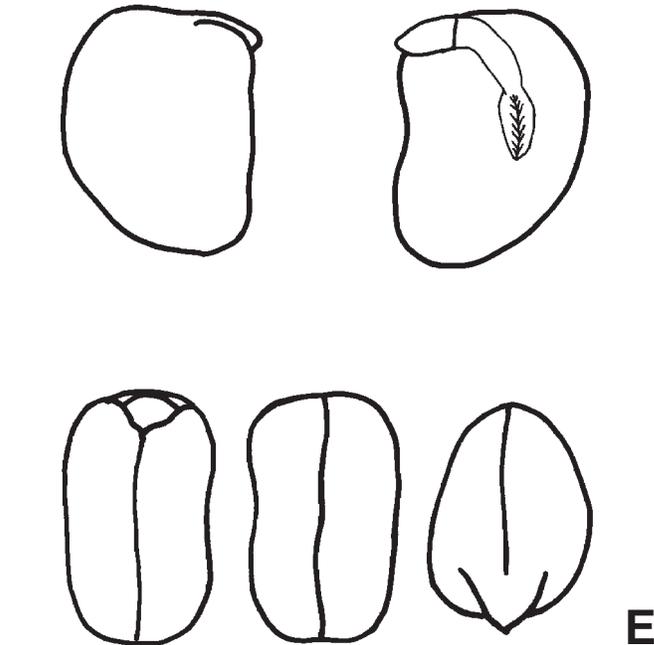
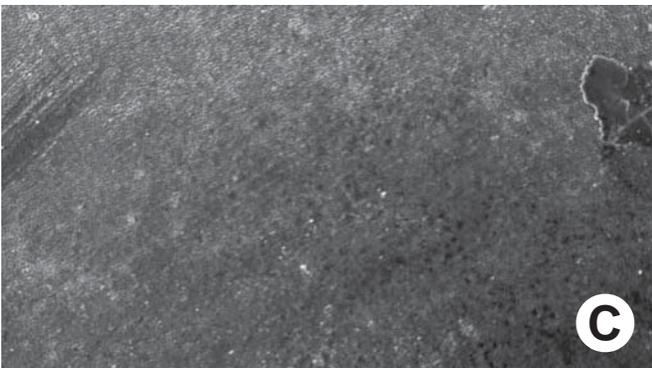
Fruit a legume; unilocular; $1.2\text{--}4.7 \times 0.5\text{--}0.9$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; falcate; when asymmetrical with both sutures parallelly curved; not inflated; compressed; with beak; straight or hooked; with solid beak the same color and texture as fruit; tapered 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 invisible or visible; with the raised seed chambers not torulose. 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; monochrome; brown or green; pubescent and indurate; with 1 or 2 types of pubescence; puberulent and sericeous or puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain and swollen or plain; glandular or eglandular; with glandular hairs and dots; without spines; not smooth; with elevated features; not veined; not tuberculate; muricate; exfoliating in part; with or without cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome; brown to tan; smooth; septate; with septa thin (tissue paper-like), flexible; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 4–5(–10) (10 from literature); length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–0.6 mm long; of 1 length only; flattened; triangular. Aril fleshy (and hard); 2-lipped rim-aril; entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; light brown to cream.

Seed $5\text{--}5.5 \times 4\text{--}4.5 \times 2.4\text{--}3$ mm; not overgrown; not angular or angular; symmetrical; reniform, elliptic, circular, or quadrangular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; reddish brown; with black and brown overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 2.5–3.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; flush; within rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm or equal to or greater than 0.5 mm in length; 0.5–0.7 mm long; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; similar color as testa; darker than testa; dark brown; within halo. Lens halo color darker than testa. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan; inner face flat; glabrous around base of radicle. Embryonic axis right angled; perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear to triangular; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed; glabrous.

Distribution: Asia to Australia.

Notes: Van der Maesen (1986) discussed the relationships of *Dunbaria* and *Cajanus* (10.73). He included six species of *Dunbaria* in synonymies of various *Cajanus* species. Lackey (1981b) included 15 species in *Dunbaria*.

Dunbaria: *D. punctata* (R. Wight & G.A.W. Arnott) G. Bentham (C–E), *D. spp.* (A–B). A, Fruits ($\times 2$); B, seeds ($\times 7.5$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Bolusafra* C.E.O. Kuntze

Phylogenetic Number: 10.75.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

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

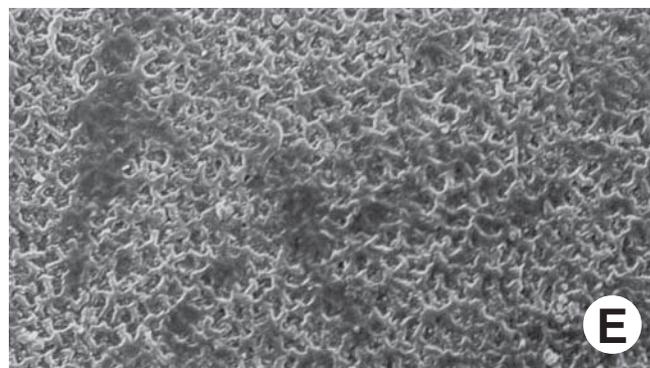
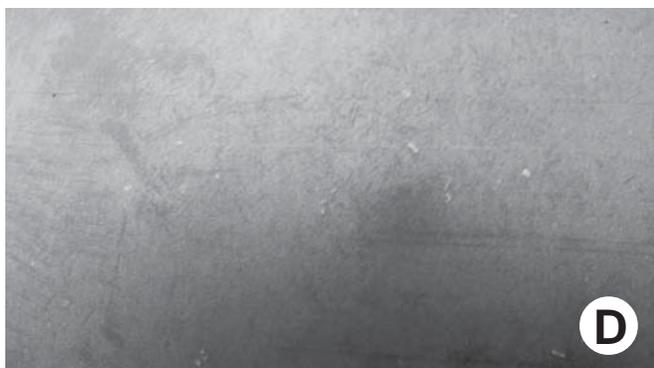
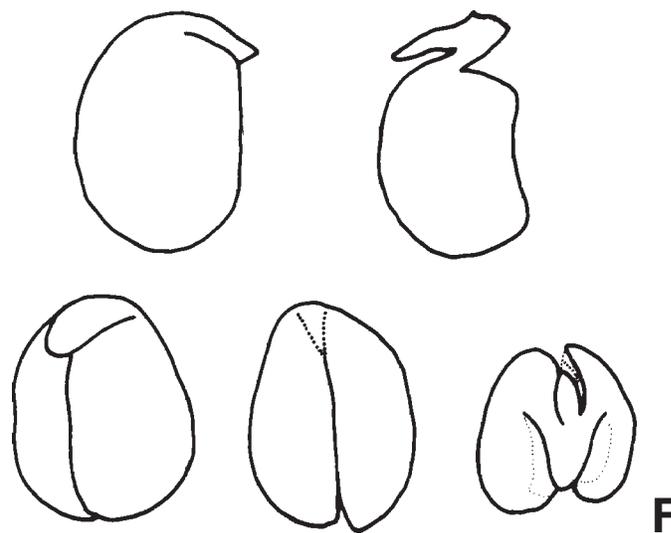
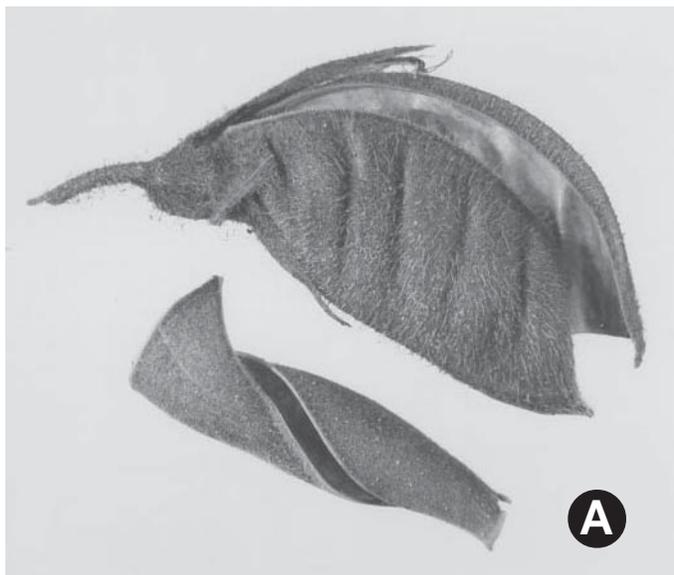
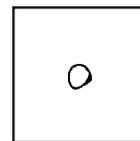
Fruit a legume; unilocular; $2.2\text{--}2.7 \times 0.8\text{--}1.1$ cm; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; not twisted; asymmetrical; reniform or irregular; when asymmetrical with both sutures unequally curved; not inflated; compressed; without beak; short tapered 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 nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 2 types of pubescence; sericeous; with pubescence golden; with pubescence uniformly distributed; with simple and glandular hairs; stiff; with hair bases swollen and plain, swollen, or plain; glandular; with glandular hairs; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2–3; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry; 2-lipped rim-aril; entire; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril; brown to cream.

Seed $4.1 \times 3.5 \times 3$ mm; not overgrown; not angular; symmetrical; elliptic to reniform; terete; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; 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 aril; with faboid split; with the lips

of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; raised; within rim. Hilum rim color darker than testa. Lens not discernible. Endosperm thin; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis right angled; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; triangular; lobe tip straight; deflexed and parallel to cotyledon width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: South Africa.

Bolusafra: *B. bituminosa* (C. Linnaeus) C.D.F. Meisner (A–F). A–B, Fruits ($\times 3.2$, $\times 3.3$); C, seeds ($\times 8$); D–E, testa ($\times 50$, $\times 1000$); F, embryos ($\times 10$).



Genus: *Flemingia* W. Roxburgh ex W.T. Aiton

Phylogenetic Number: 10.77.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

Species Studied—Species in Genus: 9 spp.—30 spp.

Fruit a legume; unilocular; $1.5 \times 0.9 \times 0.7$ cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregular or harp-shaped; when asymmetrical with both sutures unequally curved; not inflated; terete or compressed; with beak; straight; with solid beak the same color and texture as fruit; short tapered or rounded at apex; apex aligned with longitudinal axis of fruit; rounded or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases swollen or plain; glandular; with glandular dots; without spines; smooth or not smooth; with elevated features; veined or not veined; transversely veined relative to fruit length; not tuberculate; glandular dotted; exfoliating in part or not exfoliating; with or without cracks; cracking oblique to fruit length. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; streaked; tan; with brown or gray overlay; smooth; with hairs scattered over endocarp; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1 or 2; length oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; up to 1.1 mm long; of 1 length only; flattened; triangular. Aril dry; rim-aril or 2-lipped rim-aril (rarely); entire; covering less than 1/2 of seed; with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril or 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril (rarely); cream.

Seed $3-5.6 \times 2.5-4.2 \times 2.5-4.3$ mm; not overgrown; not angular or angular; symmetrical or asymmetrical; circular, irregular, reniform, or rhombic; terete to compressed; with surface smooth; without (mostly) or with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified or modified by a bloom; colored; monochrome or mottled; with frequent mottles; black or brown (dark); with black or brown overlay; glabrous; smooth; coriaceous. Fracture lines present or absent; transverse. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–1.5 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length or apical at apex of radicle tip (rarely); flush; within rim or rim and halo. Hilum halo color darker than testa. Hilum rim color darker than testa, color of testa, or lighter than testa (rim lighter if with halo). Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; 0.5 mm long; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; brown; within rim. Lens rim color of or darker than testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at 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 or oblique; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous or triangular; lobe tip straight; deflexed and parallel to cotyledon width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule well developed to rudimentary (rarely); glabrous.

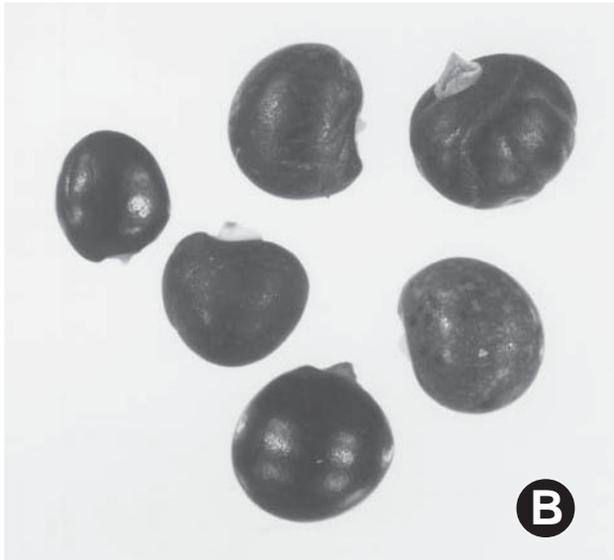
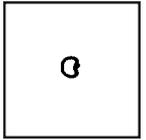
Distribution: Africa to Asia and Australia.

Notes: Hutchinson (1964) described the seeds as estrophiolate; however, rim-arils were present on all species studied, so Hutchinson's interpretation is probably similar to that of Gear and Dengler (1976), which is referred to in the notes for *Eriosema* (10.81).

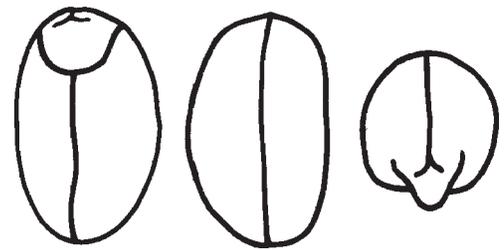
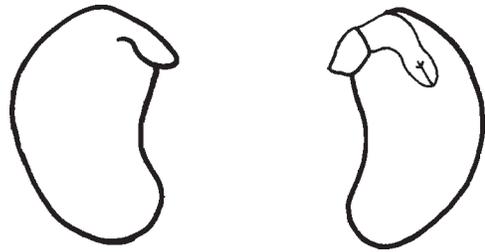
Flemingia: *F. macrophylla* (C.L. von Willdenow) E.D.
Merrill (*C-E*), *F. spp.* (*A-B*). *A*, Fruits ($\times 3.5$); *B*, seeds
($\times 7.3$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 8$).



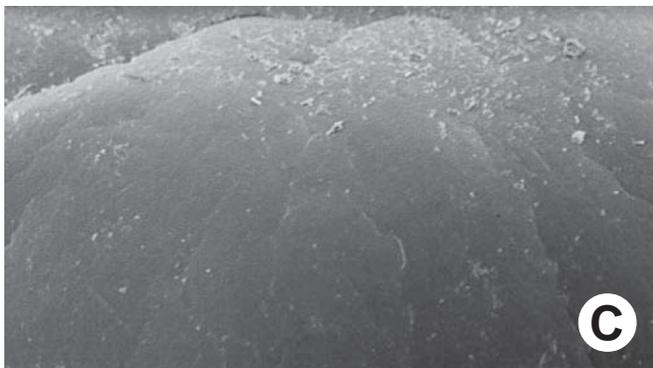
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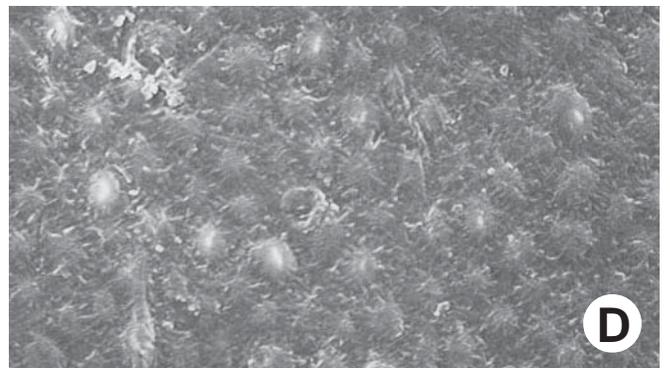
B



E



C



D

Genus: *Chrysoscias* E.H.F. Meyer

Phylogenetic Number: 10.78.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

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

Fruit a legume; unilocular; $1.7-2 \times 0.5-0.7 \times 0.4-0.5$ cm; with deciduous or persistent calyx; with calyx longer than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; narrowly elliptic; not inflated; terete; with beak; straight (2–3 mm long); with solid beak the same color and texture as fruit; tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally invisible. Fruit margin 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; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown; with surface texture uniform; pubescent and indurate; with hairs erect; with 1 type of pubescence; velutinous; with pubescence white or yellowish white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases swollen (yellow); antrorse; straight at apex; eglandular; without spines; not smooth; with recessed features; not veined; not tuberculate; obliquely, shallowly grooved; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; without reniform canals; solid; chartaceous. Endocarp glossy; opaque; monochrome; white; smooth; without adhering pieces of testa; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; ca. 0.5 mm long; flattened; broadly triangular. Aril fleshy; 2-lipped rim-aril; entire; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril.

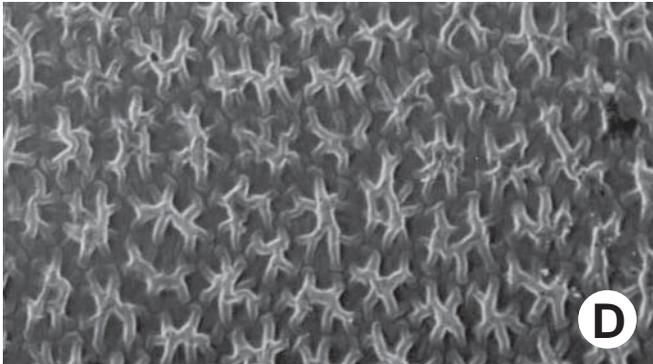
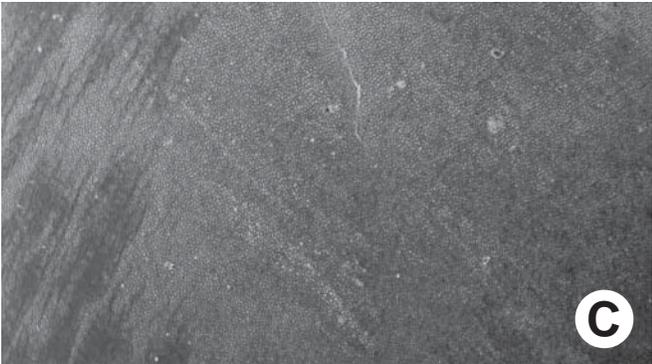
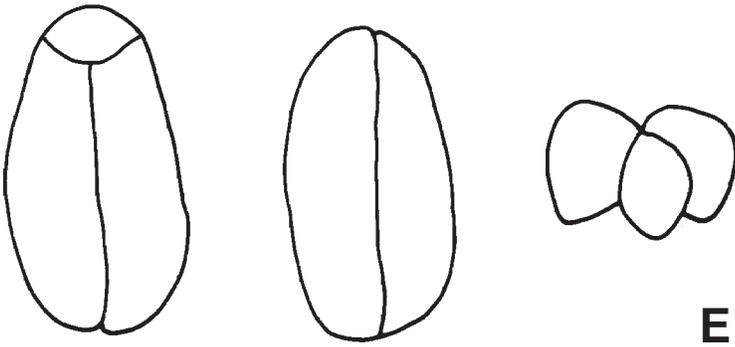
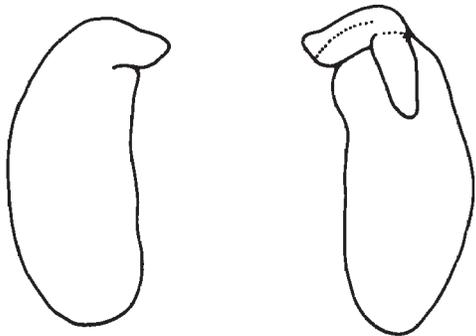
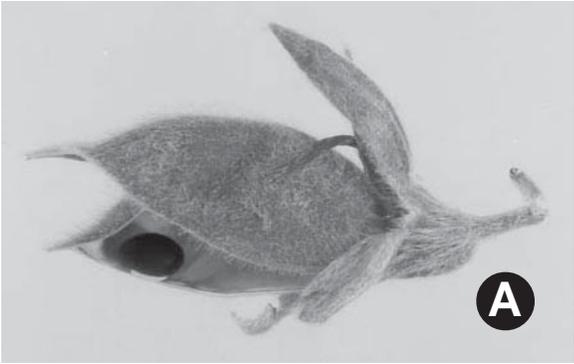
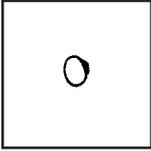
Seed $3.6-4.7 \times 3-3.7 \times 2.7-3$ mm; not overgrown; not angular; symmetrical; ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Testa not adhering

to endocarp; free from endocarp; dull to glossy; not modified by a bloom; colored; mottled or monochrome; with frequent mottles; black or brown (dark); with brown overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1.5–2.8 mm long; with curved outline; elliptic; marginal according to radicle tip; recessed; within halo or not within corona, halo, or rim. Hilum halo color lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.5–0.8 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed or flush; same color as testa; black or brown; within halo. Lens halo color lighter than testa. Endosperm absent. Cotyledons smooth; with 2 outer faces on each cotyledon, one flat and the other 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; dark 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 differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: South Africa.

Notes: The status of *Chrysoscias* is ambiguous. It has been maintained as a genus (Lackey 1981b, Polhill 1994b) and synonymized under *Rhynchosia* (10.80) (Gear 1978, Arnold and Wet 1993). Pending detailed studies, we accept it as a genus.

Chrysoscias: *C. argentea* (C.P. Thunberg) C.A. Smith (A, C–E), *C. parviflora* E.H.F. Meyer (B). A, Fruits ($\times 3.2$); B, seed ($\times 10.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 16$).



Genus: *Rhynchosia* J. de Loureiro

Phylogenetic Number: 10.80.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

Species Studied—Species in Genus: 29 spp.—200 spp.

Fruit a legume; unilocular; $0.4\text{--}5.5 \times 0.3\text{--}1.2 \times 0.2\text{--}0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight to curved (slightly); not plicate; assumed not twisted; asymmetrical; falcate, ovate, harp-shaped, or irregular; when asymmetrical with both sutures parallelly or unequally curved; not inflated; compressed or terete (Gear 1978); with or without (rarely) beak; straight or declined; with solid beak the same color and texture as fruit; tapered or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; long tapered, tapered, or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible to invisible; with the raised seed chambers not torulose. 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; assumed apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome or multicolored; mottled; brown, green, or tan; with green or brown (dark, rarely) overlay; with mottling over seed chambers; pubescent and indurate; with 1 or 2 types of pubescence; puberulent, puberulent and pilose, or pilose (rarely); with pubescence golden or white; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases swollen and plain, swollen, or plain; glandular or eglandular; with glandular hairs and dots; without spines; not smooth; with elevated features; irregularly veined or obliquely veined relative to fruit length (rarely); not tuberculate; glandular dotted, pusticulate, scurfy, or wrinkled (rarely); not exfoliating; with or without cracks; cracking transverse to fruit length. Mesocarp present or absent; thin or thick (rarely); 1-layered; without balsamic vesicles; with or without (rarely) fibers; fibrous throughout or solid; chartaceous or ligneous (rarely). Endocarp dull or glossy; monochrome, mottled, or streaked (rarely); tan, yellow, or white (rarely); with mottling over seed chambers; with brown or yellow (rarely) overlay; cobwebby, smooth, smooth and floury-filamentous, or

scurfy and smooth (rarely); nonseptate; coriaceous or chartaceous; not exfoliating; remaining fused to mesocarp and epicarp or to epicarp; entire. Seeds 2 or 1; length parallel with or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; up to 1 mm long; of 1 length only; flattened; triangular or curved. Aril hard fleshy or dry; when fleshy caplike; entire; covering less than 1/2 of seed; when dry rim-aril or 2-lipped rim-aril; entire; covering less than 1/2 of seed; without tongue (or flap-like) on lips of 2-lipped rim-aril or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril; cream to tan.

Seed $2.5\text{--}9.5 \times 2\text{--}6.4 \times 1.3\text{--}5.1$ mm; not overgrown; not angular; symmetrical or asymmetrical; cordate, elliptic, ovate, reniform, or bilobed, cicerlike; terete, compressed, or flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull to glossy; not modified by a bloom; colored; monochrome, bichrome, or mottled; with frequent mottles; black and red, brown, tan, black, or yellow; with black, brown, or gray overlay; glabrous; smooth or not smooth; with elevated or recessed features; tuberculate; pitted with small separate pits; coriaceous. Fracture lines present or absent; transverse. Rim absent. Wings absent. Raphe not visible. Hilum visible, partially concealed, or fully concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5–3.5 mm long; with curved outline; circular, elliptic, or oval; apical according to radicle tip but marginal according to seed length; flush or recessed; within rim or rim and halo. Hilum halo color darker than testa. Hilum rim color of, lighter than, or darker than testa. Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; 0.5–2.1 mm long; with margins straight or curved; linear; elliptic; not in groove of raphe; confluent with hilum; mounded or flush; dissimilar color from testa; lighter or darker than testa; black, brown, or purple; within rim or halo or not within corona, halo, or rim. Lens halo color darker than testa. Lens rim color darker than testa. Endosperm trace; not pluglike and not resembling tip of radicle or pluglike and resembling tip of radicle (rarely); restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at

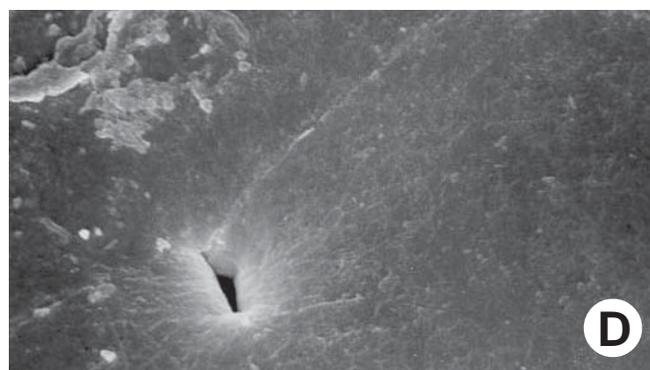
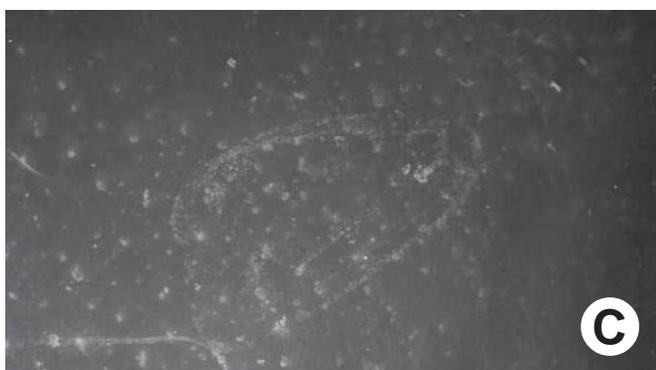
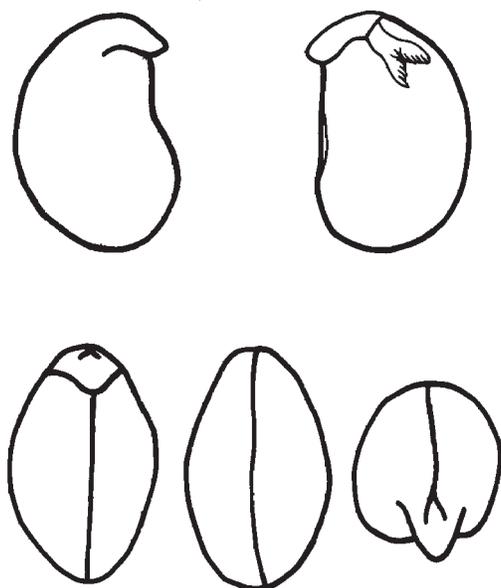
radicle; without lobes; with the interface division terminating at base of radicle; without or with 1 margin recessed; recessed on side opposite from radicle; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed or oblique; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous; lobe tip straight; deflexed and parallel to cotyledon length or width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Pantropics.

Notes: Gear (1978) monographed the New World species. Labat and Du Puy (1996) synonymized *Baukea* G.C.W. Vatke (10.76) with *Rhynchosia*. The specific epithet of the single *Baukea* species could not be transferred into *Rhynchosia*, so they created the new name *R. baukea* J.-N. Labat & D.J. Du Puy for it. Other faboid taxa with red and black seeds are *Abrus precatorius* (5.01), which are deadly poisonous, and some species of *Ormosia* (2.15).

Rhynchosia: *R. phaseoloides* (O.P. Swartz) A.-P. de
Candolle (*C-E*), *R. spp.* (*A-B*). *A*, Fruits ($\times 2.5$); *B*,
seeds ($\times 3.3$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos
($\times 5$).

8



Genus: *Eriosema* (A.-P. de Condolle) H.G.L.R.
Reichenbach

Phylogenetic Number: 10.81.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

Group: Cajaninae.

Species Studied—Species in Genus: 19 spp.—130 spp.

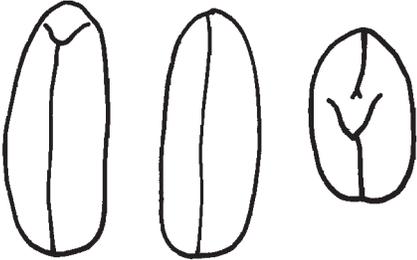
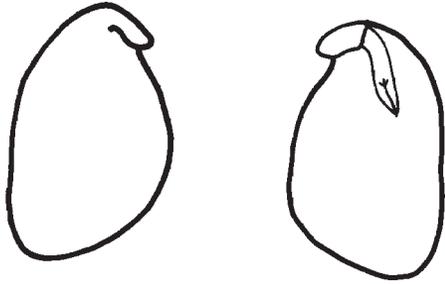
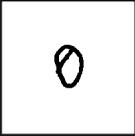
Fruit a legume; unilocular; 1–1.8 × 0.7–1 × 0.4 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved; not plicate; not twisted; asymmetrical; irregular or reniform; when asymmetrical with both sutures unequally curved; not inflated; compressed; with beak; straight or declined; with solid beak the same color and texture as fruit; rounded at apex; apex oblique, right-angled, or aligned with longitudinal axis of fruit; rounded or short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible or visible. 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; monochrome; reddish brown; pubescent and indurate; with 2 types of pubescence; sericeous to tomentose and villous or pilose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain and swollen, plain, or swollen; eglandular or glandular; with glandular dots; without spines; not smooth or smooth; with elevated features; not veined; not tuberculate; muricate; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; solid; chartaceous. Endocarp dull; monochrome or mottled; tan or brown; with mottling over seed chambers; with brown or gray overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1 or 2; length transverse or oblique to fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 0.5–0.6 mm long; of 1 length only; flattened; straight or triangular. Aril fleshy; 2-lipped rim-aril; entire or crenate; covering less than 1/2 of seed; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 2 tongues or flaps, 1 on each lip of 2-lipped rim-aril.

Seed 4.5–8.5 × 2.7–5.5 × 2–3.5 mm; not overgrown; not angular; symmetrical or asymmetrical; oblong, elliptic, or quadrangular (rarely); compressed to terete (nearly); with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or mottled; with frequent mottles; black or brown (reddish); with brown overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully to partially concealed; concealed by aril; with faboid split; larger than punctiform; 4–6.2 mm long; with straight outline; linear; apical according to radicle tip but marginal according to seed length; raised to flush; within rim. Hilum rim color darker or lighter than testa. Lens discernible; less than 0.5 mm to equal to or greater than 0.5 mm in length; 0.5 mm long; with margins curved; punctiform; not in groove of raphe; confluent with hilum; mounded; similar color as testa; lighter or darker than testa; light brown; within rim. Lens rim color darker than testa. Endosperm present or absent; trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat; glabrous around base of radicle. Embryonic axis oblique or right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; bulbous to triangular; lobe tip straight to curved; deflexed and parallel to cotyledon length or width or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately to well developed; glabrous.

Distribution: Pantropics.

Notes: Grear (1970) monographed the American species, and Jacques-Felix (1971) monographed the species of central and eastern Africa. Grear and Dengler (1976) studied the rim-aril of *Eriosema glaziovii* H.A.T. Harms and discussed its importance in distinguishing *Eriosema* from *Rhynchosia*. They also discussed the misinterpretation of *Eriosema* seeds as estrophiolate by Hutchinson (1964) and Bentham (1865).

Eriosema: *E. floribundum* G. Bentham (C–E), *E. spp.* (A–B). A, Fruits (× 2.2); B, seeds (× 4.3); C–D, testa (× 50, × 1000); E, embryos (× 6).



E



Genus: *Paracalyx* S.I. Ali

Phylogenetic Number: 10.82.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

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

Fruit a legume; unilocular; $1.9 \times 0.8 \times 0.5$ cm; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; fusiform or reniform; when asymmetrical with both sutures unequally or parallelly curved; not inflated; compressed; with beak; straight or declined; with solid beak the same color and texture as fruit; tapered to short tapered at apex; apex aligned with longitudinal axis of fruit; tapered or short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. 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; assumed apical and down; active; with valves breaking. Replum invisible. Epicarp dull; monochrome; brown to yellow; pubescent and indurate; with 2 types of pubescence; puberulent; with pubescence golden; with pubescence uniformly distributed; with simple and glandular hairs; pliable; with hair bases swollen and plain; glandular; with glandular hairs; without spines; smooth or not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; glandular dotted; not exfoliating; without cracks. Mesocarp thin; 1-layered; without balsamic vesicles; without fibers; mealy; chartaceous. Endocarp dull; mottled; with mottling (dark); with tan overlay; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; triangular. Aril dry; 2-lipped rim-aril; entire; without or with tongues (or flap-like) on lips of 2-lipped rim-aril; with 1 tongue or flap on 1 lip of 2-lipped rim-aril; cream or white.

Seed 6–9.5 \times 4–6 \times 3–5.5 mm; not overgrown; not angular; symmetrical; reniform; terete; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa

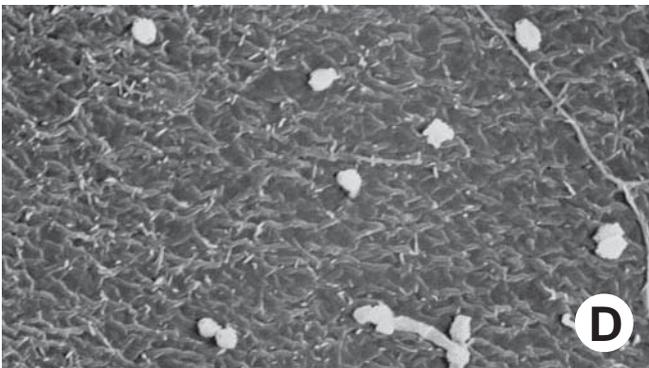
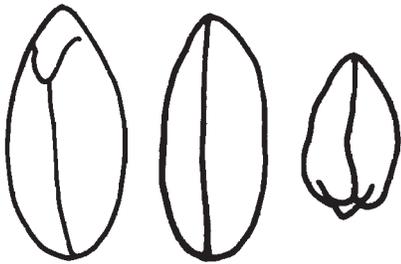
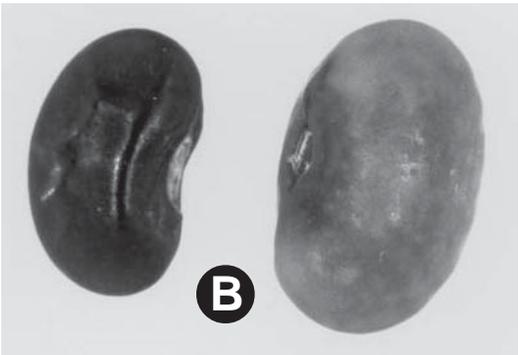
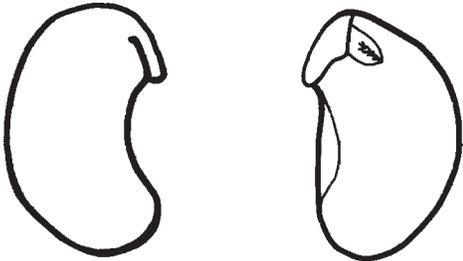
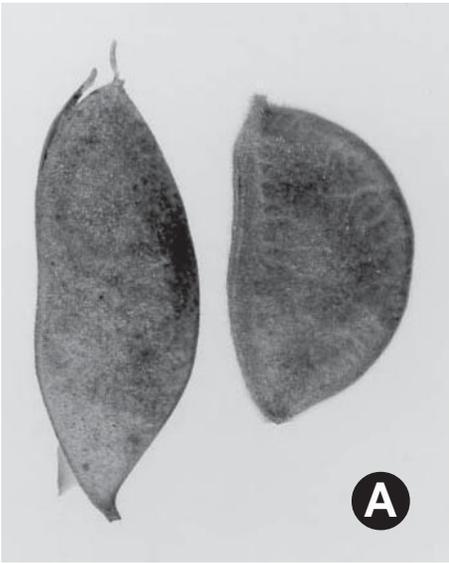
not adhering to endocarp; dull; not modified by a bloom; colored; mottled; with frequent mottles; dark brown or green; with black or brown overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1–2 mm long; with curved outline; elliptic; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.7–1 mm long; with margins curved; elliptic; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; with 1 margin recessed or without margins recessed; recessed on same side as radicle; pale tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; deflexed and parallel to cotyledon length or oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Africa to Asia.

Notes: Only one whole fruit was studied.

Paracalyx: *P. scariosus* (W. Roxburgh) S.I. Ali (C–E), *P.* spp. (A–B). A, Fruits (\times 3.6); B, seeds (\times 6.9); C–D, testa (\times 50, \times 1000); E, embryos (\times 6).

3



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

Phylogenetic Number: 10.83.

Tribe: Phaseoleae.

Subtribe: Cajaninae.

Group: Cajaninae.

Species Studied—Species in Genus: 3 spp.—15 spp.

Fruit a legume; unilocular; $3\text{--}5.2 \times 1.2\text{--}1.5$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; curved; not plicate; not twisted; asymmetrical; C-shaped; when asymmetrical with both sutures parallelly curved; not inflated; compressed; without beak; short tapered at apex; apex oblique with longitudinal axis of fruit; tapered at base; base aligned or right angled with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along sutures. Dehiscence of valves along both sutures; apical and down; active; with valves twisting. Replum invisible. Epicarp dull; monochrome; brown to reddish brown; pubescent and indurate or pubescent but soon deciduous; with 1 or 2 types of pubescence; pilose; with pubescence brown (reddish) or golden; with golden glandular hairs and short-pilose reddish-brown intermixed; with pubescence uniformly distributed; with simple and glandular hairs (sometimes); pliable; with hair bases swollen and plain, swollen, or plain; glandular; with glandular hairs; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; wrinkled; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; solid; coriaceous. Endocarp dull and glossy (usually under seed); monochrome; tan; smooth; subseptate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1 or 2; length parallel with or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril; entire; gray to tan.

Seed $6.5\text{--}9.5 \times 5.5\text{--}8.7 \times 2.6\text{--}4.1$ mm; not overgrown; not angular; symmetrical; circular; compressed; with surface smooth; without visible radicle and cotyledon lobes; with shallow hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified or modified by a bloom; colored; monochrome; reddish to dark brown; glabrous; smooth or not smooth; with recessed features; large depressions on each face; 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; larger than punctiform; 2 mm long; with straight outline; linear; apical according to radicle tip but marginal according to seed length; recessed; within rim. Hilum rim color of or lighter than testa. Lens discernible; equal to or greater than 0.5 mm in length; up to 1 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; mounded; same color as testa; not within corona, halo, or rim or within rim. Lens rim color of testa. Endosperm trace; restricted to region of embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; notched at radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white to tan; inner face flat; glabrous around base of radicle. Embryonic axis oblique to right angled; oblique or perpendicular to length of seed; without a joint evident between the radicle and the cotyledons. Radicle differentiated from cotyledon; linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Africa.

Adenodolichos: *A. punctatus* (M. Micheli) H.A.T. Harms (C–E), *A. spp.* (A–B). A, Fruits ($\times 1.4$); B, seeds ($\times 4.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).

