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1

FLORA
OF THE PRAIRIE PROVINCES

Bernard Boivin

Part IV

(continued)

CYPERACEAE

Order 71. CYPERALES

A single family of Grass-like herbs with solid stems which are nearly always triangular.

125. CYPERACEAE (SEdge FAMILY)

Flower typically reduced to a bract, some stamens and a single ovary which matures into an achene. Perianth usually lacking, or sometimes reduced to bristles, more rarely to small bracts.

- a. Pistillate flower subtended by two bracts, the inner one bottle-shaped and completely enclosing the flower except for the protruding style.
 - b. Spikelet reduced to 1-2 flowers 8. Kobresia
 - bb. Flowers more numerous 9. Carex
- aa. All floral bracts open.
 - c. Spikelet reduced to 1-2 flowers and a number of empty scales.
 - d. Achene crowned by a tubercule (as in Eleocharis) 7. Rhynchospora
 - dd. No tubercule 6. Cladium
 - cc. Flowers more numerous.
 - e. Scales distichous, that is alternating on opposite sides of the rachis to form only 2 longitudinal rows.
 - f. Inflorescence terminal 2. Cyperus
 - ff. Axillary 1. Dulichium
 - ee. Scales spirally imbricated, that is borne on all sides of the rachis.
 - g. Achene surrounded by numerous bristles which soon elongate into a conspicuous tuft of "cotton" 3. Eriophorum

- gg. Spikelets not maturing into heads of "cotton".
 h. Stem leafless, the basal leaves reduced
 to bladeless sheaths 5. Eleocharis
 hh. Stem leafy, or at least with basal
 leaves or large inflorescence
 bracts 4. Scirpus

1. DULICHIMUM Pers.

Stem round and the inflorescences axillary, the latter resembling Cyperus. Perianth of 6-9 bristles.

1. D. arundinaceum (L.) Britton var. arundinaceum -- Galingale, Three-Way-Sedge -- Stem terete and hollow as if a Grass, but the flowers as in Cyperus. Stiffly erect, leafy herb with a simple and soft stem mostly 4-8 dm high. Leaves in three vertical rows. Sheath green all around, margined in red brown. Inflorescence an axillary raceme of + 5 spikelets. Anthers (3.0)-3.5-(5.0) mm long. Mid summer. Shores of boggy lakes. -- NF-SPM, NS-seMan, BC, US.

Known in our area by only two collections: M.G. Dudley, Whitemouth River, Oct. 1, 1938 (DAO); Boivin & Champagne 14190, Réserve Forestière Whiteshell, Lily Pond, rivage, 25 sept. 1960 (DAO). It has also been collected at Ingolf just across the border in Ontario. The B.C. collections (CAN, DAO) are apparently recent introductions related to Cranberry cultivation.

From James Bay eastward, one will also find var. boreale, a generally smaller plant, 4 dm high or less, with shorter stamens, (1.5)-2.5-(2.8) mm long, growing on river shores rather than in boggy places.

2. CYPERUS L.

GALINGALE

A basic type with the perfect flowers in distichous spikelets. Inflorescence terminal. Perianth (or bristles) lacking.

- a. Annual, 3-15 cm high 1. C. aristatus
 aa. Taller perennials.
 b. Spikelets in pectinate racemes 2. C. strigosus
 bb. In dense terminal glomerules.
 c. Stem very scabrous 3. C. Schweinitzii
 cc. Smooth or nearly so 4. C. Houghtonii

1. C. squarrosus L. (C. aristatus Rottb.; C. inflexus Muhl.) -- Scales acuminate into a strongly recurved tip. Tufted. Bracts large, about half the height of the plant. Inflorescence congested, sessile. Late summer. Inconspicuous herb of exundated shores. -- NB-BC, US, (CA), SA.

For the correct name of this species, see *Blumea* 10: 642, 1960.

2. *C. strigosus* L. -- Nut-Grass -- Scales lanceolate. Stem somewhat bulbous at base. Leaves up to 5-10 mm wide. Inflorescence often gold-tinged. Summer. Rare shore plant: Wawanesa, Watrous. -- swQ-S, US.

A fairly variable species, more so further south, and especially so on the Costal Plain. Many varieties have been described with longer spikelets, or longer scales, etc., but the material at hand is inadequate and we cannot tell if these are mere extremes of variation or possibly geographical varieties.

The limited number of collections (DAO) from our area, both in 1932, would seem to indicate a non-persistent adventive.

3. *C. Schweinitzii* Torrey -- Tufted with a bulbous base and numerous bulbous offshoots that are easily broken off. Stem scabrous on the angles. Scales broadly ovate, over 2.5 mm long, gold-tinged on the sides, acuminate, the acumen about 0.5 mm long. Late spring. Active sand dunes. -- O-S, US.

The source for an Alberta report by Moss 1959, repeated by Boivin 1967, remains obscure as no corresponding specimen could be located at ALTA in 1971.

4. *C. Houghtonii* Torrey -- Rather easily confused with the preceding, but the stem smooth to slightly scabrous near the top. Scales smaller, the middle ones 2.0-2.5 mm long, purplish on the sides, merely mucronate at tip, the mucro about 0.1 mm long. Early summer. Sandy Pine woods. -- swQ-seMan, US, Eur (Breslau).

3. ERIOPHORUM L.

COTTON-GRASS

As in *Scirpus* but the perianth-bristles very numerous and elongating into a conspicuous "cotton" tuft. As in most other Grass and Grass-like plants, the anthers are usually trapped in the inflorescence and are often still available for measuring at the maturity of the fruit.

Well collected specimens, not as easily done as said, will show conspicuous differences in the mode of growth. Species 1-5 are stoloniferous and the stems will arise singly or sometimes (especially *E. viridicarinatum*) in small clusters of 2 or 3 stems. Species 6-8 produce no stolons but grow in small to very large tufts.

a. Inflorescence of 2 or more spikelets; stem leaves with a blade.

b. Upper leaf with a reduced limb, shorter than its sheath 3. *E. gracile*

- bb. Limb at least as long as its sheath.
 c. Scales with the midnerve dilated above
 the middle 2. E. viridicarinatum
 cc. Midnerve gradually more tenuous
 upwards 1. E. angustifolium
- aa. Inflorescence reduced to a single terminal
 spikelet; stem leaves mostly reduced to
 bladeless sheaths.
 d. Stoloniferous.
 e. Anthers 0.5-1.0 mm long; scales blackish,
 barely hyaline-margined 4. E. Scheuchzeri
 ee. Anthers bigger, 1.5-3.0 mm long; scales
 with a broad hyaline margin, the blackish
 center covering only about half the width
 5. E. Chamissonis
- dd. Tufted.
 f. Scales with a broad hyaline margin, the
 outer ones becoming squarrose or reflexed
 8. E. vaginatum
 ff. Scales blackish throughout.
 g. Stem 1.0-2.5 dm high, with 1-(2)
 sheaths located below the middle
 7. E. callitrix
 gg. Taller stem, 3-7 dm high, with 2-(3)
 sheaths of which the upper is borne
 above the middle 6. E. brachyantherum

1. E. polystachion L. (E. angustifolium Honckeney, var. majus Schultz) -- Cotton-Grass (Herbe à coton) -- Inflorescence lateral, subtended by 2-(3) leafy bracts, these blackish in the lower 1-2 cm. Leaves 2-5 mm wide. Scales blackish, or brownish, the margin hyaline, the midnerve gradually evanescent above the middle. Anthers 2.5-5.0 mm long. Early summer. Boggy places. -- G-Aka, L-SPM, NS-BC, US, Eur.

Plants from the higher latitudes and altitudes tend to be smaller and usually more intensely coloured. Such specimens are often distinguished as var. triste Th. Fries, especially if they are less than 2.5 dm high. We have been unable to establish var. triste on anything other than a few arbitrary size distinctions and we suspect that size could be mostly ecologically conditioned. It may be significant that specimens from any area where both forms occur are likely in flower if they have been named var. triste, but much more likely to be filed as typical polystachion if they are full grown and fruiting with full heads of cotton.

2. E. viridicarinatum (Eng.) Fern. -- Resembles the above, but the base of the inflorescence green or brownish and the anthers only 1.0-1.5 mm long. Scales rather greenish, the midnerve gradually thickened upwards, becoming 2-3 times thicker

and wider tipwards than basewards. Early summer. Sphagnum bogs and marshy places. -- K-Mack, sAka, L-SPM, NS-BC, US.

Reports of E. tenellum Nutt. from our area may be mostly referable to E. gracile, but the two collections from lake Athabaska (CAN; DAO) listed by Raup 1936 have been revised to E. viridicarinatum.

3. E. gracile W.D.J. Koch var. gracile (E. tenellum AA.) -- Frog-Hair -- Inflorescence subtended by only one leafy bract, which is shorter than the inflorescence. Scales rounded at tip. Anthers 1-2 mm long. Early summer. Very wet and floating bogs, marshy flats and around boggy pools. -- Mack, Aka, L-NF-(SPM), NS-BC, US, Eur.

4. E. Scheuchzeri Hoppe -- Anthers very short. A smallish, 1-2-(3) dm high, stoloniferous species with a single terminal spikelet. Spikelets 1.0-1.5 cm long at anthesis, elongating to 2-3 cm in fruit. Scales narrowly hyaline along the margin, the lowest scale less than 1 cm long. Bristles white. Late spring and early summer. Edge of boggy pools and late snow patches. -- G-Aka, L-NF, Q-nO-nMan, swAlta-BC, wUS, Eur.

5. E. Chamissonis C.A. Meyer var. Chamissonis (var. aquatile AA.; E. medium AA.; E. russeolum Fries) -- Taller than the preceding and with longer anthers. Stem 2-6 dm high, 1-4 mm thick. Lowest scale mostly 1-2 cm long. Spikelet 1.5-2.0 cm high in flower, elongating to 3-5-(6) cm in fruit, the bristles cinnamon-coloured. Early summer. Around boggy pools. -- K, (Y)-Aka, L-SPM, NS-seMan, (Alta)-BC, (US), Eur -- Var. albidum (Nyl.) Fern. (f. subalbidum (Lindb. f.) Blomgr., f. Turneri Raymond; E. medium AA.; E. russeolum Fries var. albidum Nyl.) -- Bristles white. -- (F)-K-Aka, (NF), NS, NB-BC, (US), Eur).

Specimens reported as Chamissonis by Breitung 1947 for east-central Saskatchewan (DAO, MT) have since been revised to var. albidum. One of these was probably at the origin of a dot on a map in Svensk Bot. Tid. 48: 75, 1954. Alberta reports by Moss 1959 and in Svensk Bot. Tid. 48: 79, 1954 for var. Chamissonis also seem questionable, especially since all collections at DAO and CAN have been revised to var. albidum, but some important collections have yet to be checked on this point.

Throughout much of its range var. albidum gives the impression of being nothing more than a casual colour form, but nearly all the specimens examined from our area proved to belong to the white-headed phase, except for a few sheets in the southeastern corner. At least as far as our experience is concerned in our area, var. albidum presents itself as a geographical variation.

The scales have a similarly broad hyaline margin in E. Chamissonis and E. vaginatum and fragmentary specimens of either are best distinguished by the colour and nervation of the

scales. In E. Chamissonis the scales are more or less tinted or punctate in chestnut, especially the lowermost scale (=spathe), and more so towards the base or the margin. The lower scale is conspicuously marked by ± 5 raised longitudinal nerves; the second scale has only 2 such nerves; all other scales are uninerve. In E. vaginatum all scales are similarly uninerve and tinted only in grayish black.

Smaller plants are at times segregated as E. russeolum.

E. medium was used by Løve 1953 in reference to specimens (WIN) of both of our varieties. E. medium has been much misapplied, but we have accepted Raymond's opinion, Svensk Bot. Tidsk. 48: 74, 1954, that it properly belongs to the hybrid E. russeolum (= E. Chamissonis) x E. Scheuchzeri, a putative hybrid not yet known from our area.

6. E. brachyantherum Trautv. (E. opacum (Bjornstr.) Fern.) -- Hare's Tail -- Coarse and densely tufted. Scales blackish, erect-appressed. Anthers up to 1.2 mm long. Bristles lightly tinted above. Early summer. Very wet bogs or gravels. -- F-Aka, L-NF, wcQ-BC, (US), Eur.

7. E. callitrix Cham. -- Like a diminutive phase of the previous, the stem typically with only one sheath located well below the middle. Scales blackish. Bristles quite white. Anthers 0.7-1.0 mm long. Early summer. Muskegs: Churchill, Rockies -- G-Aka, L-NF, Q-nO-nMan, swAlta-nBC, (wUS), Eur -- F. moravium (Raymond) Boivin -- Scales straw-coloured. Chur-Chill. -- (Mack, Aka, L), nMan.

8. E. vaginatum L. var. vaginatum -- Cotton-Grass, Catlocks -- Scales strongly squarrose-reflexed. In very large tufts, the sheaths of the basal leaves often very long, up to 1 dm or more. Spikelet usually oblong or cylindrical at flowering, its rachis usually elongating to 1-2 cm at maturity. Anthers 2-3 mm long. Early summer. Very wet muskegs. -- wF-Aka, swMan (Riding Mt.)-nwS-BC, Eur -- Var. spissum (Fern.) Boivin (E. spissum Fern.) -- Cotton-Plant, Hares's Tail -- Anthers shorter, 1-2 mm long. Spikelet obovoid at flowering. Rachis 1 cm long or less. -- eF-Mack, Aka, L-SPM, NS-Alta, US.

4. SCIRPUS L.

BULRUSH

Basic type of the family, with perfect flowers. Spikelet with only 0-2 empty scales at the base. Perianth lacking or reduced to 8 bristles or less.

- a. Inflorescence terminal, subtended by leaf-like bracts Group A
- aa. Inflorescence various, but not subtended by leaf-like bracts Group B

Group A

Inflorescence subtended by 2 or more leaf-like bracts.

- a. Bristles much longer than the scales, crinkly and rather obvious 5. S. cyperinus
- aa. Bristles shorter than the scales and hidden behind them.
 - b. Spikelets 1.0-2.5 cm long.
 - c. Larger leaves 10-17 mm wide 1. S. fluviatilis
 - cc. Only 5-8 mm wide 2. S. maritimus
 - bb. Much shorter.
 - d. Sheaths pale green 3. S. atrovirens
 - dd. Light to deep red 4. S. microcarpus

Group B

Bracts lacking or at least not leaf-like, often resembling the stem and continuing it.

- a. Inflorescence secund and seemingly lateral.
 - b. Stem 1-4 dm high, weakly trigonous 6. S. nevadensis
 - bb. Much taller.
 - c. Stem sharply trigonous 7. S. americanus
 - cc. Quite round 8. S. lacustris
- aa. Inflorescence clearly terminal, not overtopped by any bract.
 - d. Inflorescence a spike of small spikelets .. 13. S. rufus
 - dd. Spikelet terminal and solitary.
 - e. Bristles very long exerted 12. S. hudsonianus
 - ee. Bristles included, being shorter than the scales.
 - f. Stem sharply trigonous and scabrous 9. S. Clintonii
 - ff. Terete and smooth.
 - g. Densely tufted; outer scales short aristate 10. S. caespitosus
 - gg. Stoloniferous; scales rounded at tip 11. S. pumilus

1. S. fluviatilis (Torrey) Gray -- Very coarse herb 1-2 m high. Stem sharply triangular. Inflorescence subtended by \pm 5 leafy bracts. Some spikelets on long pedicels. Stigmas 3. Achene sharply trigonous. Early summer. Lake shores in shallow water: Edmonton eastward. -- (NB)-Q-cAlta, US, Eur.

2. S. maritimus L. var. paludosus (Nelson) Kllk. -- (S. paludosus Nelson) -- Bayonet-Grass (Trianglé) -- Like the above, but smaller, less than 1 m high. Inflorescence subtended by 2- (3) leafy bracts, nearly always compact. Stigmas 2. Achene lenticular. Early to mid summer. Alkaline shores and shallow

waters. -- seK-swMack, Aka, NS-BC, US, (CA).

As defined above, var. paludosus includes the costal S. pacificus since reputed criteria of the latter (e.g. colour of scales, laxness of inflorescence, etc.) occur sporadically in our area.

In var. maritimus of the east coast there are 3 stigmas and the achene is triangular, while the anthers tend to be shorter.

3. S. atrovirens W. (var. pallidus Britton; S. Hattorianus Mak.; S. pallidus (Britton) Fern.) -- Inflorescence a compound umbel of globose glomerules of small sessile spikelets. A coarse herb with the habit of the last two. Stem 2-3 mm thick toward the middle. Inflorescence with 1-2-(3) rays much longer than the others. Bristles retrorse-barbed above the middle only. Scales mucronate from the excurrent midrib. Achene triangular-compressed. Stigmas 3. First half of summer, often becoming proliferous in late season. Very wet places in freshwater areas. -- NF-SPM, NS-cAlta, US, (Eur).

The scales vary from acuminate to mucronate and from 1.3 to 2.5 mm in length. Plants from our area and west of the Mississippi tend to bear longer scales, i.e. \pm 2.0 mm long, and may be recognized on that basis as var. pallidus. Those to the east have predominantly shorter scales, i.e. \pm 1.5 mm long, and constitute var. atrovirens. But there is a wide range of variation in any area, and even within a single inflorescence. It seems doubtful that the distinction, if coldly implemented and without regard to the place of collecting, would result in a meaningful sorting of specimens.

4. S. microcarpus Presl var. confertus (Fern.) House (var. rubrotinctus (Fern.) M.E. Jones; S. rubrotinctus Fern.) -- (Rouche) -- The sheaths light to deep red and the stem thicker, 3-5 mm thick in the middle internode. Sheaths somewhat inflated, mostly 7-10 mm thick in the herbarium. The 5-8 longer rays of the inflorescence of about the same length; the glomerules more numerous. Scales broadly rounded and not mucronate. Bristles retrorse-barbed almost to the base. Stigmas 2 and the achene lenticular. Late spring and early summer. Marshy places. -- sMack, L-SPM, NS-BC, US.

Ours has seeds 0.6-1.0 mm long. The more western var. microcarpus has slightly larger seeds, 1 mm long or more, and its sheaths are usually green. Also, it tends to be a generally larger plant, its leaves closer to 1.5 cm wide (than to 1.0 cm in var. confertus), and its spikelets tend to be somewhat longer and quite sharply acute at summit. To the extent that we have investigated them, all reports from our area, or even all reports east of the Rockies, proved to be based on specimens of var. confertus. The range extension of microcarpus northward

into the Mackenzie District was based on a Kakisa River collection (DAO) similarly revised to var. confertus by Koyama in 1962. Another variant, var. Bissellii (Fern.) House (= S. expansus Fern.), has been reported for east of us, but we have not been able to substantiate its occurrence in Canada.

5. S. cyperinus (L.) Kunth var. cyperinus -- (Wool-Grass) -- Perianth bristles \pm crinky and exserted, about 2-3 times the length of the scales and giving the inflorescence a brown-woolly appearance. Habit of the last few, the stem not quite round and the leaves narrowly elongate, mostly \pm 5 mm wide. Involucral bracts much longer than the inflorescence and light to dark brown at base, forming an obvious colour patch at the base of the inflorescence, the latter becoming \pm one-sided, its branches arching to drooping. Spikelets mostly 2-5 mm long, numerous, dark brown to blackish, some of them pedicellate, but mostly in glomerules of (2)-3-5. Mid summer. Marshes and shores at Lake of the Woods and Caddy and Shoal Lakes -- NF, NS-seMan, US -- Var. brachypodus (Fern.) Gilly (S. atrocinctus Fern.) -- The inflorescence bracts with darker and more conspicuous sheaths, blackish to black. More common and widespread. -- L-SPM, NS-BC, (US).

Reports of S. cyperinus (including S. Eriophorum Mx., etc.) from our area are apparently all referable to var. brachypodus, with the exception of a few collections from the extreme southeast corner of Manitoba. A collection from Lac-du-Bonnet (WIS) reported in Proc. Ac. Nat. Sc. Phil. 115: 306. 1964 proved to be somewhat intermediate in colouring.

6. S. nevadensis Watson -- Resembles the next, but much smaller. Stem somewhat triangular above, roundish below. Spikelets mostly over 1 cm long. Scales entire and usually not aristate, merely rounded at tip. Early summer. Shores of marshes: Delta and westward. -- scMan-BC, US, (SA).

7. S. pungens Vahl (S. americanus AA.) -- Three-Square, Sword-Grass -- A virgate, triangular herb, the stem leafless, the inflorescence secund and borne near the top. Stem sharply triangular, up to 1 m tall. Inflorescence bract stiffly erect, similar to the stem and seemingly continuing it. Spikelets usually not over 1 cm long. Scales short aristate and emarginate at summit, the sinus about 1 mm deep. Mid summer. Shores and marshes. -- (Aka), NF-SPM, NS-BC, US, (CA, SA, wEur, Oc).

The correct name of this species was worked out by A.E. Schuyler in Rhodora 76: 51-52. 1974.

8. S. lacustris L. (var. tenuiculmis Sheldon; S. acutus Muhl.; S. heterochaetus Chase; S. validus Vahl, var. creber Fern.) -- Bullrush, Toolies (Grand Jonc, Jonc des chaisiers) -- Very tall, leafless, cylindric stems, somewhat reminiscent of

a tall Onion leaf, 1-2 m high. Inflorescence lateral and seemingly near the top, the stem-like and erect bract rather short, often shorter than the inflorescence. Early summer. Common in less than 1 m of water. -- Mack-Y-(Aka), NF-SPM, NS-BC, US, (CA, SA), Eur.

Usually subdivided into a number of microspecies of which three are commonly recognized in U.S. and Canadian floras. The distinguishing criteria vary from flora to flora to monograph. In any of the classifications the criteria are neither strongly marked nor very constant, and the rank of species seems hardly warranted here. At the varietal rank they may be briefly noted as follows.

Var. tenuiculis Sheldon; S. heterochaetus Chase -- Spikelets light brown. Stigmas 3. Achene unequally trigonous, one angle being much lower than the other two. Pedicels and spikelets more elongated than in the next two.

Var. condensatus Peck; S. validus Vahl -- Spikelets dull brown. Scales not strongly spotted. Stigmas 2. Achene biconvex.

Var. glaucus (Sm.) Bück., var. occidentalis Watson; S. acutus Muhl. -- Spikelet darker, red brown, the scales being abundantly maculate in deep red. Stigmas 2. Achene biconvex. Glaucus is probably not the earliest available epithet.

All three segregates have been recognized from our area; they are largely, if not wholly, sympatric; their taxonomic interest, if any, is not yet obvious to us.

9. S. Clintonii Gray -- Resembles an Eleocharis, but the filiform stem is triangular and scabrous above the middle. Mostly 1-2 dm high and tufted. Spikelet less than 1 cm long, subtended by a small bract shorter than the spikelet and often scale-like. Early summer. Rare in dry coniferous forests: Meadow Lake, Buck Lake. -- NB-O, S-Alta, US.

10. S. caespitosus L. var. caespitosus (var. callosus Big., ssp. austriacus AA.) -- Deer-Grass, Deer's Hair -- Also resembling an Eleocharis; in large tufts of filiform and leafless but round stems. Leaves all basal and reduced to a sheath and sometimes a vestigial blade. Mostly 2-3 dm high. Achene about 2 mm long. Early summer. Infrequent in boggy places. -- G-Aka, L-SPM, NS-BC, US, Eur.

Usually subdivided in two varieties or subspecies by most European authors, the primary basis being the slant of the summit of the sheath of the uppermost leaf. In var. caespitosus (or var. callosus), widespread around the northern hemisphere, the opening is slanted at about 45° and measures about 1.0-1.5 mm along the longer axis. In var. austriacus (Palla) stat. n., Trichophorum austriacum

Palla, Ber. Deutsch. Bot. Ges. 15: 468. 1897, of European distribution, the angle is much steeper and the opening is commonly 2-3 mm long. Other reported criteria did not measure up to expectations.

In accordance with the Code of Botanical Nomenclature the correct varietal name for our plants is var. caespitosus since it is the typical variety.

11. S. pumilus Vahl var. Rollandii (Fern.) Beetle -- Resembles the previous, but stoloniferous and forming very small tufts. Less than 2 dm high. Achene small and black. Early summer. Rare or inconspicuous in alkaline bogs and limestone river flats. -- swMack-sY, (cL), seQ, cS-BC, (US).

Seen only from Sutherland (DAO) and Jasper (DAO).

Ours is technically separable from the paleogean phase on minutiae of size and shape of the achene. In var. pumilus the achene is narrowly ellipsoid-trigonous, mostly 1.6-1.7 mm long by 0.7 mm broad, at least twice as long as broad or a little longer, the angles nearly equally sharp and the sides flattish. In var. Rollandii the achene is lenticular-obovate, (1.3)-1.4-1.6-(1.7) mm long by (0.7)-0.8-0.9-(1.0) mm wide and usually less than twice as long as broad, convex on one face, the other with a low and obtuse ridge. Other reported criteria did not stand up under close checking.

12. S. hudsonianus (Mx.) Fern. (Eriophorum alpinum L.; Leucocoma alpina (L.) Rydb.) -- Bristles elongating to 2 cm or more as in Eriophorum, but not forming a dense tuft, there being only 6 bristles per flower. Late spring and early summer. Muskegs. -- seK-Aka, L-SPM, NS, NB-BC, US, Eur.

An intermediate type, it is often placed in Eriophorum, or erected into a monotypic genus.

13. S. rufus (Hudson) Schrader -- Inflorescence a deep brown distichous spike of spikelets. Stem 2-4 dm high with the habit of the last 4 species. Bract of the inflorescence varying from small and inconspicuous, to overtopping the spike. Early summer. Alkaline bogs, rare: Sutherland and eastward. -- seK-Mack, Aka, NF, NS-cS.

Known or reported from Delta, the Red Deer River, Churchill (QFA) and Sutherland (DAO).

American plants are reputed to have smaller and more tapered achenes, hence they have been segregated as var. neogaeus Fern. But the distinction is not borne out by the specimens at hand.

Despite Manitoba reports of S. Torreyi Olney by Fernald 1950 and Scoggan 1957, we have found no corresponding sheet at

CAN or GH. But there is a collection labelled V.W. Jackson, Delta, July 25, 1921 (WIN) which is a mixture on the one hand of two plants of S. americanus linked by a rhizome, and on the other hand a dissected fragment of S. Torreyi. Obviously this fragment does not come from the colony represented by the rest of the sheet, and further the fragment is in a more advanced stage of maturity and corresponds to a collection that might have been made in late summer. We see no reason to accept the label data as applicable to the dissected fragment. To our knowledge, Manitoba reports of S. Torreyi are still to be substantiated.

5. ELEOCHARIS Br.

SPIKE-RUSH

Achene crowned by the persistent and much enlarged base of the style. Otherwise as in Scirpus and especially like the last few species. Stem leafless, the basal leaves reduced to sheaths with or without a vestigial blade. Spike small, solitary, terminal, its bract small and similar to the scales.

- a. Annual in large tufts of divergent stems 3. E. ovata
- aa. Perennial and stoloniferous, the erect stems solitary or in small tufts.
 - b. Style not constricted at base 1. E. quinqueflora
 - bb. Base of the style set off by a constriction from the top of the achene.
 - c. Achenes white, with longitudinal ribs 2. E. acicularis
 - cc. Coarser plants with coloured and ribless achenes.
 - d. Stigmas 2; achene lenticular... 4. E. palustris
 - dd. Stigmas 3; achene trigonous 5. E. tenuis

1. E. quinqueflora (Hartmann) Schwarz (E. pauciflora (Lightf.) Link, var. Fernaldii Svenson, var. Suksdorfiana (Beauv.) Svenson) -- Somewhat intermediate to Scirpus, the bract slightly longer than the scales and the elongate style only slightly enlarged at base, not set off by a constriction. Lowest bract or scale at least half as long as the spikelet, otherwise quite similar in texture and colour to the other scales and sharply differentiated from the tissue of the stem. First half of summer. Water's edge. -- G, (seK)-Mack-Y-(Aka), NF-SPM, NS-PEI-(NB)-Q-BC, US, Eur.

Most american floras call this plant E. pauciflora, but it was pointed out by Schwarz 1949 that the epithet quinqueflora has priority by 10 years.

Plants from eastern North American are often distinguished as var. Fernaldii and those from our area have been called either var. Fernaldii or more rarely var. Suksdorfiana. Repu-

ted varietal differences are not borne out clearly by the specimens at hand.

The basis for the Alberta report of E. rostellata Torrey by Moss 1959 and Boivin 1967 was a pair of specimens, Brinkman 814, Craigmyle, 1923 (ALTA) and Breitung 16623, Chief Mtn., 1953 (ALTA), both revised since to E. quinqueflora. The Waterton collection was not listed by Breitung 1957.

2. E. acicularis (L.) R. & S. (var. occidentalis Svenson, var. submersa (Nilss.) Svenson) -- Forming dense carpets of filiform stems, usually 0.1-0.2 m thick and less than 1 dm high. Sheath dilated-ventricose and membranous in the upper part. Spikelet small, often lacking. Scales up to 2.5 mm long. Achene small, pearly-white. Summer. Exundated places. -- G-Aka, L-SPM, NS-BC, US, (CA), Eur, (Oc).

Re E. Wolfii Gray reported for Alberta by Gleason 1952, see comment under Buchlo^u dactyloides. A report for Saskatchewan by Fernald 1950, repeated by Svenson 1957, was similarly discounted by Breitung 1957. Despite the many reports, only one Canadian sheet could be located under that name: J. Macoun 7548, Crane Lake, June 9, 1894 (NY). It is a small plant with a polygonal stem 0.2 mm thick, etc., and we can't see why it should not belong with E. acicularis.

3. E. OVATA (Roth) R. & S. (E. Engelmannii Steudel, var. monticola (Fern.) Svenson; E. obtusa (W.) Schultes) -- Dense tufts of stems of widely varying lengths, the longest often 10 times the shortest. Spikelet becoming truncate at base at maturity. Achene mostly 1 mm long or slightly less, whitish turning brown, strongly biconvex with a pair of raised marginal nerves. Summer. Places submerged earlier. -- (NF), NS-BC, US, Eur, (Oc).

Present evidence would seem to indicate an introduced species in our area. The first collection, and the only one known to Scoggan 1957 or to Svenson, the monographer of the genus, was by Macoun at Killarney along a railroad in 1896. All other collections seen are of the last twenty years and are rather few in number. For Manitoba we have seen it from Otterburne, 1954 (MSM) and Hecla Island, 1961 (DAO). Breitung 1957 does not list it for Saskatchewan and we have seen only the following more recent collections: Regina, 1958 (DAO); Saskatoon, 1965 (DAO); Sutherland, 1965 (DAO), and Govan, 1967 (DAO). For Alberta we know of only a collection by Moss in 1952 at Granum (DAO). The habitat of the oldest collection, the general lack of old collections across our area and the high sporadism of the few known collections, all point to an adventive in process of entrenchment around sloughs and other wet places.

4. E. palustris (L.) R. & S. (E. calva Torrey; E. mamillata Lindb. f.; E. uniglumis (Link) Schultes) -- Clubrush (Jonquine) -- Highly variable species from blackish rhizomes. Stem 1-6 dm high, (0.5)-1.0-3.0-(5.0) mm thick. Tissue of the stem grading into the tissue of the lowermost scale to form a broad green zone in the lower half. Spikelet usually lanceolate, commonly 1 cm long or more. Lowest scales less than $\frac{1}{2}$ as long as the spikelet. Stigmas 2. Achene obovoid, mostly \pm 1.5 mm long, yellowish turning brown, obscurely lenticular, both faces being strongly convex. Tubercule higher than broad. First half of summer. Wet places. -- G, seK-Aka, L-SPM, NS-BC, US, (CA), Eur, (Afr, Oc).

The american representatives of E. palustris are often subdivided into 2 to 6 species. The primary basis of the classification is the \pm clasping base of the lowermost scale of the spikelet. In E. uniglumis the base of the scale encircles the stem completely or nearly so. Such plants always have a thin stem. But E. palustris proper is usually a coarser plant with a fatter and longer spikelet and the lowermost scale encircles the stem only halfway or two thirds of the way around. The variation on that score appears to be continuous and gradual throughout the range; the distinction seems arbitrary.

In the more elaborate classification adopted by Fernald 1950 and accepted in the North American Flora 1957, three names refer to costal plants, the three other names refer to inland plants and are relevant to our area. In this latter scheme the plant described above as E. uniglumis becomes E. calva (or E. erythropoda Steudel) while E. palustris is restricted to the Old World, its american counterparts being an eastern E. Smallii Britton from Manitoba eastward and a western E. mamillata (or E. macrostachya Britton). The geographical segregation of E. palustris (Old World), E. Smallii and E. macrostachya is plain enough, but the morphological basis of the distinction is more elusive.

5. E. tenuis (W.) Schultes var. tenuis (E. nitida Fern.) -- Kill-cow, Poverty-Grass -- As the preceding but the tubercule depressed, much wider than high. Stems filiform, mostly 0.2-0.3 mm thick, with 4-(5) rather sharp angles. Spikelet tending to ovoid and commonly \pm 0.5 cm long. Stigmas 3. Achene \pm 1.0 mm long, usually golden yellow, \pm trigonous, the faces slightly convex. First half of summer. Wet places; rare: Stony Rapids -- (Aka), NF-SPM, NS-O, nS, US -- Var. borealis (Svenson) Gleason (E. elliptica Kunth) -- Stem thicker and not flattened, angular-cylindric, mostly 0.3-0.5 mm wide, the angles mostly 6-8. -- NF-(SPM), NS, NB-BC, US -- Var. atrata (Svenson) Bolvin (E. acuminata AA.; E. compressa Sullivant) -- Stem flattened, 0.5-1.5 mm wide, about 2-3 times wider than thick, the 6-8 angles being very unequal. -- NS, Q-Man-(S)-

Alta-BC, US.

Var. tenuis with filiform stems is primarily eastern and var. atrata with flattened stems is primarily western, while var. borealis is more or less transcontinental. Old records are not very reliable. Macoun 1888 at first reported E. tenuis as far west as the Rockies, but in 1890 the Manitoba and Saskatchewan records were transferred to E. acuminata. More recently Scoggan 1957 has placed the Porcupine Mountain specimen under E. pauciflora, Breitung 1957 has referred the Moose Jaw report to E. compressa and we have revised the Kananaskis collection (DAO, MTMG) to E. quinqueflora. However a more recent report of Argus 1968 from the eastern end of lake Athabaska proved to be based on a specimen (SASK) quite characteristic of var. tenuis, which leads us to speculate that the typical phase may still prove to extend westward across the northern reaches of our area, even if all earlier and more southern reports proved to be questionable.

6. CLADIUM Browne

As in Scirpus, but each spikelet subtended by more than one sterile scales and holding only 1-(2) fertile flowers. Bristles lacking.

1. C. mariscoides (Muhl.) Torrey (Mariscus mariscoides (Muhl.) Kuntze) -- Twig-Rush -- General habit of S. atrovirens, etc., but with 1-2 additional inflorescences on long peduncles from the axils of the upper leaves. Stem cylindrical, becoming deeply channeled above on one side. Spikelets warm brown. Mid summer. Bogs; very rare: Wallwort. -- swNF, NS, NB-O, ecS, US.

Collected once at Wallwort near Dahlton in 1936 (DAO, SASK). The McKague report by Breitung 1947 is apparently a lapsus calami.

7. RHYNCHOSPORA Vahl

BEAK-RUSH

The flower borne amid a ring of bristles. Achene crowned by a tubercle as in Eleocharis. Otherwise similar to Cladium, the spikelet similarly much reduced and subtended by many empty scales.

This genus has been rarely collected in our area and comes from rather scattered localities. The first species is known from Dahlton (SASK), Wallwort (DAO), McKague (DAO), Little Gull Lake (SASK), Hudson Bay Junction (DAO), Prince Albert (SASK) and Nipawin (DAO). The discontinuity across Manitoba and Alberta is rather unexpected. The second species has been collected at Bird's Hill (DAO), Nipawin (DAO, MT), Wallwort (DAO), Prince Albert, and Heather Down (DAO). It is

not clear at this stage if this reflects the true occurrence of these species on merely the inadequacy of field work.

- a. Spikelets whitish to pale coloured 1. R. alba
 aa. Darker and brown 2. R. capillacea

1. R. alba (L.) Vahl -- Spikelets whitish at first, maturing pale pinkish-brown. Bristles about 10. Spikelets in 1-2-(3) glomerules. Achene broadly obovate, abruptly contracted into the tubercule. First half of summer. Bogs, rare. -- Aka, L-SPM, NS-O, S(c,n), BC, Eur.

2. R. capillacea Torrey -- Generally larger, the spikelets brown. Bristles about 6. Achene oblong, gradually tapering into the tubercule. First half of summer. Bogs, uncommon. -- NF, NS, NB-Alta, US.

On a distribution map of R. fusca (L.) Aiton f. by Hultén 1958 there is a dot in east-central Saskatchewan. The source of the report has not been investigated.

8. KOBRESIA W.

Generally resembling Carex. Spikelet reduced to 1-(2) fertile flowers. Each achene subtended by 3 bracts, the outer being the bract of the spikelet and the inner, partly enclosing the achene, is the equivalent of the perigynium. Spikelets numerous in a condensed spike or panicle of spikelets.

- a. Panicle of spikelets, the lowermost branch
 bearing 2-8 one-flowered spikelets ... 1. K. simpliciuscula
 aa. Inflorescence simple, a spike of
 spikelets 2. K. myosuroides

1. K. simpliciuscula (Wahl.) Mack. var. americana Duman -- As the following but taller, mostly 2-3 times taller than the leaves, and the inflorescence more complex. Early summer. Arctic tundra and subalpine bogs. -- G-Aka, NF, Q-nMan, swAlta-BC, US.

The eurasian var. simpliciuscula has a slightly larger achene, its body \pm 2.5 mm long.

2. K. myosuroides (Vill.) F. & P. (K. Bellardii (All.) Degland) -- Resembles a densely tufted Carex, but the scape leafless and the inflorescence devoid of leafy bracts. Basal leaves tending to be as tall as the scape. Mid summer. Alpine slopes. -- G-Aka, L, nQ, swAlta-eBC, US, Eur.

The epithet myosuroides is usually supposed to start with Villars, Hist. Pl. Dauph. 2: 194. 1787, two years later than Bellardii Allioni, Fl. Ped. 2: 264. 1785. But it was pointed out by Mansfeld 1938 and Hylander 1945 that myosuroides

actually came out much earlier in Villars, Prosp. Hist. Pl. Dauph. 17. 1779 and has priority. The latter could not be checked as it is a very rare book and we are aware only of the one copy in existence, in the library of De Candolle.

9. CAREX L.

SEDGE

Achene enclosed in a bottle-shaped bract termed "perigynium", with only the style and stigmas exerted. Flower unisexual, subtended by a scale, borne in spikes that are often unisexual. The spike is termed "androgynous" if the male flowers are at the top and the female ones at the base, or "gynandrous" if the pistillate ones are at the top. In the text that follows the unspecified description of scales always refers to pistillate scales.

We are indebted to J.H. Hudson, of Saskatoon for much documentation and many invaluable comments and suggestions with regard to our treatment of Carex.

By far our largest genus and a rather important one. Most of our species belong to a few sections that may be readily recognized as follows. The two subgenera are also useful concepts.

Subgenus Vignea. Species 1-52. Stigmas 2 and the achene lenticular. Perigynium tending to reflect the shape of the achene and to be similarly flattened into a biconvex or plano-convex structure. Spikelets typically all similar, and mostly carrying both staminate and pistillate flowers. At maturity the staminate flowers are often reduced to a group of empty scales at the top or base of each spikelet. Spikelets nearly always sessile. The perigynium shows a dorsal suture.

Sections 1. Nardinae to 3 Callistachys, species 1 to 4, are unispicate.

Sections 4. Foetidae to 11. Vulpinae, species 5 to 20. Terminal spike androgynous. Further, the species of the first four sections are long stoloniferous, but loosely to densely tufted in the last four.

Sections 12. Heleonastes to 16. Ovales, species 21 to 52. Terminal spikelet gynandrous, the others spikelets either gynandrous or pistillate.

Section 12. Heleonastes, species 21-30. Resembles the Ovales, but the perigynium not winged. This and section Ovales comprise nearly all the species with gynandrous spikelets.

Sections 16. Ovales, species 35-52. Perigynium strongly flattened and produced at the sides into longitudinal wings. The 6. Arenariae, species 9-10, also have winged perigynia, but their spikelets are androgynous.

Subgenus Carex, species 54-128. Stigmas typically 3 and the achene triangular. Perigynium tending to be round, often inflated. Spikelets typically dimorphic with the terminal one entirely staminate and the lower ones entirely pistillate. Often the lower spikelets are borne on long pedicels and drooping. Perigynium without obvious dorsal suture.

Sections 17. Polytrichoideae to 42. Cryptocarpae, species 53 to 113. Style of a different texture from the achene and withering in age, usually falling off at the junction point. This large group does not lend itself to convenient subdivisions, but some more readily recognizable types can be singled out.

In subgenus Carex the style divides into three stigmas, but there are three exceptional sections as follows. Section 41. Acutae, species 103-110. Stigmas 2 and the achene lenticular, the perigynium rather flattened, otherwise typical of the subgenus. Scales obtuse to acute. The 42. Cryptocarpae, species 111-113, differ from the Acutae by their aristate scales and the achene is marked by a deep groove on one angle or face. The 27. Bicolores, species 71-73, also have 2 stigmas. And 122. C. saxatilis in the Vesicariae has only 2 stigmas.

Section 40. Atratae, species 96-102. Resembles the Acutae by its small beakless and strongly compressed perigynia, but the stigmas are 3 and the achene is trigonous. The terminal spike is mostly gynandrous. The 39. Limosae, species 93-95, are also similar but the roots are felty-pubescent and the terminal spike is staminate.

The stem may bear many spikelets, but 6 species belonging to as many small sections have only one spikelet. These are: 17. Polytrichoideae, 19. Filifoliae, 20. Obtusatae, 22. Scirpinae, 24. Rupestres, and 25. Firmiculmes.

The perigynia are densely puberulent and \pm obovoid, being somewhat tapered at base, in section 21. Montanae, species 58-61. Some spikelets may be \pm hidden among the basal leaves. Another 10 species with pubescent perigynia are found in sections 23. Digitatae, 32. Sylvaticae, 36. Ferrugineae, 38. Hirtae. Further, there are two species with glabrous perigynia but pubescent foliage in sections 32. Sylvaticae, and 37. Virescentes.

Some 8 or 10 species with a gynandrous terminal spikelet are found in sections 31. Gracillimae, 33. Capillares, 36. Ferrugineae and 40. Atratae.

Mostly the spikelets are borne together near the top of the stem, or at least in the upper half of the stem. But in some 8 species the inflorescence is more scattered and

at least one spikelet is borne below the middle of the stem. These are in sections 21. Montanae, 23. Digitatae, 28. Paniceae, 29. Laxiflorae, 30. Granulares and 33. Capillares.

Finally there are some 12 species with their style sharply defined as described above, but either they cannot be regarded as members of any broadly defined group, or else they fit only in part in any of the above groupings. These comprise sections 18. Phyllostachyae, 26. Albae, 28. Paniceae, 29. Laxiflorae, 33. Capillares, 34. Longirostres and 35. Extensae, along with part of sections 20. Obtusatae and 24. Rupestres.

Lastly, in sections 43. Orthocerates to 48. Lupulinae, species 114 to 128, the achene and the style are of the same colour and texture, and the style is persistent. The perigynium is strongly inflated in such a way that the achene occupies only half of the cavity of the perigynium.

Briefly these last 6 sections may be characterized as follows: 43. Orthocerates is unispicate; in 44. Folliculatae and 48. Lupulinae, the perigynium is longest, at least 1 cm long; in 45. Pseudo-Cyperae there is only one staminate spikelet; in 46. Paludosae and 47. Vesicariae there is usually 2 or 3 staminate spikelets. The inflorescence may also bear more than one staminate spikelet in the following sections: 38. Hirtae, 41. Acutae and 42. Cryptocarpae.

The reader interested in this genus should consult Hudson 1978 for more detailed descriptions and pertinent comments as to ecology, distributions, and distinctiveness of the more troublesome taxa.

KEYS TO CAREX

- a. Inflorescence simple, a single terminal spike Group A
- aa. Inflorescence compound: a spike of spikelets or a raceme of spikelets; sometimes a panicle of spikelets.
- b. Inflorescence entirely staminate. Divisae.
- c. Spikelets subcylindric, 3-4 times longer than wide 6. C. Douglasii
- cc. Much shorter and rather ovoid to oblong 8. C. praegracilis
- bb. Perigynia present.
- d. Stigmas 3; achene trigonous or round Group G
- dd. Stigmas 2; achene lenticular; perigynia glabrous.
- e. Lower spikelets clearly pedicellate ... Group B
- ee. All spikelets sessile except usually the upper one.
- f. Spikelets dimorphic, the terminal much narrower and staminate Group B
- ff. Spikelets rather similar, at least in their general appearance, the terminal one entirely or partly pistillate. Subgenus Vignea.
- g. Spikelets gynandrous.
- h. Perigynia flattened, the edges grading into a marginal wing. Ovales Group C
- hh. No marginal wing Group D
- gg. Spikelets androgynous, exceptionally dioecious.
- i. Long stoloniferous Group E
- ii. Densely to loosely tufted Group F

UNISPICATE SPECIES

Group A

Inflorescence a single terminal spike. See also Group E for some species simulating group A, their many spikelets reduced and crowded into a spike-like but really compound inflorescence.

- a. Spike staminate only.
- b. Leaves less than 1 mm wide. Dioicae 31. C. gynocrates
- bb. 2-3 mm wide. Scirpinae 62. C. scirpoidea
- aa. At least partly pistillate.

- c. *Perigynia* pubescent.
 - d. Spikes hidden among the leaf bases 61. *C. umbellata*
 - dd. Spikes borne on scapes at least as long as the leaves.
 - e. Spike entirely pistillate ... 62. *C. scirpoidea*
 - ee. Spike androgynous. Filifoliae 55. *C. filifolia*
- cc. *Perigynia* glabrous.
 - f. Spike with a single (rarely 2) perigynium at the base. Firmiculmes 69. *C. Geyeri*
 - ff. With more than one pistillate flower.
 - g. *Perigynia* 2.0-3.5 mm long Group A-1
 - gg. Longer, 4-8 mm long.
 - h. Scales leaf-like and many times longer than the erect perigynia. Phyllostachyae .. 54. *C. Backii*
 - hh. Scales much shorter than the perigynia, the latter reflexed at maturity. Orthocerates.
 - i. *Perigynia* 3-4 mm long 114. *C. microglochis*
 - ii. *Perigynia* fewer and bigger, 5-8 mm long 115. *C. pauciflora*

Group A-1

The single spike bearing more than 2 perigynia, these glabrous, rather small, and erect to spreading.

- a. *Perigynia* green, beakless and rounded at tip. Polytrichoideae..... 53. *C. leptalea*
- aa. *Perigynia acutē* to beaked.
 - b. Styles 2; leaves less than 1 mm wide.
 - c. Mature perigynia strongly falcate and mostly spreading. Dioicae 31. *C. gynocrates*
 - cc. *Perigynia* straight.
 - d. *Perigynia* narrowly obovate and stipitate. Nardinae 1. *C. nardina*
 - dd. *Perigynia* broadly ovate and sessile.
 - e. Spike androgynous; plant 1 dm high or more. Capitatae ... 2. *C. capitata*
 - ee. Spike gynandrous; stem less than half as high 25. *C. ursina*
 - bb. Styles 3; leaves mostly wider.
 - f. Scales lightly tinged in brown and much lighter in colour than the dark red-brown perigynia. Obtusatae 56. *C. obtusata*
 - ff. Scales dark brown, about as deeply coloured or more deeply coloured than the

perigynia.

- g. Scales about as long as the sessile perigynia, the latter with a short and abruptly defined beak.

Rupestres 67. C. rupestris

- gg. Perigynia stipitate, protruding beyond the scale by about 1 mm, or about the length of the poorly or weakly defined beak. Callistachys.

h. Loosely stoloniferous; leaves mostly 2-3 mm wide 4. C. nigricans

hh. Densely tufted; leaves around 1 mm wide 3. C. pyrenaica

DIGYNOUS SPECIES

Group B

Stigmas 2 and the achene lenticular. Perigynia compressed to inflated. Otherwise typical in habit of the subgenus Carex. Cryptocarpae, Bicolores and Acutae.

- a. Scale abruptly contracted into a long scabrous awn. Cryptocarpae.
- b. Tufted; stem scabrous at least above and in the inflorescence 111. C. crinita
- bb. Stoloniferous; stem smooth 112. C. paleacea
- aa. Scale awnless or sometimes with a short and smooth awn.
- c. Stem short, usually under 5 cm; terminal spike gynandrous 71. C. rufina
- cc. Stems taller; terminal spike usually staminate.
- d. Perigynia inflated to somewhat compressed, becoming broadly rounded along the edges.
- e. Beak \pm 0.5 mm long; perigynium usually dark purple. Vesicariae 122. C. saxatilis
- ee. Perigynium beakless, pale coloured. Bicolores.
- f. Pistillate scales broadly rounded, deep brown with a green midnerve 72. C. bicolor
- ff. Scales of a lighter colour and obtusish to short cuspidate; peduncles longer 73. C. aurea
- dd. Perigynia strongly flattened, sharply acute at the edges.
- g. Achene with a deep groove on one side near the middle; scales acutish to short aristate; maritime plants. Cryptocarpae 113. C. salina

gg. Achene plump. Acutae Group B-1

Group B-1

Acutae. Perigynia strongly flattened and the scales not aristate. Stigmas 2, as above. Often with 2 or 3 staminate spikes.

- a. Terminal spike less than 2 cm long, mostly around 1 cm.
- b. Terminal spike staminate; stem and leaf margins scabrous throughout 103. C. Bigelowii
- bb. Terminal spike usually gynandrous; leaves and stems smooth or scabrous only towards the tip 106. C. eleusinoides
- aa. Longer, 2-6 cm long, only exceptionally shorter.
- c. Scales exserted, being longer than the perigynia.
- d. Perigynia with 5 longitudinal nerves on each face; leaves 3-7 mm wide 107. C. nebraskensis
- dd. Either the perigynia nerveless or the leaves narrower.
- e. Aphyllopodic; stem scabrous and sharply triangular; spikelets mostly 3-4 mm wide 110. C. stricta
- ee. Phyllopodic.
- f. Lowest bract overtopped by the inflorescence; spikelets 5-7 mm wide 108. C. aperta
- ff. Lower 2 or 3 bracts equalling or overtopping the inflorescence; stem smooth or nearly so 109. C. aquatilis
- cc. Scales shorter than, to nearly as long as the perigynia.
- g. Stem very scabrous on the angles, deeply concave on the faces; densely tufted 110. C. stricta
- gg. Stem smooth or nearly so, flattish on the sides.
- h. Leaves 2-8 mm wide, at least some of them over 3 mm; long stoloniferous, the stems in small tufts.
- i. Perigynia with \pm 12 prominent nerves, one on each side and \pm 5 on each face 107. C. nebraskensis
- ii. No nerves on either face, only the 2 marginal ones present; perigynia sessile or nearly so.. 109. C. aquatilis

- hh. Leaves narrower, 1.0-2.5 mm wide;
tufted plants; perigynia stipitate.
- j. Inflorescence primarily green in
colour and gradually more lightly
coloured below, the lower scales
with a median green band at least
as wide as the lateral red brown
zones 104. C. lenticularis
- jj. Inflorescence darker, the scales
with a much narrower green band
..... 105. C. Kelloggii

Group C

Perigynia strongly flattened and the edges produced into a narrow to wide peripheral wing. Tufted and the spikelets gynandrous. Ovales.

The key to Group C is quite homogeneous, comprising all species of the section Ovales and none other. For the convenience of the user this key has therefore been placed at the beginning of the section Ovales.

Group D

Spikelets gynandrous and generally resembling the Ovales, but the perigynia not quite so flat and the edges wingless, merely bordered by a raised nerve on each side. In this group the lateral spikelets are quite sessile. Some specimens of section Bicolores may tend to key out here, but they will stand out by their dark brown scales and, upon close examination, the lower spikelet will proved to be pedunculate by at least 1-3 mm and the perigynium is devoid of spongy tissue.

- a. Perigynium without spongy tissue at base;
inflorescence deep brown, small, crowded,
and pyramidal, about 1 cm long 38. C. illota
- aa. Spongy tissue present; inflorescence green
to lightly brown-tinged, varying from crowded
to moniliform.
- b. Lower 1/3 or 1/2 of the perigynium cavity
filled with soft, spongy tissue; achene
stipitate and occupying only the upper
part of the cavity.
- c. Scales and beaks at least lightly
brown-tinged; perigynia shorter.
Stellulatae.
- d. Perigynium \pm 2.5 mm long 32. C. interior
- dd. Larger, (3.0)-3.5-(4.0) mm
long 33. C. phyllomanica
- cc. Inflorescence pale green; perigynia
usually 4-5 mm long. Deweyanae ... 34. C. Deweyana

- bb. Only a thin layer of spongy tissue;
achene occupying nearly the whole of
the cavity. Heleonastes Group D-1

Group D-1

Plants tufted. Spikelets sessile and gynandrous. Perigynia with a thin layer of spongy tissue in the lower part, yet the achene still occupying most of the cavity. Heleonastes.

- a. Spikelets \pm overlapping.
b. Scales membranous and quite colourless
except for the green midnerve.
c. Spikelets 2-(3) 23. C. tenuiflora
cc. Much more numerous 30. C. arcta
bb. Scales light to dark brown 26. C. Heleonastes
aa. At least the lowermost spikelet distant.
d. Lowest spikelet very remote and subtended
by a bract as long as the inflorescence
..... 22. C. trisperma
dd. Bracts much shorter, usually shorter than
the spikelets.
e. Perigynia obtusish and quite beakless
at tip 24. C. loliacea
ee. Contracted into an acute but short beak.
f. Spikelets subglobose and spreading
..... 28. C. brunescens
ff. Spikelets oblong and nearly erect.
g. Perigynia sessile 29. C. curta
gg. Stipitate, the stipe 0.3-0.5 mm
long 27. C. Mackenziei

Group E

Long stoloniferous species with at least the terminal spikelet androgynous. Or sometimes dioecious. Stigmas 2 and the achene lenticular. Spikelets sessile or essentially so, often small and crowded into a small inflorescence which may simulate a single spike.

- a. Perigynia narrowly wing-margined above as in
the Ovales. Arenariae.
b. Perigynia 4.5-6.0 mm long 10. C. siccata
bb. Perigynia shorter; spikelets more
numerous 9. C. Sartwellii
aa. Not wing-margined, merely with prominent
lateral nerves.
c. Scale broadly acute to obtuse, shorter
than the perigynium.
d. Perigynia rounded on the sides, almost
globular. Heleonastes 21. C. disperma

- dd. Perigynia acute along the sides, more so towards the summit. Foetidae ... 5. C. maritima
- cc. Scale acute to cuspidate, longer than the perigynium.
- e. Perigynia at first strongly flattened, becoming nearly globular; stem arising from a superficial stolon.
- Chordorrhizae 11. C. chordorrhizae
- ee. Perigynia plano-convex. Stem borne on an underground rhizome. Divisae.
- f. Usually (3)-4-(5) dm high; Leaves mostly 2 mm wide 8. C. praegracilis
- ff. Shorter plants, the leaves all or mostly narrower, often filiform.
- g. Heads dioecious or nearly so and usually pale green 6. C. Douglasii
- gg. Spikelets deep brown and androgynous 7. C. stenophylla

Group F

Spikelets androgynous and generally similar to group E, but growing in loose to dense tufts, not spreading by long stolons, nor forming a carpet.

- a. Inflorescence a spike of spikelets Group F-1
- aa. Inflorescence more or less obviously branched into a narrow panicle Group F-2

Group F-1

Spikelets borne one at a time, forming a spike.

- a. Spikelets quite remote.
- b. Perigynia mostly in 2's and equally convex on both faces. Heleonastes 21. C. disperma
- bb. Perigynia 3-5 to a spikelet, flat ventrally, convex dorsally. Bracteosae 12. C. rosea
- aa. Spikelets conspicuously overlapping.
- c. Leaves 3.5-5.0 mm wide.
- d. Stem winged, the wing about 0.5 mm wide. Vulpinae 20. C. alopecoidea
- dd. Stem triangular and wingless, although the corner nerve is often strongly raised on the edge. Bracteosae 15. C. gravida
- cc. Narrower, 1.5-3.5 mm wide. Bracteosae.
- e. Scales \pm acute, as long as to shorter than the perigynia 13. C. Hoodii
- ee. Scales cuspidate to short aristate, longer than the perigynia 14. C. Hookerana

Group F-2

Inflorescence more complex, more or less paniculate, at least a lower branch present and bearing 2 or more spikelets. All of our species with a branched inflorescence belong in this group.

- a. Bracts quite conspicuous, the lowest usually overtopping the inflorescence. Multiflorae 16. C. vulpinoidea
- aa. Bracts very short or the lower sometimes longer than its spikelet.
 - b. Leaves 1-3 mm wide. Paniculatae.
 - c. Upper part of sheath copper-brown .. 18. C. prairea
 - cc. Sheath merely brown-dotted ventrally 17. C. diandra
 - bb. Leaves larger, the largest 4-8 mm wide. Vulpinae.
 - d. Beak of perigynium longer than the body 19. C. stipata
 - dd. Beak obviously shorter than the body 20. C. alopecoidea

TRIGYNOUS SPECIES

Group G

Stigmas 3 and the achene consequently trigonous, but sometimes obscurely so when the achene is so plump as to appear round.

- a. Perigynia pubescent Group H-1
- aa. Perigynia glabrous, or at most scabrous-puberulent along the margins.
 - b. Herbage variously pubescent Group H-2
 - bb. Herbage glabrous or, at the most, scabrous.
 - c. Terminal spike gynandrous Group I
 - cc. Terminal spike staminate or sometimes androgynous.
 - d. Spikelets scattered; some borne below the middle or at the base of the stem Group K
 - dd. Spikelets all borne well above the middle of the stem, forming a terminal raceme or spike of spikelets.
 - e. Pistillate spikelets all sessile, or sometimes the lowest on a short peduncle less than 5 mm long Group L
 - ee. Pistillate spikelets pedunculate, the lowest peduncle over 5 mm long, but sometimes somewhat included in the sheath of the bract.

- f. Staminate spikes 2-4 Group M
- ff. Only 1.
 - g. Spikelets 1.0-2.5 cm wide Group N
 - gg. Narrower.
 - h. Spikelets pale coloured, the scales hyaline to straw-coloured Group O
 - hh. Darker, the scales at least with 2 broad brown bands.
 - i. Lowest bract with a sheath at least 5 mm long Group P
 - ii. Sheaths shorter, mostly 1-2 mm long Group Q

PUBESCENT SPECIES

Group H-1

An artificial group comprising all the species of the subgenus Carex with pubescent perigynia.

- a. Terminal spike androgynous, the lateral ones drooping on long peduncles.
 - b. Inflorescence terminal. Ferrugineae Group J
- bb. Spikelets borne from base to top of the stem 63. C. pedunculata
- aa. Terminal spike staminate.
 - c. Beak emarginate or obliquely cut and asymmetrical at tip, obtusish, or more rarely prolonged into a single sharp point; not bifid.
 - d. Bracts leaf-like and overtopping the spikelets. Sylvaticae 82. C. assiniboinensis
 - dd. Bracts bladeless, reduced to a coloured scale or sheath. Digitatae.
 - e. Pistillate scales finely ciliate 64. C. concinna
 - ee. Not ciliate.
 - f. Spikelets widely scattered from base to top of the stem 63. C. pedunculata
 - ff. Spikelets all borne near the top.
 - g. Bracts reduced to coloured sheaths about 1 cm long 66. C. Richardsonii

- gg. Bracts smaller, scale-like
and only short sheathing
..... 65. C. concinnoides
- cc. Beak shallowly to deeply bifid into a pair
of sharp and subequal teeth.
- h. Terminal staminate spike 2 cm long or
more. Hirtae.
- i. Perigynia densely tomentose, the
pubescence obscuring the nerves
..... 92. C. lasiocarpa
- ii. Pubescence more sparse, the
nerves obvious 91. C. Houghtoniana
- hh. Staminate spike shorter, less than
2 cm. Montanae.
- j. Stems all elongate and somewhat
longer than the leaves.
- k. Scale shorter than the peri-
gynium, not reaching the base
of the beak 58. C. nigromarginata
- kk. Scale about as long as the
perigynium 59. C. pennsylvanica
- jj. All stems, or some of them, much
shorter than the leaves.
1. Elongated stems present;
lowest bract leaf-like and
usually equalling or over-
topping the inflorescence .. 60. C. deflexa
11. Elongated stems absent or,
if present, with the lowest
bract very short and †
scale-like 61. C. umbellata

Group H-2

Miscellaneous species with pilose herbage, but glabrous
perigynia.

- a. Leaves pilose on both faces. Virescentes .. 90. C. Torreyi
- aa. Leaves glabrous above.
- b. Leaves pilose below and ciliate to the
tip. Sylvaticae 81. C. castanea
- bb. Leaves pilose on the sheaths and blades
mainly near the throat. Paludosae .. 121. C. atherodes

TRIGYNOUS AND GLABROUS

Group I

Terminal spike gynandrous.

- a. Inflorescence pale, the scales membranous.

- b. Perigynia rounded at tip and beakless.
Gracillimae 80. C. gracillima
- bb. Perigynia acute at tip and obviously
 beaked. Capillares 83. C. capillaris
- aa. Inflorescence dark-coloured, the scales
 brown to blackish.
- c. Lowest bract with sheath 5-20 mm long.
Ferrugineae Group J
- cc. Bracts sheathless or nearly so.
Atratae.
- d. Lowest bract leaf-like, 3-5 mm wide
 101. C. Mertensii
- dd. Bracts much smaller, less than 2 mm wide.
- e. Small plants, less than 1 dm high,
 the stems overtopped by the foliage
 71. C. rufina
- ee. Much taller, the stems taller than
 the foliage, commonly twice taller.
- f. Spikelets narrow, less than
 4 mm and mostly 2-3 mm wide
 96. C. Parryana
- ff. At least 4 mm wide.
- g. Scales narrowly lanceolate
 and cuspidate, usually
 longer than the perigynia
 102. C. Buxbaumii
- gg. Scales shorter and broader,
 broadly ovate to narrowly
 elliptic.
- h. Scales and perigynia
 less than 2.5 mm long;
 the inflorescence small
 and compact 97. C. norvegica
- hh. Scales, perigynia and
 inflorescence longer
 100. C. atrata

Group J

Spikelets rather dark-coloured and generally resembling
 the Atratae, but the lower bract long-sheathing, its blade most
 often reduced or vestigial. Perigynia very flat and much larger
 than the small trigonous achene. Ferrugineae.

- a. Terminal spike(s) androgynous 87. C. petricosa
- aa. Terminal spike staminate or gynandrous.
- b. Perigynia \pm 1 mm wide, lanceolate 88. C. misandra
- bb. Broader, narrowly ovate 89. C. atrofusca

Group K

Spikelets widely scattered along the stem, some borne below the middle or even arising among the basal leaves.

- a. All bracts leaf-like and overtopping their spikelets.
 - b. Both the staminate and the lower pistillate spikelet much shorter than their peduncles 75. C. tetanica
- bb. Either the staminate or the pistillate spikelets much longer than their peduncles.
 - c. Peduncle of the staminate spikelet longest 79. C. Crawei
 - cc. Peduncle of the staminate spikelet lacking or many times shorter than most.
 - d. Stem wingless and merely acute on the angles, flattish on the sides; perigynia mostly 20-30 per spikelet 78. C. granularis
 - dd. Stem produced on the angles into a wing about as wide as the central core; perigynia mostly 5-10 to a spikelet 77. C. laxiflora
- aa. At least the upper bracts reduced and much shorter than the spikelets.
 - e. Spikelets stiffly erect or ascending.
 - f. Inflorescence blackish, usually overtopping the foliage 103. C. Bigelowii
 - ff. Greenish and overtopped by the foliage 61. C. umbellata
 - ee. Spikelets drooping on very long peduncles.
 - g. Bracts reduced mainly to an elongate sheath, the blade many times shorter or vestigial. Digitatae 63. C. pedunculata
 - gg. At least the middle and lower bracts with a blade longer than the sheath.
 - h. Perigynia obovoid and almost beakless. Paniccae 75. C. tetanica
 - hh. Perigynia ovoid and tapering to a fairly well defined beak.
 - i. Leaves 0.5-4.0 mm wide. Capillares 83. C. capillaris
 - ii. Basal leaves broader, 4-8 mm wide. Laxiflorae 77. C. laxiflora

Group L

Pistillate spikelets sessile or nearly so. Terminal spikelet staminate.

- a. Pistillate spikelets 2-5 mm wide Group L-1
 aa. Over 5 mm thick Group L-2

Group L-1

Spikelets narrow, 5 mm wide or less.

- a. Pistillate spikelets light green. Extensae
 85. C. viridula
 aa. Darker, brown to purple black.
 b. Stem smooth and roundish. Rupestres.. 68. C. glacialis
 bb. Stem sharply triangular and often scabrous
 on the angles.
 c. Pistillate spikelets ovoid; leaves less
 than 1.5 mm wide. Obtusatae 57. C. supina
 cc. Spikelets cylindrical; leaves wider.
 d. Stigmas 3; stem 2-3 times taller
 than the foliage; perigynium 2.0-
 2.5 mm long, completely filled by
 the achene. Atratae 96. C. Parryana
 dd. Stigmas normally 2, exceptionally
 3; stem usually about as tall as
 the foliage; perigynium 2.5-3.5 mm
 long and empty in the upper third,
 being \pm 1 mm longer than its achene.
Acutae 103. C. Bigelowii

Group L-2

Pistillate spikelets fatter, over 5 mm wide.

- a. Staminate spikelet on an elongate peduncle
 which is well over 5 mm long and usually
 overtops the upper pistillate spikelet.
 b. Perigynia at least 1 cm long.
Lupulinae 128. C. intumescens
 bb. Much smaller. Vesicariae.
 c. Perigynia very numerous 124. C. rotundata
 cc. Fewer, only 3-10-(15) to a
 spikelet 127. C. oligosperma
 aa. All spikelets sessile or nearly so. Extensae.
 d. Beak less than half as long as the body
 85. C. viridula
 dd. Perigynia longer, the beak more than
 half as long as the body 86. C. flava

Group M

Staminate spikes 2-4. Plants rather large with usually
 large and open inflorescence of many coarse spikelets. N.B.:
 the Cryptocarpaceae also usually have two staminate spikelets, but
 only two stigmas (group B).

- a. Perigynia with only 2 nerves, i.e. only the two lateral ones. Longirostres 84. C. Sprengelii
- aa. Also with nerves on both faces.
- b. With 15-20 nerves, i.e. 7-12 nerves simultaneously visible on a face.
Paludosae.
- c. Teeth of the perigynia about 0.5 mm long 119. C. lacustris
- cc. Longer, mostly around 1 mm 120. C. laeviconica
- bb. With 8-10-(12) nerves, i.e. with 3-5-(7) nerves visible at a time. Vesicariae.
- d. Beak less than 1 mm long 124. C. rotundata
- dd. Beak longer.
- e. Perigynia mostly reflexed; bracts many times longer than the inflorescence 126. C. retrorsa
- ee. Perigynia more or less ascending; bracts up to twice as long as the inflorescence.
- f. Stem very sharp and scabrous on the angles, thinly clothed (\pm 3 mm thick) at base with red sheaths, these mostly short and bladeless 123. C. vesicaria
- ff. Stem obtusish and smooth or nearly so on the angles, thickly clothed (5-15 mm thick) below with old leaf bases which are mostly brownish to straw-coloured 125. C. rostrata

Group N

Coarse plants with coarse spikelets over 1 cm wide, the lower pedunculate, but only one staminate spikelet.

- a. Perigynia at least 1 cm long, in subglobose heads.
- b. Perigynia narrowly lanceolate, \pm 2 mm wide.
Folliculatae 116. C. Michauxiana
- bb. Perigynia ovoid, \pm 5 mm wide. Lupulinae 128. C. intumescens
- aa. Perigynia shorter and in elongate spikelets.
- c. Perigynia with only 2-(4) nerves.
Longirostres 84. C. Sprengelii
- cc. With 8-20 nerves.
- d. Bracts many times longer than the inflorescence. Vesicariae 126. C. retrorsa
- dd. Bracts less than twice as long as the inflorescence. Pseudo-Cyperae.
- e. Perigynia straight, mostly widely spreading 117. C. hystericina

- ee. Falcate and somewhat reflexed
 118. C. Pseudo-Cyperus

Group O

Miscellaneous group, the spikelets narrow, pale-coloured, pedunculate, the terminal one staminate.

- a. Perigynia somewhat less than 2 mm long.
Albae 70. C. eburnea
- aa. At least 2.5 mm long.
 b. Perigynia all or mostly 5-7 mm long.
Vesicariae..... 127. C. oligosperma
- bb. Only 2.5-4.0 mm long.
 c. Perigynia with 2 obvious lateral nerves,
 otherwise nerveless. Capillares..83. C. capillaris
- cc. With more numerous longitudinal ribs
 or nerves.
 d. Leaves 1-3-(4) mm broad. Paniceae
 75. C. tetanica
- dd. Foliage much coarser and longer,
 the basal leaves 4-10 mm wide.
 e. Beak of perigynium truncate
 rather than bifid at tip.
Laxiflorae 77. C. laxiflora
- ee. Beak ending in a pair of sharp
 teeth (0.4)-0.6-1.0 mm long.
Pseudo-Cyperae 118. C. Pseudo-Cyperus

Group P

Much as above, but the scales darker, brown or more often purplish brown to blackish. Lowest bract with a well developed sheath.

- a. Perigynia as black as the blackish or purple-black scales. Ferrugineae 89. C. atrofusca
- aa. Perigynia green to purple brown, paler than the scales.
 b. Perigynia spreading or usually reflexed.
Vesicariae 124. C. rotundata
- bb. Perigynia divergent to nearly erect.
Paniceae.
 c. Beak nearly straight and 0.5-1.0 mm
 long 76. C. vaginata
- cc. Beakless or with a shorter and strongly
 bent beak.
 d. Foliage glaucous, some or all the
 leaves less than 2 mm wide 74. C. livida
- dd. Foliage green, the leaves at least
 2 mm wide 75. C. tetanica

Group Q

As in group P, but the bracts not sheathing or only short-sheathing.

- a. All pistillate spikes drooping on filiform peduncles. Limosae.
- b. Scales lanceolate, about half as wide and nearly twice as long as the perigynia 95. C. magellanica
- bb. Scales ovate, about as wide and nearly as long as the perigynia.
- c. Stem smooth throughout; scales dark purple 93. C. rariflora
- cc. Scabrous in the upper 1/3; scales golden brown 94. C. limosa
- aa. At least the upper pistillate spikes erect or strongly ascending on shorter and stiff peduncles.
- d. Pistillate spikes 2-3 times thicker than the staminate spike.
- e. Terminal spike long-pedunculate, the peduncle often longer than the spike. Vesicariae 124. C. rotundata
- ee. Terminal spike sessile or nearly so. Atratae 99. C. Reynoldsii
- dd. Pistillate spikes not much thicker than the staminate one.
- f. Perigynia 2.0-2.5 mm long; leaves long attenuate into filiform and \pm curly tips. Atratae 96. C. Parryana
- ff. Perigynia 2.5-4.5 mm long; leaves gradually tapered to straight tips.
- g. All spikes erect or nearly so; staminate spike (2)-3-(4) mm thick. Acutae 103. C. Bigelowii
- gg. Lowermost spike usually drooping; staminate spike rather fat, \pm 5 mm thick. Atratae 98. C. podocarpa

SHORT INDEX TO CAREX

This listing is to facilitate the concurrent use of the key and the descriptions since many important characters once given in the key are not usually repeated in the description. Mainly the recognized species are listed, discounted species and most synonyms are omitted. The page references are first to the key, then to the corresponding description.

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1. NARDINAE

A vestigial structure termed rachilla is present inside the perigynium; it is a vestigial structure, a seta-like axis, somewhat shorter than the achene. A rachilla is also present in the Capitatae and Filifoliae, and becomes conspicuous in one species of Orthocerates. A rachilla is normally lacking or sometimes minute in all other sections. Tufted, unispicate, androgynous, distigmatic and the perigynia flattened, longitudinally nerved, tapering to a substipitate base.

1. C. nardina Fries (var. Hepburnii (Boott) Kuk.) -- Small and densely tufted species with filiform leaves and a single spike. Leaf-bases marcescent, becoming chestnut-brown. Perigynia finely puberulent-scabrous above along the edges. Early summer. Dry alpine outcrops, especially on ridges and mountain tops. -- G-Aka, nL, Q, swAlta-BC, wUS, Eur.

Larger plants are often segregated as var. Hepburnii, an extreme of variation found throughout the range.

A collection from Waterton (CAN) was identified as C. elynoides Holm and so reported in Can. Field-Nat. 56: 112. 1942. But its perigynia are glabrous, the beak scabrous-ciliate, very short and brown, the scales elliptic and the achene lenticular; it has been revised to C. nardina.

2. CAPITATAE

Much as in the first, but the perigynia nerveless and rounded to a sessile base.

2. C. capitata L. (f. arctogena (H.Sm.) Raymond) -- Same habit as the above. Spike short and compact, typically ovoid. Scale shorter than the body of the perigynium. Perigynia pale green, with a nearly orbicular body abruptly contracted into the beak. Early summer. Alpine slopes and peaty places in the arctic and subarctic regions. -- G-Aka, L-NF, Q-nMan-BC, US, (CA, SA), Eur.

Smaller plants with a darker head may be distinguished as f. arctogena, apparently an ecological form of drier habitats, widely sporadic in the range of the typical phase.

3. CALLISTACHYS

As the first two, but tristigmatic. Perigynia stipitate, the beak obliquely cut into a single, dorsal, and obtusish point.

3. C. pyrenaeica Wahl. var. pyrenaeica -- Densely tufted species with very narrow to filiform leaves and a single spike. Spike dark brown. Perigynia broadly lanceolate, acute at tip, abruptly contracted into a stipe \pm 0.5 mm long. Early summer. Alpine prairies.-- wMack-Y, swAlta-BC, wUS, Eur.

A fairly variable species. In our typical phase the leaves are 0.3-1.2 mm wide and the stigmas 3, while the beringian var. micropoda (C.A. Meyer) Boivin has a smaller perigynium, 2.4-3.0 mm long, the leaves 1-2 mm wide and the stigmas mostly 2. Further variations are found in Japan where the perigynia are longer, in the Kuriles where the perigynia are reflexed, etc.

4. C. nigricans C.A. Meyer -- Closely resembles the preceding. Leaves larger, 1-3 mm wide. Stoloniiferous. Scales soon deciduous. Perigynia contracted into the beak, becoming reflexed at maturity. Stipe rather thin and sharply defined, 0.3-1.2 mm long. Early summer. Wetter alpine prairies. -- sAka, swAlta-BC, wUS, (eEur).

4. FOETIDAE

Like the next, but the beak not bidentate at tip, merely cut obliquely into a single rounded or truncate tip. This and the next few sections, up to the Vulpinae included, with the terminal spike (or often all spikes) androgynous, that is with staminate flowers at top, the pistillate ones at base, hence the spikelets tend to be rounded at base.

5. C. maritima Gunner var. maritima (C. Dutillyi O'Neill & Duman; C. incurva Lightf.) -- Stem usually arching like the leaves. Less than 2 dm high and very stoloniferous, the stolons deeply buried. Nearly smooth except the leaf tips. Inflorescence small, compact, ovoid and brown. Perigynia ovate to broadly ovate, usually quite nerveless. Early summer. Gravelly soils along the coast. --G-Mack-(Y)-Aka, L-NF, Q-nO-nMan, (Eur) -- Var. incurviformis (Mack.) Boivin (C. incurviformis Mack.) -- Generally somewhat smaller, less than 1 dm high, and the perigynia narrowly ovate and faintly nerved on both faces. Late-snow patches in the mountains (Banff), dunes of lake Athabaska and, more rarely, on gravelly shores of glacier draining rivers: York Factory, Edmonton -- (swY), Man-nS-Alta-eBC, nwUS.

Previous reports of C. maritima for York Factory (ALTA) by Scoggan 1957, William River (DAO) by Argus 1968, and Edmonton (ALTA) by Moss 1959 were based on specimens since revised to var. incurviformis. Also adventive on railway gravel at The Pas (DAO), and the specimen has been checked to var. incurviformis. Cf. Blue Jay 32: 25-26. 1974.

In the more southern material the perigynium, including the beak, is commonly 3.0-3.5 mm by 1.2-1.6 mm while in the coastal and more northern specimens it is usually 3.5-4.0 by 1.7-2.0 mm. The collections from York Factory (ALTA, CAN, GH) exhibit the full range of variation of both taxa.

5. DIVISAE

As the next section, but the perigynia not wing-margined. Or similar to the Bracteosae, but stoloniferous. Beak usually bidentate.

6. C. Douglasii Boott -- Dioecious or near so, the anthers rather large and the perigynia completely hidden behind the much larger scales, but the styles conspicuous, rather long exerted, usually by 4-8 mm, marcescent and tending to form tangled masses. Smallish species with a rather fat and crowded inflorescence. Dioecious or nearly so. Leaves \pm filiform, about as long as the stem. Inflorescence of numerous spikelets, green to lightly brown-tinged. Perigynium body suborbicular and the beak about as long as the body. Early summer. Wet saline meadows or sandy shores. -- soMan-BC, US.

7. C. stenophylla Wahl. var. Eleocharis (Bailey) Breitung (var. enervis AA.; C. Eleocharis Bailey) -- A small and common prairie species with a small dark brown inflorescence. About 1 dm high, singly or in small tufts from deeply buried blackish rhizomes. Leaves filiform, marcescent. Spikelets many and very small, crowded into a spike-like head, the latter commonly \pm 1 cm long, compact, cylindrical. Perigynia 2.5-3.0 mm long, stipitate, brown, but the beak hyaline and obliquely cut into a single point. Late spring and early summer. Steppes and prairies, common. -- (sMack)-Y-sAka, sMan-BC, US, (eEur).

The typical phase is Eurasian and is supposed to differ from our plants mainly on the basis of the slightly larger perigynia, 3.0-3.5 mm long. The paucity of eurasian sheets at hand does not allow for a close scrutiny of this distinction. We are maintaining it for the time being but we note that Cronquist 1969 was dissatisfied with it, possibly with good cause.

On var. enervis we have adopted the solution proposed by M. Raymond ex C. Rech. f., Symb. Afg. 6: 32. 1965. According to Raymond C. enervis C.A. Meyer rests on a chinese plant related to C. maritima and is not applicable to our taxon.

8. C. praegracilis W. Boott var. praegracilis -- A middle size species with rather coarse and brown to blackish rhizome. Stem about twice taller than the foliage and leafy near the base only. Leaves 1-2-(3) mm wide. Inflorescence subdioecious, mostly 2-3 cm long, deep brown, crowded. Scales minutely sca-

brous-ciliate dorsally along the midnerve, about as large as the perigynia, the latter 2.5-3.5 mm long, rather small, deep brown and shiny, the beak at least 0.5 mm long. First half of summer. Marshy places, even if alkaline. -- swY, w0-sMan-BC, US, (CA, SA) -- Var. simulata (Mack.) Boivin (C. simulata Mack.) -- Plant bases and rhizomes brown rather than blackish. Perigynia smaller, (1.7)-2.0-(2.5) mm long, broadly ovoid, truncate to subcordate at base, abruptly contracted into a smaller beak about 0.3-0.5 mm long. Wet meadows (not saline) in forested areas: Shand, Wood Mountain to Cypress Hills, Central Saskatchewan westward, and southwestern Alberta, also at Harris Pike Lake and Burke Lake. -- S-Alta, (US).

Collections of var. praegracilis from east of us (DAO, TRT) seem to represent a recent highway and railway introduction.

Var. simulata (Mack.) stat.n., C. simulata Mack., Bull. Torrey Bot. Club 34: 604. 1908. Within its range var. simulata seems to be only an extreme of variation with smaller fruits, but since this phenotype is restricted to much less than half of the range of the species it seems desirable to accord it recognition as a geographical variety.

6. ARENARIAE

Stoloniferous and the spikelets androgynous. Otherwise pretty much as in the Ovales, the perigynia similarly flattened and wing-margined.

9. C. Sartwellii Dewey (C. disticha AA.) -- Often with most of the upper spikelets entirely staminate. Rhizome and lower part of plant black. Resembles the preceding, but the stem more leafy, clothed with leaf sheaths up to about the middle, with somewhat larger leaves, and the inflorescence paler with more numerous spikelets. Foliage about as tall as the stem and the main leaves (2)-3-(4) mm wide. Sheath of stem leaves green ventrally, except the upper few millimeters where it becomes membranous and hyaline or brownish. Scales 3 mm long or less, usually slightly smaller than the perigynia. The latter small, 2.5-3.5 mm long, narrowly wing-margined above the middle, its beak \pm 0.5 mm, in numerous small pale brown spikelets. Early summer. Swamps and sloughs, often a pioneer on bare clay shores. -- seK-sMack, swQ-BC, US.

10. C. siccata Dewey (C. foenea AA.) -- Spikelets few and all androgynous, or more commonly rather numerous and the middle ones entirely staminate. Long stoloniferous sand-binder, blackish below. About 3-4 dm high, its leaves near basal and 1-2 mm wide. Sheaths hyaline ventrally. Inflorescence light brown. Resembles the last two but the scales are larger, (3.5)-5.0-(6.0) mm long, the perigynia also larger, 4-6 mm long, with a

conspicuously winged margin. Beak commonly ± 2 mm long. Late spring to early summer. Sandy soils, wet or dry. -- (sMack)-sY, swQ-Alta-(BC), US.

The interpretation of the type of C. foenea has produced a wide variety of opinions. In 1836 Schlechtendal identified it to C. albolutescens Schwein., but to Kunth in 1837 it was a mere form of C. scoparia. Nearer to our times, Bailey in 1889 has identified it to C. argyrantha while in 1938 Svenson places it with C. siccata. All these tergiversations are a source of confusion and we have chosen not to use C. foenea until a better type photograph becomes available, in the hope that we may then be able to make a convincing choice among so many authoritative opinions. A tracing of the type (W 17,167) made by J.M. Greenman in 1900 and 2 photos at GH show a plant 5-6 dm high, with leaves 2.0-2.5 mm wide. On size alone, it seems not too likely that the type of C. foenea could belong with C. siccata.

At GH there is a second tracing made in Berlin by H.K. Svenson with a sketch of a single perigynium. This second tracing would easily fit into Carex siccata, but unfortunately it does not match the earlier tracing, nor does it jibe with the two photographs of the type specimen or the microfiche at DAO. One wonders what specimen Svenson was studying; certainly it was not Willdenow's number 17,167, even though his drawing is inscribed with that number. Fernald's discussion in Rhodora 40: 325-9. 1938 is apparently based on the specimen illustrated by Svenson rather than the plants shown in the photographs; hence his conclusion is not accepted as clearly relevant.

7. CHORDORRHIZAE

New shoots at first erect, elongate, leafy and sterile, becoming prostrate the second year and producing fertile culms at the tip and from the leaf axils; eventually overgrown by Sphagnum and becoming a buried rhizome. Otherwise much as in the last two, especially the Divisae, but the perigynia at first slightly flattened, becoming inflated and strongly rounded on the sides.

11. C. chordorrhiza L. f. -- The very long rhizomes at first running on the surface of the bog, eventually buried by the fast growing Sphagnum. Stem 1-3 dm high. Leaves marcescent and strongly dimegueth, those of the sterile shoots more than twice as long as the new leaves at the base of the flowering stems. Inflorescence small and compact, simulating a single spike, the spikelets being few-flowered, with only 1-3 perigynia each. Perigynia brown, conspicuously lined with darker nerves. Early summer. Sphagnum bogs. -- sF-Mack, Aka, (L)-NF-SPM, PEI-BC, US, Eur.

8. BRACTEOSAE

A generalized type of the subgenus Vignea, not specialized in any particular direction: tufted, inflorescence a spike of spikelets, distigmatic, perigynia flattened and bidentate. At least the terminal spikelet with a few staminate flowers at tip, i.e. androgynous, hence the spikelets generally rounded at base.

12. C. rosea Schkuhr (C. convoluta Mack.) -- Spikelets small and remote, mostly of 3-8-(15) perigynia spreading horizontally. A fine species, densely tufted. Resembles C. interior, but in the latter the terminal spikelet is conspicuously gynandrous. Second spikelet from the top often with only 1-2 perigynia. Perigynia pale green, the lower half filled with spongy tissue. Stigmas at first straight or flexuous, becoming strongly recurved, eventually breaking off. Scales small, barely tinted. Mid spring. Wet spots in mixed woods, from The Pas eastward. -- NS, NB-Man, US.

13. C. Hoodii Boott -- Perigynia brown, deep green along the margin. Inflorescence short and crowded and the whole plant resembling C. macloviana, but the spikelets androgynous and the body of the perigynia not winged, while the beak is scabrous-serrulate to the tip and the base is spongy like the last. Scales \pm brownish with a green midnerve. Late spring and early summer. Wetter montane prairies. -- swS-swAlta-BC, US.

14. C. Hookerana Dewey (C. Hookeriana sphalm.) -- Perigynia membranous, except for the green margin, the brown achene visible through the wall. Very scabrous and densely tufted from a blackish base, with a brown inflorescence, the bracts long aristate, the scales short aristate. Early summer. Infrequent on dryer prairies or hillsides. -- w0-Alta, ncUS.

Native in our area and barely spreading beyond our borders. The single Ontario collection is from Schreiber (GH) and is apparently an introduction. An early report from B.C. by Henry 1915, queried by Boivin 1967, could not be substantiated in any of the herbaria inventoried.

15. C. grävada Bailey var. grävada -- Sheaths much paler than the blades, membranous ventrally, \pm membranous dorsally. A rather tall and coarse tufted species, the divergent stems commonly 1 m tall. Perigynia triangular-ovate, 4 mm long or a little longer, 2.5 mm wide, 3-5 times wider than thick, commonly brown ventrally and straw-coloured dorsally, with thin green margins. Early summer. Galerie-forests, rare or overlooked: Oxbow, Roche-Percée, Shand, Willowbunch. -- sw0, sS, US.

Grades southeastward into var. Lunelliana (Mack.) Hermann with a broader and stubbier perigynium, the body orbicular and

about 3 mm wide, more abruptly contracted into the beak.

Manitoba reports by Løve 1959 and Scoggan 1978 were based on J.-P. Bernard 54/289, Saint-Pierre Jolys, en bordure du bois, 24 juillet 1954 (DAO, QFA), since revised to C. alopecoidea.

9. MULTIFLORAE

Like the last, but the inflorescence is a panicle in this and the next two sections, the spikelets being crowded on the lower branches. But this paniculate condition not always very obvious because of the crowding of the spikelets, or because the actual branching may be reduced to the two lowermost spikelets being borne on a very short branch, the panicle then becoming essentially spiciform. In all our other sections the inflorescence is a single spike or a spike of spikelets, or a raceme of spikelets. Perigynia plano-convex, winged along the margin above the middle, not spongy at base. Upper dm or so of the sheath becoming transversely corrugated on the hyaline side.

16. C. vulpinoidea Mx. var. vulpinoidea -- With many conspicuous and setaceous bracts. Tufted stems 1-6 dm high, from half as long as to nearly as tall as the foliage. Inflorescence green, crowded, much branched. Scales small, the brownish body about 1 mm long, produced into an awn mostly at least as long. Perigynia quite small, only 2-3 mm long, the body 1.0-1.5 mm wide, broadly ovate and membranous, but the beak pale green along the edges. Early summer. Sandy shores. -- NF-SPM, NS-BC, US, Eur(nat.).

In late summer the stem may elongate to overtop the leaves, the perigynium turns brownish and, being distended by the maturing achene, its body becomes nearly orbicular and the beak appears to be relatively shorter. Such late season specimens have been at times named C. annectens Bickn.

Southward there is a var. xanthocarpa (Bickn.) Klk. with slightly larger fruits, 1.6-1.8 mm wide, often yellowish tinged at maturity.

10. PANICULATAE

Inflorescence branched as in the last and the next, but the perigynia strongly convex on both sides and devoid of spongy tissue. Sheaths variously tinged in brown.

17. C. diandra Schrank -- Sheaths brown-dotted ventrally and the perigynia very small, 2.0-2.5 mm long, brownish, turning deep brown to purple black and falling off readily at maturity. In small tufts 4-6 dm high. Spikelets small, numerous, mostly 3 to 8 on each branch, the latter appressed into a

cylindric inflorescence. Perigynium shiny, convex on both faces, more so dorsally, nerveless except the two marginal nerves. Beak triangular, strongly flattened, slightly concave ventrally, broadly wing-margined, minutely ciliate. Early summer. Common in bogs. -- (K)-Mack-Aka, sL-SPM, NS-BC, US, Eur, (Afr), Oc.

18. C. prairea Dewey -- Sheaths conspicuously copper-brown in the upper few millimeters. 3-6 dm high in flower, elongating to 6-8-(10) dm in fruit. Similar to the preceding, the inflorescence light brown to chestnut brown, and not so crowded, the lower branch often somewhat remote, the perigynia slightly longer. Spikelets so crowded, so small and so few-flowered that often the branching is none too obvious. Perigynium chestnut brown, flattish on the ventral side. Late spring to mid summer. Calcareous bogs. -- (NS), nwNB-BC, US.

11. VULPINAE

In this and the two previous sections the inflorescence is clearly to obscurely branched into a narrow or spiciform panicle. Scales awnless. Perigynia plano-convex, not winged, filled with spongy tissue in the lower half. The part which is filled with spongy tissue tends to shrink slightly in drying. Hence the lower half of the perigynium tends to become slightly wrinkled while the upper half remains clearly distended over the firm achene. The presence of spongy tissue is associated with a stipitate achene. In this and the previous sections the terminal spikelet is androgynous, the lateral ones are androgynous or pistillate.

19. C. stipata Muhl. var. stipata -- With the most obviously paniculate inflorescence. A coarse species with broad leaves 4-8 mm wide and thick and spongy stems, especially so below. Perigynia (3.5)-4.0-5.0 mm long, narrowly conical-lanceolate, broadest at the somewhat bulbous and spongy base, the beak somewhat longer than the body. Late spring. Marshy places. -- sAka, L-SPM, NS-BC, US, eEur.

In our typical variety the sheath is convex ventrally at the margin, thin and very fragile. In the more eastern var. laevivaginata Kük. the sheath margin is concave ventrally and reinforced by an opaque marginal cartilaginous thickening, while the perigynia are usually 5-6 mm long. Recombinations of these characters are occasional.

C. conjuncta Boott was reported for Manitoba by Løve 1959, queried by Scoggan 1978, based on J.-P. Bernard, St.-Pierre-Jolys, 16 juin 1958 (MT, MTJB, QFA). The sheet at QFA is now filed a C. vulpinoidea and the two duplicates have also been revised, perhaps to C. alopecoidea.

20. C. alopecoidea Tuck. -- Similar to the previous, generally smaller, the perigynia rather much flattened and the

beak obviously shorter than the body. Stem not soft, but flattened into 3 thin wings. Inflorescence not obviously branched. Perigynia broadly ovate, 3-4 mm long, about 1.5 mm wide, less than twice as wide as thick. Early summer. Moist deciduous woods. -- sQ-ecS, neUS.

If the branching of the lower part of the inflorescence is not detected, a specimen is likely to end up at C. grävada in the key. Allowance for this difficulty has been made in the key. Also, in C. grävada the perigynium is much more flattened.

12. HELEONASTES

In this and the remaining sections of Vignea the spikelets are gynandrous, hence the spikelets will often affect a \pm clavate shape because the staminate part of the spikelet is much narrower. The gynandrous condition is fairly obvious at flowering time. Later on the staminate part of the spikelet is reduced to a series of empty scales at the base of the spikelet. In this section the plants are tufted, the perigynia are wingless and the layer of spongy tissue at the base is thin, the cavity being almost wholly filled by the achene, while in the next three section the spongy tissue occupies the lower $\frac{1}{2}$ of the cavity. No spongy tissue in the Ovales.

21. C. disperma Dewey -- The remote spikelets mostly with only 2 perigynia each. In very loose tufts and somewhat stoloniferous. Inflorescence rather pale green. Perigynia plump, the beak very short. Early summer. Shaded and mossy ground. -- (swG, swK)-Mack-Aka, L-NF-(SPM), NS-BC, US, Eur.

22. C. trisperma Dewey -- Inflorescence rather characteristic, being made typically of 3 very small and few-flowered spikelets of which the upper 2 are quite close together while the other is very remote and subtended by a bract about as long as the inflorescence. Stoloniferous and forming a lax carpet of weak stems. Spikelets pale green with very few and inconspicuous staminate flowers. Scale membranous with a green midnerve. Early summer. Bogs and Black Spruce forests. -- (G), L-SPM, NS-BC, US.

Known in Saskatchewan only from the south shore of Lake Athabaska (DAO, SASK). The Candle Lake region (SASKP) sheet listed by Breitung 1957 was revised to C. brunnescens by J.H. Hudson in 1967.

The range was extended northward to Chippewyan (QFA) and Fort-Norman (QFA) by Louis-Marie 1961. Upon examination, both specimens cited proved to belong to C. disperma.

A Mackenzie report by Porsild 1968, repeated by Cody & Pors., Can. Field-Nat. 82: 266. 1969 and Scoggan 1968, was based on a depauperate collection of C. brunnescens: Cody 15476, Mantic Lake, July 26, 1966 (DAO).

C. trisperma is stoloniferous, has a pale green inflorescence; few staminate flowers, only 1-2 to a spikelet; scales hyaline but for the green midnerve; perigynia 3.0-3.5 mm long. By contrast C. brunnescens is tufted, has usually more than 3 spikelets, these \pm brownish in age; terminal spikelet clavate because of the more numerous staminate flowers; scales with a green midnerve flanked by castaneous strips and a wide hyaline border; perigynia smaller, \pm 2 mm long.

23. C. tenuiflora Wahl. -- Resembles C. trisperma minus the lower spikelet and the long bract. Not quite so stoloniferous, forming a denser carpet. Spikelets usually 2, sometimes 3, always congested in a pale green head. Perigynia ellipsoid, beakless. Early summer. Muskegs. -- K-Aka, L-NF, NB-BC, US, Eur.

24. C. loliacea L. -- Inflorescence pale green and the perigynia beakless as in the last 3 species, but spreading horizontally at maturity. Especially similar to C. disperma, but the perigynia more numerous, (3)-5-8-(10) per spikelet. Spikelets 3-4, gradually more remote below. Bracts small, or the lowest sometimes half as long as the inflorescence. Late spring and early summer. Wet coniferous woods northward. -- Mack-Aka, O-BC, Eur.

On the basis of its general distribution it should be widely distributed across northern Manitoba, yet Scoggan 1957 mentioned only a Lake Nuelin (CAN, TRT, WIN) collection and we know of no other.

25. C. ursina Dewey -- Smallest, less than 5 cm high, and usually unispicate, or bearing a second much reduced spikelet just below the main one. Forming small tufts or large cushions. Leaves equalling or somewhat overtopping the inflorescence. Spike ovoid, \pm 5 mm long, with deep brown scales, dull green perigynia and a few staminate flowers at base. Perigynia ovate, \pm 2 mm long, nearly beakless. Early summer. Sandy or muddy flats at high tide: Churchill. -- G-Aka, L, (nQ), nMan, Eur.

26. C. Heleonastes L. f. var. Heleonastes (C. amblyorhyncha Krecz.; C. bipartita All., var. amphigena (Fern.) Pol.; C. glareosa Wahl.; C. Lachenalii Schkuhr; C. marina Dewey; C. neurochlaena Holm) -- The dorsal suture, a common feature of species in subgenus Vignea, particularly obvious in this species; it presents itself as a sulcate line commonly 0.5-1.0 mm long, running down the center on the dorsal side of the perigynium from the tip downwards; actually it is a deep sinus the sides of which touch each other or overlap slightly; there is no corresponding sinus on the ventral side. About 4 gynandrous spikelets of wingless perigynia which become about as dark brown as the brown scales. Loosely tufted and 1-4 dm high, the stems overtopping the foliage. Inflorescence brown, 1-2 cm

long, the terminal spikelet obviously clavate, the lower spikelet(s) sometimes entirely pistillate. Scales brown with paler center and a broad membranous margin, just about covering the whole of the perigynium, the latter mostly 2-3 mm long and green at first. Beak short to nil, darker brown. First half of summer. Bogs, wet rocky ledges and alpine prairies, mostly on late-snow patches. -- G-Aka, L-SPM, (nNB)-Q-BC, (nUS), Eur, (Oc).

On the other side of the Rockies one may find a variant with shorter scales (1.2)-1.5-(2.0) mm long, covering only about two thirds of the perigynium, the latter averaging smaller, (1.5)-2.0-(2.2) mm long: var. dubia (Bailey) Boivin (stat. n., C. canescens L. var. dubia Bailey, Bot. Gaz. 9: 119. 1884; C. praeceptorum Mack.). One may also add that in var. Heleonastes there are commonly 4 spikelets, occasionally only 2-3, while in var. dubia there are usually 4 spikelets, occasionally as many as 5-6.

Sometimes subdivided into two (Boivin 1967), or more commonly three, taxa (Mack. 1931, Pors. 1957, Hultén 1962). The last two authors have provided us with comparable distribution maps. More rarely up to 6 segregates have been proposed.

C. bipartita (= C. Lachenalii) is the smaller plant with a smooth stem and a perigynium commonly 2.0-2.5 mm long. Plants with narrower perigynia have been distinguished as C. glareosa. Seashore plants may be identified as var. amphigena (= C. glareosa in Hultén = C. marina in Mack.), but we have not been able to detect here any difference other than the habitat. Taller plants with scabrous stems and perigynia \pm 3 mm long are usually tagged C. Heleonastes (= C. amblyorhyncha). The latter may be subdivided further into C. neurochlaena if the beak is indistinct, C. amblyorhyncha if the beak is poorly defined, and C. Heleonastes if the beak is well defined.

The specimens examined do not conform readily with the criteria given above; the morphological variation seems continuous and random between C. bipartita and C. Heleonastes. Their distributions as per published maps are roughly similar, except that the more common phenotype has a fuller, more rounded out distribution. We are not convinced that these two names represent either significant or workable distinctions. The other segregates appear to be uncommon extremes of variation and of no obvious import.

27. C. Mackenziei Krecz. (C. norvegica W.) -- Maritime counterpart of C. curta, the terminal spikelet very conspicuously gynandrous, the staminate part usually longer than the pistillate. Spikelets mostly 3. Scales brownish. Perigynia stipitate. Early summer. Tidal marshes: Churchill. -- swG, (K-Mack), Aka, (L)-NF, NS-nMan, (neUS, Eur).

28. C. brunescens (Pers.) Poiret (var. sphaerostachya (Tuck.) Klk.) -- Similar to the next and the last, but the spikelets smaller, shorter and all but the top one spreading. Inflorescence at first pale green, often turning brown at maturity. Terminal spikelet narrowed at base into a short staminate portion comprising only a few staminate flowers. Common in cool forests, becoming more abundant after a fire or lumbering. -- G, sK-sAka, L-SPM, NS-BC, US, Eur.

Plants from shaded habitats tend to be more luxuriant and have been distinguished as var. sphaerostachya, an ecological form more frequent southward.

29. C. curta Good. var. curta (C. canescens AA., var. sublobiacea Laest.) -- Spikelets conspicuously gynandrous, especially the terminal and basal ones. Densely tufted. Somewhat glaucous and the inflorescence of 5-6 stiffly erect spikelets. Inflorescence pale green to lightly brownish. Beak less than 0.3 mm. Early summer. Muskegs, common northward. -- G, (F-K)-Mack-Aka, L-SPM, NS-BC, US, SA, Eur, (Oc).

Apparently, the type specimen of C. canescens belongs with C. Buxbaumii, hence the name change. See below under the latter name. See also D.M. Moore & O.A. Chater in Bot. Not. 124: 324. 1971.

In the more western var. robustior (Klk.) Boivin (= C. arctiformis Mack.) the spikelets are more crowded, as crowded as in C. arcta, and the lower spikelets are strongly overlapping.

30. C. arcta Boott var. arcta -- Inflorescence pale green and of overlapping spikelets, each with very few staminate flowers at base. Densely tufted and resembling C. curta, except for the much more crowded inflorescence. Foliage usually overtopping the stems. Spikelets 6-9. Scales sometimes becoming brown-tinged at maturity. Perigynia much compressed and pale green, mostly around 2.5 mm long or slightly shorter, the body bordered by thickened nerves, the beak 0.5 mm long or less, scabrous-ciliate in the manner of most Ovales. Early summer. Marshy or peaty shores northward. -- sY-Aka, L, NB-BC, US.

Seemingly transcontinental, but rarely collected in our area and possibly discontinuous between Pinkney L. (DAO) in central Saskatchewan and Fort Saskatchewan (CAN) in central Alberta.

In the more western var. oregana (Bailey) stat.n. (C. canescens var. oregana Bailey, Mem. Torrey Bot. Club 1: 75. 1889) the inflorescence is usually more deeply coloured because of the brown tinged scales and the perigynia are bigger, 2.6-3.2 mm long, the beak 0.6-1.2 mm.

13. DIOICAE

Long stoloniferous. Perigynia wingless and filled with spongy tissue in the lower 1/3. The inflorescence is reduced to a single spike. A polygamous plant, the spike being typically gynandrous, but varying to entirely pistillate or entirely staminate.

31. C. gynecrates Wormsk. (C. dioica L. var. gynecrates (Wormsk.) Ost.) -- Small stoloniferous species half buried in Sphagnum. Spike solitary, usually androgynous, but variable. Perigynia becoming brown, spreading and curved, the beak deflexed. Early summer. Shaded Sphagnum bogs. -- G-Aka, L-SPM, eNS, nNB-BC, US, Eur.

Quite closely related to the eurasian C. dioica. The morphological discontinuity is minimal here and the one taxon could quite reasonably be treated as a variety of the other as was done by Breitung 1957.

14. STELLULATAE

The lower part of the perigynium is filled with spongy tissue, as in the Vulpinae, but the inflorescence is a simple spike of spikelets. Tufted. Perigynia small and divergent to spreading, wingless, yet very thin at the margin, becoming almost wing-margined in the beak.

C. muricata L. has been used in Europe and in America as a collective name for a group of species that comprises most of the Stellulatae. Similarly C. sterilis W. has been used as a collective name for a group of North American taxa centering about C. angustior and C. atlantica. We are not ready at this stage to propose a coherent classification of the Stellulatae, but it seems that tentatively the two following taxa may be recognized at the specific level.

32. C. interior Bailey (C. muricata AA., var. sterilis AA.) -- Usually 3 small spikelets of which the terminal one is conspicuously clavate, the pistillate portion being usually shorter than the much narrower staminate base. Grows in tufts of fine stems and leaves, the latter (0.5)-1.0-2.0-(2.5) mm wide. Inflorescence small on a long and thin stem. Scales shorter than the body of the perigynium, the latter squarrose from the base and becoming spreading to reflexed. Perigynium \pm 2.5 mm long and 1.5-1.7 mm wide, less than twice as long as wide, the body elliptic-ovate, contracted into a beak 0.6-0.7 mm long, its summit barely notched, the teeth obtusish and hardly 0.1 mm long. Early summer. Common in wetish places. -- (Y-Aka), NS-(PEI-NB)-Q-Alta-(BC), US.

33. C. phyllomanica W. Boott var. angustata (Carey) Boivin -- (C. angustior Mack.; C. muricata AA., var. angustata

(Carey) Bailey; C. sterilis AA.) -- A fine herb with the inflorescences readily tangling because the perigynia are squarrose from the base and spreading to somewhat reflexed. Similar to the last, but the tufts tending to be larger and lower. Inflorescence usually of 4 spikelets of which the terminal is less conspicuously clavate, the staminate portion being a bit shorter than the pistillate. Perigynia finely nerved, at least dorsally, flat ventrally, the lateral nerves conspicuously thickened below, becoming scabrous-serrulate and often nearly wing-margined above, (3.0)-3.5-(4.0) long, (1.0)-1.2-(1.5) mm wide, nearly 3 times longer than wide, triangular-lanceolate and the beak indistinct or the body slightly narrowed into a beak 1.0-1.5 mm long, ending into very sharp teeth \pm 0.3 mm long. Early summer. In bogs northward. -- L-(NF, NS-PEI)-NB-O-(Man)-S-(Alta-BC, US).

Many Saskatchewan collections are unusual in having the terminal spikelet entirely staminate.

The typical phase occurs west of us on the coast and in the Cascades; it differs essentially by its slightly longer perigynia, (3.5)-4.0-(4.5) mm long, its beak 1.5-2.0 mm; its leaves often a bit larger, up to 3.0 mm wide at the end of the summer. Spikelets overlapping.

C. phyllomanica var. angustata (Carey) stat. n., C. stellulata var. angustata Carey in A. Gray, Man., ed. 1: 544. 1848.

Another variant occurs further south, in the Sierra Nevada, in which the inflorescence is laxer and longer, the lower spikelet distant, otherwise the perigynia longer as in var. phyllomanica, namely: C. phyllomanica var. ormantha (Fern.) stat. n., C. echinata Murray var. ormantha Fern., Proc. Am. Ac. 37: 483. 1902.

The taxonomy of this interior-angustior group is much debated at present. K.K. Mackenzie, the last monographer of the genus, recognized 10 species in 1930, Fernald went further and recognized 13 species for the east in 1950. But in 1952 Gleason accepted only 10 species and 4 varieties. In 1969 Cronquist recognized only two species in the west. We have been unable to make up our mind fully on this problem, however we would recognize at least 5 species and one variety in Canada, of which only the above two occur in our area. Authors who would greatly reduce the number of species in this group are liable to use any one of the following as a collective name: C. echinata Murray, C. muricata L., C. stellulata Good., or C. sterilis W.

15. DEWEYANAE

A rather weak segregate of the last section. Perigynia appressed and somewhat bigger, 3.5-5.5 mm long.

34. C. Deweyana Schwein. var. Deweyana -- Mature achene brown, visible through the membranous and nearly hyaline perigynium. Tufted, the tall stems much longer than the foliage, rising at an angle, weak and eventually touching the ground at tip under the weight of the ripe inflorescence. The latter pale green, of 3-4 spikelets, of which the lowest is much remote and subtended by a fine and long bract. Scales membranous with a green midnerve, the latter scabrous from the middle upward. Early summer. Common in woods, especially in wetter situations. -- Mack-Aka, NF, NS-BC, US.

A Keewatin report by Mackenzie 1931 has never been confirmed; it may have been based on a Northern Ontario collection, but no justifying sheet could be located at NY in 1972.

Grades into the following western variants: var. leptopoda (Mack.) Boivin, spikelets commonly 5 and less distant, the lowest almost overlapping the base of the next; bracts shorter, the lower one often shorter than its spikelet; scale and beak of the perigynium mostly brown tinged. Occurs from the interior plateau of B.C. southward. Var. Bolanderi (Olney) W. Boott, spikelets commonly longer and \pm cylindric, all overlapping or the lower slightly distant; inflorescence brownish, the scales being brown-tinged and the beak of the perigynium with a brown line on the back or on both faces; bracts short. Ranges from southwestern B.C. to California.

Var. collecteana Fern. was based on specimens typical of the species except for the shorter inflorescence, the lower spikelet being barely remote; it is an uncommon phenotype of sporadic occurrence in the range of the typical phase and is not considered to be significant.

Quebec reports of var. Bolanderi and of C. leptopoda Mack. were apparently based on specimens (GH, MT, NY) of var. collecteana.

16. OVALES

Marginal nerves expanded into a thin peripheral wing, as in 6. Arenariae, but the plants tufted.

This section has given us endless trouble. It seems that we are dealing here with two groups of polythetic taxa. We have tried lumping, even drastic lumping, and found it even more unsatisfactory than the fine splitting offered by Mackenzie in 1931 (74 species), Fernald 1950 (33 species), or Gleason 1952 (27 species). The present treatment is a halfway house arrived at after much correspondence with J.H. Hudson. The intermediates between certain species are frequent and especially noted by Hudson 1978. We have regarded such specimens as casual intermediated between imperfectly isolated species rather than interspecific hybrids.

- a. Bracts foliaceous, at least the lowest many times longer than the spike of spikelets.
 - b. With 3 or 4 foliaceous bracts of nearly equal length 35. C. sychnocephala
 - bb. Longest bract 2-4 times longer than the next longest 36. C. athrostachya
- aa. Bracts very narrow, setaceous and usually very small, rarely overtopping the inflorescence.
 - c. Inflorescence short, ovoid to pyramidal, usually under 2 cm long Group A
 - cc. Inflorescence more elongated.
 - d. Scales nearly as long and as wide as the perigynia Group B
 - dd. Scales narrower and shorter by about 1 mm.
 - e. Perigynium 6-9 mm long 41. C. petasata
 - ee. Shorter.
 - f. Perigynium body nearly orbicular (2.0)-2.5-3.0-(4.0) mm wide..52. C. brevior
 - ff. Perigynium body ovate or obovate or elliptical, (1.0)-1.5-2.0-(2.5) mm wide Group C

Group A

Inflorescence short and compact, deltoid to ovoid. Wings of the perigynium tapering out before reaching the tip of the beak, the latter therefore wingless and \pm cylindrical in the last 0.3-0.5 mm. Stem usually about twice taller than the foliage.

- a. Perigynia only 2.5-3.0 mm long 38. C. illota
- aa. Bigger, 3.5-5.5 mm long.
 - b. Spikelets 5-10, crowded into a short inflorescence.
 - c. Spikelets rounded at base 37. C. macloviana
 - cc. Staminate flowers more numerous, hence the spikelets cuneate at base.. 39. C. pachystachya
- bb. Inflorescence short by virtue of their being only 3-4 overlapping spikelets.
 - d. Perigynium broadest well below the middle, the body ovate and clearly contracted near the upper third 39. C. pachystachya
 - dd. Perigynium broadest about the middle, rhomboid-lanceolate, gradually tapered above the middle 40. C. phaeocephala

Group B

Scale about the same size as its perigynium, and more or less covering it. Hence when the spikelet is viewed sideways the visible surface is taken up mainly or almost entirely by

the tips of the scales, the latter hyaline to brown.

- a. Inflorescence dark brown, the scales being dark brown with narrow hyaline margins and tip; perigynia similarly coloured at least along the edges and at the tip.
 - b. 1-3 dm high, leaves 0.5-2.0 mm wide. 40. C. phaeocephala
 - bb. Taller, main leaves 2-4 mm wide ... 39. C. pachystachya
- aa. Inflorescence greenish to light brown or golden bronze, the scales with very broad hyaline zones.
 - c. Staminate flowers more numerous at the base of the uppermost spikelets; only 1-3 staminate flowers at the base of the lower spikelets; hence at maturity the lowermost spikelet will be \pm rounded at base 44. C. adusta
 - cc. Staminate flowers most numerous at the base of the lowermost spikelet, hence the latter is cuneate to long attenuate at base.
 - d. Inflorescence stiffly erect; leaves 1-2 mm wide 43. C. xerantica
 - dd. Inflorescence arching and nodding; larger leaves 2-3 mm wide.
 - e. Perigynia about 3 times longer than wide 42. C. argyrantha
 - ee. Mostly 2-2½ times longer; staminate portion of lower spikelet shorter 41. C. petasata

Group C

Scales shorter and narrower than the perigynia by about 1.0-1.5 mm. Hence when viewed sideways the surface of the spikelet is largely taken up by the tips of the greenish perigynia. Marginal wings usually tapered to the tip of the beak, the latter plano-convex to the tip.

- a. Perigynia narrow, 1 mm wide or slightly less, and 4-6 times longer than wide 45. C. Crawfordii
- aa. Perigynia more stubby, about 1½-3 times longer than wide, and almost always over 1 mm wide.
 - b. Main leaves 4-6 mm wide.
 - c. Beaks of some of the mature perigynia incurved, but most of them straight to slightly curved outward or even squarrose at tip 47. C. cristatella
 - cc. Beaks straight or mostly incurved, none squarrose.
 - d. Perigynia 2-2½ times longer than wide 48. C. normalis
 - dd. 3-4 times longer than wide... 49. C. tribuloides
- bb. Not over 4 mm, mostly 1-3 mm wide.

- e. Inflorescence deep brown 39. C. pachystachya
 ee. Lighter in colour, green to light brown.
 f. Perigynia 4.0-6.5 mm long, 3-4 times
 longer than wide 46. C. scoparia
 ff. Smaller and about twice longer than
 wide.
 g. Perigynia (1.5)-1.7-(2.0) mm wide,
 commonly \pm 15 to a spikelet.. 50. C. tenera
 gg. Narrower and commonly 2-4 times
 more numerous 51. C. Bebbii

35. C. synchocephala Carey -- Inflorescence bracts unusually long and leafy, representing $\frac{1}{4}$ to $\frac{1}{2}$ the height of the plants; 3 or 4 of the bracts being many times the length of the inflorescence. Perigynia narrowly lanceolate, 4.5-6.5 mm long, mostly twice as long as the scales. Summer. Shores and lately exundated places. -- sMack-Y, swQ-BC, nUS.

36. C. athrostachya Olney var. athrostachya -- With the lowest bract leafy and many times longer than the inflorescence, but the second bract much narrower and only half as long, yet usually also longer than the inflorescence. Inflorescence compact, more or less rhomboid. Perigynia broadly lanceolate, 3.0-4.5 mm long, the beak terete and wingless in the last 0.3-0.5 mm. Early summer. Low meadows and sloughs. -- seAka, sS-BC, US.

In the more western var. unilateralis (Mack.) stat. n. C. unilateralis Mack., Erythraea 8: 43. 1922, the lowest bract tends to be vertical or nearly so, the inflorescence is usually deflected from the vertical by 45° or more, and the beak of the perigynium tends to be winged to the tip. Some transitional material occurs in Saskatchewan and was noted by Cronquist 1969 and Hudson 1978, but the only characteristic Canadian specimens seen were from B.C.

37. C. macloviana D'Urv. var. Haydeniana (W. Boott) Holm (C. Haydeniana Olney; C. incondita F.J. Hermann; C. nubicola Mack.) -- Inflorescence dark brown, compact and pyramidal. Tufted, the stems thickish and usually about twice as high as the foliage. Leaves around 1 dm long, sometimes much shorter. Perigynia (3.5)-4.0-(5.0) mm long and 2 mm wide or a little less, dark brown to red brown along the edge and at the center, the intervening zones green. Beak hyaline in the last 0.2 mm or so and along the edge of the dorsal cut. Scales usually dark brown or red brown, sometimes with a very narrow hyaline border. Early summer. Montane and alpine prairies, sporadic eastward: Riding Mtn., mouth of Qu'Appelle, Cypress Hills and Rockies. -- Mack-Aka, swMan-swS-BC, US -- Var. microptera (Mack.) Boivin (C. festivella Mack.; C. microptera Mack.) -- Perigynia narrower and \pm lanceolate, 1.0-1.5 mm wide, coloured

as above, or more commonly entirely light green except for the brown beak. Scales brown. Tends to be a taller plant, commonly 5-8 dm high. -- Cypress Hills and from the Edmonton area westward. -- swS-BC, (wUS).

Barely distinct from the eastern representatives of the species. The latter is referred to var. macloviana in which the perigynia are dull brown, with paler submarginal stripes, which sometimes become green in the beak; the scales display a broad to narrow hyaline margin. In our western phase the perigynia are deep brown with submarginal zones in bright green; the scales are entirely of the same deep brown as the perigynia or they may exhibit a narrow hyaline margin. There is some variation from plant to plant and the perigynia darken as they mature. Yet this admittedly thin difference in colour appears to be adequate to separate our western material from the eastern phase; something we failed to do in our Enumération of 1966-67.

In part of the range plants are frequently found with taller stems, narrower and paler perigynia. These are arbitrarily separable as var. microptera.

In C. macloviana, its segregates, and relatives, the beak of the perigynium tends to be thinner than in other species of the section. In most floras and monographs this characteristic is overstressed and is commonly used as a major division in keys. But we find this character to be rather tenuous and often elusive. It would probably be more realistic to state merely that in this group of species the perigynium is usually attenuated into a somewhat longer and thinner beak.

Eastward, C. macloviana is a reasonably discrete and not too variable entity. But in our area and westward it dissolves itself into an endless and confusing series of named variants that have provided us over the years with much frustration, wasted herbarium time, and little intellectual satisfaction.

38. C. illota Bailey (C. limnophila F.J. Hermann) -- Perigynium smaller, its wings narrow to obsolete. Inflorescence somewhat smaller, narrowly deltoid, about 1 cm long and slightly narrower. Perigynia broadly lanceolate, 2.5-3.0 mm long, (0.9)-1.2-(1.4) mm wide. Otherwise quite similar to C. macloviana; except for being generally somewhat smaller, the tufts usually only \pm 2 dm high and the leaves not over 2 mm wide. Just before mid summer. Wetish and subalpine to low alpine meadows, commoner about timberline. -- swAlta-sBC, wUS.

Because of the near lack of marginal wing this will sometimes key out to C. Heleonastes, but otherwise C. illota is obviously related to C. macloviana despite the inconspicuous wing.

39. C. pachystachya Cham. (C. macloviana D'Urv. ssp. pachystachya (Cham.) Hultén; C. platylepis Mack.; C. Preslii Steudel) -- Not always clearly separable from C. macloviana. Usually taller, 3-6 dm high, and the spikelets not so crowded as the last. Leaves longer, the main ones around 1 dm long and 2-4 mm wide. Inflorescence varying from ovoid to cylindrical. Spikelets resembling C. petasata, but not so distant. Perigynium 3.5-4.5 mm long, the body with a brown center and a green wing, the beak brown to the tip or very narrowly hyaline along the dorsal sinus. First half of summer. Wet openings in montane forests. -- (Aka, swAlta)-BC, wUS.

40. C. phaeocephala Piper -- Not always clearly separable from the preceding. The foliage all basal, 1-2 dm high, stiff, narrow and marcescent, the leaf tips becoming curved or curly. In dense tufts 1-3 dm high. Leaves 0.5-2.0 mm wide. Inflorescence dark brown, the spikelets only 3-5, strongly overlapping, short-clavate. Perigynium 3.0-4.5 mm long, 1.2-1.5 mm wide, rhomboid-lanceolate, broadest about the middle, gradually tapered above. Cylindrical part of the beak about 0.5 mm long. Mid summer. Alpine gravels and rocky slopes, usually above timberline. -- (seAka), swAlta-BC, wUS.

In this and other relatives of C. macloviana the marginal wings do not reach the top of the beak, thus the upper part of the beak is \pm cylindrical for about 0.5 mm long. In the next species this feature is also usually recognizable. In the remaining species of the section the wings will normally taper to the top of the beak and the latter will appear to be planoconvex rather than cylindrical in the upper part.

41. C. petasata Dewey var. petasata -- Perigynia longest. Resembles the taller variants of C. macloviana by its stiff stems about twice taller than the foliage, but the inflorescence more like that of C. argyrantha var. aenea. Leaves 1.5-2.5 mm wide. Inflorescence mostly 3-4 cm long, stiffly arching. Spikelets golden brown, narrowly ovate to broadly cylindrical, conspicuously tapered at base. Scales 6 mm long or more. Perigynia (6)-7-(8) mm long, 2.5-3.0 mm wide, green with a brown center and a green wing \pm 0.3 mm wide, pencil-margined in brown at maturity. Early summer. Festuca prairies in the Cypress Hills and the Rockies. -- (Y), swS-BC, (US) -- Var. minor (Boott) Boivin -- (C. praticola Rydb.; var. subcoriacea F.J. Hermann; C. Piperi Mack.) -- Perigynia smaller (4.5)-5.0-6.0 mm long, (1.8)-2.0-(2.2) mm wide, $2\frac{1}{2}$ -3 times longer than wide, broadly lanceolate. Scales just about covering the perigynia. General and frequent in moist prairies. -- (G), K-Aka, (L-NF, NE), Q-0-(Man)-S-Alta-(BC) US .

C. petasata Dewey var. minor (Boott) stat. n., C. adusta Boott var. minor Boott in W.J. Hooker, Fl. Bor.-Am. 2: 215. 1839.

Grades into C. aenea, but not in a frequent or troublesome manner. Nearly all specimens can be readily identified satisfactorily by checking on the longer perigynia for var. minor, the narrower shape, and the higher length-width ratio.

Readers who use more than one book in their identification work will no doubt notice certain discrepancies in measurements between our text and those of Cronquist 1969, Fernald 1950, Gleason 1952, Hudson 1978 and Mackenzie 1935, for this and other species.

The measurements by Cronquist, Hudson and ourselves were almost invariably made afresh on the material available to each worker. The figures in Gleason, Fernald and Mackenzie are either similarly made afresh or repeated from previous editions of their own work. In part, the discrepancies will arise because each writer is working from a different series of specimens, often specimens from a different area.

Sizes in Hudson tend to be on the short side of ours; this may arise from different techniques of measurement under magnification.

Numbers in Gleason and Mackenzie often seem surprisingly precise, more precise than one would expect in the measurement of variable biological objects. E.g. 1.75 mm, 4.1 mm. In the early part of this century the New York group was using the English foot for measurements with an inch divided in 12 lines. Each line was almost equal to 2 mm. Checking the current edition against a previous one, many current measurements seem derived from the use of a conversion table: $1\frac{1}{4}''=2.4$ mm, $1\frac{1}{2}''=2.9$ mm, $2''=3.9$ mm, $2\frac{1}{2}''=4.9$ mm, etc.

Numbers in Fernald often include all the extreme and exceptional variants. Thus Rosa blanda is stated to be 0.07-2 m high, a statement which fails to carry the information that this shrub is commonly around 1 m high. Measurements of extreme variations are best denoted by the use of bracketed numbers, e.g. (2.5)-3.0-4.0-(5.0) mm, and very extreme individuals are best ignored if numbers are to remain meaningful and carry an image of what a particular plant looks like.

All this does not explain the basic discrepancy in perigynium measurements given by Fernald for var. minor (= C. pratensis): 4.5-6.5 X 1.5-2, and C. aenea: 4-5 X 1.9-2.7, while ours read (4.5)-5.0-6.0 X (1.8)-2.0-(2.2) and 3.5-4.5 X 1.7-2.3 respectively. With Fernald the dimensions overlap in both directions with the difference being most marked in the width. With our figures the overlap in width is the same, while in length there is no overlap.

42. C. argyrantha Tuck. var. aenea (Fern.) Boivin (C. aenea Fern.; C. foenea AA.) -- Inflorescence arching, moniliform

in the lower half, the spikelets abruptly contracted at base into a stipe-like staminate portion, the lowermost spikelet with the staminate portion at least half as long as the pistillate portion, or more commonly of about equal length. In dense tufts of slightly divergent stems, (2)-4-6-(8) dm high and much overtopping the leaves, the latter (1)-2-(3) mm wide. Spikelets (4)-6-(8). Bracts small, narrower than the scales, not much different from them, usually awnless. Scales largely hyaline below to brownish above, giving their colour to the inflorescence. Perigynium 3.5-4.5 mm long, 1.7-2.3 mm wide, about twice as long as wide, the body ovate, becoming brown in the lower half at maturity, with 7 nerves on the dorsal side and 0-5 on the ventral side. Contracted to the narrowly triangular beak. Early summer. Wet sands or gravels in forested regions. -- seK-Aka, L-NF, NS-BC, nUS.

Not to be confused with the habitually similar C. petasata var. minor, also with an inflorescence frequently arching and partly moniliform. But in var. minor the lowermost bract is most often short aristate and reaches the summit of its spikelet; staminate flowers usually fewer, hence the spikelets commonly are merely cuneate or short-attenuate at base; but mainly the perigynia are broadly lanceolate and a bit longer in var. minor.

Occasional specimens will exhibit up to 5 nerves on the ventral side of the perigynium and such specimens have often been reported as C. argyrantha Tuck., but the latter is a more southern species that does not approach our borders. The following specimens of var. aenea from our area have been noted with 5 nerves on the ventral side: W. Krivda 211, Lynn Lake, 1958 (DAO, QFA); G. Gardner 90, Flin-Flon, 1930 (DAO, QFA); J.S. Maini, La Ronge, 1960 (QFA).

A Manitoba report of C. argyrantha by Scoggan 1957 and 1978 is herewith discounted. It was based on the C. aenea collection cited above for Flin-Flon.

Other western reports of C. argyrantha, including our own in 1968, were also based on specimens of C. aenea as pointed out by Scoggan 1978. In 1968 we had not yet seen any satisfactory material of var. argyrantha and we were placing into argyrantha such specimens of var. aenea that had five good nerves on the ventral side. This faulty interpretation led us eventually to consolidate aenea and argyrantha.

After repeated attempts to distinguish them, we have come to the conclusion that C. argyrantha and C. aenea are not morphologically discrete. We are here confronted with a cline in which a very large proportion of the material is intermediate. However it is quite true that many southern plants tend to be taller, have on the average a paler inflorescence, a perigynium

mostly half a millimeter shorter, with slightly broader wings, a better defined beak, and 5-(7) nerves on the ventral side. Most northern plants tend to be a shade or two darker brown in the inflorescence, the perigynium is often triangular ovate and nerveless on the ventral side. The most confusing intermediates are those with the general characters of aenea, but 5-(7) well marked nerves on the ventral side; such specimens have been the basis of many herewith discounted reports of C. argyrantha from Labrador to Manitoba.

In order to achieve a meaningful sorting we have found it necessary to define var. argyrantha rather restrictively and to verse all intermediates into var. aenea.

Var. argyrantha. The main criteria are based on the shape and nervation of the perigynia. The latter is 3-4 mm long, its body suborbicular to short elliptic, typically 2.7 mm by 2.0 mm, light green, not turning brown at maturity, although the dark achene is somewhat visible through the thin wall. The shape is well illustrated by Gleason 1952 with the body abruptly contracted into the beak, the latter (0.5)-0.7-1.0 mm long. The white nerves are strongly expressed and obvious on both faces, but a bit fewer and only 5-(7) on the ventral side. Other characters are less readily definable or are mere statistical averages. The range of the typical phase is quite restricted in Canada; we have seen specimens only from Oka (RIM), Pointe-au-Chêne (DAO), Pont-Rouge (DAO), Cape Blomidon (DAO), Camp One (DAO) and Kentville (DAO), out of nearly 1,000 sheets checked.

Var. aenea (Fern.) stat. n. (Carex aenea Fern., Proc. Am. Ac. 37: 480. 1902). Perigynia more variable, sometimes ovate and abruptly contracted into a beak 1 mm long or more, varying to triangular-ovate and gradually tapering into the beak, as illustrated by Gleason 1952; lower half of the body commonly turning brown. Nervation variable on the ventral side, commonly lacking or weak, sometimes approaching the condition in var. argyrantha. Common and widespread across Canada.

The range of var. aenea (as C. aenea) was extended to southeastern Keewatin by Louis-Marie 1961. A rather likely extension, but the justifying sheet, A. Dutilly 10,090, Strutton Island, baie James, 1942 (QFA, GH) is somewhat intermediate to C. petasata. Its perigynia are 4.4-4.5 X 1.7-1.8 mm and somewhat nerved ventrally; its scales are darker brown with a broad silvery-hyaline margin. Yet, after examination, it seemed a bit closer to var. aenea and has been retained as such.

Hudson 1978 has noted the existence of intermediates to C. adusta, C. brevior, C. praticola (= C. petasata var. minor), C. tenera and C. xeranthica.

43. C. xerantica Bailey -- Foliage rather narrow and short, not reaching much beyond 2 dm above ground level, and the blades only 1-2 mm wide. Stems (3)-4-(6) dm high, rather rigid and about twice taller than the foliage. Inflorescence straight, whitish to light-coloured, the rachis stiffly zigzag, the scales lightly tinted and partly hyaline. Spikelets 5 to 8 and not crowded, but somewhat overlapping, cuneate at base but not long attenuate, the staminate portion less than half as long as the pistillate. Perigynia 3.5-5.0 mm long, 1.6-2.0 mm wide, rhomboid-lanceolate, broadest about the middle, its beak ill-defined. (Early summer?). Prairies on sandy or gravelly soil -- swMan-sBC, (US).

44. C. adusta Boott -- Bracts rather broadly dilated towards the base, at least the lowest bract with a base obviously broader than the scales. Similar to C. tribuloides, but generally a larger and coarser plant with the scales longer, about as long as the perigynia, \pm 5 mm long, usually with a wide membranous margin giving the inflorescence a pale silvery appearance, or sometimes darker and brownish. Fairly tall, the stem stiff and much overtopping the leaves, the latter mostly 3-4 mm wide. Inflorescence crowded, the (4)-5-(7) spikelets ovoid and \pm rounded at base. Perigynia \pm 5 mm long, thickened and strongly convex dorsally, ovate, with a peripheral wing, which is narrow and very finely ciliate above the middle, but tends to grade below the middle into a thickened, glabrous, shining, and strongly raised marginal nerve. Early summer. Wet sands. -- (Mack), NF, NS, NB-BC, (US).

Hudson 1978 reports the existence of transitional (or hybrid?) material to C. aenea (= C. argyrantha var. aenea).

44X. C. tinctoria Fern. -- Possibly a hybrid with C. Bebbii but perhaps only intermediate material. Similar to C. Bebbii with the scales covering most of the beak, but the perigynia longer than in C. Bebbii, yet not quite as long as in C. adusta. Early summer. Wet sands and shores. -- PEI-Q, S-Alta, (US).

Our usage of C. tinctoria is only tentative and we are not too sure that it is realistic to talk about hybrids in the Ovales. It might be better to call such specimens "intermediates" and let it go at that. A medley of such intermediates occur throughout the section, which prompted Hudson (in litt.) to comment "There must be something peculiar in the reproductive situation in Ovales for the appearance of a very large number of very slightly different species (or alternatively, a smaller number of variable species) with intermediates between the entities no matter how fine (or how coarsely) one divides up the material".

45. C. Crawfordii Fern. -- Perigynia lanceolate to narrowly lanceolate, 4-6 times as long as wide, only 1 mm wide or

slightly less. Densely tufted and 2-4 dm high. Otherwise similar to the following and generally smaller. Spikelets (6)-8-(15), strongly overlapping to crowded, and rather narrow, rhomboid or obovate, and usually twice longer than broad, less than 5 mm wide. Perigynia 3-4 mm long, acute at base, almost gradually tapered to a fairly long beak. Early summer. Shores and wet places. -- Mack, Aka, L-SPM, NS-O-(Man)-S-BC, US, (Eur).

Hudson 1978 reports intergradation to C. Bebbii.

46. C. scoparia Schkuhr -- Perigynia 4.0-6.5 mm long, longer than in most of its relatives, lanceolate like the last, but somewhat larger, 1.5 mm wide or slightly broader, 3-4 times longer than wide, obtuse to rounded at base. Mostly 4-6 dm high, with many somewhat shorter sterile shoots. Leaves mostly 1-3 mm wide. Inflorescence at first crowded, becoming nearly moniliform and arching, of 5-6 relatively large spikelets, the latter mostly 10-12 mm long, oblong to rhomboid, about twice as long as wide. Late spring and early summer. Wet meadows and shores. -- NF-(SPM), NS-seMan, (Alta)-swBC, (US).

We have seen from our area only collections from Lac-du-Bonnet and Sasaginnigak Lake. Reports for Saskatchewan by Ledingham 1943, Fraser 1944, Russell 1954, Breitung 1957, Scoggan 1978, queried by Boivin 1967, were based on collections from Saskatoon and Carnduff, both at SASK. But Hudson (in litt.) could not find the Saskatoon collection, while he reports the Carnduff (SASK) one as probably mislabelled and likely originating from Olds, Alberta. Further the latter has been revised to C. Bebbii. Hence the corrected range.

The Alberta reports have not been checked yet but they now seem doubtful in view of the absence of the species from Saskatchewan. The B.C. reports appear based on introductions.

47. C. cristatella Britton -- Some of the perigynia with the beak curved outward at maturity or even squarrose at tip. Commonly 6-8 dm high and producing numerous sterile shoots about as high. Stem leafy and clothed with sheaths in the lower half. Leaves (4)-5-(6) mm wide. Inflorescence (2)-3-(4) cm long, of (6)-8-(12) crowded spikelets, the latter subglobose, (6)-7-(8) mm long, green with a light brown tinge. Scales broadly lanceolate. Perigynium 3-4 mm long by 1.5-2.0 mm wide, about twice longer than broad, the body ovate to short elliptic. Marginal wings tending to be undulate, often inflected inward about the middle. Beak of most perigynia straight to slightly curved outward, and almost invariably with a few of them squarrose at tip. (Early summer?). Occasional in open marshes, sometimes in marshy woods. -- sQ-sMan-(s), US.

Previous Saskatchewan reports of C. cristatella 1954 were referred to C. Bebbii by Breitung 1957. The justifying sheets

(SASK) were revised to C. Bebbii by J.H. Hudson. However Hudson 1978 would retain a collection (not seen) from Anglin L. (SASKP) as C. cristatella. Alberta reports by Turner 1949, and Scoggan 1978 are based on Fort Saskatchewan sheets (SASK) of C. Bebbii. A related species was reported for Manitoba by Hooker 1839 and Macoun 1888 as C. arida Schwein. & Torr., by Fernald 1950, Gleason 1952 and Scoggan 1957 and 1978 as C. muskingumensis Schwein. In 1964 we leafed through the whole of the Ovales at CAN without finding any of the sheets cited. We expect those reports to be unsubstantiated or perhaps based on mis-identifications.

48. C. normalis Mack. -- Habit and herbage like the last but the inflorescence often laxer, the scales triangular ovate, and the beaks straight or incurved. -- (NB-Man), US.

Judging from published descriptions and a few reliably identified U.S. sheets, C. normalis differs only by the two characters noted above, both of which seem to intergrade with C. cristatella. Furthermore, of the 50 or so Canadian sheets at hand from Quebec, Ontario and Manitoba, none is a good match for the U.S. sheets, most of them have either the narrow leaves of C. tenera, or the narrow perigynia of C. projecta. We are however refraining from passing judgement on this taxon at this juncture; we are only expressing our dissatisfaction.

49. C. tribuloides Wahl. var. reducta Bailey (C. projecta Mack.) -- Habit and herbage of C. cristatella, but the inflorescence laxer, the perigynia narrower, and the beaks straight or incurved. Inflorescence often very loose or moniliform in the lower half, of 5-10 smallish greenish spikelets, these \pm 5 mm wide, often with less than 20 perigynia each. Scales broadly lanceolate. Perigynia (3.0)-3.5-(4.0) mm long, (0.8)-1.2-(1.4) mm wide, triangular-lanceolate, ($2\frac{1}{2}$)-3-(4) times longer than wide, the beak broadly winged, but the body with a very narrow to obsolete wing. Early summer. Swampy places. -- NS-PEI-(NB)-Q-seMan, US.

Typical C. tribuloides has more numerous perigynia (30-60) in longer spikelets and the scales are more deeply tinged in chestnut.

Manitoba and Alberta reports of C. tribuloides Wahl. by Boivin 1967 are to be discounted as they were based on earlier reports of C. cristatella. The report of C. tribuloides for B.C. queried by Boivin 1967, repeated by Taylor 1977, is in need of rechecking.

50. C. tenera Dewey -- Obviously resembling the last by its small and few-flowered spikelets in a lax inflorescence, but the foliage much finer and the perigynia a bit wider. Commonly 4-6 dm high, densely tufted and producing numerous tall sterile shoots in the manner of C. cristatella. Leaves (1)-2-

(3) mm wide. Inflorescence 2-4 cm long, usually moniliform and arching over, or the (4)-5-(8) spikelets \pm overlapping, the latter (4)-5-(6) mm wide, short ovoid or short obovoid, relatively few-flowered, commonly of about 15 perigynia each. Scales broadly lanceolate. Perigynia triangular to triangular-ovate, 3-4 mm long, (1.5)-1.7-(2.0) mm wide, 2-(2 $\frac{1}{2}$) times longer than wide. Early summer. Mainly in wetish spots under Aspen. -- (NS, NB)-Q-S-(Alta-BC), US.

51. C. Bebbii Olney -- Similar in habit to C. Crawfordii, but taller, a gracile species with small perigynia gathered into a short inflorescence. Stems (4)-6-(9) dm high and commonly equalling the leaves, these (1.0)-2.0-3.0-(3.5) mm wide. Inflorescence (1.5)-2.0-(2.5) mm long, of (4)-8-10 strongly overlapping spikelets. Spikelets broadly ovoid, 5-6-(7) mm long, narrower by about 1 mm, often similar to C. tenera, but the smaller perigynia more crowded and much more numerous, usually 30-60 to a spikelet. Perigynia ovate-lanceolate, (2.5)-3.0-(3.5) mm long, the body ovate to elliptic, (0.8)-1.2-(1.5) wide, weakly contracted into an ill defined beak. Achene surrounded by spongy tissue as in C. brevior, but the ring narrower and less obvious. Early summer. Very common in wet open places, especially if under fresh water in early spring. -- NF, NB-BC, US.

The range was extended northward into Mackenzie by Thieret 1963, repeated by Boivin, 1967, Porsild 1968, and Scoggan 1978, but the justifying sheet from the Kakisa River (DAO) has been revised to C. Crawfordii. The range of C. Bebbii was also extended into Alaska by Fernald 1950, and Scoggan 1978, queried by Boivin 1967; no justifying sheet could be located at GH in 1965.

The following intermediates may be met with as noted by Fernald 1950 and Hudson 1978.

C. Bebbii to C. Crawfordii

C. Bebbii to C. cristatella

C. Bebbii to C. scoparia

C. Bebbii to C. tenera

A report of C. festucacea Schkuhr for the west by Boivin 1967 was properly discounted by Scoggan 1978 as it was based on specimens of C. Bebbii.

52. C. brevior (Dewey) Mack. (C. Bicknellii Britton; C. cumulata (Bailey) Mack.; C. Merritt-Fernaldii Mack.; C. molesta Mack.) -- Perigynia broadest, the body orbicular or nearly so. Stems mostly 3-6 dm tall, overtopping the foliage by about 1/3. Leaves (1)-2-(3) mm wide, partly in sterile shoots, partly cauline, their sheaths clothing the lower third of the stem.

Inflorescence (1)-2-3-(4) cm long, mostly of (3)-5-(8) spikelets, tinged brown, with a yellowish cast. Spikelets 6-7 mm wide, very abruptly contracted into a short and narrow staminate base 1-3 mm long. Perigynia (3.5)-4.0-4.5-(5.5) mm long, (2.0)-2.5-3.5-(4.0) mm wide, the body suborbicular, its wings very broad, abruptly contracted into the beak. Achene not filling the whole of the perigynium, but centrally located and surrounded by a narrow ring of spongy tissue. Early summer. Sandy places and sand dunes, sometimes on dry rocks. -- swQ-Man-(S)-Alta-(BC), US.

Many more segregates have been proposed, but we are still unconvinced on their value. Hudson's experience (in litt.) is similar to ours. "In feeding material of our C. brevior into the keys of Mackenzie, Fernald, and Gleason ... one could wind up at any of half-a-dozen other names: Bicknellii, cumulata, molesta, Merritt-Fernaldii, etc., etc. The name arrived at on a coldly objective following of the key varied from specimen to specimen of what were plainly samples of the same population".

Commenting on the segregates of this and the previous species, Cronquist 1969 wrote "Monographic study might lead to a broader specific concept, with several varieties, but these varieties would be unusual in lacking ecogeographic differentiation inter se". The differentiation remains just as unsatisfactory when recognized as species.

Canadian reports of C. straminea W. by Boivin 1967 were largely based on the distribution of C. brevior.

17. POLYTRICHOIDEAE

Sections from here to the end belong to subgenus Carex as described above on pp. 71-72. Also, most of these sections, except the last four, have a style more or less deciduous and of a different texture than that of the achene. In this section there is only one spike, it is androgynous, and the scales of the staminate flowers form a tight sheath around the rachis, their edges being fused for at least half of their length.

53. C. leptalea Wahl. var. leptalea -- Small species with a single small spike of green perigynia. Forming dense carpets, 1-2 dm high, of fine and soft foliage. Spikelet green and usually 0.5-1.0 cm long. Pistillate scales hyaline except the green midnerve, or sometimes partly tinged in brown, especially towards the edge and the apex, usually falling off before the fruit matures. Perigynia few, beakless, 2.0-3.5 mm long, rounded at tip, conspicuously nerved. Late spring. Boggy woods. -- swK-sMack, L-SPM, NS-BC, US -- Var. Tayloris Boivin -- Spikelets bicolor: green and brown. Pistillate

scales brown but the midnerve green. Lower scales acuminate to cuspidate or sometimes more or less aristate. Jasper and westward. -- Aka-sY, coAlta-CB.

A rather distinct type and not to be confused with anything else. In our area, and throughout the continental part of its range, it is a rather uniform plant, but near the coasts a number of variations occur that are not matched by the inland material. The following three are recorded.

On the east coast, from Nova Scotia southward, plants with longer perigynia (i.e. 3.5-4.0-(5.0) mm) have been distinguished as var. Harperi (Fern.) Weath. & Grisc. Not otherwise similar to the west coast C. Jimcalderi which also tends to longer perigynia.

To the west and northwest of us a var. Talyloris with bicolor spikelets and lower scales with the midnerve excurrent into a short point or more rarely into an awn. To the north of us, from northern Manitoba to southern Mackenzie, intermediates leptalea-Tayloris are fairly frequent; mostly the scales approach those of var. Tayloris in colour, more rarely some intermediates have excurrent midnerves. However none of these intermediates exhibited both characters and they have therefore been referred to var. leptalea, the only variety known otherwise to occur in the area.

From Vancouver Island to southeastern Alaska there is a coarser plant which has been previously described as ssp. pacifica, but upon close study has proved to differ by quite a number of small characters. We are therefore recognizing as a species in its own right. Var. leptalea and the new species may be contrasted as follows.

Var. leptalea: stems (1)-2-(4) dm high, (0.3)-0.5-(0.7) mm thick near the base, including the sheaths. Lowermost leaf 0.6-1.0 mm wide, the others narrower still. Inflorescence mostly 0.5-1.0 cm long. Pistillate scales as described above. Perigynia ellipsoid to broadly lanceolate, (2.0)-2.5-3.0-(3.5) mm long. Achenes narrowly obovoid, at least $1\frac{1}{2}$ times as long as wide, commonly 1.6 mm long by 0.7-1.0 mm wide, acute on the angles, the stipe 0.4-0.6 mm long. Anthers 0.4-0.5 mm long.

C. Jimcalderi: stems (2)-3-(4) dm high, coarser and more densely tufted, (0.8)-1.0-1.2-(1.5) cm thick near the base, including the sheaths. Lowermost leaf 1.0-1.2-(1.5) mm wide. Inflorescence mostly 1.0-1.5 cm long. Scales as in var. Tayloris. Perigynia (3.0)-3.5-4.0-(4.5) mm long, broadly to narrowly lanceolate. Achenes obovoid, 1.5 mm long by 0.8-1.2 mm wide, rounded on the angles, about $1\frac{1}{2}$ times longer than wide, exclusive of the stipe 0.8-1.2 mm long. Anthers 0.8-1.0 mm long.

Carex leptalea var. Tayloris var. n. Inflorescentia bicolor, perigyniis viridulis, squammis brunneis. Squammae foemineae brunneae nisi nervo medio viride. Squammae inferiores nervo medio plus minusve excurrente, interdum etiam aristatae. Typus: T.M.C. Taylor & alii 1421, Haines Road, mile 46, wet peat bog, July 15, 1956 (DAO). Named after Dr. T.M.C. Taylor, formerly of Toronto, now of Victoria. He has made a major contribution to the knowledge of the flora of Canada, especially of British Columbia.

Carex Jimcalderi sp.n., C. leptalea ssp. pacifica Calder & Taylor, Can. J. Bot. 43: 1391-2. 1965, nec Carex pacifica Drejer, Flora excursoria hafniensis, p. 292. 1838; nec Carex pacifica Grisebach, Archiv für Naturgeschichte (Wiegmanni) 8: 292. 1852. Type: J.A. Calder & R.L. Taylor 35,217, Moresby Island, 1964 (DAO). Named after James A. Calder, Jim Calder to his friends, a keen student of the Cyperaceae, outstanding collector of Canadian plants, his contribution yet unmatched for quality and quantity; about 250,000 sheets over a 20 year period.

18. PHYLLOSTACHYAE

Lower pistillate scales much enlarged, green, foliaceous, resembling bracts. Staminate scales sheathing as in the last section, these being the only two sections with this feature. Beak of the perigynium empty, triangular-flattened.

54. C. Backii Boott var. Backii -- Inflorescence inconspicuous, being immersed in the foliage and overtopped by many unusually large, green, and leaf-like (or bract-like) scales. Perigynia 5-6 mm long, few, green, gradually tapered and compressed into a beak 2-3 mm long. Late spring. Rare in wooded hills in the south. -- NB-BC, US -- Var. saximontana (Mack.) Boivin (C. saximontana Mack.) -- Perigynia shorter, \pm 4 mm, the beak being only \pm 1 mm long. Hills, usually on sandy soil, more frequent northward. -- sMan-BC, US.

The presence of the related C. Willdenowii Schkuhr in our area is still doubtful at best. It is a highly localized species and we know of only 3 Canadian collections: Sorel (MT) in Quebec, Niagara (CAN) in Ontario, and a Macoun collection in 1872 (MTMG, QK) on the Lake of the Woods. The latter is debatable as to provincial appartenance, and is likely to remain so, until confirmed by a modern collection. Tentatively we have refered it to Ontario on grounds of probability. It was cited by Macoun 1888. A Manitoba report by Lowe 1943 was somewhat indefinite or tentative and was discounted by Scoggan 1957. We concur with his approach until better documented or more convincing evidence becomes available.

19. FILIFOLIAE

Resembles the Montanae, but the inflorescence is reduced to a single androgynous spike.

55. C. filifolia Nutt. -- Niggerwool -- Spike solitary and the perigynia finely puberulent towards the top. Densely tufted species with filiform leaves and brown, marcescent leaf bases. Stem nearly cylindrical, with 6 low ridges. Scales large, broadly obovate to nearly orbicular, brown with a very wide membranous margin. Early spring. Rolling steppes and hill-sides. -- swMack-sY, swMan-BC, US.

20. OBTUSATAE

Technically similar to the next because the weakly trigonous perigynium reflects the shape of the closely enclosed achene. Perigynium lustrous, glabrous, its nerves weak or obscure, its wall thickish, often ridged.

56. C. obtusata Lilj. -- Common prairie species and sand binder, stoloniferous and with a single spike. 2 dm high or less, with blackish rhizome and narrow leaves. Perigynia few, brown to blackish and very shiny. Beak margin very obliquely cut into a single and broadly membranous point. Late spring. Well drained prairies and steppes. -- wMack-Aka, sMan-BC.

57. C. supina Wahl. var. spaniocarpa (Steudel) Boivin -- Inflorescence small and compact, reduced to 2-(3) spikelets, of which the terminal is longer and staminate, while the lateral one(s) is usually reduced to 2-5 perigynia. Stoloniferous, 1-2 dm high, the leaves narrow. Perigynia red-brown and very glossy. Beak as in previous species. Mid spring (?). Northern prairies. -- G-K-(Mack-Aka), nQ, (Man)-nwS-nAlta-nBC, (ncUS), Eur.

According to Hultén 1942 the scales of the paleogean var. supina are shorter than the perigynia. In our var. spaniocarpa the scales are about as long as the perigynia and the latter have a more prolonged, more evenly tapered beak.

21. MONTANAE

In this and the last three sections the achene is only weakly trigonous, its walls being convex, and the perigynium, which envelops the achene closely, is also weakly trigonous to orbicular in cross-section. Spikes more than one. Perigynia more or less puberulent.

58. C. nigromarginata Schwein. var. elliptica (Boott) Gleason (C. Peckii Howe) -- A common forest species with puberulent perigynia, similar to the following, but the narrowly

obovoid perigynia gradually tapered at base. Forming a loose carpet with reddish bases and stems that overtop the leaves. Inflorescence short, green or brownish, the staminate spike light coloured and not very conspicuous, about 1 mm thick, usually under 1 cm long, and little overtopping of the inflorescence. Spikelets crowded or the lower sometimes distant. Perigynia 3-4 mm long, the beak up to 1 mm long, the ill-defined stipe about as long. Scale reaching to about the base of the beak. Early to mid spring. Common in mixed and deciduous woods. -- Y-(Aka), NB-BC, US.

The nomenclature and taxonomy of this group have known many avatars and are currently somewhat confused.

The specimens from eastern Canada are commonly identified C. Peckii if they have a crowded inflorescence, but C. varia Muhl. (or C. artitecta, sometimes C. Emmonsii) if the lowermost spikelet is more or less remote. These same variations occur throughout our area, but nobody seems to have attempted to subdivide our western material in the same manner. Further this usage of C. varia and C. artitecta is apparently incorrect as these two names actually refer to more a southern variant with smaller perigynia.

The more realistic taxonomy is that of Gleason 1952. His var. Muhlenbergii (Gray) Gleason (= C. artitecta Mack., C. Emmonsii Dewey and C. varia Muhl.), is mainly a planicostal and magnilacustrine type, with smaller perigynia, (2.0)-2.5-(3.0) mm long, 0.7-1.0 mm wide, about equalling their scales, the latter often hyaline, hence the inflorescence is usually pale green. Also the leaves tend to be relatively longer and the inflorescence is more often laxer.

According to Gleason, the stems in var. Muhlenbergii overtop the leaves, while they are shorter than the leaves in var. minor (Boott) Gleason. This distinction did not prove very convincing and we would refer the latter name to the synonymy of var. Muhlenbergii.

Four Manitoba collections named C. communis Bailey were examined, including the one listed for Otterburne (MT, QFA) by Løve 1959 and Scoggan 1978; all have been revised to C. nigromarginata var. elliptica.

59. C. pennsylvanica Lam. var. pennsylvanica -- Staminate spike rather conspicuous, being \pm 3 mm thick, mostly around 1.5 cm long, and about as long as the rest of the inflorescence. General habit of the preceding. Commonly 3-4 dm high, the foliage about 2 dm high. Perigynia 2-3 mm long, 1.0-1.5 mm wide, the subglobose body abruptly contracted above and below into a beak and a coarse stipe, both about the same length. Mid to late spring. Mixed or deciduous woods. -- (NS), NB-SMan, US -- Var. digyna Boeckl. (C. heliophila Mack.) --

A common prairie type with puberulent perigynia. Generally a smaller plant, but the perigynia larger. Stems usually 1-2 dm high, the foliage mostly around 1 dm high. Bracts not sheathing and the pistillate spikelets all sessile. Perigynia (2.5)-3.0-3.5-(4.0) mm long, 1.0-1.5 mm wide. Mesic or dryer prairies and sandy woods. -- O-neBC, US -- Var. vespertina Bailey (C. inops Bailey) -- Like var. digyna but the bracts usually longer and short sheathing, the sheath up to 4 mm. Lower spikelet on a short peduncle, up to 4 mm long, which is usually included in the sheath of its bract. Mountain prairies. -- swAlta-BC, wUS.

60. C. deflexa Horn. var. deflexa (C. brevipes W. Boott) -- Stems very uneven in length, some very short, others many times longer and nearly equalling to somewhat overtopping the foliage. Stoloniferous, yet forming small to large tufts. Bracts with purplish auricles. Scales shorter than the perigynia, the latter 2-3 mm long, the beak \pm 0.5 mm long. Staminate spike small, 5 mm long or less, and often overtopped by the uppermost pistillate spike. Early summer. Coniferous woods on acid soils. -- G, seK-Aka, L-SPM, NS-BC, neUS -- Var. Rossii (Boott) Bailey (C. Rossii Boott) -- More scabrous with larger perigynia, 3.0-4.5 mm long, the beak (0.7)-1.0-1.5 mm long. Staminate spike up to 15 mm long. Bracts with membranous auricles. Banks and dry woods. -- sMack-sAka, wO-BC, US.

61. C. umbellata Schkuhr var. brevirostra Boott (C. abdita Bickn.; C. umbellata sensu Mack.) -- Most stems very short and hidden among the leaf bases: some stems longer and more obvious, yet shorter than the leaves. Very scabrous throughout. Leaves 1-3 mm wide, \pm marcescent. Perigynia abundantly puberulent all over except towards the base, \pm 3 mm long, abruptly contracted into a beak (0.5)-0.7-(1.0) mm long and less than half as long as the obovoid body, the latter \pm 2 mm long. Scales as long or longer than the perigynia. Early summer. Dry sands, wooded or not, especially if disturbed. -- (L-SPM, NS, NB)-Q-Man-(S)-Alta-(BC, US) -- Var. tonsa Fern. (C. tonsa (Fern.) Bickn.) -- Perigynia bigger and glabrous or nearly so, except the lateral nerves being ciliate to puberulent. Growing in \pm hemispherical tufts. Elongated stems few, often lacking. Leaves stiffer and often broader, up to 3-4-(5) mm wide. Perigynia mostly 3.5-4.5 mm long, the beak (1.0)-1.2-1.5-(1.8) mm long and more than half as long as the body. Dry sands and precambrian outcrops. -- (L), NS-PEI-[NB]-Q-nBC, US.

Löve 1959 extended the range of var. umbellata to Manitoba on the basis of Otterburne collections (QFA) since revised to var. brevirostra. Moss 1959 also reports C. umbellata from Alberta with an ambiguous description in which the perigynia

exhibit the unlikely combination of small overall size and quite long beaks. Alberta material examined belonged either to var. brevirostra or to var. tonsa.

The species was recently reported from Greenland as C. abdita (= var. brevirostra) but the report is varietally ambiguous as the perigynia are described as glabrous (= var. tonsa) by B cher in his flora of 1968.

Mackenzie 1935 extended the range of var. brevirostra to Keewatin, but this cannot be accepted without more precise knowledge of the place or date of the justifying collection, as large tracts of Ontario and Manitoba were part of Keewatin until 1912.

Our two varieties are reasonably distinct in our area, but eastward the situation is quite different because of the additional presence of a typical variety which is intermediate between our taxa and intergrades with both. This has led some authors, including Gleason 1952 and Boivin 1967 to unite all three taxa. However, Hudson 1978 has rightly pointed out that in our area only two varieties occur and that there is here no problem of intergrades. Hence it seems justifiable to recognize these three varieties even if their distinctiveness is poor in parts of their overlapping ranges.

There has been some debate and conflicting usages as to which variety should be called var. umbellata. This point does not seem to have been settled clearly yet and we are therefore sticking to the traditional usage, which happens to coincide with that of Fernald 1950 and Breitung 1959. In 1915 Mackenzie claimed that C. umbellata had been misapplied and was really synonymous with var. brevirostra (or C. abdita). For the plant previously called C. umbellata (= var. umbellata of this text) he proposed the name C. rugosperma. Fernald retorted in 1942 in *Rhodora* 44: 288-290. 1942, in an article that we find overassertive, needlessly sarcastic and not fully convincing. The illustrations of Schkuhr reproduced by Fernald do not show clearly a longer beak for var. umbellata. As for the difference in the shape of the scales, it is far from being decisive and as sharp as Fernald makes it. In both taxa the scales are narrowly ovate to ovate-lanceolate with a tendency to somewhat longer and relatively narrower scales in var. umbellata (= C. rugosperma). Fernald's descriptions in his 1950 Manual are an exaggeration of a weak statistical difference. The type of the species is in need of a careful check.

22. SCIRPINAE

In this and all the sections that follow, except those with two stigmas, the achene is strongly trigonous, its sides being either flattish or concave. In this and the next four

section the perigynium is not inflated and holds the achene so tightly that at maturity the perigynium reflects the strongly trigonous shape of the achene. In this and the next section the perigynia are more or less puberulent. In this section the spike is solitary and unisexual.

62. C. scirpoidea Mx. var. scirpoidea (C. stenochlaena (Holm) Mack.) -- Dioecious, with the hirsute perigynia in a single dark-coloured terminal spike. Stoloniferous, mostly 2-4 dm high. Leaves 2-3 mm wide. Sheaths abundantly and finely puberulent on the ventral side. Spike linear, dark coloured. Scales usually ciliate, deeply coloured to the margin except for the paler midnerve. First half of summer. Boggy meadows and wetter rocky places, mainly northward. -- G-Aka, L-SPM, eNS, Q-BC, US, Eur -- Var. scirpiformis (Mack.) O'Neill & Duman (C. athabascensis F.J. Hermann; C. scirpiformis Mack.) -- Spikes more lightly coloured because of the scales having a conspicuous hyaline border, the latter mostly 0.3 mm wide. Prairie meadows; somewhat alkali tolerant. -- wQ-BC, (US).

The shape of the perigynium varies from broadly ovate to \pm lanceolate and its length varies accordingly. Plants with the longer perigynia (= var. stenochlaena Holm) are supposed to occur only from the Rockies westward, but this does not come out clearly in the material at hand.

23. DIGITATAE

Bracts purplish and bladeless, reduced to a tubular sheath. Perigynia more or less puberulent as in the last two sections.

63. C. pedunculata Muhl. -- Spikelet on very long peduncles and arising from all levels, at least one of them from the conspicuously reddish base. Perigynia conspicuously trigonous, conspicuously clavate-ob lanceolate, pale green and \pm puberulent above, abruptly tapering to a whitish base. Early spring. Dry open woods from Cumberland Lake and Hudson Bay Junction eastward. -- wNF-SPM, NS-ecS, US.

Largely distributed from southern Ontario eastward, but its Canadian distribution is more spotty in the west. It is found in the Thunder Bay area and occurs westward to Caribou (DAO) and Seven Sisters in southeastern Manitoba. It reappears on the Prairie Coteau at Riding Mt. (DAO) and Duck Mountain, northward to Cumberland House (GH, K) at 54° N. The latter represents the limit of the range as known to us. An Alberta report by A.E. Roland, Fl. Nov. Scot., Proc. N.S. Inst. Sc. 26: 167. 1966 is undetermined as to its source; it may have been a Jasper (CAN) sheet once filed as C. pedunculata, now revised to C. deflexa var. Rossii. We know of only one B.C. collection; Macoun, Revelstoke, 1890 (CAN). It was checked by

Mackenzie and is apparently the source of all subsequent B.C. reports. Considering that this is the only collection west of the Dakotas and of Cumberland House, considering the absence of any recent collection, we judge the stated B.C. locality to be probably in error.

It was also mentioned by Boott ex Hooker 1839 for Norway House and the Rockies. The Norway House report arises from difference in labelling of the Cumberland House collection, some specimens (GH) being labelled "Cumberland House" while others (K) obviously of the same collecting are inscribed "Norway & Cumberland House". The Rocky Mountains (K) collection is correctly identified, but likely erroneous as to locality, having never been confirmed.

64. C. concinna Br. -- Scales minutely ciliate above the middle. Small and tufted, the stems commonly 1 dm high and the foliage only half as tall. Not scabrous except the leaf tips. Inflorescence short, with pale green, puberulent perigynia, and shorter, dark brown scales, the latter with a green base and hyaline margins. Bracts reduced to sheaths 1-3 mm long, the blades lacking or sometimes a mere awn 1-3 mm long. Styles 2-3, about half as long as the perigynium. Mid spring. Wetter Spruce woods, etc. -- seK-Aka, L-NF, nNB-BC, US.

A report by Louis-Marie 1961 of a Dutilly collection from Resolution Island at the southeast tip of Baffin in Franklin district, queried by Boivin 1967, may have been only a lapsus calami for Fort Resolution in southern Mackenzie where Dutilly collected his number 8305 in 1940 (QFA). The range of the species has been amended accordingly.

65. C. concinnoides Mack. -- Stigmas usually 4 and about as long as the perigynium. Resembling the previous, but about twice as large. Stem smooth throughout or scabrous near the summit. Bract reduced to a narrowly triangular lanceolate and coloured structure which is barely sheathing at base. Scales with a broad membranous margin and a broad, deep purple-red center. Perigynia short-hirsute, pale green to red-spotted. First half of summer. Mountain woods to timberline. -- swAlta-BC, wUS.

66. C. Richardsonii Br. -- Lower $\frac{1}{4}$ of the stem bearing two or three bladeless leaves reduced to reddish sheaths. Long stoloniferous. Stem nearly round, strongly scabrous all around and from base to summit. Bracts reduced to elongate purple-red sheaths with a broad membranous margin. Perigynia shorter than the membranous purple-red scales. Late spring and early summer. Sandy soils in open to lightly wooded areas. -- swMack, cQ-BC, nUS.

24. RUPESTRES

Inflorescence small and blackish. An unspecialized type related to the last few and next few sections: perigynium not hairy; style not bulbous; bractless, or the bracts sheathless or nearly so.

67. C. rupestris Bell. (C. Drummondiana Dewey) -- Small alpine species with a single androgynous spike and leaves which become spirally curled at tip when very old. Around 1 dm high and stoloniferous. Leaves 1-3 mm wide, marcescent. Scales with a wrap-around base, nearly sheathing the rachis. Spring. Dry and rocky tundra, arctic or alpine, especially on limestone. -- G-Y-(Aka), L-NF, Q, nMan, swAlta-eBC, (wUS, Eur).

68. C. glacialis Mack. -- A small, densely tufted species, with a small and strongly two-toned inflorescence. Usually 2 or 3 pistillate spikes, each bearing only (1)-3-(6) perigynia. Scales dark purple, often with a broad membranous margin. Perigynia about 2 mm long, 1 mm wide, the green body subglobose, abruptly contracted to a short stipe and ringed in deep purple around the base of the beak. Late spring. Alpine tundras in the Rockies and arctic or subarctic tundra in northern Manitoba and Saskatchewan. -- G-Aka, L-wNF, nQ-nMan-nS-swAlta-nBC, Eur.

Some eastern material was segregated specifically in 1942 as C. terraenovae Fern., reduced to a variety by Boivin 1967. We now have at hand some 15 collections of this segregate and we must admit that we do not find it to be a tenable distinction when the reputed differences are applied coldly. Some differences, such as the caducous scales, are only exceptional events, while others, such as the colour of the base of the tuft, are of erratic occurrence and not obviously linked; we find it difficult to identify these specimens as a varietal segregate without undue attention on their geographical origin.

25. FIRMICULMES

Inflorescence reduced to a single spike which is mostly staminate with few or only one perigynium at its base. Perigynium filled with spongy tissue below the stipitate achene.

69. C. Geyeri Boott -- With a single spike and typically with a single rather large perigynium at its base. Loosely tufted, the leaves as long or longer than the stems. Scales rather large, 6-11 mm long. Perigynium 5-6 mm long, broadly oblanceolate, somewhat removed from the rest of the spike. Spring. Dry slopes near timberline: Waterton. -- swAlta-seBC, US.

26. ALBAE

Like the last four sections, but unlike most of the following, the perigynium is trigonous because it fits closely over the trigonous achene with flat to concave sides. Bracts reduced to their sheaths. Base of style (or top of achene) enlarged in a manner reminiscent of Eleocharis.

70. C. eburnea Boott -- Delicate forest species with very fine foliage forming a lax carpet. 1-2 dm high. Bracts reduced to membranous sheaths. Spikelets very small, typically 3, of which the terminal one is staminate and sessile or shorter than its peduncle, and is overtopped by at least one of the pistillate spikelets. Perigynia few, 1.5-2.0 mm long, conspicuously trigonous, becoming membranous with the blackish achene visible through at maturity. Early summer. Woods, especially near watercourses in calcareous areas. -- Mack-Aka, NF, NS, NB-BC, US.

27. BICOLORES

Differs from the next few and last few sections by its lenticular achene topped by only 2 stigmas. Surface of the perigynium minutely (under X 30) granular-bullate, usually white to golden yellow, rarely whitish to partly purplish. From this section to the end, the perigynium does not usually fit tightly over the perigynium and there is an air space over the achene. From here to 42. Cryptocarpae the style is of a different colour and softer texture than the achene, hence the style is mostly deciduous. From here to 36. Ferrugineae the lowest bract is sheathing at base and its sheath is rarely less than 5 mm long.

71. C. rufina Drejer -- A small plant, less than 1 dm high, the short stems overtopped by the leaves. Leaves less than 1 mm wide, canaliculate and falcate, with a whitish or light tan sheath, auricles, and ligule. Scales brown, with a green midnerve, overtopped by the very short-beaked perigynium. Stigmas short, about 1 mm long. Just before mid summer. Marshy tundra: Lake Nueltin. -- G, K, nwMan-(nwS), nwEur.

A very rare plant, or perhaps merely small and overlooked, known only from Iceland, Greenland, Thaanne River and Lake Nueltin, reported by Hudson in 1978 from Thomson Bay on Lake Athabaska. Our plant is perhaps an undescribed variety. See Hudson p. 133-4.

72. C. bicolor Bell. -- Spikes strongly bicolour, the terminal one obscurely gynandrous, being mostly pistillate with a few staminate flowers at the base. Small plant, usually around 1 dm high, the stem overtopping the leaves. Spikelets crowded and nearly sessile or short pedunculate, the

inflorescence usually less than 1 cm long. Perigynia pale green, minutely whitish-granular. Scales dark brown with a wide central green band and broadly rounded tip. Early summer. Tundra and wet montane forests. -- G-Mack-(Y)-Aka, NF, Q-nO-nMan-nS-swAlta, Eur.

Highly sporadic and known in our area only from Churchill (CAN, DAO, QFA, SASK), lake Hashbala (DAO, SASK) and the Rockies (DAO).

73. C. aurea Nutt. (C. Garberi Fern., var. bifaria Fern., C. Hassei AA.) -- Perigynia conspicuous, being at first whitish green and granular as in the above, but usually ripening dull orange and becoming fleshy. Spikelets drooping on elongate peduncles, the inflorescence commonly 2-10 cm long. Terminal spike entirely staminate, or more commonly with a few terminal perigynia. Scales often largely membranous, or brownish with a green center and a membranous margin, obtusish to cuspidate at tip. Early summer. Wetter places, usually forested, or marly meadows. -- seK-Aka, (L)-NF, NS-BC, US.

Subdivided in two species on the basis of the colour and fleshiness of the perigynium, the length of the sheath of the lower bracts, the shape of the upper edge of these same sheaths, the colour of the scales and their shape at the tip, the length and sex of the terminal spike. These characters occur throughout the range in a sporadic fashion and without being clearly linked inter se.

In any fair-sized institutional collection it should be easy to demonstrate that C. Garberi is only an earlier stage of C. aurea. Sort out the specimens according to date of collecting or as to stage of maturity. On the average, specimens identified C. Garberi will have been collected about three weeks earlier than those named C. aurea. Nearly all specimens mature enough to have begun losing their fruits will be filed under C. aurea, but the spikelets will be undecimated in most specimens labelled C. Garberi. We have used this technique of date sorting in this and quite a few other cases, often with satisfyingly conclusive results.

Ledingham 1943 noted that C. Garberi resembles immature C. aurea, and for our part we have been unable to detect C. Garberi as a distinct population in the field. W.J. Cody had the same experience in Mackenzie district. J.H. Hudson has paid special attention to this segregate and his experience is similarly negative. He writes: "I can't find a population in the field. If C. Garberi be a species, it ought to have some kind of ecological niche, different from that of C. aurea where the ranges overlap, where an experienced field observer could find it with some degree of regularity". See Hudson 1978 for comparative descriptions and further discussion.

Until C. Garberi can be ecologically individualized in the field, its distinction will remain mechanical in the herbarium, with no evidence that the resulting segregate is a natural entity of some significance.

28. PANICEAE

Not a strongly differentiated section. Long stoloniferous and phyllopodic, that is, the new stem (except var. Woodii) arises from the center of an old sterile tuft hence the base of the flowering shoot is clothed with the \pm withered remnants of old leaves. The sections following, up to 36. Ferrugineae, are all of tufted plants, except the 32. Sylvaticae which are aphyllopodic, and except C. Crawei with its spikelets more or less evenly spaced from the base of the stem up.

74. C. livida (Wahl.) W. (var. Grayana (Dewey) Fern.) -- Foliage pale greenish, glaucous. Leaves 1-3-(4) mm wide. Much like the following, but the blades mostly narrower, the scales broadly rounded at summit and the shorter inflorescence usually under 5 cm long. Basal sheaths grayish brown and all or nearly all blade-bearing. Scales conspicuously green and brown. Perigynia pale green and very asymmetrical at the beakless tip, the orifice facing outward. Late spring. Coniferous bogs, rare. -- (G, seK-nwMack)-scY(Teslin)-Aka, (L)-NF-SPM, NS-PEI-(NB)-Q-BC, US, (Eur).

75. C. tetanica Schkuhr var. tetanica (C. Meadii Dewey) -- A middling species, long stoloniferous, rather stiffish. Basal sheaths as above. Leaves green, 2-4 mm wide. Spikelets lax, \pm remote, the lower often borne towards the middle of the stem. Scales deep brown with a green center, all acuminate or the upper obtusish. Perigynia as above, but sometimes very short beaked, at first narrowly oblong, maturing to broadly obovoid. Mid spring. Wetter prairies from the File Hills eastward. -- O-sMan-ecS, US -- Var. Woodii (Dewey) Wood (C. Woodii Dewey) -- Conspicuously clothed at base with many bladeless deep red sheaths. Sheaths of the lower stem leaves tending to be similarly coloured. Spikelets often still more lax and more remote, and less deeply coloured, the scales partly hyaline. Deciduous woods along the lower Assiniboine: Brandon, Portage. -- O-sMan, US.

A report of C. tetanica for Alberta by Mackenzie 1935, repeated by Ledingham 1943, may be unsubstantiated as we found no corresponding specimen at NY where Mackenzie's herbarium is now preserved. Nor at GH, etc. A similar report by Gleason 1952 was likely based on Mackenzie's.

Modern authors consulted hold C. tetanica and C. Meadii as distinct species. Two good series of Canadian specimens are at hand and were identified by Mackenzie as C. Meadii and

C. tetanica respectively. There is no difference that we can detect between the two series and it seems doubtful that the diagnostic criteria adduced by Mackenzie were actually used in selecting names for these specimens.

Fernald's 1952 classification is the same as Mackenzie's, but his morphological emphasis is different with C. Meadii having somewhat broader leaves and fatter spikes. A few U.S. sheets at hand were identified by Fernald as C. Meadii and they do have somewhat wider leaves and thicker spikes. If these characters be significant, a proposition not evident from the material at hand, then at least all the Canadian sheets examined belong with C. tetanica proper because of their narrow leaves and medium to thin spikes.

Gleason's 1952 classification is different still with C. Meadii and C. tetanica rated as species, but C. Woodii as a mere variety of the latter. Not a very cogent arrangement since on morphological and ecological grounds C. Woodii is a better defined segregate than C. Meadii.

We have accordingly submerged C. Meadii and retained C. Woodii only as a minor variant, just as Wood himself would have it.

76. C. vaginata Tausch (C. saltuensis Bailey) -- Stem much taller than its foliage, bearing remote and leafy-bracted spikelets. Leaves marcescent, the new ones appearing only after flowering. Spikelets very lax and \pm erect on their elongate but stiffish peduncles. Bracts long-sheathing, the sheath often as long as the blade. Perigynium ovoid. Beak straight or slightly sigmoid, slightly deflexed outward, obliquely cut at tip and ending into a single point or two very small teeth. Early summer. Mossy coniferous forests. -- G-sF-Aka, L-NF, NB-eBC, neUS, Eur.

29. LAXIFLORAE

Plants tufted. Otherwise resembling the last (Panicaceae) and the spikelets similarly lax and drooping on long and thin peduncles, the inflorescence rather elongated, and the perigynium trigonous, being somewhat tight over the trigonous achene.

Manitoba and Saskatchewan reports of C. plantaginea Lam. were discounted by Scoggan 1957 and Breitung 1957 respectively. The justifying collection is labelled: Drummond, between Norway and Cumberland House (K). It is correct as to identification, but in the absence of later confirmation, is considered doubtful as to locality. An apparent duplicate at GH is labelled: Norway House & Rocky Mounts, Herb. Hooker. Both specimens are barely coming into anthesis and were probably collected in the second half of April.

Another reputed Manitoba sheet, I.L. Hargrave, St. Remi, Man., 1882 (MTMG), is also discounted as likely to be mislabeled. Although Hargrave did some collecting in Manitoba, his St. Remi collections should be ascribed to Quebec rather than Manitoba where no such locality exists.

77. C. laxiflora Lam. var. varians Bailey (C. leptonervia Fern.) -- Much like the next, the spikelets remote and leafy-bracted, but the perigynia more strongly beaked and less crowded, only 5-12 to a spikelet. Tufted. Basal leaves 4-10 mm wide. Bracts 5 mm wide or less. Scales hyaline, broadly rounded to truncate, the green midnerve usually excurrent. Perigynia strongly trigonous and weakly nerved, the nerves \pm 5 per face and (0.2)-0.3-(0.4) mm apart, the base and the summit about equally tapered, the base spongy, the summit strongly asymmetrical and slightly contracted into an ill-defined beak which is about 0.5 mm long and strongly arched outward at about 45°. Late spring. Rare in rich woods in the Whiteshell and on the Porcupine Mountain. -- L-SPM, NS-seMan-cS, neUS.

The only Manitoba collection (CAN, GH, MT) seen was also the basis of a report by Scoggan 1957 and 1978 of C. blanda Dewey from our area. A Brandon collection reported as C. blanda has not been verified. More recent collections from Vassar and Pansy have been revised to C. gracillima.

Also occurs on the Prairie Coteau, at least on the Porcupine Mountain (SASK), where it was collected by J.H. Hudson in 1973 and reported in 1978 as var. blanda.

The more recent listing by Dugle 1969 of C. blanda for the Whiteshell was based on a Pinawa collection (PINAWA) since revised to C. gracillima.

C. laxiflora has been subdivided into about eight weak varieties or very weak species. They overlap quite a lot morphologically and their ranges are largely coincident. Some have basal leaves very broad, up to 2-3 cm wide (= var. latifolia Boott); in another (= var. blanda (Dewey) Boott) the perigynium is nearly beakless and shows 2-3 times more nerves than our var. varians, etc.

30. GRANULARES

Wall of the perigynium thickish, longitudinally ridged on the outside, smooth on the inner face. Spikelets scattered from top to base of the stem. Peduncles not much longer than the enclosing sheaths, hence the spikelets are nearly erect, in contrast with the two adjacent sections where the spikelets are more or less drooping on long pedicels.

78. C. granularis Muhl. (var. Haleana (Olney) Porter) -- Spikelets very remote and subtended by elongate and leaf-

like bracts which give the stem an unusually leafy appearance for the genus. Tufted. Main leaves 5-8 mm wide. Most peduncles very long, but the upper two spikelets, of which one is staminate, are sessile or nearly so and borne very close together. Scales \pm acuminate, hyaline or more commonly brown-tinged with a green midnerve. Perigynia smallish and crowded, 1.8-2.8-(4.0) mm long, obovoid and very asymmetrical at the very short-beaked tip ($= \pm 0.1$ mm). Early summer. Wet meadows of the Qu'Appelle and Pipestone, from Broadview eastward. -- NB-sMan-ceS, US.

Nearly all Canadian sheets have smaller perigynia, less than 3 mm long and not over 1.5 mm wide. These could be distinguished as var. Haleana. A few (3) sheets at hand from Ontario and the USA have bigger perigynia and could be denoted as var. granularis. But it is not clear from this scanty material if var. granularis is an uncommon extreme of variation or a geographical variant reaching as far north as James Bay. Western specimens seen had the smaller perigynia of var. Haleana, including the Manitoba sheets (QFA) reported by Löve 1959 as var. granularis.

79. C. Crawei Dewey -- Much resembling the above but stoloniferous and the length relations of the peduncles reversed. Peduncle of the terminal staminate spikelet about as long to twice as long as its spikelet and as any of the other spikelets. Peduncles of the pistillate spikelets much shorter and barely protruding from sheaths of the subtending bracts. Leaves 1-4 mm wide. Perigynia acutish and barely asymmetrical at tip. Early summer. River gravels and ground seepage areas. -- (NF, NS, NB)-sQ-seS-wAlta-BC, US.

There is apparently a distributional gap between southeastern Saskatchewan and western Alberta.

31. GRACILLIMAE

Spikelets long and drooping, the terminal one gynandrous. Pubescent, as the next section, but the pubescence inconspicuous, being usually confined to the dorsal side of the basal sheaths.

80. C. gracillima Schwein. -- Spikelets elongate, drooping and green, the terminal one with a few perigynia at the tip. Tufted. Spikelets linear on elongate peduncles. Scale membranous with a green midnerve, shorter than the green and beakless perigynium. Mid spring. Wetter deciduous woods. -- NF-SPM, NS-seMan, US.

32. SYLVATICAE

The herbage or the perigynia, or both, pubescent. A rather middling type not easily circumscribed; it turns up at 7 different end points in Gleason's 1952 key. Differs from the last few and next few sections by being stoloniferous. Stems aphyllopodic, being clothed at base with imbricated and deeply coloured bladeless sheaths.

81. C. castanea Wahl. -- Pubescent: leaves pilose below, glabrous above, the stem pilose. Tufted. Spikelets elongate, drooping. Perigynia green, long beaked, glabrous, about twice as long as the brown and ciliolate scales. Late spring. Floodplains: Sandilands. -- L-NF, NS, NB-seMan, neUS.

82. C. assiniboinensis W. Boott -- Very narrow and elongate pubescent perigynia in very lax spikelets. Herbage glabrous. Flowering stems rather inconspicuous. Spikelets remote, with long peduncles and long leafy bracts. Perigynia turning yellowish at maturity. Beak as long as the body and obliquely cut into a single elongate point. Common and often dominant on the floor of galerie-forests. -- sMan-seS, ncUS -- F. ambulans Bernard -- Producing aerial stolons which are at first erect, then elongate to about 1 m and root at tip. Leaves reversed beyond the mid point. More frequent than the type and probably ecologically conditioned. -- sMan-seS, ncUS.

Earlier reports of C. debilis Mx. were discounted by Scoggan 1957 and 1978. A more recent Churchill report by Louis-Marie 1961 could not be substantiated at QFA in 1965.

33. CAPILLARES

Perigynium nervation as in the next section, i.e. reduced to the two marginal nerves, these quite strongly expressed. But the beak not bidentate at tip, being rather more or less truncate.

83. C. capillaris L. var. capillaris (var. elongata Olney, var. major Blytt) -- A smallish species with small drooping spikelets on elongate capillary peduncles. Tufted and (1)-2-3-(4) dm high with widely scattered spikelets, sometimes borne all the way from the base of the stem. Spikelets short, the staminate less than 1 cm long, the pistillate mostly around 1 cm and often shorter than their peduncle. Late spring and early summer. Wetter and usually shaded places on somewhat acid soils. -- G-Aka, L-SPM, NS, NB-BC, US, Eur -- Var. Krausei (Böck.) Krantz -- Terminal spike gynandrous. Commoner northward. -- G-Aka, nQ-nMan, (Eur) -- Var. Williamsii (Britton) Boivin (C. Williamsii Britton). Generally smaller, the leaves less than 1 mm wide. Inflorescence smaller, more crowded, of shorter and often non-drooping spikelets, the staminate one

frequently overtopped by the upper pistillate spikelet. More northern and rare; perhaps only an ecological variant of more exposed situations. -- F-Aka, L, SPM, Q-neO-Man, (Eur).

Taller plants occur in shaded habitats and have been distinguished as var. elongata, apparently a normal ecological reaction.

34. LONGIROSTRES

In the last six or eight sections the beak of the perigynium is mostly truncate or emarginate at tip, sometimes obliquely cut into a single point, sometimes bilobed into a pair of obtusish teeth, or more rarely the beak is straight and ends into a pair of short and acute teeth. In this and the next section the beak is arched or deflexed and ends into a pair of straight and very sharp teeth. In this section the perigynium has very few nerves, usually only the two lateral ones, while the teeth of the beak are soft and membranous.

84. C. Sprengelii Dewey -- Conspicuous in deciduous woods, the spikelets long pendulous and the perigynia very long-beaked. In large tufts of divergent stems, less than 1 m high. Perigynia ovoid, slightly asymmetrical, being gibbose ventrally towards the base of the beak, shiny, with 2-(4) conspicuous nerves and a beak about as long as the body. Scales long-tapered and about as long as the perigynia. Late spring. Common, especially in galerie-forests. -- nNB-BC, US.

35. EXTENSAE

Perigynia somewhat asymmetrical, the lower ones \pm spreading, the beaks somewhat deflexed downwards. Differs from the preceding by its perigynium showing many strong nerves and the beak ending in a pair of very stiff teeth.

85. C. viridula Mx. (C. Oederi AA., var. viridula (Mx.) Klük.) -- Similar to the next, yet the perigynia shorter, less asymmetrical, merely spreading and the beak shorter. Similarly long-bracted. Perigynia mostly (1.5)-2.0-2.5-(3.0) mm long, the beak 1 mm long or less. Early summer. Bogs and shores. -- G, seK-seAka, NF-(SPM), NS-BC, US, Eur.

This used to be called C. Oederi Retzius, but Nelmes 1939 having examined the type pointed out that it belongs with C. pilulifera L. Retzius himself came to realize this equivalence and eventually consolidated the two concepts. C. viridula is then the earliest name now available for what used to be incorrectly called C. Oederi.

86. C. flava L. var. flava (var. fertilis Peck, var. laxior (Klük.) Gleason; C. cryptolepis Mack.) -- Hedgehog-Grass

-- Short spikelets of conspicuously falcate perigynia, most of them somewhat reflexed. Tufted. Bracts leaf-like and many times longer than the inflorescence. Scales about as long as the body of the perigynium. Perigynia 3-6 mm long, yellowish green, turning brown, the beak at least half as long as the body. Early summer. Wet meadows and shores. -- seK-seAka, NF-(SPM), NS-(PEI)-NB-Man, Alta-BC, US, Eur.

The more eastern var. Nelmesiana (Raymond) Boivin (= C. lepidocarpa A.A.) is glaucous, its lower spikelet remote, and its short perigynium more inflated, the body obovoid. Other varieties have been described but seem to be only extremes of variations of sporadic occurrence. Thus a collection at hand: W. Scott, Banff, July 16, 1893 (TRT), has the perigynia only 3-4 mm long and keys out to the reputedly eastern var. fertilis.

Seems uncommon and perhaps geographically restricted in Manitoba. At any rate we have checked only one collection: Gillett & Scoggan 10152, 20 miles south of The Pas (DAO). Hudson 1978 also reports it from Flin Flon. A previously reported Criddle 1939 collection from Aweme has been revised to C. retrorsa.

36. FERRUGINEAE

Perigynium much larger than the achene but not inflated, being very flat, or at least strongly flattened with a ridge on one face. Otherwise a very diverse group of species, glabrous to pubescent, tufted to stoloniferous, stigmas 2 or 3, etc. Inflorescence dark-coloured.

87. C. petricosa Dewey var. petricosa -- Red-brown perigynia somewhat minutely scabrous puberulent especially towards the tip. Tufted and mostly 2-3 dm high. Inflorescence secund, the spikelets drooping, the terminal androgynous. Perigynia (1.0)-1.5-(1.8) mm wide, \pm lanceolate. Scales red brown with a paler midnerve. First half of summer. Alpine cliffs and rocky slopes. -- (wF), Mack-(Y)-Aka, swAlta-seBC -- Var. Franklinii (Boott) Boivin (C. Franklinii Boott) -- Perigynia broader and more obviously puberulent, 2 mm wide or slightly larger. Plant generally taller, mostly 4-6 dm high. River gravels in the mountains. -- (Y)-Aka, swAlta.

A range extension of var. Franklinii northeastward into Mackenzie by Porsild 1968 turned out to be based on specimens from Cli Lake (DAO) and Little Doctor Lake (DAO) with the typically narrower (i.e. 1.3-1.5 mm) perigynia of var. petricosa.

The more northern var. distichiflora Boivin differs from var. Franklinii by its bigger perigynia, 6-7 mm long, in laxer spikelets. The more eastern var. misandroides (Fern.) stat. n.,

C. misandroides Fern., Rhodora 17: 158. 1915, also resembles var. Franklinii, but is generally a smaller plant and its style has only two stigmas.

88. C. misandra Br. -- The blackish perigynia rather narrow, 1 mm wide or slightly less. Stems much taller than the leaves, the latter arching, numerous, marcescent and forming tufts 3-10 cm high. Sheaths \pm purplish. Spikelets blackish and drooping, at least the terminal one gynandrous. Early summer. Rocky, Dryas-covered tundra. -- G-Aka, L, Q-(nO-nMan), swAlta(Jasper, Cadomin)-BC, wUS, Eur.

89. C. atrofusca Schkuhr var. atrofusca -- Much resembling the previous but the terminal spike staminate or androgynous and the perigynia broader, 1.5-2.0 mm wide. Early summer. Wet arctic and alpine tundra. -- G-Aka, L, Q-nMan, Eur.

By contrast the alaskan var. major (Bück.) Raymond is a taller plant, 3-6 dm high, with bigger perigynia, 5.0-5.5 mm long, only slightly longer than the scales.

37. VIRESCENTES

In this and the next five sections the sheaths of the bracts are very short, rarely more than 5 mm long, often reduced to a pair of auricles. In this and the next section the herbage is pubescent. Virescentes are tufted while Hirtae are long stoloniferous. Further to this section, the perigynium is small, its beak short or absent, and the inflorescence is overtopped by the lowest bract or the upper stem leaf.

90. C. Torreyi Tuck. -- With the general appearance of C. nigromarginata, but pubescent throughout except the perigynia. Leaves pubescent on both faces. Stem pubescent or ciliate on the angles. Scales puberulent along the midnerve. Perigynia green, ellipsoid, ribbed, with a well marked but very short beak. Late spring and early summer. Chernozems and moister prairie spots from the Prairie Coteau west to Dawson Creek; also at Otterburne. -- seMan-neBC, US.

38. HIRTAE

Pubescent as in the last, but long stoloniferous. Perigynia heavily pubescent.

91. C. Houghtoniana Torrey (C. Houghtonii Torrey, nom. ill.) -- Common and somewhat coarse pioneer species of disturbed sands in Jack Pine forests, the coarse perigynia hirsute. Long stoloniferous. Spikelets \pm distant and subtended by leaf-like bracts. Lanceolate scale much shorter than the perigynia, the latter 4.0-6.5 mm long. Late spring to early summer. Light, sandy woods. -- NF, NS, NB-cAlta, neUS.

The spellings Houghtoniana and Houghtonii were both used from the very beginning of the species in 1836, the first spelling appearing slightly earlier. The correction to Houghtonii was proposed by Torrey on the basis that the plant had been named after its discoverer. However, this is not among the reasons recognized by the code as justifying a change of spelling in a name. Hence the return to the original spelling of Houghtoniana.

92. C. lasiocarpa Ehrh. var. lasiocarpa (var. americana Fern.) -- Perigynia densely grayish pubescent, borne in remote, long-bracted, and sessile or near sessile spikelets. A rather tall, thinnish and wiry plant, stiffly erect. Leaves \pm 1 mm wide, stiff, long, and thin, appearing cylindric, being tightly folded. Although the edges are scabrous, these are so tightly enrolled that the leaf is smooth to the touch. Sheath light to deep brown ventrally near the top. Scale usually longer than its perigynium, often with a short awn. Perigynia mostly 3-4 mm long, with a short beak and two strong and sharp teeth. Nerves \pm obscured by the pubescence. Early summer. Wet places, especially in bogs. -- Mack, sAka, (L)-NF-SPM, NS, NB-BC, US -- Var. latifolia (Böck.) Gilly (C. lanuginosa Mx.) -- Leaves broader and \pm flat, 2-5 mm wide, scabrous along the edges. Wet places, especially marshes. The more common type southward. -- (K), Aka, (NF)-SPM, NB-BC, US, Eur.

There is a statistical difference between the Eurasian and American material of var. lasiocarpa; the perigynia and their teeth average shorter in America. These differences, the basis for var. americana, were exaggerated by Fernald in 1950 and in fact at least half of the specimens fall in the zones of overlap. In the same manner the perigynia and their teeth of var. latifolia are also statistically shorter than in Eurasian material of C. lasiocarpa. The lowest bract is sheathless in most Eurasian specimens, just as it is in most American specimens.

A collection from the Turtle Mountain, Looman 14435 (DAO, SCS), has unusually large perigynia and the pubescence is much lighter than expected; it could represent a hybrid of C. lanuginosa parentage, the other putative parent not being recognized yet.

39. LIMOSAE

Perigynium strongly flattened, thus suggesting the Acutae, but much larger than the achene, the latter trigonous with 3 styles. Roots abundantly clothed in long yellow root hairs, these rather easily detected as these species are commonly found growing in Sphagnum; roots seem dressed in yellow felt.

93. C. rariflora (Wahl.) Sm. var. rariflora -- Terminal spike staminate and erect, the lateral ones pistillate and drooping, with blackish brown scales strongly contrasting the pale green perigynia. Stoloniferous. Upper pistillate spike usually longer than its peduncle. Scales with a wrap-around base, the pistillate ones darker than the staminate. First half of summer. Boggy tundra. -- G-Mack, Aka, L-SPM, nQ-nMan, (neUS), Eur.

The more western var. pluriflora (Hultén) Boivin has somewhat denser spikes of slightly larger perigynia, 3.5-4.0-(4.5) mm long.

94. C. limosa L. -- Scales golden brown. Stoloniferous and similar to the last. Upper pistillate spikelet usually shorter than its peduncle. Scales not wrapped around the base of the pale green perigynia, the staminate ones as dark or darker. Early summer. Wetter bogs, especially floating ones. -- (sK)-Mack-Aka, L-SPM, NS-BC, US, Eur.

Hudson 1978 reports the existence of hybrids or intermediates to the next.

95. C. magellanica Lam. var. irrigua (Wahl.) BSP. (C. paupercula Mx., var. irrigua (Wahl.) Fern., var. pallens Fern.) -- Roots easily dug up and conspicuously covered with a dense yellow-brown felt of radicles. Loosely tufted, but otherwise resembling the last two. Spikelets all shorter than their pedicels, the terminal staminate. Scales commonly red brown and green, varying to golden brown or purple black. Perigynia tending to be subopposite. (Early summer?). Common in bogs. -- (G), swK-Aka, L-SPM, NS-BC, US, Eur.

In the typical South American phase the terminal spikelet is practically always gynandrous. We have been unable to detect any other substantial difference for our boreal variant.

40. ATRATAE

Much as the next, but stigmas 3 and the achene trigonous. Inflorescence rather dark-coloured. Terminal spike generally gynandrous, with the pistillate flowers more numerous.

96. C. Parryana Dewey var. Parryana (C. Hallii Olney) -- Habitally similar to C. scirpoidea but with more than one spike. Stoloniferous, the leaves all basal and only half as tall as the stem. Spikelets 2-3-(6), narrowly cylindrical, erect, overlapping, all pistillate or the terminal gynandrous to rarely staminate. Perigynia 2-(3) mm long, (1.0)-2.0 mm wide, broadly obovate to elliptic, flattened. Scales reddish to purple brown, with a membranous margin. (Late spring?). Low prairies, mainly in ground seepage areas. -- soY-sAka, sMan-BC, US.

In our area the scales vary from broadly rounded to acutish at tip and from shorter than, to slightly longer than, the perigynia and our plants may be denoted as var. Parryana. By contrast the more southern var. idahoana (Bailey) Boivin (C. idahoana Bailey, Bot. Gaz. 21: 5. 1896; C. idahoana sphalm.) has acuminate scales that are about twice as long as the perigynia. To conform with the International Rules of Botanical Nomenclature the state name Idaho used as an epithet should either be given the form of an adjective (i.e. idahoana) or of a noun in the genitive (i.e. idahonis). We have corrected the plant name accordingly.

More southern plants have also been segregated as C. Hallii on the basis of the terminal spike being unisexual, either staminate or pistillate, and the perigynia being slightly larger. The character of the sexuality of the terminal spike is unlikely to be here a sound specific difference. Further our specimens seem to form a single population and the distinction cannot be implemented except in a very mechanical and unsatisfactory manner. Intermediates seem to occur throughout the range. In 1965 we noted that the two species had been lumped at NY. To which we concur.

In a more recently proposed sorting, Brittonia 21: 55-76. 1969, the two taxa are redefined as follows.

Ssp. Parryana: bearing at least three spikes, at least one of the lateral spikes narrowly cylindrical and nearly as long as the terminal spike. Ranges from Manitoba to Alaska, south to Utah.

Ssp. Hallii (Olney) Murray: bearing one or more spikes, but the lateral spikes short cylindrical and not more than half as long as the terminal one. Ranges from Manitoba south to Colorado and Nebraska.

Material at hand does not readily conform to the above. Both phenotypes are found together on many sheets, and the Hallii form occurs also in Saskatchewan and Alaska.

Judging from the scanty Nebraska material at hand one could perhaps achieve a satisfactory classification by a more restrictive definition of C. Hallii, in such a way as to include mainly the Nebraska material and so as to exclude most, if not all, of the Canadian specimens.

97. C. norvegica Retz. (var. inferalpina (Wahl.) Boivin; C. media Br.; C. Vahlia AA.) -- The small scales purplish black with a very narrow membranous margin, but without a paler mid-nerve, smaller than the perigynia. Loosely tufted, the culms about twice as high as the foliage. Terminal spike larger and with only a few staminate flowers at base. Perigynia 2.0-2.5 mm long, green to brownish, often blackening at maturity. Stigmas short, (0.3)-0.5-(1.0) mm. Early summer. Wet meadows

and woods. -- G-Aka, L-(NF), nNB-BC, US, Eur.

Usually subdivided in two varieties or species. Plants to the northeast of us are reported to belong to C. norvegica proper with perigynia about 2.0 mm long, abruptly short-beaked, and tending to be dark-coloured and not much paler than the scales. The more southern and transcontinental var. inferalpina (or C. media) has perigynia longer, 2.5 mm or more, more tapered to the beak, and usually light green to brownish, forming conspicuously two-toned spikelets, but the perigynia may become much darker before falling off. If these criteria are applied strictly, it will be found that most specimens from our area have the smaller perigynia of typical C. norvegica and that this type ranges westward all the way to Alaska; the reputed geographical restrictions disappear. However we must note that the 4 or 5 Greenland sheets at hand all have the shorter and darker type of perigynium.

A dot for C. holostoma Drejer at Churchill on a map by Hultén 1958 has not been investigated.

98. C. podocarpa Br. var. podocarpa (C. montanensis Bailey; C. nesophila Holm; C. spectabilis Dewey; C. Tolmiei Boott) -- A conspicuous species with a secund inflorescence of blackish spikelets, of which the terminal one is staminate, the lateral pistillate and the lowest drooping. Variable, often with last year's leaves marcescent and present at the base of the stem. Scales blackish, acute to cuspidate. Perigynia (3.0)-3.5-(4.5) mm long, ovate to narrowly lanceolate, $1\frac{1}{2}$ -3 times longer than wide, green to blackish, with raised marginal nerves, largely covered by the scales. Mid summer. Common in mountain meadows at all altitudes. -- wMack-Aka, swAlta-BC, nwUS -- Var. Paysonis (Clokey) Boivin -- Perigynia broadly ovate, the marginal nerves displaced towards the back and appearing submarginal. Waterton. -- swAlta -sBC, nwUS.

Generally subdivided into a series of 4 or 5 species. As pointed out by Hultén 1942, they have the same type of perigynium, they differ mainly by their scales or on vegetative parts. These characters do not seem to vary in accord and, on the basis of material at hand, will turn out anywhere within the range of collective species. From which we deduce that we are here dealing with a single species with one weak variation as above.

C. podocarpa Br. var. Paysonis (Clokey) stat. n.; C. Paysonis Clokey, Am. J. Sc. s. V, 3: 90. 1922.

99. C. Reynoldsii Dewey -- Perigynia only slightly compressed in contrast with the other Atratae. Especially resembles the last, but more leafy and the inflorescence not secund. Perigynia ovoid or ellipsoid, green to brownish, longer than the black scales. Mid spring. Montane prairies in the Rockies and Cypress Hills. -- swS-(Alta)-sBC, wUS.

100. C. atrata L. var. atrata (C. albonigra Mack.; C. atratiformis Britton; C. atrosquama Mack.; C. epapillosa Mack.; C. Raymondii Calder) -- Inflorescence \pm blackish and usually of 3 fat, ellipsoid spikelets of which the terminal is gynandrous and the lower tends to droop. Tufted, the stems about twice taller than the foliage. Scales usually shorter than the perigynium, blackish, membranous-pencilled at the margin, the midnerve not colour-differentiated or only weakly so. Perigynia (2.5)-3.0-3.5-(4.0) mm long, frequently minutely granular towards the base of the beak. First half of summer. Alpine or arctic tundras and boggy woods. -- G, Mack-Aka, L-NF, eNS, nNB-BC, US, Eur.

A form with greenish perigynia, f. Wolfii (Kneucker) Kük., (= C. Raymondii) is uncommon and sporadic in the range of the species. But in the northern part of our area it becomes the more common type.

In the more southern var. chalciolepis (Holm) Kük. the scales are larger and they overtop the perigynia.

Our Canadian plant is often called C. atratiformis and may be further subdivided in two or more varieties or species. We have been unable to recognize or detect in our area any phenotype sufficiently constant and discrete to warrant recognition as a species or geographical variation.

101. C. Mertensii Prescott var. Mertensii -- Inflorescence conspicuously secund against the background of a large and stiffly erect bract; the spikelets rather numerous, elongate, and all somewhat staminate at base. Spikelets mostly 6 to 8, drooping on long pedicels, two-toned, the narrow staminate base conspicuously darker than the rest of the spikelet. Scales awnless, very dark to black, the midnerve variable. Perigynia green. Late spring. Along watercourses at edge of coniferous forests. -- Y -Aka, swAlta-BC, (wUS).

The Japanese vicariant has aristate scales and may be distinguished as var. urostachys (Franchet) Kük.

102. C. Buxbaumii Wahl. (C. canescens L.; C. Morrisseyi Pors.) -- Generally similar to the last few species but the lateral spikelets more remote and sessile or nearly so, while the longer scales are strongly two-toned. Scales typically longer than the green perigynia, cuspidate to short aristate, with a central green strip and lateral strips dark brown to black. Early summer. Shallow water in boggy places. -- sG, K-Aka, L-SPM, NS, NB-BC, US, Eur.

As pointed out by Nelves, Reinwardtia 1: 444. 1951, Linné's description of C. canescens fits equally well C. curta and C. Buxbaumii. And the Linnean type turned out to be C. Buxbaumii. We have been able to confirm this by a photograph of the type. A change is therefore required in the application

of C. canescens. A rather annoying and even confusing name change, yet it seems unavoidable. As a temporary expedient we are making only a partial change at this time, introducing C. curta for what used to be called C. canescens while still retaining C. Buxbaumii, until the old usage of C. canescens has been abandoned and the new usage can be fully introduced with a minimum of confusion.

41. ACUTAE

Achenes very flat and the stigmas only two. Otherwise quite typical of the subgenus Carex, the terminal spike staminate, the lateral ones pistillate and pedunculate. Perigynia numerous, flat, crowded into dense spikes. Peduncles fairly short, hence the spikelets tend to be \pm erect.

103. C. Bigelowii Torrey (f. anguillata (Drejer) Fern.; C. concolor AA.; C. gymnoclada Holm; C. rigida AA.; C. scopulorum Holm) -- Like all members of this section, stigmas 2 and the small perigynia strongly flattened, but the staminate spike under 2 cm. Common and highly polymorphic arctic and alpine type with long and coarse rhizomes. Scales awnless, dark brown to purple black except for the thin and paler mid-nerve, elliptic to obovate, commonly just about the size and shape of the perigynium, but often smaller. Stem less than 4 dm high, triangular and acute on the angles, phyllopodic with usually purplish or brownish leaf bases. Leaves smooth or the margin scabrous. Bracts typically about as long as the inflorescence and with membranous auricles coloured like the scales, or sometimes more lightly coloured. Spikelets sessile to long pedunculate, crowded to very remote, the lowest sometimes even basal, but always erect or nearly so. Perigynia green to purple black, strongly flattened. Stigmas 2 or a mixture of 2 and 3. Achene lenticular and plump, not grooved. First half of summer. Arctic, subarctic, and alpine or subalpine meadows, usually wettish or rocky, often a pioneer species. -- G-Aka, L-NF, NB-Q, nMan-nS-swAlta-BC, US, Eur.

Readily distinguished from the other members of the Acutae by its single and shorter staminate spike.

Not to be confused with the habitually similar C. salina, especially the smaller individuals and those with non-cuspidate scales. C. salina has a nearly round stem, broadly rounded on the angles, the scales have a broader green central strip, and the achene is deeply grooved transversally on one side. Further all the bracts will easily overtop their spikelet, while in C. Bigelowii only the lowest bract will normally overtop its spikelet.

Oddly enough there seems to be a distributional gap across northern Ontario to James Bay, Quebec. We have come

across no Ontario mention in the botanical literature and the few herbarium sheets encountered have all been revised to other species, mainly to C. salina.

104. C. lenticularis Mx. -- One of the middle spikelets gynandrous, bearing a few staminate flowers at the base, or sometimes staminate at both base and top; terminal spikelet commonly gynandrous, sometimes merely staminate. Otherwise resembling C. aquatilis, but tufted, generally smaller, and the leaves only 1.0-2.5 mm wide. Basal leaves overtopping the inflorescence. Spikes erect. Perigynia short stipitate, $1\frac{1}{2}$ -2 times longer than wide, with \pm 5 very fine nerves on the dorsal face. Scales small, shorter than the perigynia, brown with a broad green midnerve. Late spring. Lake shores. -- Mack, L-SPM, NS, NB-S-(Alta), neUS.

At NY and some other herbaria we have found C. Kelloggii and C. paucicostata Mack. lumped with C. lenticularis. Apparently, this is how the more eastern C. lenticularis came to be reported from Alberta. We more or less expect that B.C. reports of the latter will turn out to have been also based on specimens of C. Kelloggii. A still more recent report by Scoggan 1978 for northeastern Alberta has not been investigated. The Alberta report by Moss 1959 was based on a Carbondale (ALTA) collection since revised to C. eleusinoides.

105. C. Kelloggii W. Boott (C. Hindsii C.B. Clarke; C. lenticularis Mx. var. limnophila (Holm) Cronq.) -- Small, compressed perigynia abruptly contracted at base and top into a very short beak and a thin stipe about $\frac{1}{4}$ as long as the body, the latter ovoid, (1.2)-1.5-(2.0) mm long. Resembles the above, but the spikelets never gynandrous, the terminal spikelet staminate. Spikes erect, the lower one 1.5-5.0 cm long. Scale shorter than the perigynium, purple black except for a thin green midnerve and a very narrow hyaline border. Mid summer. Lake shores from Jasper to Waterton. -- sAka, swAlta-BC, wUS.

106. C. eleusinoides Turcz. (C. Enanderi Hultén; C. eury-stachya F.J. Hermann; C. kokrinensis Pors.) -- Perigynia as in the last, but the inflorescence smaller and more crowded, the terminal spike about evenly gynandrous. Somewhat smaller plant (1)-2-3-(5) dm high, in looser tufts. In the more crowded extremes somewhat resembling C. norvegica, but the latter has 3 stigmas, sessile perigynia and the scales lack a green midnerve. Inflorescence usually overtopping the basal foliage, the lower spikelet 0.5-2.0 cm long. Scales like the last. (Just before mid summer?). Wet alpine habitats, preferably if disturbed. -- swY-sAka, swAlta-BC, (nwUS).

Has been lately collected at Mt. Dolomite (DAO), Twin Cairn Mt. (TRT), and Mt. Edith Cavell (DAO); to be expected throughout our Rockies. Also at Carbondale (ALTA).

107. C. nebraskensis Dewey -- Rather readily confused with C. aquatilis, but the perigynia more inflated, about half as thick as wide, and with more nerves. Leaves tending to be larger, up to 7 mm wide and scabrous above the middle, but smooth below. Spikes thicker, 5-9 mm wide, because of the more inflated perigynia, the latter slightly bigger, 3.0-3.5 mm long. Beak somewhat longer, \pm 0.3 mm long. Around sloughs. Rare: Aden -- scAlta, wUS.

Although recorded as a member of our flora for over a century, the only correctly named collections seen were a rather recent set by E.H. Moss in 1954 from Aden (MTJB) near the Montana boundary. Macoun 1888 and 1890 reported it first as C. Jamesii Torrey, later as C. nebraskensis Dewey var. praevia Bailey, rating it as common from the Alberta Rockies to the Selkirks. But we have located no sheet from the Alberta Rockies and his Kicking Horse Lake collection (CAN, GH, MTMG) has been revised to C. aquatilis. Dawson's collection from the Kootanie Pass (CAN) is a bit young but may be tentatively placed with C. sitchensis. Other reports have not been investigated individually, but their justifying sheets have presumably been revised to other species as nothing else has been found under C. nebraskensis in the various collections consulted.

108. C. aperta Boott -- Much like the next but the foliage shorter, clearly overtopped by the inflorescence. Less variable, 3-5 dm high, the stem more as in C. stricta, sharply triangular, concave on the faces, scabrous on the angles above the middle, clothed at base with some remnants of last year's leaves. Leaves 2-3 mm wide, those of the sterile rosettes produced later and up to 5 mm wide. Typically bearing 4 spikes, of which the terminal is staminate, the next is androgynous, the other two pistillate and 5-8 mm thick. Sometimes with 2 staminate spikelets, of which the lower one is much reduced. Scales lanceolate and longer than the perigynia, at first bicolour as in C. aquatilis, gradually becoming entirely deep purple black. Perigynia not so much compressed, about half as thick as wide. Early summer. Shores of lakes and sloughs in Waterton. -- swAlta-sBC, nwUS.

Only collection known is Breitung's from the shores of Lonesome Lake (ALTA). Other Alberta collections encountered under that name proved to belong to C. aquatilis.

109. C. aquatilis Wahl. (var. altior (Rydb.) Fern., var. stans (Drejer) Boott, var. substricta Klük.; C. stans Drejer; C. substricta (Klük.) Mack.) -- Highly variable and common; typically a very coarse species, deeply and strongly rooted, with long and coarse stolons, the stems solitary or nearly so. Often over 1 m high. Sheaths of basal leaves nerveless on the membranous side (i.e. ventrally), eventually breaking up into irregular pieces. Phyllopodic, that is the base of the stem is clothed with remnants of old leaves, hence the base of the

plant is (5)-10 mm thick and † spongy. Height varies greatly, (3)-6-10-(15) dm. Stem 1.5-2.5 mm thick, smooth throughout, or scabrous near the top on the angles, the sides flattish. Leaves 2-5 mm wide, scabrous on veins and margin. Lowest bract often twice as long as the inflorescence. Spikelets numerous, long and coarse, typically the upper 2-3 are staminate, the middle ones staminate at tip, the lower ones pistillate. Scales often lanceolate and longer than the perigynia, but usually shorter and broader, bicolour, the median strip green and usually about as broad as the purple brown to purple black margins. Perigynia very numerous, small and strongly compressed, often wafer-thin. Achene not grooved. Early summer. All kinds of very wet meadows. -- (G)-F-Aka, L-NF-(SPM), NS-BC, US, Eur.

Exceptionnally variable, particularly as to size. Smaller specimens, especially those from higher latitudes or altitudes, are commonly named C. stans, but the rank of form, f. sciaphila (Holm) Kük., might be more realistic. Taller plants from more congenial habitats are often tagged var. altior or C. substricta.

Has been confused with other species, including C. Bigelowii. The latter is shorter, less scabrous and its scales are stubbier and darker, being purple black with a merely thin and paler midnerve, lacking a conspicuous green mid strip. Further, C. Bigelowii has only one staminate spike and it is less than 2 cm long. Very easily confused with C. stricta from which it differs mainly in its mode of growth. Fragmentary specimens that lack the basal portion of the plant can only be guessed at.

109X. C. halophila Nyl. (C. subsalina Lepage) -- Hybrid with C. salina or perhaps merely intermediate between the two. Scales short and the achenes grooved, or the scales long and cuspidate but the achenes not grooved. Churchill. -- (K-Mack, L)-NF, Q-(O)-nMan, (Eur).

110. C. stricta Lam. (var. elongata (Böck.) Gleason; C. Emoryi Dewey) -- Most basal sheaths, bladeless or not, are thinly membranous on the ventral side and the membrane is reinforced by elongated nerves; soon it disintegrates to a pinnate reticulum of nerves. Stem strongly scabrous from base to top on the angles, the latter sharp and very thin, the sides being strongly concave. A rather large species, up to 1 m high, growing in dense clumps. Leaf bases brown, often fibrillose ventrally. Lowermost leaves reduced to pointed and bladeless sheaths. Inflorescence elongate, of numerous, thin and elongate spikelets, mostly 3-4 mm wide, subtended by elongate leafy bracts. Mid or late spring. Marshy meadows and shores. -- NS, NB-seMan, US, Eur.

Of the reported Manitoba collections: S. Criddle, Treesbank, June 29, 1939 (DAO) and some of the Otterburne collections (MT, QFA) reported by Löve 1959 were revised to C. aquatilis, while Breitung 7595a, Sasaginigak Lake, July 8, 1949 (DAO) was revised to C. lenticularis. But the Pine Ridge col-

lection (CAN) and one of the Otterburne collections are herewith confirmed and represent the known western limit of the range of the species.

42. CRYPTOCARPAE

Achene constricted across the middle (i.e. obpanduriform) or with a deep transversal groove across one face, or with a deep notch on one angle. As in the last section the achenes are lenticular and the stigmas two, but the peduncles usually longer, hence the pistillate spikelets are drooping.

111. C. crinita Lam. var. crinita -- A large forest species with long aristate scales. Stems \pm scabrous, mostly around 1 m high, rising at an angle and forming an open tuft. Inflorescence conspicuously secund, the many greenish spikelets elongate and drooping. Perigynia inflated and abruptly short-stipitate. Late spring. Wet woods. -- (NF-SPM), NS-sMan, US.

Our only voucher is in need of confirmation. It is a W.N. Denike collection in 1940 at Winnipeg (DAO). But some of Denike's labels at DAO appear to record a point of mailing in lieu of a place of collecting. The general distribution of the species suggests that it could occur in southeastern Manitoba where Denike did much of his collecting.

Our variety is less scabrous, at least the leaf sheaths being smooth, and the body of the scale is retuse or truncate at summit. Grades into the more eastern var. gynandra (Schwein.) Schwein. & Torr., the herbage scabrous throughout, the body of the scale acutish at tip, and the perigynia rather strongly flattened.

112. C. paleacea Wahl. -- A seacoast species with long aristate scales. Stem smooth. Up to 1 m high and stoloniferous. Inflorescence secund; all the spikelets on long peduncles and drooping, even the terminal one. Spikelets more deeply coloured because of the scale bodies brown to deep purple. Perigynia strongly flattened. Late spring. Salt marshes at York Factory. -- seK, L-SPM, NS-nMan, neUS, Eur.

An inland report by Hooker 1839 for Cumberland House was based on a Drummond collection. It was quite naturally discounted by Scoggan 1957. Actually, Drummond's collection is labelled "Cumberland House to Hudson's Bay", i.e. York Factory at the mouth of Hayes River. See also under Helianthus divaricatus and Carex plantaginea. Greenland reports are possibly based on a mislabelled Vahl collection (GH).

113. C. salina Wahl. var. salina -- Intermediate between the Acutae and the Cryptocarpae, the scales acutish to cuspidate, but never long aristate, yet mostly longer than the perigynia. Achene (like the last two species) with a deep transverse groove across one of the faces. Highly variable and

resembling C. aquatilis and C. lenticularis. Phyllopodic, coarsely stoloniferous, forming a loose carpet. Mostly 2-3 dm high, the stem smooth, weakly triangular, rounded on the angles. Staminate spike solitary, rarely 2, less than 2 cm long except in some of the larger individuals. Scales with 3 rugose nerves delimiting a central green zone, the margins brown or red brown to deep purple, the midnerve usually excurrent into a short awn, the latter not longer than the body of the scale. Late spring. Saline meadows along the seacoast. -- (sG, K), L-(NF-SPM), Q-nO-(nMan), nwEur -- Var. subspathacea (Wormsk.) Tuck. -- On the tidal flats a small stoloniferous herb with spikelets overtopped by bracts dilated as described below. Generally less than 2 dm high. Staminate spike less than 2 cm long. Lowest bract about 2 mm wide at base, enlarging slightly upwards to about 3 mm and tending to be wrapped about halfway around its spikelet, hence its varietal name. Scales usually smaller and about as long as the perigynia, the tip awnless, merely acutish to short acuminate. Tidal flats. -- G-Aka, (L)-NF, Q-nO-(nMan), Eur.

The only Manitoba (MT) collection seen of C. salina could not be determined positively as to variety.

Not to be confused with members of the Acutae, especially with C. Bigelowii (which see), C. stricta and C. aquatilis. In C. salina the scales are usually cuspidate, the stem is nearly round and the achene is deeply grooved. Occasional achenes will lack this groove and smaller plants may have merely acutish scales. Such smaller plants of C. salina can still be recognized by their darker, thinner, generally monochromous, and slightly clavate spikelets; typically all the spikelets are purple-black because the perigynia are well covered by the scales, these being about as wide and slightly longer than the perigynia, and their green midnerve is quite thin; the pistillate spikelets are only 3-4 mm thick and thickest above the middle, gradually tapered below because the lowermost perigynia barely overlapping; the staminate spikelet is the same colour as the others.

In C. stricta and C. aquatilis, the terminal spikelet is paler: brown or straw-coloured; the pistillate spikelets are often thicker, and cylindric, the perigynia being much more crowded and uniformly so; further the pistillate spikelets are bicolor, the green perigynia being only half covered by the shorter and narrower scales, these red brown or purple red.

The european C. salina var. mutica Wahl. (= C. halophila Nyl. nm. flavicans (Nyl.) Boivin) was reported from Greenland, Hudson Bay and Cumberland House by Hooker 1839 and Macoun 1888. The exact basis of the Greenland and Hudson Bay reports has not been determined. The Cumberland House report was likely based on a misidentification, C. salina being strictly a seacoast species.

There is a fair amount of disagreement at present about the segregates of C. salina. Gleason 1952 does not even mention them. Fernald 1950 recognizes four varieties. Scoggan 1978 recognizes three varieties. Mackenzie 1935 recognizes three species. In 1967 we recognized two varieties. Tentatively we now recognize four varieties connected by numerous intermediates: var. salina, var. tristigmatica Klük, var. subspathacea, and var. kattegatensis (Fries) Almq. Alternately we could recognize three species and one variety: C. salina var. salina, var. tristigmatica, C. subspathacea and C. recta Boott; the intermediates would become a network of six interspecific hybrids. Obviously such a weak genetic barrier does not militate in favour of recognition at specific level.

43. ORTHOCERATES

In previous sections the style is of a different texture and colour from the ovary. As the achene matures, the style withers, as abscission layer is formed and the style, or its upper part, frequently falls off along with the stigmas. In this section and all the following ones, the style is of the same colour and texture as the achene. At maturity the style hardens and remains on the achene, although the stigmas may break off. In this section the inflorescence is reduced to a single androgynous spikelet which lacks a bract at its base.

114. C. microglochin Wahl. var. microglochin -- Closely resembling the next, but smaller, and the rachilla present. Stem trigonous or more commonly polygonal (6 angles). Leaves all basal, the 2 or 3 main ones subequal in length and nerveless ventrally. Perigynia more numerous, containing a rachilla which protrudes at the beak as a sharp point exerted by 1-2 mm. Perigynium only 3-4 mm long, but seemingly 4.0-5.5 mm long if the rachilla tip is included. Late spring to early summer. Bogs and wet places over shallow bedrock. -- G-(seF)-K-Aka, (L)-NF, Q-nMan, swAlta-eBC, wUS, Eur.

Quite rare in our area and we have checked specimens only from Churchill (DAO), Eisenhower Junction (DAO), Sunwapta Pass (DAO), Kananaskis Lake (DAO) and Lake Louise (DAO). From the Equator south to Tierra del Fuego it is replaced by the taller var. oligantha (Boott) Klük. with a laxer spike and stipitate perigynia.

115. C. pauciflora Lightf. -- A noticeable small bog species with a single terminal spike bearing a few elongate perigynia which become reflexed at maturity. Stoloniferous and sparse species with nearly filiform leaves, these strongly heteromegath, the main one being 2-5 times longer than the next, and finely nerved ventrally, with the upper face showing a whitish band in lieu of the midnerve. No rachilla, only the brown style may protrude from the beak by up to 1 mm. Scales

soon deciduous. Late spring. Sphagnum bogs, rare: Lac-du-Bonnet, Caribou Bog, Reindeer and Athabaska lakes, Fedorah. -- (swY)-sAka, L-SPM, NS, NB-BC, nUS, Eur.

44. FOLLICULATAE

Perigynium narrow, lanceolate or narrower, and long attenuate into a poorly defined beak, thus resembling the last section, but there is more than one spikelet. In the sections that follow the perigynium is commonly ovoid and abruptly contracted into an obvious beak. In this and the remaining sections the bracts are relatively large, the lowest one will almost always overtop the inflorescence and is usually not much narrower than the basal leaves; also the perigynia are fairly long, hence the spikelets are rather fat, 1 cm thick or more. In this and in 48. Lupulinae the perigynia are longest, 10 mm long or more.

116. C. Michauxiana B&C. -- Perigynia narrowly lanceolate and second longest, mostly 10-12 mm long and \pm 2 mm wide. Spikelets typically 3, the staminate one hidden between the pistillate, the latter two crowded into a globular cluster. A fourth spikelet is often present and usually remote by 5-10 cm. Bracts long overtopping the inflorescence. Perigynia tapered into a long beak. (Early summer?). Very wet bogs, especially boggy shores. -- L-SPM, NS, NB-O, nwS, neUS, (eEur).

Known by only two collections in our area: Argus 491-63, Lake Athabaska, east of William River, bog island, 31 July, 1963 (DAO, SASK) and Tenier & Jasieniuk 2237 collected in 1973 at the south end of Reindeer Lake (SASK). Apparently a range disjunction of more than eight hundred miles from Lake Superior region. Or perhaps this species is only overlooked across the northern parts of our area since it is a denizen of the wettest and softest pioneering fringe of bogs.

45. PSEUDO-CYPERAE

Pistillate scales aristate, the awn usually as long or longer than the blade. In related sections the scales are awnless or the awn is very short. Only one staminate spike in this and the last section, but in the remaining sections there is usually 2-3 staminate spikes. Perigynia numerous and crowded, widely divergent to somewhat reflexed, especially the lower ones. Lowest bract not more than twice as long as the inflorescence.

117. C. hystericina Muhl. (C. hystericina sphalm.) -- \pm pendulous spikelets of green and widely spreading perigynia. Tufted. Scales with a short body hidden between the perigynia and abruptly contracted into a usually longer and scabrous awn, the latter protruding between the perigynia. Beak of the peri-

gynium thin, \pm 2 mm long. Late spring. Mainly springy places; infrequent. -- NF, NS-S-(Alta)-BC, US.

It seems fairly obvious that the original spelling hystericina was a lapsus calami for hystricina since the original place of publication provides a rather descriptive German equivalent (Stachelschweinartige Segge), which corresponds roughly to C. hystricina (porcupine-like), but not to C. hystericina (hysterical), of obscure connotation, unless it be a misspelling.

118. C. Pseudo-Cyperus L. -- Pretty much like the previous, but the perigynia falcate, somewhat flattened, more or less reflexed and more gradually tapering into a shorter and poorly defined beak. Early summer. Rather rare: shaded shores and swampy places; lake Eden eastward. -- NF, NS-Alta, US, Eur, (Afr).

46. PALUDOSAE

Perigynium wall thickish and firm, with numerous (15-20) and strongly marked nerves. Lowest bract up to twice as long as the inflorescence. Almost invariably with 2 or more staminate spikelets.

119. C. lacustris W. var. lacustris -- A coarse species with fusiform perigynia and 2-3 spikelets of each sex. Stem thick and rather easily crushed below, the lower part of the plant often up to 1 cm thick. Rather tall, tufted and often around 1 m high. Basal sheaths eventually disintegrating as in C. rostrata. Pistillate spikelets coarse, ascending, remote, subtended by large leaf-like bracts, the lowest of which overtops the inflorescence. Scales with a broad green center and lateral bands in purple brown. Perigynia green, lanceolate, with 15-20 nerves, gradually tapering into an ill-defined and very short beak, about 1 mm including the teeth, the latter usually triangular and around 0.5 mm long. Early summer. Shores and wet ground, frequent. -- (NF), NS-Alta, US.

The more eastern var. laxiflora Dewey barely enters Canada in southwestern Ontario. It has larger perigynia, \pm 7 mm long and \pm 2.5 mm thick and the scales ending in a short awn reaching about the top of the perigynium.

120. C. laeviconica Dewey -- Teeth of the perigynia subulate and rather elongate, 0.8-1.8 mm long. Otherwise much as in the preceding, but tending to be smaller, mostly 5-6 dm high, the stem thinner and firmer, the base of the plant usually 4-6 mm thick, the sheaths disintegrating as in C. vesicaria, the perigynia fatter, rather similar to those of C. atherodes, ellipsoid-lanceolate, 5-7 mm long, often obscurely puberulent, the nervation coarser, the nerves tending to become as thick as the internerves, the beak longer, more obvious, and usually

2-3 mm long including the teeth. Late spring. Infrequent in marshy places, usually in alluvial woods, from the Lake of the Woods west to Moose Jaw and Big Meadow -- wO-sMan-seS, cUS.

One collection dated 1888 is labelled Lake of the Woods, Canada (MT). It has never been confirmed and, for the lack of a more precise location, cannot be assigned to a particular province, or state.

121. C. atherodes Sprengel -- A coarse and pilose species, common about sloughs. Around 1 m tall. Densely pilose near the top of the sheaths and on the back of the leaves near the base. Bracts nearly as large as the leaves. Perigynia 7-9 mm long, lanceolate, the beak ending into 2 very sharp and usually recurved teeth 1.8-3.0 mm long. Early summer. Common on muddy shores in non saline areas. -- Mack-Aka, swQ-BC, US, Eur -- F. imberbis (Gray) Boivin (f. glabra AA.) -- Herbage glabrous throughout; possibly an ecological reaction to higher water levels. Recorded from Park Bay. -- (Mack-Y), O, (S), (Eur).

One collection from Sifton, Sask. (MT) is unusual in its slightly pilose perigynia.

F. imberbis (Gray) stat.n., Carex trichocarpa Muhl. var. imberbis Gray, Man., ed. 5: 597. 1867. Not f. glabra (Uechtr.) Lepage which belongs with the paleogean C. aristata Br.

The Yukon report of f. glabra was based on pilose material (DAO).

C. atherodes is easily recognized by its unusual pilosity, but the occasional glabrous specimen is apt to be confused with C. laeviconica. The latter tends to be a smaller plant, mostly 5-6 dm, hence merely doubled up on the herbarium sheets, and the leaves are usually 5 mm wide or less. C. atherodes is usually bent over twice and its leaves are mostly over 5 mm wide. Better criteria are derived from the length of the perigynium and its teeth. Further, the perigynium of C. atherodes is so gradually narrowed into the beak that it is difficult to say how long the beak is, while in C. laeviconica there is a definite change in curvature at about one mm below the base of the teeth.

47. VESICARIAE

Closely related to the last section from which it differs mainly by its perigynium being thin-walled and with only 8-10-(12) expressed nerves. Lowest bract varying from somewhat shorter to twice longer than the inflorescence.

122. C. saxatilis L. var. saxatilis (var. miliaris (Mx.) Bailey) -- Stigmas 2 and the achene lenticular, otherwise resembling the next few species. Pistillate spikes tending to be short, usually less than 2 cm long, or even less than 1 cm, dark

purplish and erect to ascending on fairly short peduncles. Perigynia 2.5-4.0 mm long. Scales dark purple, but hyaline at tip for the last half millimeter or so. Early summer. Open shores and peaty margin of montane or arctic pools. Waterton and from northern Saskatchewan eastward. -- G-sMack, L-NF-(SPM), NS, NB-O-(Man)-nS-swAlta, (neUS), Eur -- Var. major Olney (var. rhomalea AA., ssp. laxa Kalela; C. physocarpa Presl) -- Lower spikes on longer peduncles and drooping. Often a larger plant with longer spikelets, mostly 2-3 cm long. Darker, the perigynia and scales entirely or mostly purple black. Perigynia bigger, 3.5-5.0 mm long. -- F-Aka, L, nQ-nO-nMan-nS-swAlta-BC, nwUS, Eur.

There is much integrading between our varieties, yet taken as a whole the material from west and north of our area has the drooping and fatter (i.e. longer perigynia) spikelets of var. major, while the specimens from eastward have the thinner and ascending spikelets of the typical phase. Most specimens seen from northern Saskatchewan were intermediate one way or another. As pointed out by Hudson 1978 the material from our area seems to form a single population and the recognition of two varieties in our range is clearly arbitrary. However the distinction is maintained because it becomes significant elsewhere.

123. C. vesicaria L. (C. inflata Hudson; ? C. Raeana Boott) -- A coarse species rather similar to C. rostrata, especially the scales and perigynia. Loosely tufted, the stem scabrous in the upper third. Leaves tending to be narrower, not over 5 mm wide, and usually not obviously nodulose to the naked eye. Sheaths membranous and nerved on the ventral side, eventually disintegrating on that side, but the nerves more persistent and holding together in a herringbone pattern because they are pinnately connected to the stronger midnerve. Perigynia 4-7 mm long, commonly 5-6 mm, the body 3-4-(6) mm long, ovoid or ellipsoid, abruptly contracted into a well defined 1-2 mm beak, the nerves set 0.7-1.0 mm apart and mostly 3 to each face (i.e. exclusive of the pair of marginal nerves, hence 5 nerves are usually visible simultaneously). Late spring. Marshes. -- L-SPM, NS-seMan, US.

At first there were so many sheets from our area filed as C. vesicaria and so many printed reports that it was expected to be a common species. But, only one sheet proved correctly identified: A.J. Breitung 7630, Sasaginnigak Lake, 1949 (DAO). All other western Canadian sheets at DAO were revised in 1964 to C. exsiccata (the B.C. collections) or C. laeviconica, but mostly to C. rostrata. The Manitoba collections at WIN were mostly (including Buller at Winnipeg) of C. laeviconica, with one sheet each of C. atherodes, C. rostrata (i.e. Bisby at Norway House) and C. retrorsa. The Saskatchewan reports of Fraser 1937 and Russel 1954 were based on sheets (DAO, SASK)

since revised to C. rostrata. The Ledingham 1943, Russell 1944 and Breitung 1957 mentions were based on a Trossachs (SASK) collection revised by J.H. Hudson to C. laeviconica. More recent collections at SASK were also revised to C. rostrata.

At TRT we found one sheet from Manitoba, two from Saskatchewan, and one from Alberta, all have been revised to C. rostrata. At MTMG an Alberta sheet from the Rockies was revised to C. saxatilis var. major. Four Alberta sheet at CAN were revised to C. rostrata and so was one B.C. sheet, Macoun 63 303, Rossland, 1902, which had been named C. vesicaria by Mackenzie. Five more B.C. sheets at CAN were revised to C. exsiccata, including one named by Mackenzie: Macoun 63 301, Sophia Mt., Cascade, 1902. Another B.C. report by Macoun 1888 (sub. C. monile) was based on Macoun 31163, Donald, 1885 (CAN) later revised by Fernald to C. Grahamii Boott and more recently revised to C. anticostensis (Fern.) Lepage, the putative hybrid of C. saxatilis X vesicaria. And the many Alaska reports were referred by Hultén 1942 to C. rostrata or C. membranacea. Calder 1968 failed to find any B.C. material in the herbaria he visited. At QFA a Saskatchewan and 2 Manitoba sheets were revised to C. rostrata, while a B.C. sheet was also revised, but record was not kept of its final disposition.

The Alberta report by Moss 1959 was based on two Waterton collections: Porsild & Breitung 15102 (ALTA) and Breitung 17124 (ALTA), the latter also the basis for a report by Breitung 1957. Both specimens have perigynia 5-7 mm long, but the first one has diseased perigynia and the second one is largely sterile, with the longer perigynia being the sterile ones. Both belong to C. rostrata.

Thus, with the exception of the first Breitung collection cited above, and despite a wide variety of reports to the contrary, we have yet to come across tangible evidence of the occurrence of C. vesicaria in our area. Our west or northwest of it.

C. Raeana was originally described from Methye Portage, but has never been recollected in the type region. It is customary to associate C. Raeana with C. vesicaria either as a variety or a mere synonym; this now seems an unlikely solution since C. vesicaria does not appear to reach as far west as the Red River. The type of C. Raeana should be reexamined; it could prove to belong to C. rostrata or to one of the minor variants described by Hudson 1978.

124. C. rotundata Wahl. var. rotundata. -- Lowest bract sharply bent at the base of the blade and spreading to reflexed. With the general characteristics of the last few and next few species, but the scales darker and the perigynia shorter. Leaves 1-3 mm wide, channelled or the margin involute. Scales with a green central band and two marginal bands red-brown or

darker. Perigynia 3-4 mm long, spreading or more commonly reflexed. First half of summer. Wet tundra. -- sF-Aka, nL, nQ, nMan, Eur.

In north America and in eastern Siberia the range of variation in leaf width is greater than in the rest of the Eurasian range of the species. On that basis two varieties have been distinguished. The typical phase is narrow-leaved. Var. compacta (Br.) Boivin (= C. membranacea Hooker; C. membranopacta Bailey) will designate such plants as have broader leaves, the larger ones up to 3-5 mm wide and flattish, or channelled towards the base only. This second variety is expected to turn up in our area sooner or later, since both varieties seem essentially sympatric in the North American part of their range. There is also a visually important statistical intervarietal difference in the number of spikelets. True, the range of variation is about the same in each: 2 to 4 spikelets in var. rotundata and 2 to 5 spikelets in var. compacta. But the frequency is not the same and by far. In a very large majority of the specimens var. rotundata has only 2 spikelets, one staminate, one pistillate, while var. compacta will most commonly bear 3 spikelets, one staminate, two pistillate.

Early reports of C. membranacea from Churchill were repeated by Scoggan 1978 although they were discounted earlier by Scoggan 1957. Perhaps an error of compilation.

Carex exsiccata Bailey is another species with a reported range far in excess of herbarium justification. Its inclusion by Moss 1959 in his Flora of Alberta was a speculative entry, while the listing by Boivin 1967 was based on a diseased specimen of C. rostrata: E.H. Moss 679, Akamena Pass, 1939 (DAO), originally identified as C. vesicaria. The Saskatchewan reports of Russell 1954, Breitung 1957 and Boivin 1967 were based on a somewhat atypical collection of C. retrorsa: G.F. Ledingham 1106, Lac-la-Ronge, bank of Montreal River 1958 (DAO). The Mackenzie report by Louis-Marie 1961, queried by Boivin 1967 and Scoggan 1978, was based on a sheet of C. rostrata: A. Dutilly 8036, Fort Smith, 1940 (MTJB, QFA). Earlier Alaska reports were discounted by Hultén 1942, but Calder 1968 reinstated it on the basis of a Ketchikan Lakes collection (DAO). Said specimen is far from typical: the perigynia are very short, often slightly arched outward, the elongate spikelets, 7-8 cm long, are drooping and borne on elongate pedicels, yet it is probably best left associated with C. exsiccata. Thus C. exsiccata is definitely known in Canada only from B.C.

125. C. rostrata Stokes (C. inflata Hudson, var. utriculata (Boott) Druce) -- A rather coarse species with the foliage obviously and abundantly septate-nodulose. Long stoloniferous, otherwise similar to C. lacustris by its thick, soft and spongy bases and its inflorescence, and to C. vesicaria by its perigy-

nia. Basal bladeless sheaths usually absent. Stem smooth throughout or nearly so, obtusish on the angles. Leaves very variable, commonly 5-8 mm wide and usually overtopping the inflorescence, as do the leaf-like bracts. Sheaths membranous and nerveless on the ventral side, the weaker part breaking up into irregular plates. Perigynia 4-5 mm long, rarely more, with the nerves about 0.5 mm apart and mostly 5 to each face, hence 6-8 nerves are usually visible simultaneously. Teeth (0.2)-0.3-0.5-(0.7) mm long. Early summer. Swampy places. -- sG, seK-Aka, L-NF-(SPM), NS-BC, US, Eur.

Larger plants have been segregated as var. utriculata (Boott) Bailey, smaller ones as var. borealis Kük. Both extremes may be little more than the effect of ecological conditioning; both have essentially the range of the species, but the one becomes more common southward, the other more frequent northward. The inverse correlation of size and latitude is the usual signature of an ecological response.

Rather similar to C. vesicaria and readily confused with it, especially in the herbarium. C. rostrata produces single stems (sometimes paired) that are borne 1 dm or more apart along a coarse rhizome. C. vesicaria is more gracile and loosely tufted or borne less than 1 cm apart along a thinner and much less deeply buried rhizome.

In the herbarium the distinction is less obvious since both species are hard to dig up and nearly all specimens, especially those of C. rostrata, will lack a convincing piece or rhizome. C. rostrata is usually recognized by its smooth stem and commonly larger leaves and bracts: the beak of the perigynium has usually shorter teeth; the body of the perigynium has more nerves, hence they are more closely set. And the nodulosity of the foliage is more conspicuous in C. rostrata. But each of the latter criteria will fail on occasion.

126. C. retrorsa Schwein. -- Coarse spikelets of retrorse perigynia, subtended by very long bracts 2-6 times longer than the inflorescence. Otherwise a coarse species, much as in C. rostrata but tufted. Spikelets very coarse, somewhat crowded, or the lower 1-2 sometimes remote and borne on pedicels rather short. Perigynia large, 7-10 mm long, somewhat falcate, the body ovoid, the beak about half as long. First half of summer. Wet woods and shores. -- swMack, NS-BC, US.

127. C. oligosperma Mx. var. oligosperma -- Perigynia rather large but not ending in a pair of sharp teeth, merely emarginate at tip and ending into a pair of small roundish lobes. Mostly (4)-6-(8) dm high. Rather similar to the last few species but the foliage narrow, the staminate spike solitary, the pistillate spike only one or sometimes two, ovoid to subglobular, mostly \pm 1 cm long, small, few-flowered, very remote, sessile or short pedunculate and subtended by a seta-

ceous yet elongate bract. First half of summer. Wetter bogs in the extreme north. -- (Mack), L-SPM, NS, NB-O-(Man)-nS-(neAlta), neUS.

Far Eastern reports are referable to var. tsuishikarensis (Koidz. & Ohwi) Boivin (stat. n., C. tsuishikarensis Koidz. & Ohwi, Journ. Fac. Agr. Sapporo 26: 273, 1931). This vicariant has not been recognized by all Japanese authors because it intergrades with the typical phase in all its diagnostic criteria; granted. However it seems sufficiently well characterized for recognition at the varietal rank. Far Eastern specimens will be usually distinct by their somewhat smaller size (2)-3-(5) dm, the inflorescence of a darker colour because of the broadly purplish scales, the spikelets more often two than one, the lower one ellipsoid and mostly 1.5-2.0 cm long.

48. LUPULINAE

Perigynia longest, 10-20 cm long. Otherwise much like the last section, the perigynia similarly inflated and the bracts leaf-like, the lowest usually 2-4 times longer than the inflorescence. Staminate spike sometimes solitary, commonly 2-(4). Perigynia with more nerves, usually 12 or more.

128. C. intumescens Rudge (var. Fernaldii Bailey) -- Perigynia longest, mostly 12-15 mm long and about 5 mm thick, in 1-3 globose to ovoid spikelets. Tufted. Bracts leaf-like and very long. Mid spring. Wet woods. -- NF-(SPM), NS-seMan, US.

The Norway House record seems unlikely.

An earlier Manitoba report of C. lupulina Muhl. was discounted by Scoggan 1957. There is also an unreported sheet labelled I.L. Hargrave, St. Remi, Man., 1882 (MTMG), but we are inclined to think that this and other similarly labelled Hargrave collections (e.g. C. plantaginea, etc.) more likely came from Saint-Rémi, Quebec.

Order 72. GRAMINALES

126. GRAMINEAE

(GRASS FAMILY)

The Grasses were originally scheduled for a separate publication, but they will likely be published as part V of this flora along with the general index, the bibliography and the glossary.

However the various taxonomic innovations in the Grasses will be presented immediately in order to lessen the awkwardness of names being used in the herbarium long before their actual publication.

Agropyron Bowdenii hybr. n., verosimiliter hybridus A. spicatum X trachycaulum. Differt ab A. trachycaulo foliis inferne laevibus, superne dense puberulentibus; glumis oblan- ceolatis, nonnunquam glabris; lemmatibus aristatis, aristis valde divergentibus. Differt ab A. spicato glumis majoribus, 7-11 mm long., arista (si adest) exclusa; aristis lemmatum amplioribus, (1.0)-1.5-2.0 cm long.; antheris 1.5-2.5 mm long. Typus: Dore & Breitung 12224, 5 miles SW of Twin Butte, Alta., natural submontane dry meadow, tufted species, many culms to a clump, Aug. 1, 1950 (DAO).

Isotypes were distributed as A. Bakeri (ALTA, G, US).

Agrostis borealis Hartman var. californica (Vasey) Koyama, stat. n., A. Hallii Vasey var. californica Vasey, Contr. U.S. Nat. Herb. 3: 74. 1892; A. alaskana Hultén; A. borealis Hartman var. paludosa (Schribner) Fern., A. melaleuca Hitchc.; A. ore- gonensis Vasey.

Agrostis borealis Hartman var. recta (Nash) stat. n., A. tenuiculmis Nash var. recta Nash, Mem. N.Y. Bot. Gard. 1: 32. 1900; A. idahoensis Nash.

Digitaria sanguinalis (L.) Scop. var. rhachiseta (Henrard) stat. n., D. adscendens (HBK.) Henrard var. rachiseta Henrard, Mon. Gen. Dig. 11. 1950.

Festuca occidentalis Hooker var. oregona (Hackel) stat. n., F. ovina L. var. oregona Hackel ex Beal, Grasses N.A., 2: 599. 1896.

Melica Hitchcockii sp. n. sectionis Bromelicae, Herba 5-8 dm alt, omnino leavis nisi foliis scaberulis in margine et dor- saliter ad summas. Caespitosus, culmis parum si vero ad basas bulbosis. Folia omnia caulinarum, 12-17 cm long., 5-7 lat., ad basas gradatim dimidio attenuata. Ligula \pm 3 mm long., ovata. Inflorescentia 7-12 cm long., simplex, clausa, race- mosa, spiculis 5-8. Pedunculus 2-4 dm long., gracilis, elonga- tus, subequans partas foliosas culmi. Pedicelli (0.4)-1.5- (4.0) cm long., appressi. Spiculae alternae vel pro parte minora geminatae, praecipue viridules sed modo purpureo suffu- sae. Flores 4-3 in spicula. Gluma inferna \pm 7 mm long., \pm 1 mm lat., anguste triangulari-lanceolata, uninervia, glabra nisi in medinervo ciliata. Gluma superna \pm 8 mm long., \pm 2 mm lat., lanceolata, trinervia, ad nervos ciliata, ceteris laevis. Rhachis ad extus dense ciliatus. Lemma princeps \pm 10 mm long., 2.0-2.5 mm lat., lanceolatum, quinquenervium, laeve per plagas, pilosum prope marginem et secundum medinervium ad basas, atque secundum nervos externos ad summas, bifida, aristata. Arista circa 1 cm long. Lemma sterilis \pm 5 mm long. Antherae 2.0-2.3 mm long. Typus: C.L. Hitchcock & L.S. Martin 7931a, Alberta, Waterton Lakes Park, in forest ca $\frac{1}{2}$ mile east of Cameron Lake, elev. ca. 5,600 ft, Aug. 7, 1941 (WTU).

Probably to be searched for along the Rockies of Montana and adjacent British Columbia.

Melica bulbosa Geyer var. spectabilis (Scribner) stat. n., M. spectabilis Scribner, Proc. Ac. Nat. Sc. Phil. 37: 45. 1885.

Panicum lanuginosum var. papillosum (Schmoll) stat. n., P. ferventicola var. papillosum Schmoll, Madroño 5: 94-95. 1939.

Poa abbreviata Br. var. Jordalii (Pors.) stat. n., P. Jordalii Pors., Can. Field-Nat. 79: 82-83. 1965.

Poa stenantha Trin. var. Sandbergii (Vasey) stat. n., P. Sandbergii Vasey, Contr. U.S. Nat. Herb. 1: 276. 1893. This has often been confused with the Chilean P. secunda Presl, a similar but possibly distinct plant discussed in Am. Journ. Bot. 28: 78-81. 1941.

Schizachne purpurascens (Torrey) Swallen var. callosa (Turcz.) stat. n., Avena callosa Turcz. ex Led., Fl. Ross. 4: 416. 1853.

Stipa comata Trin. & Rupr. var. falcata var. n. Arista 1-2 dm, internodo terminale falcato vel curvato, nec spirali, Type: Carlston & Holstein (N-29) 1718, near Yerington, Nevada, 5-8-39 (DAO).

Stipa spartea var. intermedia (Scribner & Tweedy) stat. n., S. comata var. intermedia Scribner & Tweedy, Bot. Gaz. 11: 171-2. 1886.

Torreyochloa pallida (Torrey) Church var. natans (Kom.) stat. n., Glyceria natans Kom., Rep. Sp. Nov. 13: 86. 1914.

NOTES ON SPATIAL DISTRIBUTION PATTERNS
FOR THREE MEXICAN SPECIES OF BEGONIA*

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ABSTRACT

Nine 25 x 30 meter quadrats were plotted for three species of Begonia at several locations in Mexico in order to determine spatial distribution patterns. These data only superficially describe the patterning for these species. The three species observed were Begonia californica, Brand., B. heracleifolia, Schlechtd. and B. nelumbiifolia Schlechtd. and Cham., the latter two being observed to occur sympatrically in one area of Chiapas. Spatial patterns were analyzed according to abundance (A), frequency (F), density (D), and A/F ratio, clumping behavior, common boundary values (CBV), and sympatric association. B. heracleifolia is found to have the lowest values for A, D, and F, B. californica the next, and B. nelumbiifolia the highest values, though the order is reversed respectively for A/F ratio with B. heracleifolia being the highest and B. nelumbiifolia the lowest. An analysis of clumping behavior indicates that as the values of A, D, F, or A/F increase there is a general increase in the number of individuals occupied in clumps and correspondingly a lower percentage of individuals occurring singly. CBVs indicate that B. heracleifolia has the greatest tendency for contiguous distribution within regional populations in spite of its low A, D and F values and lower number of individuals/quadrat. Distinct patterns of dominance are exhibited by B. heracleifolia and B. nelumbiifolia even though they occur sympatrically within the same quadrat; it is found that 55% of the classifiable groups are comprised of a single species, 30% show a minimum of 75% dominance by one species, and the remaining 15% have between 63% and 66.7% dominance. Distinct habitat preferences are revealed by the sympatry of B. heracleifolia and B. nelumbiifolia around the base of the waterfall where the quadrats were set up; the former species occupies areas closer to the edge of the surrounding forest and the latter being found more frequently near the margin of the pool. No hybridization was observed between these two species.

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INTRODUCTION

While on collecting expeditions in Mexico during several months of 1975 and 1976, I made casual observations on the spatial distribution patterns of three species of *Begonia*. This paper is limited in data and thus makes no attempt to provide a complete description of the spatial patterning for the three species, but is a systematic approach to the observations made.

The recent applications of spatial distribution patterns among plant groups are varied, and several have involved work in tropical environments. Fedorov (1966) concluded that tropical tree families, often represented by many species, frequently occur in low densities and the individuals within a given regional population often are isolated from each other, even in cases where the species was very abundant. Contrary to Fedorov's work are the results of Poore (1968), who points out that contiguous distribution of individuals is common among certain rainforest tree taxa. Ashton (1969) reports on spatial distribution patterns and speciation among tropical forest trees in West Sarawak, Borneo, with particular references to species in the Apocynaceae, Dipterocarpaceae, Moraceae, and Sapotaceae. Working in Costa Rica, Bawa and Opler (1977) report on the spatial patterning of staminate and pistillate taxa within the Meliaceae, Rubiaceae, and Polygonaceae. Also working in tropical lowland rainforest of Costa Rica were Richards and Williamson (1975) who report on the patterns of understory species following large tree-falls. Though not specifically dealing with spatial distribution, there is a study by Smith (1975) on the distribution of herbaceous angiosperm species in the mountains of New Guinea. A number of distribution pattern studies have been carried out among north temperate climate plants. Day and Monk (1974) analyzed an Appalachian watershed community in terms of several topographic parameters. Distribution patterns of two species of *Artemisia* were studied in relation to certain environmental factors including soil preferences, ion exchange variances, and distribution of other plant species (Hazlett and Hoffman, 1975). Two evolutionary studies utilizing distribution patterns were conducted on the Cruciferae: Solbrig and Rollins (1977) mention distribution patterns in their investigations on the autogamy of *Leavenworthia* and the patterning of Pierid butterfly eggs on various Southern Rocky Mountain cruciferous plants has been carried out by the Chews (1977). The distribution patterns of *Thymelaea hirsuta* (L.) Endl. and its associated flora was analyzed along the Mediterranean coast of Egypt by El-Ghonemy et al. (1977).

The Begoniaceae is a small family characterized by the genus *Begonia*, which has approximately 1600 species (Barkley and Golding 1972), though new species are being discovered with additional exploration. The Begoniaceae are found geographically in the tropics worldwide and in some semi-tropical areas. Field observations on

my part from countries in the neotropics and old world tropics indicate that Begonia has a preference for stream margin habitats, though other habitats are encountered. Regal (1977) points out that the unstable stream margin habitat of the tropics is an ancient ecosystem. Several other characteristics of Begonia are of botanical interest also: 1) Species of Begonia are monocious. Observations from growing about 75 species in cultivation indicate that the staminate flowers always appear before the pistillate flowers, 2) medullary and cortical vascular bundles are found in certain taxa of the genus (Debary 1884), 3) a high frequency of polyploidy is present within the genus (Darlington 1955) and (Legro and Doorenbos 1969, 1971), 4) the presence of residual meristematic potential of the leaves of many species have the capability of reproducing new plants (Howard 1974), and 5) the stomata of many species of Begonia occur in distinct clumps, where each stoma is separated by subsidiary cells and the clumps themselves are separated by epidermal cells (Barkley, personal communication and Hoover, unpublished results).

Clumping behavior was observed for several species of Begonia in Colombia, of which two occurred sympatrically in close association, B. hexandra Irm. and B. toledana Smith and Schubert (Hoover 1974). Unlike the investigation of spatial patterning of tropical rain forest trees, this study involves patterning of herbaceous plants. Table 1 lists the geographical and regional locations, elevation, latitude and longitude, and habitat of the quadrat positions for B. californica, B. heracleifolia and B. nelumbiifolia. Figure 1 is a map showing these geographical locations. The latter two species are represented by many collections in the Gray Herbarium and Missouri Botanical Garden. Review papers and general studies on the subject of plant spatial distribution are reported in the works by Goodall (1952), Grieg-Smith (1964), and Kershaw (1964).

METHODS

At this time, the reproductive biology of these species of Begonia is not known, which does raise questions concerning the concept of the individual within the quadrats mapped. An individual in this study is considered as any separate or distinct organism, independent of the possibility that it may have been reproduced vegetatively. Vegetative reproduction, which may frequently occur within Begonia, will result in plants that have identical genetic systems. The concept of the individual in a clonal population is an interesting idea and much could be said about this problem.

A quadrat size of 25M x 30M was chosen as the standard. This size was adopted from Day and Monk (1974), who chose a 25M x 50M quadrat for their work in the Appalachians. A smaller quadrat was found to be practical to work with in the tropics on Begonia, because the plants of a particular population rarely occupied an area

larger than 750M². The 25M x 30M plot size remains constant though the position of individual square meters is an estimation. Great difficulty in maneuvering was frequently encountered. Often the areas to be mapped were littered with slippery logs and boulders, or were very steep, vertical in some locations, due to the habitat conditions where one frequently encounters Begonia. Table 1 indicates that all the quadrats, except No. 6 in Sinaloa, were mapped in stream margin habitats.

The calculations of A, D, and F are referred to by Grieg-Smith (1964) and the ratios for determining them are as follows:

$$A == \frac{\text{Total No. of Individuals}}{\text{Number of Occupied Quadrats}}$$

$$D == \frac{\text{Total No. of Individuals}}{\text{Total No. of Quadrats}}$$

$$F -- \frac{\text{No. of Occupied Quadrats}}{\text{Total No. of Quadrats}}$$

The A/F ratio is determined by the following: $\frac{100D}{F2}$

In the section on CBV, a number of standards were adopted. The groups listed as A, B, C, etc. in Tables 4 and 5, and in Fig. 3 are defined according to a minimum separation of two meters between each group. The CBV is a numerical figure consisting of the number of occupied square meters and the number of common borders shared by clumps within the group. A common boundary is when two or more square meters have an adjacent side or a common point, as with two square meters being diagonal to one another.

Selection of quadrats was largely made according to the availability of the plants. Each quadrat except nos. 1 and 2 represents an isolated population of Begonia in the environment. Quadrats 1 and 2 of B. heracleifolia near Palenque, Chiapas, were randomly selected from an entire section of a stream that was occupied with this species. Except for these quadrats near Palenque, the areas occupied by each of the plots likely represents the bulk of an interbreeding population. At the Misola waterfall in Chiapas a few scattered individuals were observed downstream, but the sympatric population was completely mapped; the cliff face occupied by B. nelumbiifolia was not plotted, for mapping would be extremely difficult and hazardous. In Baja California considerable effort was spent trying to locate B. californica and only at the Las Animas area was this species found. The plots for B. californica were made in November 1976, at which time they were observed as dried up, partially decayed vegetative shoots and capsules. It is unknown how many plants were represented in their tuberous form. In Sinaloa, B. heracleifolia was observed in only one area along the road.



Fig. 1 - Geographical Locations of Spatial Distribution. Quadrats.

(X) - Quadrat Locations

TABLE 1

Geographical Locations of Spatial Distributions

for B. californica, B. heracleifolia, B. nelumbifolia

<u>Species</u>	<u>Quadrat Number</u>	<u>Location of Habitat</u>	<u>Elevation</u>	<u>Latitude / Longitude</u>
<u>B. heracleifolia</u>	1	Stream by ruins of Palenque, Chiapas	600-650M	18° / 94°
<u>B. heracleifolia</u>	2	" "	600-650M	18° / 94°
<u>B. heracleifolia</u>	3I	Misola waterfall, Chiapas	600-650M	18° / 94°
<u>B. nelumbifolia</u>	3II	" "	600-650M	18° / 94°
<u>B. heracleifolia</u>	4I	" "	600-650M	18° / 94°
<u>B. heracleifolia</u>	4II	" "	600-650M	18° / 94°
<u>B. heracleifolia</u>	5I	" "	600-650M	18° / 94°
<u>B. heracleifolia</u>	5II	" "	600-650M	18° / 94°
<u>B. heracleifolia</u>	6	Roadside from Mazatlan to Durango, Sinaloa	1500-1700M	23½° / 106°
<u>B. heracleifolia</u>	7	" "	1500-1700M	23½° / 106°
<u>B. californica</u>	8	Cerro el Picacho, Baja California Sur	250-350M	23½° / 110°
<u>B. californica</u>	9	" "	250-350M	23½° / 110°

It may be important to note that the spatial patterning of these species of Begonia is subject to considerable variation through time. The disturbance of the stream margin habitat of the tropical rainforest is very great and may contribute to understanding the variation within the plant groups occupying these habitats.

ABUNDANCE, DENSITY, AND FREQUENCY ANALYSIS

Table 2 presents the data on the number of individuals in a quadrat, and the A, D, F, and A/F ratios. Quadrat 6 for B. heracleifolia in Sinaloa had the fewest number of individuals of all the plots, where 13 plants were counted. Quadrat 6 correspondingly exhibits the lowest values of A (1.2), D (.017), and F (1.5). The largest number of individuals were found in quadrat 5II for B. nelumbiifolia in Chiapas where 135 plants were counted. Quadrat 5II consists of a sympatric association of B. heracleifolia and B. nelumbiifolia, the latter exceeding the other quadrats in A, D, and F also; these parameters respectively being 4.7, .18 and 4.4. As is expected, the greater the number of individuals in a quadrat, the greater the values of A and D, and generally of F, also, but not for A/F. Due to limited data, the A/F ratio yields little information.

The information in Table 3 is an averaging of A, D, F, and A/F for each species. B. heracleifolia has the lowest average number of individuals per quadrat and the lowest values for A, D, and F, though it has the highest A/F ratio. B. californica ranks second in comparison for the 4 parameters, though it is not much greater among any of them, exceeding B. heracleifolia in number of individuals per quadrat only by 6.1 individuals. As was mentioned above, these figures are less than actual for B. californica because it is not known how many individuals were represented in their tuberous form. B. nelumbiifolia exceeds the other two species in all parameters except A/F ratio which is less than the others, being .85 as compared to .89 for B. heracleifolia, and .87 for B. californica. The higher A/F value for B. heracleifolia may be accounted for by its ability to spread out within the habitat the species has invaded; the higher A/F ratio of this species likely corresponds to its greater CBV.

A noticeable difference in the parameters exists between the quadrats plotted for B. heracleifolia in Sinaloa, nos. 6 and 7, and those in Chiapas, nos. 1, 2, 3I, 4I and 5I; the former are represented by fewer individuals and consequently lower A, D, and F values, as Table 3 shows. Quadrat 7 from Sinaloa does exceed quadrat 3 in total number of individuals, D, and F though not in A or A/F. An F value of 2.8 for quadrat 7 exceeds the F values of all other B. heracleifolia, but averages of the parameters of these northern quadrats are less than those from Chiapas. Several factors may explain why the spatial patterning is different between

TABLE 2

NUMBER OF INDIVIDUALS,

A, D, F, AND A/F FOR EACH QUADRAT

Grid No.	Species	Total No. of Individuals	A	D	F	A/F
1	<u>B. heracleifolia</u>	51	3.19	.068	2.13	1.50
2	<u>B. heracleifolia</u>	46	2.56	.061	2.40	1.00
3I	<u>B. heracleifolia</u>	20	1.66	.027	1.60	1.06
3II	<u>B. nelumbifolia</u>	46	2.42	.061	2.53	.95
4I	<u>B. heracleifolia</u>	38	2.38	.051	2.13	1.12
4II	<u>B. nelumbifolia</u>	35	1.75	.047	2.67	.66
5I	<u>B. heracleifolia</u>	51	2.04	.068	3.33	.61
5II	<u>B. nelumbifolia</u>	36	4.00	.181	4.53	.88
6	<u>B. heracleifolia</u>	13	1.18	.017	1.47	.79
7	<u>B. heracleifolia</u>	31	1.48	.041	2.80	.52
8	<u>B. californica</u>	48	2.09	.064	3.07	.68
9	<u>B. californica</u>	36	2.25	.048	2.13	1.06

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TABLE 3

MEAN NUMBER OF INDIVIDUALS, AVERAGE A, D, F, AND A/F

<u>Species</u>	<u>Mean Number of Individuals</u>	<u>A</u>	<u>D</u>	<u>F</u>	<u>A/F</u>
<u>B. californica</u>	42	2.2	.056	2.6	.89
<u>B. heracleifolia</u>	35.7	2.11	.048	3.0	.95
Chiapas	.41.2	2.3	.056	2.4	.97
Sinaloa	22	1.4	.029	2.2	.69
<u>B. nelumbifolia</u>	72.3	2.32	.096	3.21	.92

the southern and northern populations. 1. The latitude is much greater than other latitudes where B. heracleifolia has been collected. (There are no other collections from Sinaloa represented in the Gray Herbarium.) 2. The elevation is significantly higher than the average for the section Gireoudia, which is averaged to be 1,050M (Hoover 1976). 3. Environmental factors, particular soil type and moisture availability may not allow for developed clumps. The plants from Chiapas grew on limestone; in Sinaloa plants from quadrat 6 grew in soil and plants from quadrat 7 grew on rocks in a stream bed, quadrat 7 being the more abundant of the two. 4. Competition from other angiosperms. In Chiapas, the dominant herbaceous flowering plants in the quadrats were Begonia. This was not the case in Sinaloa, for the environment in Sinaloa had characteristics that allowed several different species to live successfully. In Chiapas the factors comprising the microhabitat appeared very specific; thus only certain adaptational characteristics of a plant species, i.e., those found in Begonia, were capable of utilizing this habitat most successfully.

CLUMPING BEHAVIOR: NUMBER OF INDIVIDUALS/CLUMP

Table 4 categorizes the number of clumps in each quadrat, including the percentage of the number of individuals in each clump. Understanding that the data are limited, a trend is observed among A, D and F, and the total percentage of individuals occurring in clumps. As A, D, and F increase, so does the percentage of individuals found in clumps. The plot for A/F does not support or reject a trend with the percentage of individuals occurring in clumps. Quadrats with few individuals exhibit higher percentages of individuals occurring singly; these include quadrats 6, 7, and 3I, six with 69.2% of its individuals occurring singly, seven with 45.2% found singly, and three-one with 45% represented as single individuals.

Quadrat number 5II for B. nelumbiifolia exhibits the greatest diversity in clump size, ranging from 2 to 10 individuals/clump. The population within this plot is considerably greater than the other quadrats also. Comparatively large clumps of 8, 9, and 10 are observed within this quadrat, though only one clump of 8 is observed for B. heracleifolia in quadrat 2 and one clump of 9 for B. californica in quadrat 10. 46.2% of the individuals in quadrat 5II are found in clumps of 8, 9, and 10.

It may be noted that it is not necessarily expected that an increase in A, D, or F would result in an increase of clumping. Besides clumping, other types of spatial development of a plant species are possible: for instance, a more evenly distributed pattern, where single individuals or two or three individuals/M² are possible rather than development of larger size clumps exhibited by these species of Begonia. This observed trend regarding the clumping behavior of these species of Begonia may be a direct

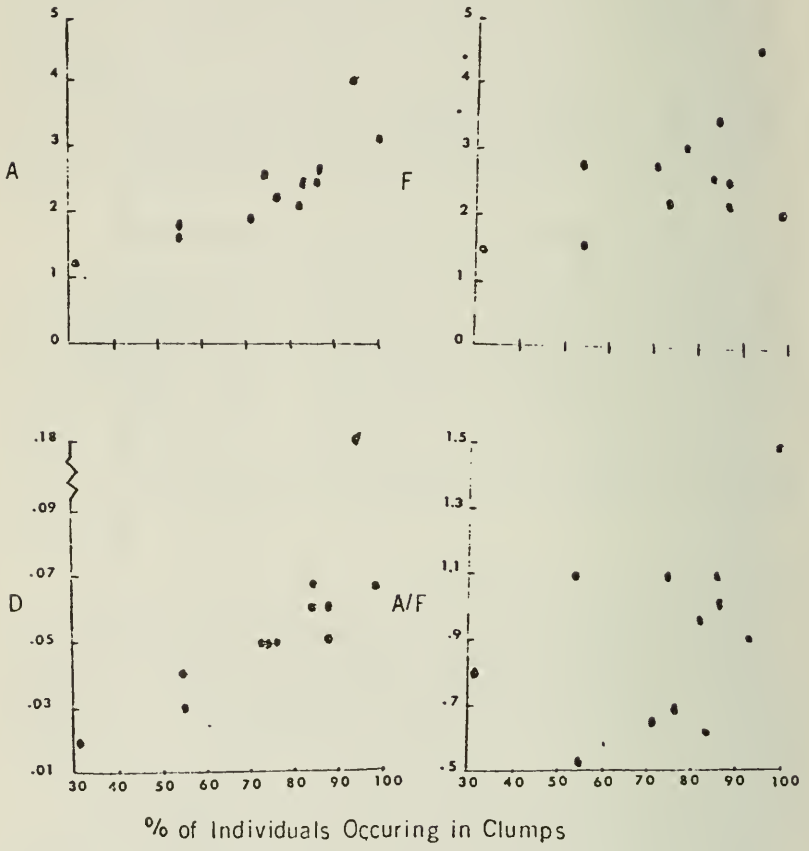
Hoover, Spatial distribution patterns

1979

Grid	NUMBER OF CLUMPS/QUADRATS AND PER CENT OF INDIVIDUALS										Total Per Cent
	1	2	3	4	5	6	7	8	9	10	
1	2(3.9)	5(19.6)	4(23.5)	3(23.5)	1(9.8)	2(23.5)	0	0	0	0	99.9
2	7(15.2)	4(17.4)	3(19.6)	2(17.4)	0	0	1(15.2)	1(17.4)	0	0	87.0
3I	9(45.0)	0	1(15.0)	2(40.0)	0	0	0	0	0	0	55.0
3II	8(17.4)	4(17.4)	3(19.6)	1(8.7)	1(10.9)	2(26.0)	0	0	0	0	82.6
4I	5(13.2)	4(21.1)	4(31.6)	2(21.1)	1(13.2)	0	0	0	0	0	87.0
4II	10(28.6)	6(34.3)	3(25.7)	1(11.4)	0	0	0	0	0	0	71.4
5I	8(15.7)	11(43.1)	4(23.5)	1(7.8)	1(9.8)	0	0	0	0	0	84.2
5II	8(5.9)	3(4.4)	10(22.1)	2(5.9)	3(11.0)	1(4.4)	0	3(17.6)	1(6.6)	3(22.1)	94.2
6	9(69.2)	2(30.8)	0	0	0	0	0	0	0	0	30.8
7	14(45.2)	5(32.3)	1(9.7)	1(12.9)	0	0	0	0	0	0	54.9
8	11(22.9)	5(20.8)	4(25.0)	1(8.3)	1(10.4)	1(12.5)	0	0	0	0	77.0
9	9(25.0)	3(16.7)	1(8.3)	1(11.1)	1(13.9)	0	0	0	1(25.0)	0	75.0

FIG 2

Relation of A.D.F. & A/F to % of
Individuals Occuring in
Clumps



manifestation of the species' reproductive biology.

CLUMPING BEHAVIOR: COMMON BOUNDARY VALUES

Table 5 presents the data on CBV. The region with plants sharing the most common boundaries is quadrat 5, for B. nelumbiifolia. In groups 5A, 5C, and 2D the number of common boundaries exceeds the number of occupied M² within the group, indicating maximum clumping behavior for these plots; 5IIA for B. nelumbiifolia has a CBV of 13:18, 5IIC a CBV of 5:6, and 2D for B. heracleifolia has a CBV of 7:12.

B. heracleifolia indicates the highest CBVs of the three species observed in this study, in spite of the very high values for B. nelumbiifolia in quadrat 5II. The next greatest values for common boundaries are observed in groups 5ID, 2A, and 4IC for B. heracleifolia, having, respectively, ratios of 22:14, 8:7 and 9:7. Quadrat 5 thus exhibits the largest CBV for both B. heracleifolia and B. nelumbiifolia.

In quadrat 2 of B. heracleifolia 93.5% of the individuals are found aggregated in two clumps, 2A and 2D. For quadrat 3, B. nelumbiifolia exceeds B. heracleifolia in total number of individuals by 26, or more than 100%, but B. heracleifolia has a CBV of 7:5, for the largest group. In quadrat 4, B. heracleifolia exceeds B. nelumbiifolia by three individuals but exhibits a considerably larger CBV at 9:7, for the largest group. B. californica shows one high CBV of 9:5 in quadrat 8.

Considering the clumping behavior in terms of the different analyses, number of individuals/clump and CBV, suggests some interesting variances, even though the scarcity of the field data negates the validity of statistical tests. B. nelumbiifolia has the greatest number of average individuals per quadrat of the three species, exhibits the largest number of individuals per quadrat, and the largest clumps, while higher CBVs are found for B. heracleifolia more often than the other species. Also, B. heracleifolia has the lowest average number of individuals per quadrat. These data suggest that individuals of B. heracleifolia have a greater tendency to form clumps occupying a larger surface area than B. nelumbiifolia or B. californica.

SYMPATRIC ASSOCIATION

OF B. HERACLEIFOLIA AND B. NELUMBIIFOLIA

B. heracleifolia and B. nelumbiifolia have been reported to occur within the same regional area near Ocoatozula, Chiapas (Ziesenhene 1947), though the degree of association of the two species was not reported by the original collector. The sympatric association of these species at the Misola waterfall is defined

TABLE 5

COMMON BOUNDARY ANALYSIS

(No. of Occupied M² / Group / No. of Common Boundaries)

Quadrat Number and Species	Group Position										
	A	B	C	D	E	F	G	H	I	J	K
1 <u>B. heracleifolia</u>	2:1	3:2	2:1	4:2	5:2	1:0					
2 <u>B. heracleifolia</u>	8:7	1:0	1:0	7:12							
3I <u>B. heracleifolia</u>	2:0	7:5	2:0	1:0							
3II <u>B. nelumbifolia</u>	3:2	6:4	4:0		3:2	3:3					
4I <u>B. heracleifolia</u>	1:0	3:2	9:7	2:1	1:0				1:0		
4II <u>B. nelumbifolia</u>	1:0	1:0	5:2		2:0	4:2	3:2	3:3			
5I <u>B. heracleifolia</u>	1:0			22:14	2:0						
5II <u>B. nelumbifolia</u>	13:18	3:2	5:6	7:3	5:4						
6 <u>B. heracleifolia</u>	1:0	1:0	4:2	1:0	1:0	1:0	1:0	1:0			
7 <u>B. heracleifolia</u>	1:0	7:6	6:5	1:0	1:0	1:0	1:0	2:0	1:0		
8 <u>B. californica</u>	4:4	1:0	9:5	1:0	1:0	1:0	1:0	1:0	2:1	1:0	1:0
9 <u>B. californica</u>	5:3	2:0	3:0	1:0	2:1	2:0	1:0				

within the limits of three 25 x 30 meter quadrats. The data presented in Table 5 indicate that B. heracleifolia and B. nelumbiifolia show closer intra-species spatial orientation than inter-species spatial orientation. Of the 20 designated groups listed in Table 6 and represented in Fig. 3, eleven, or 55.0%, are comprised of a single species; six groups, or 30.0%, are ones having a minimum of 75.0% dominance for one species, and the remaining four groups have between 63.0% and 66.7% dominance. The lowest percentage of dominance is 63.0% for B. nelumbiifolia found in quadrat-group 3B. The distribution of individuals within quadrat 3 exhibits the lowest percentages of dominance of the three quadrats, for there are more individuals of both species occurring in close proximity to one another per group than in the other two 25M x 30M quadrats. Fig. 4 is a photograph showing the sympatry of these species of Begonia.

Considering that these species occur sympatrically within the same habitat, the degree to which they are associated is minimal. Of the 113 individual square meters occupied by B. heracleifolia and B. nelumbiifolia only 10, or 8.8%, are found to have both species within the same square meter.

The following locations are the only places where B. heracleifolia and B. nelumbiifolia occupy the same square meter: in quadrat-group 3B there are two occurrences of sympatry, in quadrat 4, four occurrences of sympatry, one in group B, three in group B, three in group C, and in quadrat 5, one occurrence each in groups A and D, and two occurrences in group E.

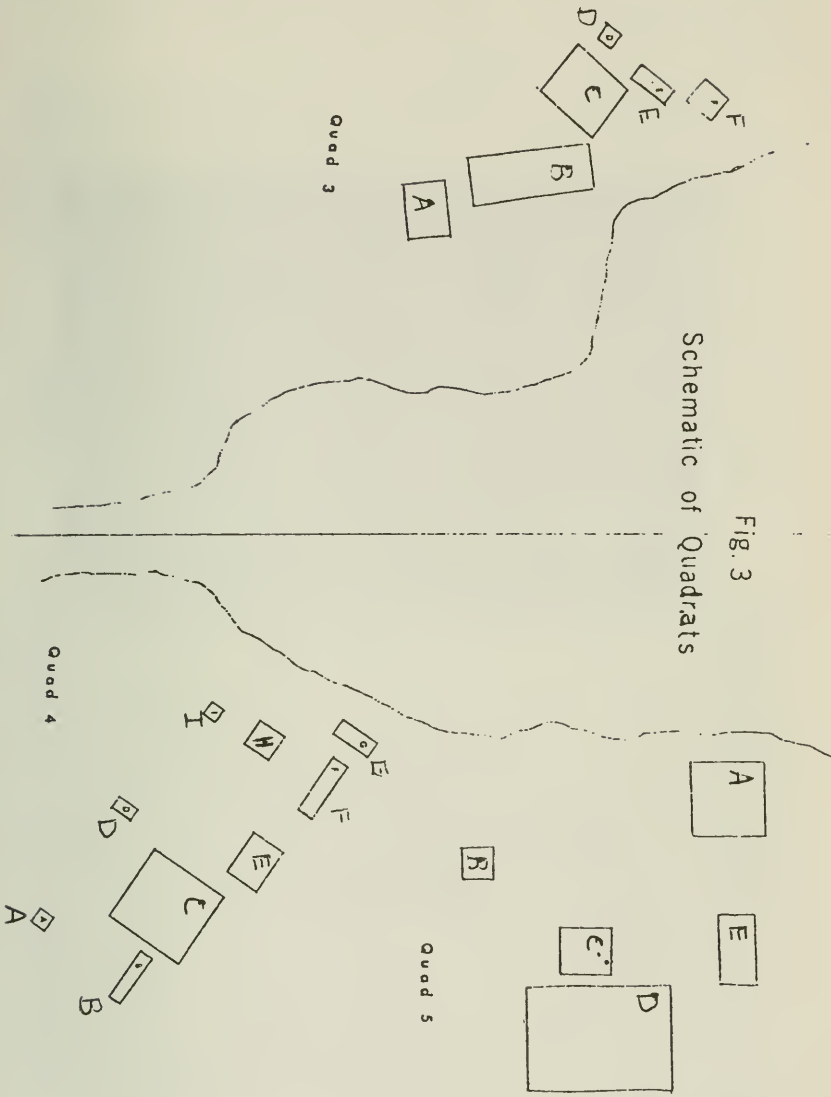
The distinct patterns of segregation exhibited by these species of Begonia appear to be based on micro-habitat preferences. B. nelumbiifolia shows a greater preference to the area near the pool side, while B. heracleifolia shows a preference for the forest margin. Table 6 lists the approximate distances the groups are from the margin of the pool. Those groups found closer to the present margin of the pool are comprised virtually always of B. nelumbiifolia, while those groups furthest from the pool are mostly B. heracleifolia. The exception to this is quadrat-groups 3A and 3B, where B. nelumbiifolia is the dominant species, but is found furthest from the margin. In quadrat-groups 3A and 3B there is the lowest degree of dominance since both species occur together at a higher frequency than in the other quadrats.

B. nelumbiifolia generally has lower percentage ratings for the dominant species within a group. Several explanations may be offered: 1. B. nelumbiifolia has a greater range of habitat tolerance than B. heracleifolia. 2. The population of B. nelumbiifolia has been represented at the habitat for a longer period of time, thus allowing for a wider habitat distribution than B. heracleifolia. The specific adaptational characteristics of these species that determine such habitat preferences are not known, but the rhizome of B. nelumbiifolia is distinctly smaller in diameter

TABLE 6

NUMBER OF INDIVIDUALS IN GROUP WITH PER CENT OF DOMINANCE

Quad. No.	Group Position	AND DISTANCE FROM POOL MARGIN		Approximate Distance from Pool Margin (in meters)
		<i>B. heracleifolia</i>	<i>B. nelumbiifolia</i>	
3	A	2	7 (77.8%)	6.0
3	B	10	17 (63.0%)	6.9
3	C	4	7 (63.6%)	4.3
3	D	4 (100%)	0	5.6
3	E	0	9 (100%)	3.5
3	F	0	6 (100%)	2.5
4	A	3 (100%)	0	11.4
4	B	8 (80%)	2	12.0
4	C	24 (75%)	8	9.3
4	D	3 (100%)	0	7.2
4	E	2	4 (66.7%)	6.7
4	F	0	6 (100%)	3.0
4	G	0	4 (100%)	1.5
4	H	0	4 (100%)	2.8
4	I	1 (100%)	0	2.8
5	A	1	84 (98.8%)	2.3
5	B	0	10 (100%)	4.5
5	C	0	16 (100%)	7.5
5	D	47 (82.5%)	10	10.4
5	E	3	15 (83.3%)	7.5



Schematic of Quadrats

Fig. 3

than B. heracleifolia. A smaller rhizome would be less likely to be uprooted in a torrential flood than a larger one having a greater surface area exposed to the current.

The position of the quadrats at the Misola waterfall contributes information regarding these species' spatial distribution, also. Quadrat 3 was set up on the northeast side of the pool. Quadrat 3 has the fewest total number of individuals of the three quadrats, 66. Quadrat 4 has 69 individuals and quadrat 5 has the greatest, with 212 individuals, which is the grid that was set up parallel and adjacent to the cliff wall. In quadrat 5 are found 45.3% of the total individuals of B. heracleifolia and 63.2% of B. nelumbiifolia. B. nelumbiifolia is heavily populating the cliff face; thus it would appear that seed has been dispersed from plants on the cliff to the area below, implying that the cliff region was occupied prior in time to the region surrounding the pool. At least the likelihood of seed being dispersed downward is greater than dispersal upward. B. heracleifolia was not observed to inhabit the cliff area at all. The smaller rhizomes of B. nelumbiifolia may also offer some explanation for this occupying the cliff face and not B. heracleifolia.

DISCUSSION

The differences in A, D, and F values for the southern and the northern regional populations of B. heracleifolia are worth noting. Specimens of B. heracleifolia from the Gray Herbarium indicate this species has been collected twice in Nayarit, and once in Hidalgo, being the next northernmost collections. This suggests a more limited northern population size than the abundantly represented material from southern Mexico and Guatemala. The limited number of northern collections of this species suggests that these populations are on the periphery of the range of B. heracleifolia, and likely make up the northern species border. It is well known that isolated populations and morphological variation occur on the periphery of a species range (Grant 1971, Mayr 1963). B. heracleifolia is reported to have four varieties according to Barkley and Golding's (1972) list, which indicates the species is quite variable in morphology. The morphological variation of the population of B. heracleifolia observed in the Sinaloa population may eventually warrant being described as another variety. Distinct differences are noted in the flower size, bract shape being larger and more persistent, and leaf lobes less indented, to name several variations. Frequently morphological variation is clinal (Mayr 1963, Ender, 1977), where certain specific character traits vary along a gradient. The possibility cannot be discarded that B. heracleifolia exhibits clinal variation, though several characteristics will have to be measured in order to determine this.

The example of an isolated population is that of B. californica of Baja California. Only several collections have been made



Example of
Fig. 4 - Sympatric Association of
B. heracleifolia (star shaped
species under palm on left)
and B. nelumbiifolia (palmate
species to the right) growing
near forest margin.

of this species: two on Baja California Sur (Carter personal communication), one in Sonora, Mexico, one in Nayarit, Mexico, and several collections from Sinaloa, and the Tres Marias Islands (Ziesenhenné personal communication). Like many species in the Begoniaceae, B. californica would be considered a rare species, thus data collected on spatial distribution is at no great loss for the species itself has a limited population size.

Spatial distribution patterns of these species of Begonia indicate a distinct tendency to clump, for the plants do not exhibit an evenly distributed pattern. This clumping behavior may be explained in several ways: 1) poor seed dispersal, 2) vegetative reproduction, 3) micro-habitat variances, such as moisture availability.

Other works on spatial patterning of tropical plants include the works of Ashton (1969) and Poore (1968), both of whom report on patterning of trees, whose reproductive biology is completely different from that of the herbaceous Begonia. Ashton (1969) points out that clumping is observed in families which have poor dispersal mechanisms, with specific reference to Shorea polyandra of the Dipterocarpaceae in W. Sarawak, Borneo. Though the Dipterocarpaceae are a tropical tree family, Ashton explains that the clumping is caused by poor seed dispersal as compared to wind dispersal of seed in families like Apocynaceae and certain Leguminosae (Koompassia). Poore (1968) also has shown that contiguous distribution is common among tropical rainforest trees. Even though the differences between herbs and trees is considerable, one cannot discount the possibility that clumping in the Begoniaceae may be attributed to poor seed dispersal. Once an individual becomes established and flowers, seed is dispersed within a short distance of the parent plant. Because the Begoniaceae show preferences to stream margin habitats there is a good possibility that water dispersal is a mechanism for local dispersal of seed. Within a regional area water dispersal could be a very efficient mechanism for establishing a population. On many occasions I have observed seedlings growing right next to the flowing water, often lodged in small cracks in rocks or spaces between exposed roots. Also, one may observe a large population of a species upstream and a single plant or a small population downstream.

The other possible means by which clumps could be developed is through vegetative reproduction in which case "clone" may be the more appropriate term to describe the pattern. The author has observed individuals of the Begonia media Merr. & Perr (affinity) complex in Papua New Guinea frequently give rise to separate individuals by vegetative means. A stem will bend over until it touches the ground, root at the nodes, and a subsequent decay to the first several internodes of the branch occurs, leaving a separate individual. The same situation has been observed by Art (personal communication) for Phragmites communis on Fire Island, New York. Specific work on the mechanisms of vegetative repro-

duction in Medeola virginiana has been reported by Bell (1974), who shows how a parent plant will produce rhizomes in varying directions, each of which results in a separate individual. Holler and Abrahamson (1977) have experimentally shown that vegetative "reproductive effort" is higher in low density plots for Fragaria virginiana of the Rosaceae, and that seed "reproductive effort" is unaffected by plant density. In the case of rhizomatous species of Begonia, vegetative reproduction could occur by a mechanism similar to that observed in B. media, or the above-mentioned other species, since separate individuals were observed and counted. The rhizomes on these plants are found above the ground, while in other species the rhizome is below the ground, which makes it extremely difficult to distinguish separate individuals. It may be noted again that one can observe separate individuals within a clump of Begonia, but the genetic character of the clump poses an interesting idea, since vegetative reproduction results in individuals having identical genomes. In the event of vegetative reproduction being the principal mechanism for clump development, the possibility exists for defining the entire clump as the individual. I consider the autonomy of the organism as the greater priority, and would thus continue to utilize the definition adopted in this paper.

Grant (1971) utilizes the term evolutionary potential (a term having considerable meaning from a metaphysical standpoint) when describing clonal complexes, stating that species exhibiting such complexes have a simpler taxonomic structure than agamic groups. The taxonomy of the Begoniaceae is very complex (Schubert, personal communication) and sexual reproduction is definitely involved in the development of clumps, because seedlings can be observed. Thus, if asexual reproduction is involved in B. heracleifolia and B. nelumbiifolia, they would more likely be considered agamic complexes than clonal.

The presence of residual meristematic potential, particularly in the section Gireoudia, to which B. heracleifolia and B. nelumbiifolia are assigned, raises the question concerning the function of a residual meristem. The residual meristem of Begonia allows horticulturists to vegetatively propagate leaf cuttings, as mentioned by Howard (1974). It is speculative whether there is any significance between this residual meristematic potential and the possibility of asexual reproduction in Begonia. Possibly the residual meristem is a characteristic that had adaptive significance at some earlier point in the evolutionary history of Begonia, and subsequently the trait was selected against. The frequency of a residual meristem is very limited in flowering plants, occurring in such families as Piperaceae, Gesneriaceae, Crassulaceae, and Cactaceae, the first two families listed having genera that often are associated with Begonia along the stream margins of the tropics, also. The questions regarding the ability of Begonia to reproduce vegetatively are of interest and will involve considerable

research, both in the field and in the laboratory.

The sympatric occurrence of B. heracleifolia and B. nelumbiifolia shows some very interesting patterns. The environment in which the two species grow appears to be subject to flooding. The large pile of logs at the periphery of the pool area would indicate that during the wet season, when heavy rains occurred, trees would be uprooted and tend to accumulate at the base of the waterfall. The orientation of B. heracleifolia and B. nelumbiifolia around the margin of the pool indicates habitat preferences. B. heracleifolia shows a very high frequency of occupation further from the pool, whereas B. nelumbiifolia has a degree of preference close to the pool, although it frequents the forest margin as well. The spatial distribution patterns of each species at this location is different also, since B. heracleifolia shows greater CBVs than B. nelumbiifolia. B. nelumbiifolia is much more evenly distributed within this habitat than B. heracleifolia. The larger CBVs of B. heracleifolia indicate that individuals become established in clumps which are more spread out than in B. nelumbiifolia, individuals of this species being aggregated in smaller groups with greater distance between the groups. Ashton (1969) mentions that within the interspecific competition between species, evolution tends toward the mutual avoidance of the species, thus allowing for greater population densities of the species. In the case of the sympatry of B. heracleifolia and B. nelumbiifolia mutual avoidance has been established since the patterns of dominance indicate high percentages of individuals of one species or the other within the observed groups of the quadrats.

No hybridization was observed among B. heracleifolia and B. nelumbiifolia, even though they occurred in a mixed population. The question is why no hybridization occurs between the two species, particularly when they have been reported to hybridize in cultivation. Thompson (1976) lists the parentage of a cultivar named "B. Lettonica" as B. heracleifolia X B. nelumbiifolia. Several points may contribute to explaining this dichotomy. 1) The original parentage was not identified correctly, thus making "B. Lettonica's" ancestry different from that suggested. 2) At other geographical locations the genetic structure of one species may be significantly different to allow hybridization to occur. Perhaps one of the varieties of B. heracleifolia was used. 3) In the course of time, a cultivated species, being frequently propagated, may assume certain variations which are not found in the wild.

Within the section Gireoudia, to which approximately 60 species are reported (Barkley and Golding 1974), there is known to be considerable hybridization (Thompson 1976). According to the specimens in the Gray Herbarium, most species within Gireoudia have much more restricted geographical distributions than B. heracleifolia and B. nelumbiifolia. It is curious as to why no hybrids were observed between B. heracleifolia and B. nelumbiifolia at the

Misola waterfall, when many species of *Gireoudia* show a frequent ability to hybridize. What factors contribute to this inability to hybridize in the wild? A great deal of literature is available to explain barriers to hybridization between closely related plant species. In the sympatric association of *Cercidium floridum* and *C. microphyllum* in California, ultraviolet floral patterns are suggested as a pre-pollination isolating mechanism (Jones 1978). The lack of hybridization between *B. heracleifolia* and *B. nelumbiifolia* may involve differences in pollinators themselves, which has been reported to occur in *Salvia* (Grant and Grant 1964). Mechanical barriers leading to a maintenance of a species' characteristics may involve morphological differences. Pollen grains of *B. heracleifolia* and *B. nelumbiifolia* were compared under a compound microscope, the former species having pollen nearly twice as large as the latter, which may have something to do with the inability of these species to hybridize.

The spatial distribution patterns revealed by these species of *Begonia* are of interest, for it is not necessarily expected that as the number of individuals within a quadrat increases, the percentage of plants occurring in clumps increases. The tendency of these *Begonias* to form clumps is a characteristic feature among many species within the genus. The many factors which may contribute to this type of spatial distribution are not known, but the fact that *Begonia* has a preference for stream margins may have a bearing on their spatial distribution patterns.

The antiquity of the stream margin habitat of the tropics has been mentioned by Regel (1977) and is of considerable interest since this habitat is continually subject to disturbance. The periodic inundation of torrential water flowing down a stream bed would frequently remove the vegetation growing along the margin of the stream. When hiking stream beds in the tropics, one can observe the same plant taxa associated with the stream margin on numerous occasions. Species of *Cytrandra*, *Impatiens*, *Pilea*, *Piper*, *Rosa*, and *Urtica* (genera of the Melastomataceae and Zingiberaceae), are frequently associated with *Begonia* along the stream margins. This is not to say that the above-mentioned taxa are restricted to stream margins, any more than *Begonia*, but there appears to be a high frequency of observing the same taxa on many occasions; it is like many other habitats, in that certain species, or taxa, are found associated with particular habitats, as shown by El-Ghonemy et al. (1977). Since this habitat of the tropics is so susceptible to disturbance, the question arises of how long these taxa, and many others, have inhabited these particular environments. One wonders whether these herbaceous angiosperms always have occupied the disturbed stream margin environments or whether there has been a great variety of different taxa that have come and gone within the habitat.

Graham (1975) points out that the tropical lowland rain forest in Vera Cruz, Mexico has experienced substantial floristic

change since the upper Miocene, contrary to the widely held view that the tropical rain forest has remained relatively unchanged for the last several million years (Dobzhansky 1950, Ashton 1969). The possibility exists that the stream margin habitat of the tropical rain forest represents a place of rapid floristic change and speciation. The fact that the climatological conditions of the tropical rain forest contribute to the great diversity of species generally may have a bearing on the variability of species that occupy the specific stream margin habitats.

It is curious to note the tremendous variability within certain species of Begonia, and for that matter within the entire genus. Certain species such as B. heracleifolia, B. lindleyana Walp., B. media, B. micranthera Gris., B. simulans Merr. and Perry, B. stigmosa Lindl., or B. urtica L.f. show great morphological variation, in some cases characterized by several varieties in a species, and in others the complexity is so great that every regional collection, represented by a herbarium specimen, may be treated as a different taxon. It is possible that the notable variability of Begonia is influenced by the habitats which species occupy. The genetic system of Begonia could be modified in response to the disturbance found at the stream margin habitat of the tropical rain forest; this idea may be applicable particularly to Begonia and, of course, certain other genera, because the genus shows variation that is greater than many other angiosperm genera. The above speculations have no basis as yet for any interpretation, as do the minimal data of this paper, but the curiosity arising when one is collecting in the tropical rain forest will forever remain a pleasure, as anyone who works there has experienced. Such speculations serve as possible guidelines for future work on the Begoniaceae and expose aspects of the group which are of botanical interest as a whole.

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ACALYPHA, CROTON AND SAPIUM IN NICARAGUA

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To report the species of Acalypha, Croton and Sapium known to occur in Nicaragua is the principal purpose of this article. At the same time, keys for identification are presented. Constructing such keys was necessary in order to identify the specimens collected by my companions and myself. It was necessary also to include all the species known to occur in Central America.

The sources employed in this paper are numerous as indicated in the bibliographies and acknowledgements. Gathering them together into two keys is calculated to save time in identification. Such a treatment as this, without full descriptions, is intended to be used with reference to familiar published works. A few characters, useful in identification, are added in the annotated list.

I wish to express my thanks to the following: Dr. Daniel B. Ward and his staff of the University of Florida; Dr. Lyman B. Smith and Dr. David B. Lellinger of the United States National Herbarium; Dr. Reed C. Rollins of the Gray Herbarium and Dr. Richard A. Howard of the Arnold Arboretum. I am much indebted to Mr. Ray Angelo for very valuable notes and observations of specimens in the Harvard Herbaria. The following, I thank for the loan of specimens from their respective herbaria: Dr. Thomas B. Croat of the Missouri Botanical Garden; Dr. Lyman B. Smith and Dr. David B. Lellinger of the United States National Herbarium; Mr. John T. Atwood of the State University of Florida.

As the outline of the leaf and its venation are featured in identification of species, line drawings have been made of a number of species. The specimen from which each drawing has been made is indicated in the annotated list following the key to each genus. My thanks to Miss Valerie D'Ippolito who made the excellent drawings!

The presence or absence of glands on the petiole or on the base of the blade is also useful in identification. It should be noted, however, that sometimes a gland may be evident on one leaf but hidden on all the other leaves.

Petals are not used in the keys because so often they are not present, and on pressed specimens, even if present, they are difficult to see.

Acalypha and Croton are so similar that the keys to species are combined into one. The key to Sapium is separate. These three genera are distinguished on the generic level mostly by the stamens, as follows:

- A. Stamens in bud bent forward, the apex of the anther turned downward; flowers usually with petals, mostly in terminal racemes, p. 2, 37 Croton
- A. Stamens straight in bud the tips of the anthers erect; staminate and pistillate flowers without petals B.
- B. Segments of the staminate calyx valvate in bud; inflorescence terminal or axillary, p. 2, 28 Acalypha
- B. Segments of the staminate calyx imbricate or open in bud; spikes mostly terminal, p. 50, 54 Sapium

ARTIFICIAL KEY TO CENTRAL AMERICAN SPECIES OF ACALYPHA AND CROTON COMBINED

The drawings of the leaves are 2/3 life-size. From what specimen each leaf was drawn is indicated in the Annotated Lists.

- A. Blades deeply lobed palmately; petioles without glands; annual; p. 42 Croton lobatus L.
- A. Blades toothed or entire, not lobed B.
- B. Plant an herb, rarely woody below, usually annual; stem usually 1-2 mm thick at summit; blades variously, distinctly toothed; glands near summit of petiole or base of blade C. cp. p. 7
- C. Hairs of stem branched at base (stellate), often tufted; blades coarsely toothed; annual D. cp. p. 3
- D. Blades triangular-ovate, acute or acuminate; petioles 2-10 mm long; glands 2, stipitate, on petioles or base of blade; ovary hirsute; capsules 3-4 mm long; seeds 3 mm long; p. 48, fig. 2, p. 6 Croton trinitatis Millsp.
- D. Blades oblong to widely ovate, obtuse or acute; glands on base of blade E.

- E. Hairs of stem long stiff spreading; blades obtuse or acute, 3-7 cm long; glands stipitate, gradually thicker toward tip; seeds 2.5-3 mm long; p. 41, fig. 1, p. 6 Croton hirtus L'Her.
- E. Hairs of stem appressed; blades very obtuse, 2-3.5 cm long; glands saucer-shaped; seeds 4 mm long; p. 40 Croton glandulosus L.
- C. Hairs of stem not branched (not stellate), not tufted, or none F.
- F. Pistillate flowers in dense heads; heads at most thrice as long as thick; blades 3-7 cm long G.
- G. Stem glabrous; blades obtuse or almost rounded at tip, coarsely crenate, lower ones on rather long petioles; spikes terminal, in umbels, 2-3.5 cm long, 15 mm thick; capsules glabrous; p. 38 Croton comes S. & W.
- G. Stem hairy at least when young; blades finely crenate or serrate; petioles 2-6 cm long; capsules pilose H.
- H. Teeth of pistillate bracts short, ovate, obtuse, 1/5 as long as united part; upper heads chiefly pistillate, twice as long as thick; styles not branched; p. 34 Acalypha poiiretii Sprengel
- H. Teeth of pistillate bracts long, filiform, spreading; heads 10-15 mm thick, mostly less than 3.5 cm long I.
- I. Spikes all axillary; blades gradually narrowed to tip; p. 29, fig. 5, p. 6 Acalypha arvensis Poepp. & Endl.
- I. Spikes partly terminal; blades abruptly acuminate; p. 28, fig. 6, p. 4 Acalypha alopecuroidea Jacq.
- F. Staminate and pistillate flowers in slender spikes; spikes more than thrice as long as thick, not dense, not head-like J.
- J. Stem with dense spreading glandular hairs; petioles 1-6 cm long; blades 3-9 cm long; spikes axillary or terminal, with bractless intervals, 5-12 cm long; pistillate bracts shallowly toothed; spikes unisexual or bisexual; p. 36, fig. 8, p. 4 . . Acalypha subviscida S. Watson
- J. Stem not stipitate-glandular K.
- K. Blades 13-14.5 cm long, 3-nerved at base; petioles, veins and spikes sparsely stigmatose; petioles 2.5-4 cm long, with 2 glands; p. 34 Acalypha radino-stachy Donn. Smith
- K. Blades 1-10 cm long L.
- L. Spikes unisexual M. cp. p. 5
- M. Blades 1-2 cm long, 0.9-1.5 cm wide; petioles 0.5-2 cm long; pistillate bracts leaf-like, 7 mm long; p. 33, fig. 7, p. 4 Acalypha nicaraguensis P. & H.



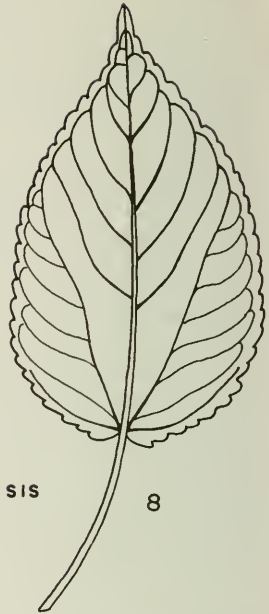
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A. alopecuroidea



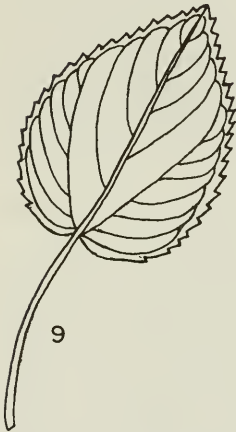
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A. nicaraguensis



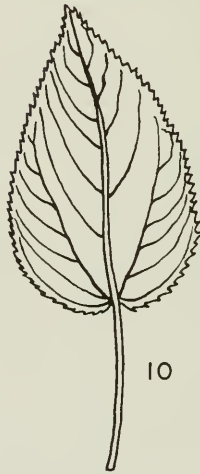
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A. subviscida



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A. salvadorensis



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A. persimilis



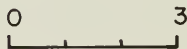
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A. guatemalensis

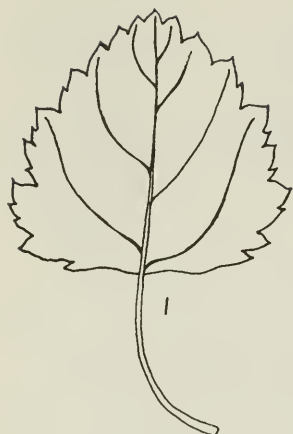


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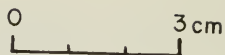
A. phleoides



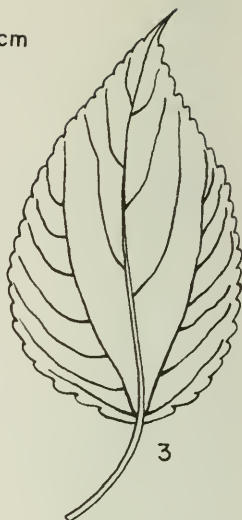
- M. Blades 2-10 cm long, 1.5-9 cm wide, palmately veined N.
- N. Staminate spikes terminal, 1 cm long; pistillate spikes axillary, 1.5-2.5 cm long; petioles 1-2 cm long; blades 2-4.5 cm long, 1.5-3 cm wide; young blades long-pilose above and beneath; p. 34
 Acalypha pseudo-alopecuroides P. & H.
- N. Staminate spikes axillary, 0.2-5.5 cm long; pistillate spikes terminal and axillary, or on axillary branches O.
- O. Pistillate bracts with filiform or setaceous teeth P.
- P. Terminal pistillate spikes 3-6 cm long, in fruit 5 mm thick; staminate spikes 1 cm long; petioles 2-7 cm long; blades widely ovate; ovary and capsule hairy; seeds 1 mm long; p. 35, fig. 4, p. 6
 Acalypha setosa A. Rich.
- P. Terminal pistillate spike 6-15 cm long, 10 mm thick; staminate spikes 2-4 cm long; petioles 4-12 cm long; blades ovate, cuspidate-acuminate; ovary and capsule glabrous; seeds 3 mm long; p. 34, fig. 3, p. 6 Acalypha polystachya Jacq.
- O. Pistillate bracts with lanceolate or wider, usually shorter teeth; terminal pistillate spikes 2.5-5 cm long Q.
- Q. Staminate spikes 0.2-1 cm long; blades 2-4.5 cm long, 1.2-3 cm wide; teeth of pistillate bracts about 7-8 R.
- R. Staminate spikes 2-3 mm long, subglobose; petioles 1.5-3.5 cm long; pistillate bracts 5-7 mm long, teeth short, obtuse; annual?; p. 35, fig. 9, p. 4 Acalypha salvadorensis Standley
- R. Staminate spikes almost 1 cm long; fruiting bracts 2-3 mm long, teeth acute; p. 35
 Acalypha septemloba M. A.
- Q. Staminate spikes up to 2-5.5 cm long, on peduncles; pistillate spikes terminal and in axils of upper leaves; staminate spikes on peduncles S.
- S. Plant annual, hairy, later glabrous; blades 3-7 cm long, 2.5-4.5 cm wide, 5-nerved; pistillate spikes 3-4 cm long; staminate spikes up to 2 cm long; bracts 3-4 mm long, teeth 19-21, narrowly triangular, acute; p. 33, fig. 10, p. 4
 Acalypha persimilis M. A.
- S. Plant perennial, densely hispid almost throughout; blades 5-10 cm long, 3-nerved; pistillate spikes dense, up to 5-9 cm long, subsessile; teeth of pistillate bracts 3, middle one acute, longer than others, lateral teeth truncate; styles purple-red; p. 36 Acalypha triloba M. A.



C. hirtus



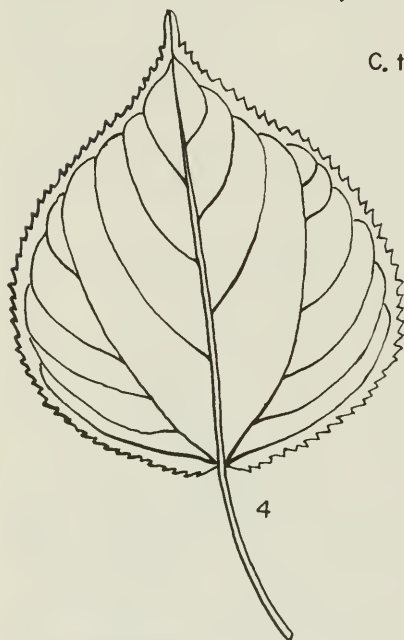
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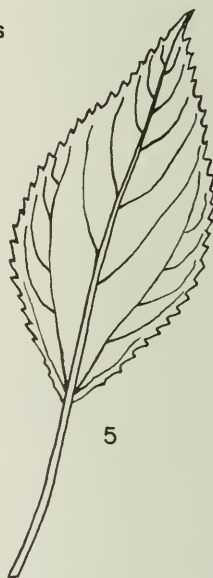
A. polystachya

C. trinitatis



4

A. setosa

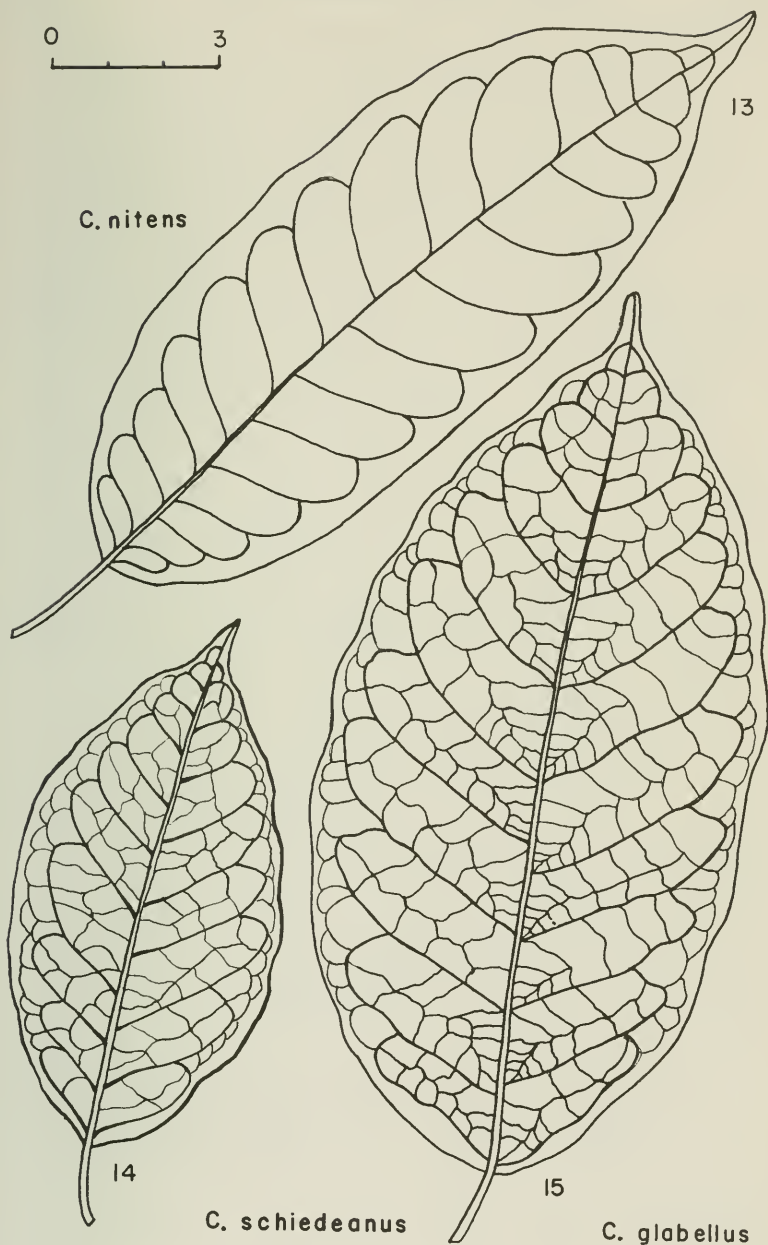
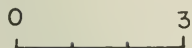


5

A. arvensis

- L. Spikes bisexual or some spike pistillate only; blades 3-5-nerved at base T. cp. p. 3
- T. Spikes at bend of branches; glands on stipes, on base of blades; blades 6-8 cm long, 3.5-5 cm wide, short-cuspidate-acuminate, appressed-stellate beneath, 7-plinerved at base; glands top-shaped; spikes 9-12 cm long; p. 43 Croton ortholobus M. A.
- T. Spikes some of them axillary; blades crenulate or serrulate U.
- U. Pistillate bracts leaf-like, 6-12 mm wide; longest petioles 2.5-3 cm long; blades obtuse or acute; styles lacinate; annual; p. 32 . Acalypha indica L.
- U. Pistillate bracts not leaf-like; styles 6-10-lacinulate V.
- V. Petioles 1-2 mm long; larger blades 2.5-4 cm long, 1-3 cm wide, obtuse or acute; terminal spikes 2-9 cm long; capsules 2 mm long; perennial; p. 34, fig. 12, p. 4 Acalypha phleoides Cav.
- V. Petioles 1-6 cm long; blades 4-7 cm long, 2-5.5 cm wide; larger spikes 4-5 cm long; bracts stipitate-glandular; annual or perennial; p. 31, fig. 11, p. 4 Acalypha guatemalensis P. & H.
- B. Plant woody, a tree or shrub; branches usually 3-5 mm thick near summit W. cp. p. 2
- W. Blades with scales, usually above, always beneath; scales minute, appressed, often dense, visible under high magnification, rarely stellate also X. cp. p. 12
- X. Inflorescences racemose-paniculate; blades 10-15 cm long; blades and branches stellate-tomentose and scaly; p. 40 Croton grosseri Pax
- X. Inflorescences not paniculate Y.
- Y. Blades 2-5 cm long, entire, usually obtuse, veins obscure; petioles without glands; pedicels 2-4 mm long; pistillate racemes about 1 cm long; p. 45 Croton punctatus Jacq.
- Y. Blades larger (5-)7-22 cm long, acute or acuminate, or almost obtuse Z.
- Z. Blades variously toothed, appressed-stellate-scaly above and beneath, later glabrate above; palmately veined; inflorescences some or all terminal; fruiting pedicels up to 5-10 mm long Aa.
- Aa. Blades 5-nerved at base, 8-14 cm long, 3.5-9 cm wide; petioles 3.5-5.5 cm long; racemes up to 15 cm long; p. 47 Croton simiarum S. & W.

- Aa. Blades 3-nerved at base, dentate; petioles with 2 glands Ab.
 Ab. Petioles 5-8.5 (-13) cm long; blades coarsely irregularly toothed, 10-20 cm long, 9.5-17 cm side, pale beneath; staminate spikes 8-15 cm long, sparsely flowered; peduncles 1.5-5 cm long; p. 48; cp. p. 25
 Croton tonduzii Pax
- Ab. Petioles 1-3.5 cm long; blades rounded or blunt at tip, sparsely scaly above and beneath; ovaries and capsules stellate-scaly Ac.
 Ac. Racemes up to 20 cm long, on long peduncles; blades 7-11 cm long, 3-5 cm wide; pistillate flowers sessile; capsules 5-6 mm long; p. 42, fig. 17, p. 11
 Croton lundellii Standley
- Ac. Racemes up to 11.5 cm long; staminate flowers on pedicels; pistillate flowers unknown; blades 3-11 cm long, 1.4-4.7 cm wide, crenate-serrate, sparsely stellate-scaly; capsules 9 mm long; p. 44
 Croton petensis Lundell
- Z. Blades entire or nearly so Ad.
 Ad. Blades pinnately veined, glabrous or glabrate; petioles and blades without glands except in C. skutchii Ae. cp. p. 8
 Ae. Capsules about 35 mm long, smooth, scaly; seeds 20-22 mm long; pedicels 3.5-7 mm long; blades 8-16 cm long, 5-8 cm wide sparsely scaly; racemes mostly bisexual; anthers 1-1.2 mm long; p. 48 Croton tenuicaudatus Lundell
 Ae. Capsules 8 to about 13 mm long Af.
 Af. Inflorescences unisexual; capsules 8 mm long, scaly, subglobose; fruiting pedicels 9-11 mm long; blades 5-12 cm long, 4.5-6.5 cm wide, elliptic-oblong, not acuminate; p. 43, fig. 13, p. 9 Croton nitens Sw.
 Af. Inflorescences bisexual; flowers on pedicels; scales sparse or apparently absent from blades above Ag.
 Ag. Blades widely rounded or very obtuse at tip, 14.5-22 cm long, 9-18 cm wide; petioles 4-11 cm long, with 2 saucer-shaped, stipitate glands; pistillate pedicels 6-9 mm long; staminate flowers clustered along axis; p. 47
 Croton skutchii Standley
- Ag. Blades acute or acuminate; petioles 0.5-4 cm long, without glands; blades 7-22 cm long Ah.
 Ah. Blades often silvery beneath, 7-15 cm long, 2.8-3.5 cm wide, acuminate; racemes densely flowered; calyx of both sexes scaly; capsules scaly, about 8 mm long; p. 40
 Croton guatemalensis Lotsy
 Ah. Blades not silvery beneath Ai.

*C. nitens*

13

14

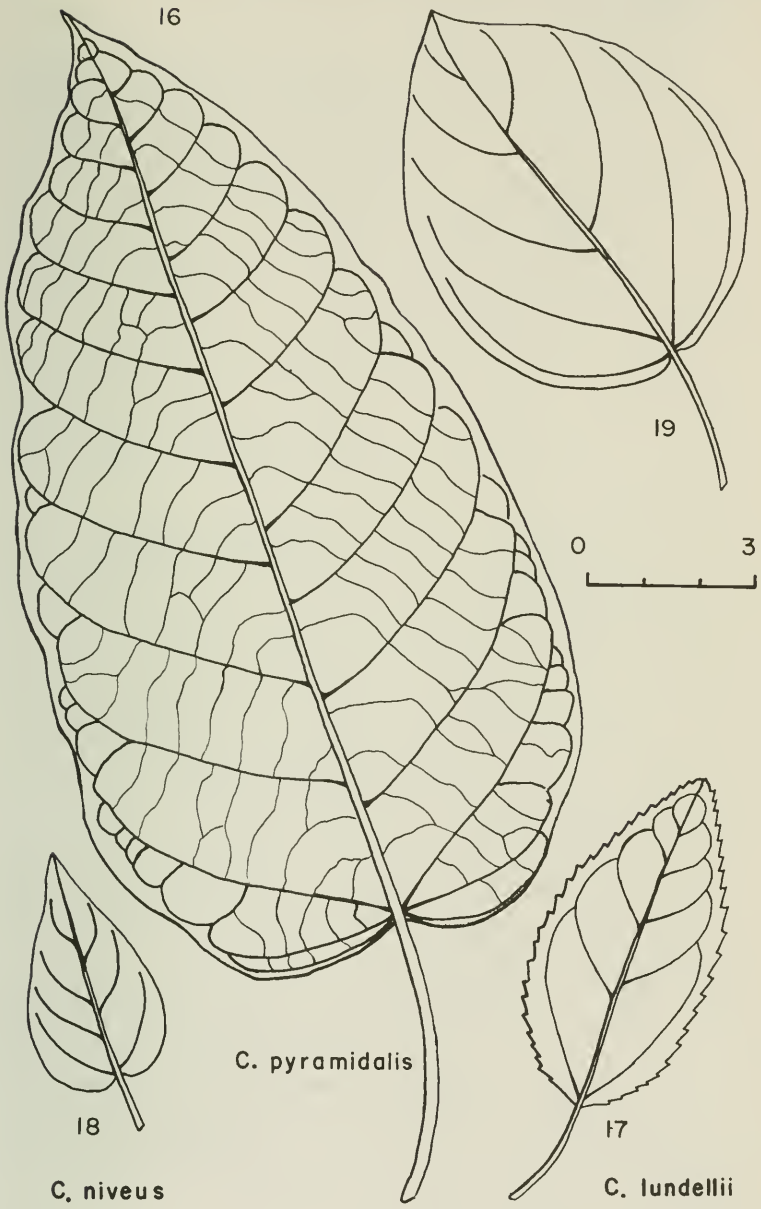
C. schideanus

15

C. glabellus

- Ai. Scales of blades white, scattered; blades green beneath, 7-22 cm long, 3-13 cm wide, acuminate; racemes 2-10 cm long; pedicels of staminate flowers 2.4-3.4 mm long; capsules warty, scaly; p. 46
 Croton schiedeanus Schlechter
- Ai. Scales of blade brown in center; blades brownish beneath (especially when young); calyx stellate-hairy; pedicels of staminate flowers 2 mm long; of pistillate flowers 6 mm long; capsules tuberculate, scaly; p. 40, fig. 15, p. 9 Croton glabellus L.
- Ad. Blades palmately veined, sparsely scaly above Aj. cp. p. 8
- Aj. Pedicels of pistillate flowers 0-2(-3) mm long; blades 6-15 cm long, scaly, often silvery, sometimes densely scaly beneath, widest near middle, 4-9 cm wide Ak.
- Ak. Blades ovate, abruptly acuminate, 5-nerved at base, shallowly cordate, 1.5 times as long as wide; scales of ovary toothed; pedicels of pistillate flowers 1-2 mm long; seeds 5 mm long; p. 45, fig. 19, p. 11
 Croton pseudo-niveus Lundell
- Ak. Blades ovate to suborbicular, obtuse or cuspidate, 5-7-nerved at base, 5-8 cm wide, often deeply cordate, 1-1.5 times as long as wide; p. 39, fig. 48, p. 19
 Croton fantzianus F. Seymour, species nova
- Aj. Pedicels of pistillate flowers in fruit up to 5-10 mm long Al.
- Al. Pedicels equaling fruiting calyx; blades densely scaly beneath, usually silvery Am.
- Am. Petioles with 2 glands; blades 10-20 cm long, 5-13 cm wide; capsules subglobose, 5.5 mm in diameter; p. 45 Croton pyramidalis Donn. Smith
- Am. Petioles without glands; blades 8-12 cm long, 5-9 cm wide; capsules 21-23 mm long, scaly, warty; seeds 5-18 mm long; p. 46 Croton pyriticus Croizat
- Al. Pedicels shorter than fruiting calyx, slender, not reflexed; petioles without glands; blades silvery beneath; 3-5-nerved at base; capsules 9-10 mm long An.
- An. Ovary and fruit smooth, densely scaly; some inflorescences terminal on some plants; p. 43, fig. 18, p. 11 Croton niveus Jacq.
- An. Ovary and fruit muricate or echinate; inflorescence 2(-2.5) cm long; scales toothed; seeds smooth, 6 mm long; p. 46 Croton reflexifolius HBK.

C. pseudo-niveus



W. Blades hairy to glabrous Ao. cp. p. 7

Ao. Blades scaly as well as hairy beneath. Go to W¹, p. 7

Ao. Blades not scaly Ap.

Ap. Blades conspicuously ciliate, 3-6 cm long, palmately veined at base, abruptly acute or acuminate; stipules conspicuous, divided into long spreading bristles; p. 38

. Croton ciliato-glanduliferus Ortega

Ap. Blades not conspicuously ciliate Aq.

Aq. Blades obtuse or rounded at tip, at least some of them so, palmately veined Ar. cp. p. 13

Ar. Blades entire or obscurely or finely toothed, ovate, densely tomentose beneath, glabrate above, 5-nerved at base As.

As. Blades rounded at tip, without short abrupt tip, 2.5-10.5 cm long, 1.6-8.5 cm wide; flowers on short pedicels; stem 30-60 cm tall; p. 44 Croton payaquensis Standley

As. Blades abruptly short-tipped, 5-8 cm long, 3.5-7 cm wide; flowers subsessile; stem 1-1.5 m tall; p. 42

. Croton lasiopetaloides Croizat

Ar. Blades variously distinctly toothed; glands 2-6 on petioles or on base of blades, sometimes conspicuous At.

At. Young blades whitened above and beneath by minute stellate hairs; mature blades widely rounded or slightly cordate at base, coarsely toothed, 7-8 cm long, 5-7 cm wide; longest petioles 6-6.5 cm long; p. 37, fig. 47, p. 26 . . Croton atwoodianus F. Seymour, sp. nov.

At. Young blades green, not whitened Au.

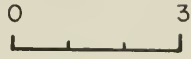
Au. Blades almost glabrous, 10-12 cm long, ovate; staminate and pistillate spikes sessile or on short peduncles; capsules 4 mm wide; p. 33 . Acalypha obtusifolia P. & H.

Au. Blades at least sparsely hairy above and beneath Av.

Av. Blades sparsely puberulent above and beneath, widely rounded at base; teeth acute; racemes shorter than leaves; capsules 5-6 mm long, with spreading white hairs; p. 46, fig. 24, p. 18
. Croton repens Schlechter

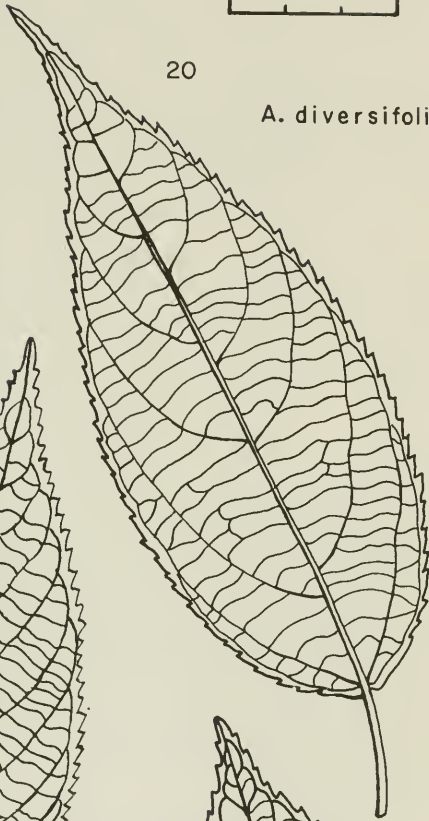
- Av. Blades densely stellate-pilose, widely cuneate at base, ashy beneath; teeth obtuse; p. 38 Croton ceanothifolius S. & W.
- Aq. Blades acute or acuminate or cuspidate Aw.cp. p. 12
- Aw. Blades gradually narrowed to long narrow base, 7-20 cm long, 2.5-10 cm wide; petioles up to 1-12 cm long Ax.
- Ax. Pistillate inflorescence branched paniculately; petioles without glands Ay.
- Ay. Inflorescences axillary; pistillate inflorescence up to 6 cm long; staminate spikes 3-6.5 cm long; side-veins 5-6 on each side; petioles 1-4 cm long; p. 31 Acalypha gummifera Lundell
- Ay. Pistillate inflorescences terminal, often 20 cm long; pistillate pedicels at least 1.5 mm long; side-veins 6-11 on each side; ; petioles 4-12 cm long; p. 30, fig. 29, p. 21 Acalypha costaricensis (Kuntze) Knobloch
- Ax. Pistillate inflorescences not branched Az.
- Az. Glands on petiole divergent, on long stipes; blades glabrous or nearly so in age, few stellate hairs persisting; teeth of blades 8-15 mm apart; p. 38 Croton brevipes Pax
- Az. Glands none on petiole or base of blade Ba.
- Ba. Blades hairy above, densely so beneath, 3-7 cm wide; petioles 1-4 cm long; branches densely pilose; p. 32, fig. 25, p. 18 Acalypha lancetillae Standley
- Ba. Blades glabrous to sparsely pilose Bb.
- Bb. Axis of inflorescence densely hairy; blades 1.3-2.5 cm wide, about 4 times as long as wide; pistillate bracts densely pilose; p. 29 fig. 26, p. 18 . Acalypha apodanthes S. & W.
- Bb. Axis glabrous; blades 8-18 cm long, 2.5-7 cm wide, about thrice as long as wide; spikes 2-15 cm long; pistillate bracts puberulent and stipitate-glandular; petioles up to 1.5 cm long; p. 30, fig. 27, p. 18 . . Acalypha ferdinandii Hoffm.
- Aw. Blades at base abruptly rounded or cuneate or cordate, widest near base or middle Bc.
- Bc. Hairs of blades beneath not branched, not stellate, not dendritic, or blades glabrous Bd. cp. p. 20
- Bd. Lower pistillate bracts leaf-like, as much as 7 cm long, middle ones 1 cm long, cordate-clasping; petioles 12-16 cm long; blades 12-15 cm long, 7-9 cm wide, 7-nerved at base; p. 29 Acalypha chlorocardia Standley

- Bd. Lower and other bracts not leaf-like, smaller Be,
 Be. Blades pinnately veined at base Bf.
 Ef. Staminate spikes sessile or subsessile, 5-11 cm long;
 blades velutinous or glabrate; young branches villous or
 appressed-pilose or glabrate; p. 30
 Acalypha diversifolia Jacq.
 Bf. Staminate spikes on peduncles; blades tomentose and
 hispid; young branches with long villous hairs; p. 39 .
 Croton costaricensis Pax
 Be. Blades palmately veined; spikes unisexual Bg.
 g. Pistillate bracts few, 1-7, usually 1-2; blades toothed
 Bh.
 Bh. Pistillate spikes sessile; pistillate bracts 3-7, rare-
 ly 1-2; blades 3-8 cm long, soft-pilose above and be-
 neath, or pilose above on veins only; petioles 1-2
 cm long; staminate spikes 1-2.5 cm long, sessile;
 p. 30, fig. 21, p. 15
 Acalypha euphrasio-stachys Bartlett
 Bh. Pistillate spikes on long filiform peduncles; pistil-
 late bracts 1(-2) Bi.
 Bi. Staminate spikes 3-6 cm long; blades 4-10 cm
 long, 3-nerved at base, pinnately nerved above,
 teeth 3-5 per cm; petioles 1-6 cm long; pistillate
 bracts 13-17-toothed; p. 32
 Acalypha leptopoda M. A.
 Bi. Staminate spikes 1-1.5 cm long; blades 2-5(-9)
 cm long, 5-nerved at base, teeth 4-5 per cm; pe-
 tioles long or short; pistillate bracts 9-11-tooth-
 ed; p. 36 Acalypha unibracteata M. A.
 Bg. Pistillate bracts many; staminate spikes sessile or sub-
 sessile Bj.
 Bj. Pistillate bracts in dense subglobose heads; heads
 on long peduncles; fruiting bracts 10-15 mm long;
 blades coarsely toothed, 5-nerved at base, 5-14 cm
 long, villous; p. 36 Acalypha trachyloba M. A.
 Bj. Pistillate bracts not in dense heads Bk.
 Bk. Bracts of pistillate flowers minute or scarcely
 4 mm long Bl.
 Bl. Pistillate flowers dense; staminate flowers in
 clusters; blades 5-9 cm long, 2-4 cm wide, 3-
 nerved at base; spikes 4-5 cm long; petioles
 0.7-3.5 cm long; p. 31, fig. 28, p. 18 . . .
 Acalypha garnieri S. & W.
 Bl. Flowers distant; pistillate spikes sparsely
 flowered Bm.



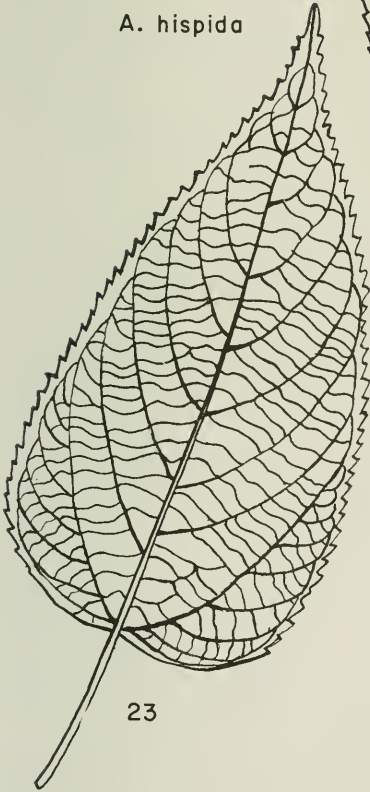
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A. hispida



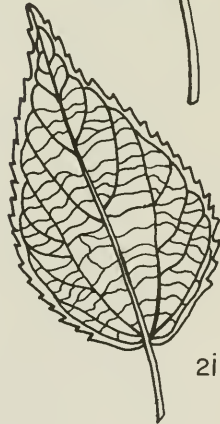
20

A. diversifolia



23

A. tenuicauda

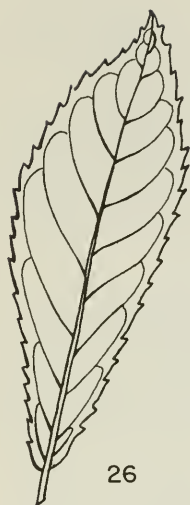


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A. euphrasio-stachys

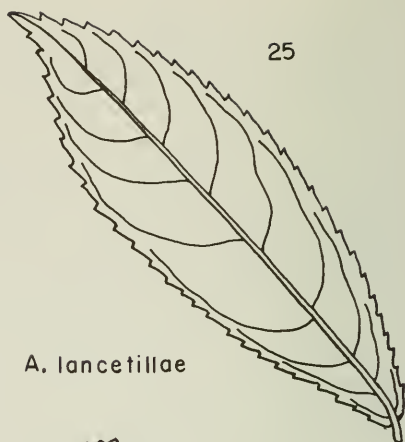
- Bm. Fruiting pedicels 8-12 mm long, 5-8 mm apart; petioles 3-5 cm long; p. 31 . . . Acalypha flagellata Millsp.
- Bm. Fruiting pedicels 1-3 mm long Bn.
- Bn. Blades glandular-punctate; fruiting pedicels 2-3 mm long Bo.
- Bo. Blades 7.5-22 cm long, 2-8 cm wide, more than twice as long as wide, caudate at tip; petioles usually 2 cm long; p. 33 Acalypha oblancifolia Lundell
- .Bo. Blades 8-18 cm long, 5-12 cm wide, less than twice as long as wide, acuminate at tip; p. 36 Acalypha villosa Jacq.
- Bn. Blades not glandular-punctate Bp.
- Bp. Blades widely ovate, 11-17 cm long, 7-11 cm wide, less than twice as long as wide, with long sparse appressed hairs above and beneath; p. 33 Acalypha muelleriana Urban
- Bp. Blades oblong-ovate or lanceolate-ovate, up to 20 cm long, about 8 cm wide, more than twice as long as wide; p. 34 . . . Acalypha pittieri P. & H.
- Bl. Bracts of pistillate flowers larger, (3-)4-15 mm long Bq.
- Bq. Pistillate inflorescences axillary; staminate spikes on peduncles Br.
- Br. Blades usually with pale margins, 3-nerved at base, widely ovate, teeth 2-3 per cm; pistillate bracts 9-13-toothed, not crowded; p. 36 Acalypha wilkesiana M. A.
- Br. Blades not pale-margined Bs.
- Bs. Pistillate bracts entire, hairy; blades cuneate at base, cuspidate, 3-nerved, 9-15 cm long, glabrous above, minutely white-dotted beneath, hairy along main veins and axils; spikes up to 30 cm long; p. 31, fig. 22, p. 15 Acalypha hispida Burm.
- Bs. Pistillate bracts 11-27-toothed; blades rounded or obtuse or shallowly cordate at base; style-branches purple; capsules 2-4 mm wide, pilose or hispid or warty Bt.
- Bt. Blades glabrous except strigose on veins beneath, about 12 cm long, 5-6 cm wide, 3-nerved at base; petioles 5-8 cm long; pistillate bracts about 11-toothed; spikes densely flowered, densely hispidulous; p. 31 Acalypha fertilis S. & W.
- Bt. Blades not strigose on veins beneath Bu.
- Bu. Pistillate bracts 2-lobed, 11-toothed; staminate spikes 5-6 cm long; pistillate spikes often 15 cm long; capsules 2 mm wide; blades glabrous or nearly so; p. 36, fig. 23, p. 15 Acalypha tenuicauda P. & H.

- Bu. Pistillate bracts (5-)11-22-toothed, not 2-lobed; staminate and pistillate spikes sessile or on short peduncles, up to 40 cm long; blades velutinous-pilose beneath, in age glabrate except on veins Bv.
- Bv. Blades 4-7 cm long, glabrate above; petioles 1.5-5 (-8) cm long; p. 32 Acalypha langiana M. A.
- Bv. Blades 10-25 cm long; petioles 5-25 cm long; styles purple; p. 32 Acalypha macrostachya Jacq.
- Bq. Pistillate inflorescences, some of them, terminal; staminate spikes axillary Bw.
- Bw. Staminate spikes on peduncles Bx.
- Bx. Blades 5-nerved at base, densely soft-pilose above, especially so beneath, 7-11 cm long; staminate spikes very dense; fruiting bracts 11-15-toothed; ovary villous; p. 33 Acalypha mollis HBK.
- Bx. Blades 3-nerved at base, sparsely hairy above, 4.5-20 cm long, 2-12 cm wide; staminate peduncles short; pistillate spikes 3-20 cm long By.
- By. Blades densely hairy beneath, 4.5-8.5 cm long; pistillate bracts 5-toothed, obtuse; hairs of stem spreading; p. 34 Acalypha porcina S. & W.
- By. Blades beneath and above almost glabrous in age; pistillate spikes 10-20 cm long, on short peduncles; bracts distant, 3-5 mm long, deeply 7-11-toothed; blades 10-20 cm long, 3-12 cm wide; styles purple-red; p. 35 Acalypha skutchii I. M. Johnston
- Bw. Staminate spikes sessile or subsessile Bz.
- Bz. Staminate spikes (5-)6-16 cm long; spikes unisexual; flowers sessile Ca.
- Ca. Blades finely toothed, 8-11 cm long, 4-5 cm wide, long-acuminate, teeth 4-6 per cm; staminate spikes 6-8 cm long; p. 29, fig. 30, p. 21
. Acalypha chordantha F. Seymour, sp. n.
- Ca. Blades coarsely toothed; larger blades 10-25 cm long, (4-)7-13 cm wide, abruptly acuminate; teeth 2-3 per cm, irregular; staminate spikes 5-16 cm long; fruiting bracts 16 mm wide; p. 33
. Acalypha mortoniana Lundell
- Bz. Staminate spikes 1.5-3(-5) cm long Cb.
- Cb. Veins elevated, reticulate beneath; blades 6.5-8.5 cm long, 3.5-5 cm wide, entire or finely toothed; petioles 1-2.5 cm long; p. 35
. Acalypha retifera S. & W.
- Cb. Veins not elevated, not conspicuous or reticulate; blades finely toothed Cc.



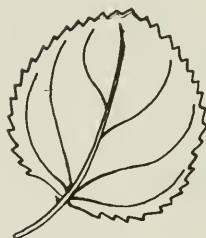
26

A. apodanthes



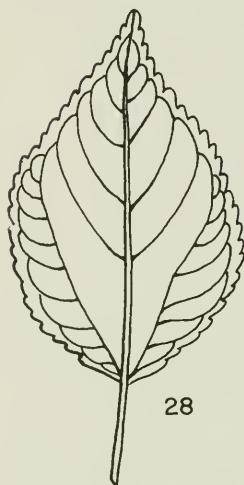
25

A. lancetillae



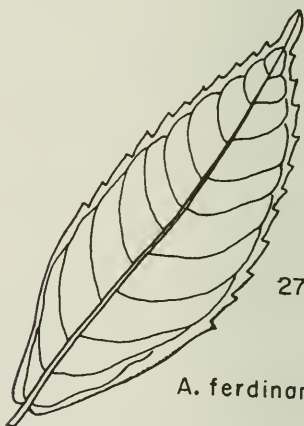
24

C. repens



28

A. garnieri

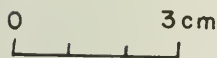


27

A. ferdinandii



- Cc. Pistillate flowers dense; pistillate spikes 3-10 cm long, on peduncles; staminate spikes up to 3 cm long, almost sessile; young petioles with soft spreading hairs; blades 5-13 cm long, cordate; fruiting bracts 5-10 mm wide; p. 35, fig. 31, p. 21 Acalypha schiedeana Schlechter
- Cc. Pistillate flowers remote or spikes interrupted; fruiting bracts 3 mm long; styles purple-red; blades commonly 4-5 cm long Cd.
- Cd. Pistillate spikes on short peduncles; young branches with dense long white spreading hairs; petioles 0.7-3.5 cm long, densely spreading pilose; axis of spikes with short dense spreading hairs; blades definitely cordate, 2.5-8 cm long; p. 34 Acalypha porphyrantha Standley
- Cd. Pistillate spikes almost sessile; young branches spreading-pilose or almost glabrous; petioles 1-7 cm long, sparsely spreading-pilose; blades slightly cordate, 3-11 cm long; p. 31 Acalypha firmula M. A.



C. fanzianus

Bc. Hairs of blades beneath branched, some stellate or dendritic; blades hairy to glabrous above Ce. cp. p. 13

Ce. Longest petioles 5-20 cm long; blades palmately veined at base Cf. cp. p. 24

Cf. Flowers distinct, not in clusters Cg.

Cg. Glands on petiole none or obscure; blades sparsely minutely puberulent above with brown hairs, 10-20 cm long, 5-12 cm wide, long-acuminate; racemes 15-20 cm long; pedicels 2-4 mm long; capsules densely minutely tomentose; p. 41, fig. 39, p. 26
 Croton jimenezii Standley & Valerio

Cg. Glands 2 or more, saucer-shaped, on petiole near base of blade Ch.

Ch. Blades gradually acuminate, suborbicular, deeply cordate (2.5 cm), 21 cm long, 19 cm wide, 7-nerved at base; hairs dark, stellate; blades hairy on midrib above, on veins beneath; petioles 12 cm long; p. 41 Croton hoffmannii M. A.

Ch. Blades abruptly acuminate; glands of petiole sessile Ci.

Ci. Blades abruptly short-acuminate, glabrate above, stellate-hairy beneath, 7-9-nerved at base, usually cordate; pistillate pedicels 3-5 mm long, 7-10 mm in fruit; p. 38, fig. 39, p. 26 Croton bilbergianus M. A.

Ci. Blades abruptly long-acuminate, sparsely stellate-puberulent above, beneath ashy, densely stellate-pilosulous, 3-5-nerved at base, deeply cordate (4 cm); pistillate pedicels 4-8 mm long; p. 38 Croton olanchanus S. & W.

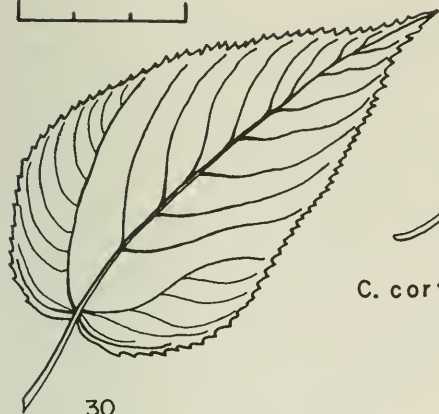
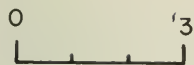
Cf. Flowers in clusters along axis or dense Cj.

Cj. Glands of petiole none; petioles 4-11 cm long; blades ashy-stellate-tomentose beneath, lanceolate or ovate-lanceolate, narrowly acuminate, pinnately veined; spikes short, dense; dark stellate hairs on branches and inflorescence; p. 45, fig. 35, p. 23
 Croton pittieri Pax

Cj. Glands of petiole present Ck.

Ck. Glands of petiole sessile; petioles 6-16 cm long Cl.

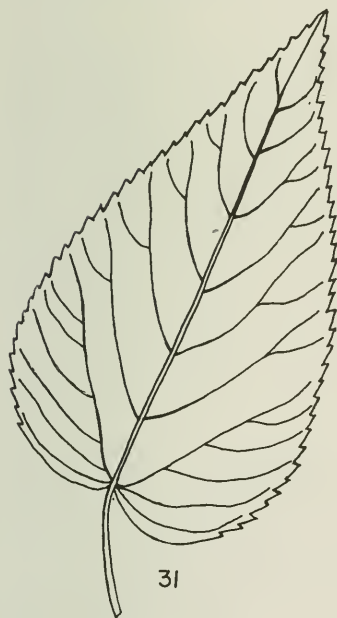
Cl. Pistillate pedicels, some of them, 5-6 mm long; blades acuminate, with much branched (dendritic) hairs beneath, often glabrate, deeply cordate, palmately nerved at base; petioles with 2-3 large glands; seeds 3mm long and wide; p. 38. Croton callistanthus Croizat



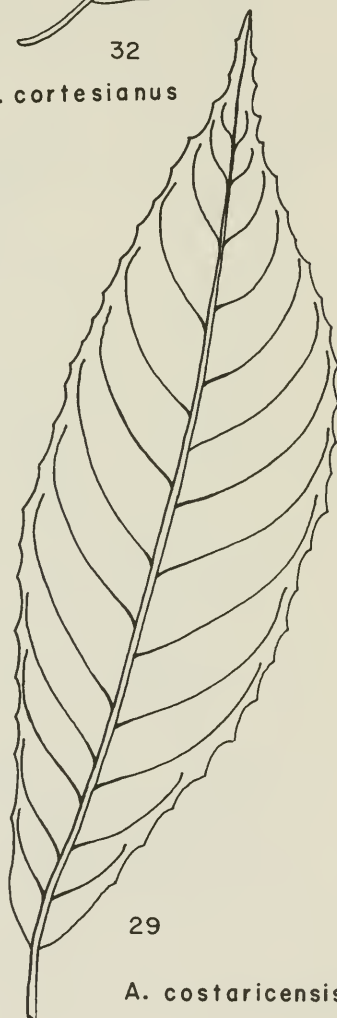
30
A. chordantha



32
C. cortesianus



31
A. schiedeana



29
A. costaricensis

Cl. Pistillate pedicels less than 1 mm long, or flowers sessile Cm.

Cm. Blades hairy beneath (hairs easily rubbed off), entire, cordate, abruptly cuspidate; cusp 1 cm long; blades 10-15 cm long, 8-12 cm wide; capsules tomentose, not hispid; p. 47 Croton steyermarkianus Croizat

Cm. Blades stellate-tomentose beneath, caudate, 25 cm long, 15.5 cm wide, denticulate or serrulate, palmately 3-5-nerved at base; petioles up to 7.5 cm long, with 4 glands beneath; young twigs with brownish hairs; pedicels of staminate flowers up to 6.5 mm long; capsules 7 mm long; p. 37 . . . Croton aguilarii Lundell

Ck. Glands of petiole on stipes; racemes usually bearing both staminate and pistillate flowers; blades sparsely hairy above Cn.

Cn. Blades flocculent-tomentose beneath, ovate, 17 cm long, 10 cm wide, cuspidate or acuminate; petioles 13 cm long; inflorescences up to 10 cm long; flowers hispid; p. 48 Croton triumfettoides Croizat

Cn. Blades tomentose beneath with stellate or dendritic hairs, 5-7-nerved at base; glands of petiole saucer-shaped; flowers not hispid Co.

Co. Blades minutely stellate-hairy above and beneath or glabrate, acuminate or acute, not cordate, 5-nerved at base, 8-16 cm long, 7-12 cm wide; hairs not dendritic; petioles 2.5-4 cm long; inflorescences 12 cm long; pedicels up to 5 mm long; capsules 10 mm long, stellate-hairy; seeds 5 mm long; p. 48 Croton verapazensis Donn. Smith

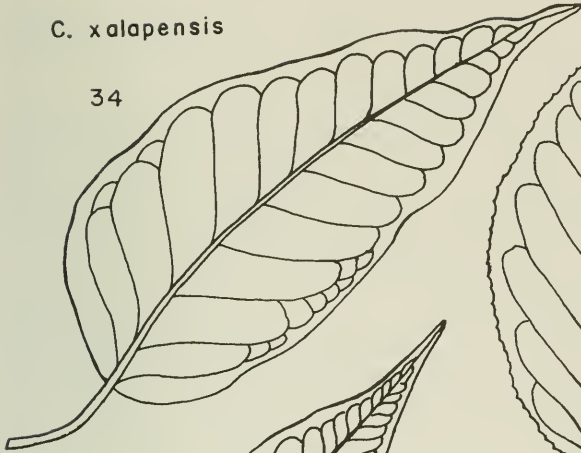
Co. Blades with dendritic and/or stellate hairs beneath Cp.

Cp. Pedicels of pistillate flowers (2-)3-6 mm long; blades gradually acuminate, (7-)10-30 cm long, (6-)7-23 cm wide, minutely glandular-dotted, truncate to deeply cordate at base; petioles 3-20 cm long, with 2-6 or more glands; styles glabrous; capsules tomentose, hispid; seeds 5 X 3.5 mm; p. 44 fig. 40, p. 26 Croton panamensis (Klotzsch) M. A.

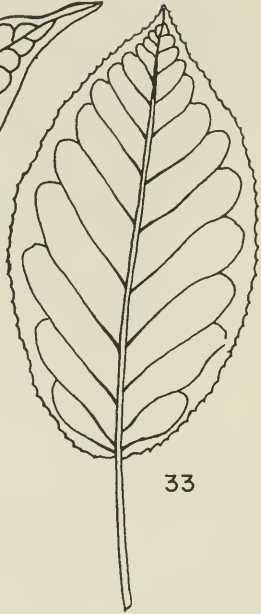
Cp. Pedicels of pistillate flowers 1-2 mm long; blades 5-15 cm long, 2-10 cm wide, abruptly acuminate, frequently cordate; petioles (1-)2-6 cm long, with 2-4 glands; styles hairy; capsules ovoid; seeds 5.1-5.7 mm long, 3.6-4.1 mm wide; p. 45, fig. 47, p. 23 Croton pungens Jacq.

C. xalapensis

34



33



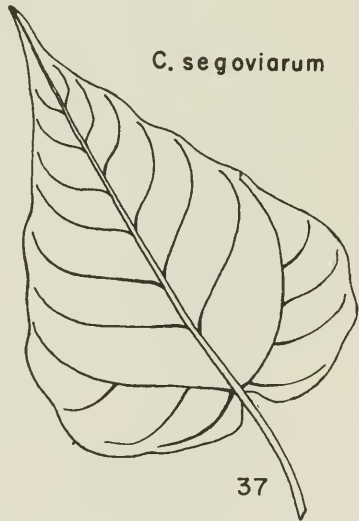
35



C. pittieri

C. segoviarum

37



36

C. pluvialis



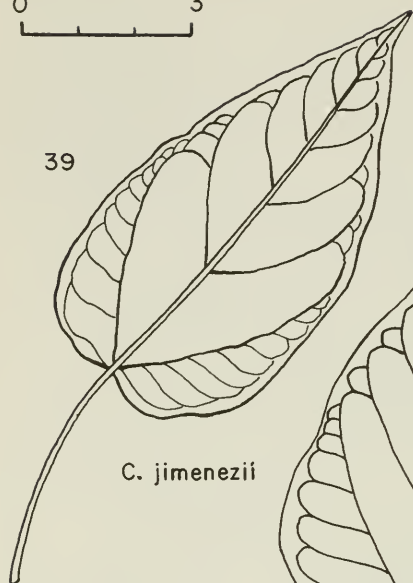
C. pungens

- Ce. Longest petioles 0.6-6(-6.5) cm long Cq. cp. p. 20
- Cq. Branches (young) usually with dark stellate hairs; blades entire or nearly so, obtuse or rounded or subcordate at base; inflorescences 5-6 cm long Cr.
- Cr. Blades glabrous above, 4-12 cm long, pinnately veined; petioles up to 3 cm long, without conspicuous glands; inflorescences up to 5 cm long; p. 38, fig. 32, p. 21 . . .
 Croton cortesianus HBK.
- Cr. Blades hairy above, 2-6 cm wide, pinnately or palmately veined at base; ovary stellate-hispid or unknown Cs.
- Cs. Petioles 4-11 cm long; blades ashy-tomentose with stellate hairs beneath, pinnately veined; p. 45, fig. 35, p. 23; cp. p. 20 Croton pittieri Pax
- Cr.Cs. Petioles 0.4-3 cm long; glands none or inconspicuous Ct.
- Ct. Blades sparsely or densely hairy, similarly hairy above and beneath, oblong or ovate-oblong, 5-13 cm long; petioles 1-3 cm long; p. 37
 Croton axillaris M. A.
- Ct. Blades densely hairy above and beneath, at least when young Cu.
- Cu. Petioles 0.4-0.7 cm long; blades thick-whitish-tomentose beneath, 2-3.5 cm long; veins obscured by dense tomentum; p. 40
 Croton heterochrous M. A.
- Cu. Petioles 1-2 cm long; blades entire, veins evident, pinnately veined, 4-7 cm long; p. 46 . . .
 Croton rhamnifolius HBK.
- Cq. Branches with no dark stellate hairs Cv.
- Cv. Blades pinnately veined at base Cw. cp. p. 25
- Cw. Blades coarsely irregularly crenate, densely hairy beneath; petioles up to 1.5 cm long; young twigs stellate-hispid; inflorescence 1.5-7 cm long, bisexual; staminate pedicels 2-3 mm long; pistillate pedicels none to 1 mm long; ovary hispid-tomentose; glands of petiole on stipes; p. 42 Croton jutiapensis S. & W.
- Cw. Blades entire or finely serrate Cx.
- Cx. Fruiting pedicels 3-5 mm long; blades 3-5 times as long as wide, gradually acuminate; sessile gland at either side of blade at base near petiole; p. 39 . . .
 Croton flavens L.
- Cx. Fruiting pedicels 0-1 mm long; petioles up to 1-3 cm long; glands on petiole 2, evident or hidden Cy.
- Cy. Blades crowded beneath inflorescence, serrulate, 1.5-2.5 cm wide, less than 3 times as long as wide; glands cylindric, often hidden, not widened at tip; pistillate flowers crowded at base of inflorescence; p. 37 . . . Croton adpersus Bth.

- Cy. Blades not crowded beneath inflorescence, densely stellate-hairy beneath, acute or acuminate Cz.
- Cz. Petioles up to 1.5 cm long; blades 3-5 cm long, acute or acuminate; inflorescences typically 7-8 cm long; entire or serrulate, palmately veined; staminate flowers on slender pedicels; pistillate flowers dense, almost sessile; glands 2, evident or hidden; p. 39 Croton fragilis HBK.
- Cz. Petioles 2-3 cm long; blades 9-20 cm long, long-acuminate or cuspidate, serrulate; glands of petiole 2, on stipes, evident; inflorescence 10-20(-25) cm long; staminate and pistillate pedicels short; p. 49
 Croton xalapensis H.B.K.
- Cv. Blades palmately veined, 3-7-nerved at base Da.
- Da. Blades coarsely or distinctly toothed Db. cp. p. 27
- Db. Glands none on petiole or small or obscure Dc.
- Dc. Axis of inflorescence with dense long spreading hairs; staminate part up to 8 cm long; blades 5-11 cm long, 3-7 cm wide, acuminate, sparsely hairy above; upper leaves sessile; lower petioles up to 4 cm long; p. 47 Croton suyapensis Molina
- Dc. Axis of inflorescence without dense long hairs Dd.
- Dd. Blades 3-nerved at base, 10-15 cm long, coarsely toothed; p. 48; cp. p. 8 . Croton tonduzii Pax
- Dd. Blades 5-7(-9)-nerved at base, sparsely stellate above and beneath, densely dotted beneath, 5-11 cm long, 2-7 cm wide; glands none or obscure; inflorescences bisexual; pistillate flowers distinct, not clustered; p. 41, fig. 38, p. 26 . . .
 Croton hircinus Vent.
- Db. Glands on petiole evident; blades not coarsely toothed De.
- De. Glands of petiole sessile or almost sessile, 2 or 4; blades caudate, 3-5-nerved at base; pistillate flowers sessile; pedicels of staminate flowers up to 7 mm long; p. 37 Croton asteroides Lundell
- De. Glands of petiole on stipes; blades not coarsely toothed, stellate-hairy above and beneath or glabrate above Df.
- Df. Pistillate flowers on pedicels; pedicels 2-3 mm long; staminate pedicels 6-9 mm long; glands 2-6; p. 40 Croton fragrans HBK.
- Df. Pistillate flowers almost sessile Dg.
- Dg. Glands of petiole 2, stipitate; seeds 5.5 mm long; p. 41 Croton jalapensis Croizat
- Dg. Glands of petiole about 4, patelliform; seeds 10 mm long; p. 46 . . Croton quercetorum Croizat



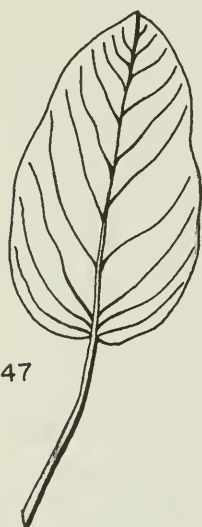
39

*C. jimenezii*

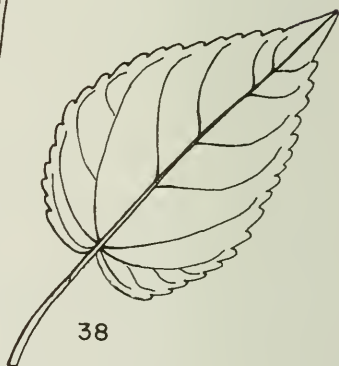
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*C. panamensis*

47

*C. atwoodianus*

38

*C. hircinus*

- Da. Blades entire to finely toothed Dh. cp. p. 25
- Dh. Pistillate flowers sessile or nearly so Di.
- Di. Hairs of blades beneath, some of them, dendritic Dj.
- Dj. Pedicels of staminate flowers 3-8 mm long; fruiting pedicels 1-2 mm long; glands of petiole 2-4; lower nodes of inflorescence with both staminate and pistillate flowers; styles once divided; p. 45, fig. 37, p. 23 Croton pungens Jacq.
- Dj. Pedicels of staminate flowers 6-9 mm long; pistillate pedicels 2-3 mm long; glands 2-6, stipitate, patelliform; lower nodes of inflorescence with only pistillate flowers; styles 2-4 times divided; p. 40 Croton fragrans HBK.
- Di. Hairs of blades beneath stellate, dense, not dendritic; blades acute or short-acuminate or caudate; petioles bearing 2 conspicuous stipitate glands; staminate flowers on short pedicels; pistillate flowers almost sessile Dk.
- Dk. Sepals of pistillate flowers 3.5 mm long; pistillate flowers distinct not in clusters; racemes 10-20(-25) cm long; blades 9-20 cm long, rounded and cordate at base, pinnately veined but basal nerves conspicuous; p. 49 Croton xalapensis Croizat
- Dk. Sepals of pistillate flowers 1.5 mm long; pistillate and staminate flowers in clusters or distinct; racemes up to 13 cm long, on peduncles; blades 6-12 cm long, 3-7 cm wide, rounded and cordate and 5-nerved at base; p. 44 . Croton pagiveteris Croizat
- Dh. Pistillate flowers, some of them, on pedicels, distinct, not in clusters; pistillate pedicels at least 2-3 mm long; racemes bisexual or staminate Dl.
- Dl. Racemes 10-20 cm long; glands of petiole hidden; blades 4-9.5 cm long, 2-6 cm wide, acuminate, 3-nerved at base; flowers not in clusters; axis stellate-pilose; p. 42 Croton juigalpensis S. & W.
- Dl. Racemes 4-7 cm long Dm.
- Dm. Blades densely stellate-hairy above; racemes 1-2 cm long; flowers densely stellate; pedicels 2-3 mm long Dn.
- Dn. Blades acute at base; petioles very short, .6-8 mm long; glands of petiole small, on stipes; p. 45, fig. 36, p. 23 . . . Croton pluvialis S. & W.
- Dn. Blades rounded at base, 3-nerved; petioles 1.5-2 cm long, without glands; p. 38 Croton comayaguanus S. & W.

Dm. Blades almost or quite glabrous above; flowers densely hairy Do.

Do. Glands of petiole saucer-shaped, sessile; racemes 1-2 cm long; petioles up to 2.5 cm long; blades cordate, 6-13 cm long, 3-7.5 cm wide, with few stellate hairs; pedicels short; ovary whitish-tomentose; seeds smooth; p. 42 Croton limnocharis Croizat

Do. Glands of petiole none or obscure; blades serrulate or entire Dp.

Dp. Blades beneath whitened or ashy, densely softly tomentose, glabrous above when mature, 4-11 cm long, 1.5-5.5 cm wide, 5-nerved at base; petioles 1-6 cm long; racemes 5-7 cm long; pedicels short; p. 47 Croton segoviarum S. & W.

Dp. Blades beneath sparsely stellate or later almost glabrous, rounded or obtuse at base; petioles 1-3 cm long Dq.

Dq. Pistillate sepals with dense reddish glands; glands ending in long hairs; blades 5-11 cm long; racemes 4-7 cm long; p. 40 Croton glandulo-sepalus Millsp.

Dq. Pistillate sepals without reddish glands; blades 2-6 (-9) cm long, 2-4 cm wide; pedicels 2-4 mm long; p. 41 Croton humilis L.

ANNOTATED LIST OF SPECIES OF ACALYPHA AND CROTON IN CENTRAL AMERICA

Acalypha alopecuroidea Jacq., Icon. Pl. Rar. 3: 19, pl. 620.
1786-1793.

Florida (FLAS), Mexico (US), Honduras (MO), Costa Rica (MO), Panama (FLAS, FSU), Jamaica (FLAS), W. I. (FLAS).

Panama, Canal Zone, Miraflores. Tyson 1391 (FSU), fig. 6, p. 4.

Nicaragua:

Dept. Rio San Juan, San Carlos. Nelson 5332 (SEYM).

Dept. Managua, Managua. Chaves 97 (US); Maxon, Harvey & Valentine 7553 (US); Neill 7494 (MO, SEYM, UCA); Croat 43153 (MO).

Dept. Masaya, Lake Masaya. Hall & Bockus 7880 (SEYM, UCA).

Dept. Granada, Laguna Blanca. Hall & Bockus 7847 (BM, FLAS, GH, MO, NY, SEYM, SMU, UC, UCA).

Dept. Rivas, Penas Blancas. Seymour 1871 (VT).

Blades widely ovate, truncate at base.

Acalypha apodanthes Standley & Williams, Ceiba 1: 241. 1950.

Stipules linear-subulate, 6-7 mm long. Petioles 1-2.5 cm long, densely pilose. Blades 5.5-10 cm long.

Costa Rica, Prov. Guanacaste, La Cruz. Wilbur & Stone 10224 (MO). Fig. 26, p. 18.

Acalypha arvensis Poepp. & Endl., Nov. Gen. 3: 21. 1845.

This species has been confused with *A. phleoides* because of the similarity in the outline of the blade. They are distinguished by the length of the petiole, in *A. arvensis* 2-3.5 cm, in *A. phleoides* less than 1 cm.

Panama, Cocle, El Cope. Tyson 5207 (FSU). Fig. 5, p. 6. Mexico (FLAS, US), British Honduras, Guatemala, Honduras (FSU), Costa Rica (FSU), Panama (FSU, MO), Martinique, tropical S. A.

Nicaragua:

Dept. Zelaya, Comarca del Cabo, Bihmona. Robbins 5676 (BM, ENAG, SEYM, SMU); Seymour 5723 (ENAG, MO, SEYM, SMU).

Corn Is. Seymour 4410 (MO, SEYM).

Rama. Seymour 720 (ENAG, F, GH, MO, SEYM, SMU).

Siuna. Seymour 3017 (SEYM).

Dept. Chontales, Santo Tomas. Atwood 2728 (SEYM);
Seymour 6313 (SEYM).

Dept. Rio San Juan, San Juan del Norte. Seymour 5302 (SEYM).
San Carlos. Seymour 5347 (MO);

Dept. Masaya, Nindirí. Zelaya 2329 (VT).
Park Nacional. Neill 2847 (UCA).

Dept. Rivas, Sapoa. Seymour 1883 (VT).

Acalypha chlorocardia Standley, Field Mus. Bot. 8: 18. 1930.

Known from the type, only, British Honduras, Middlesex. Schipp S-45.

Acalypha chordantha F. Seymour, species nova

This species was recognized by Standley & Williams and named by them but never published. I hereby validate the name and publish it, retaining the name given by them.

Frutex ramosus, gracilis, ramis teretibus, cinereis, pilis brevibus densis patentibus. Stipulae caducae. Petiolis pubescentibus ut caule 1-4 cm longis. Lamina ovata, 7-9.5 cm longa, 4-4.5 cm lata, sensim attenuato-acuminata, 5-7 denticibus per cm, arcte serrulata, basi breviter cordata, 3-nervia, supra viridis sparsim pilosa, simpliciter pilosula, subtus mollis tactu, costa elevata, nervis lateralibus utroque latere (supra nervos basales) 5-7. Spicis unisexualibus. Spicis masculis

dense multifloris, breve pedunculatis vel sessilibus, 5-9 cm longis, 1.5-1.8 cm crassis. Floribus pilosis hispidulosis; rachidi minute pilosa. Spicis feminis terminalibus sessilibus, bracteis non congestis, 7-11-dentatis hispidulis.

TYPE: Nicaragua, Dept. Esteli, 15.5 mi N of Esteli, roadside thickets, alt. 2100 feet, 7 July 1962. Shrub 2 m high. Webster, Miller & Miller 12063 (MO), Fig. 30, p. 21.

Dept. Esteli, 5 kms from Esteli, thickets slong Esteli River, 3 Nov. 1968, alt. 900 m. Shrub 2 m. Molina 23005 (MO).

Dept. Madriz, ca. 7 miles south of Ocotol, along highway 15; disturbed roadside; 650 m elevation, 6 Aug. 1977. Shrub 2 m; inflorescence greenish. Croat 42801 (MO).

Acalypha costaricensis (Kuntze) Knobloch in Just, Bot. Jahrsb. 19: 337. 1894.

Honduras, Dept. Atlantida, Lancetillo Mountain. Molina & Molina 25632 (MO), fig. 29, p. 21.

Costa Rica (FLAS, FSU, MO), Panama (FSU).

Acalypha diversifolia Jacq., Pl. Hort. Schoenbr. 2:63, pl. 244. 1797.

Blades 4-8 cm wide.

Honduras (FSU, MO), Costa Rica (FSU), Panama (FSU).

Nicaragua:

Dept. Jinotega, Comarca de Bocaycito. Neill N95 (MSC, SEYM).
Penas Blancas. Atwood A72 (MSC, SEYM).

Dept. Matagalpa, Tuma. Neill 7224 (GH, MO, SEYM, UCA).

Dept. Rivas, Penas Blancas. Atwood 1810 (BM, ENAG, FLAS, GH, MO, NY, SEYM, SMU, UC). Fig. 20, p. 15.

Dept. Masaya, Lake Masaya. Seymour 3308 (SEYM).

Acalypha euphrasio-stachys Bartlett, Proc. Amer. Acad. 43:55. 1907. Type from Guatemala, Fl. Guatemala 6: 33. 1949.

Mexico, Dist. Tomescaltepec, Rincon del Carmen. Hinton 1954 (MO). Fig. 21, p. 15.

Guatemala. Spikes sessile.

Acalypha ferdinandii K. Hoffm., Pflanzenreich IV, 147, xvi:63. 1924.

- a. Parts glabrous except the very young and inflorescence; fruiting bracts 1-2-flowered var. ferdinandii
a. Branches and petioles tawny-tomentose; leaf above sparingly, beneath on midrib and veins soft-hairy; pistillate bracts solitary, 1-flowered, in axils of leaves
. var. pubescens K. Hoffm.

Acalypha ferdinandii var. ferdinandii.

Mexico (MO), Guatemala, Honduras (MO), Costa Rica.

Mexico, near Palenque. Hoover 153 (MO), fig. 27, p. 18.

Acalypha ferdinandii var. pubescens K. Hoffm., Pflanzenreich IV, 147, xvi: 64. 1924.

Mexico (MO), British Honduras (MO), Honduras (MO).

Acalypha fertilis Standley & Williams, Ceiba 1: 146. 1950.

Mexico (FSU), Costa Rica.

Acalypha firmula Muell. Arg., Linnaea 34: 21. 1865.

Type from San Salvador, Fl. Guatemala 6: 34. 1949.

Honduras (FSU, MO).

Acalypha flagellata Millsp, Field Mus. Bot. 2: 417. 1916.

Mexico (FSU), Yucatan, Guatemala.

Acalypha garnieri Standley & Williams, Ceiba 1: 147. 1950.

Costa Rica, Prov. Guanacaste, Finca La Pacifica. Opler 829 (MO), fig. 28, p. 18.

Nicaragua, Dept. Jinotega. Standley 10042 (F), type; same, dup. 10042 (EAP); Standley 49663.

Dept. Managua, Sierra de Managua. Garnier 125.

Acalypha guatemalensis Pax & Hoffm., Pflanzenreich IV. 147, xvi: 27. 1924.

Guatemala, Lake Atitlan, Panajachel. Burch 5560 (MO), fig. 11, p. 4. Dept. Huehuetenango, Jacaltenango-San Marcos. Boeke 194 (MO).

Blades 2-5.5 cm wide. For comparison with similar species, see Croizat, Field Mus. Bot. 22: 447. 1942.

Acalypha gummifera Lundell, Contr. Univ. Mich. Herb. 4: 10.

British Honduras.

Type: British Honduras, Camp 34, boundary. Schipp 1290.

Acalypha hispida Burm., Fl. Ind. 203, pl. 61, f. 1. 1768.

Flowers sessile. Blades scabrous above and minutely white-dotted, beneath hairy along main veins and in axils, otherwise sparsely hairy, glabrescent and minutely resinous.

Mexico, State Sinaloa, Maxatlan. Ortega 5768 (MO), fig. 22, p. 15.

Petioles without glands. The uppermost leaves on very short petioles.

Mexico (MO), Guatemala, Antigua, S. Pacific, Fl. Guatemala 6: 36. 1949.

Acalypha indica L., Sp. Pl. 1036. 1753.

a. Spikes 1-7 cm long var. indica

a. Spikes 0.5-1 cm long var. mexicana

Acalypha indica L. var. mexicana (Muell. Arg.) Pax & Hoffm.

Pflanzenreich IV. 147, xvi: 35. 1921. This is the only var. known in Central America.

S. Mexico (MO), Guatemala, Costa Rica (FSU, MO).

Acalypha lancetillae Standley, Field Mus. Bot. 4: 312. 1929.

British Honduras (MO), Honduras.

British Honduras, Dist. Toledo, Medina Bank. Proctor 35894 (MO), 35895 (MO), fig. 25, p. 18.

Acalypha langiana Muell. Arg., Linnaea 34: 159. 1865.

Petioles 1.5-5(-8) cm long. Spikes 1.5-5(-7) cm long.

S. Mexico (MO), Guatemala, Fl. Guatemala 6: 137. 1949.

Acalypha leptopoda Muell. Arg., Linnaea 34: 39. 1865.

Fl. Guatemala 6: 38. 1949 distinguishes the varieties as follows:

a. Leaves and stems glabrate, leaves often quite glabrous at maturity var. glabrescens

A. Leaves densely velutinous-pilose, especially beneath, pubescence persistent in age var. mollis

Acalypha leptopoda var. glabrescens Muell. Arg. in DC., Prodr. 15, pt. 2: 524. 1866. S. Mexico (FSU), Guatemala, Honduras, Salvador to Panama (FSU).

Blades 3-nerved at base, pinnately nerved above base.

Nicaragua, Dept. Esteli, Esteli. Molina 23005 (MO).

Acalypha leptopoda var. mollis. Muell. Arg. in DC., Prodr.

15. pt. 2: 824. 1866.

S. Mexico, Guatemala, Honduras, Costa Rica, Panama (FSU).

Acalypha macrostachya Jacq., Pl. Hort. Schoenbr. 2: 63, pl. 245. 1797.

Fl. Guatemala 6: 39. 1949 distinguishes the varieties essentially as follows:

a. Branches when young and petioles usually very densely pilose; blades densely velutinous-pilose beneath, pubescence persistent in age var. hirsutissima

a. Branches and petioles sparsely or rather densely hirsute or pubescent; blades in age glabrate except on nerves var. macrophylla

Acalypha macrostachya var. hirsutissima (Willd.) Muell. Arg.,
Linnaea 34: 11, pt. 2: 345. 1865.

Mexico, British Honduras to Costa Rica (FSU), Panama
(LAS, FSU).

Acalypha macrostachya var. macrophylla (HBK.) Muell. Arg.,
in Mart. Fl. Bras. 11, pt. 2: 345. 1874.

Mexico (MO), British Honduras (MO), Guatemala, Honduras,
Panama (FSU), tropical S. A.

Acalypha mollis HBK., Nov. Gen. & Sp. 2: 94. 1817.

S. Mexico (FSU, MO), Guatemala, Fl. Guatemala 6: 40. 1949.

Acalypha mortoniana Lundell, Bull. Torrey Club 64: 552. 1937.

Type: Guatemala, Dept. Peten, Uaxactun. Bartlett 12740
(MICH). British Honduras (FSU, MO).

Acalypha muelleriana Urban, Symb. Ant. 1: 338. 1899.

Similar to *A. villosa* in having small distant fruits. In *A. muelleriana*, fruiting pedicels are 1-2 mm long, the fruits are 1-3 mm apart. In *A. villosa*, fruiting pedicels are 2-3 mm long, fruits are 5 mm apart.

Costa Rica (FSU, MO).

Acalypha nicaraguensis Pax & Hoffm., Pflanzenreich IV, 147,
xvi: 254. 1924.

Mexico, State Colima, Manzanillo. Eiten 328 (MO), fig. 7,
p. 4.

Nicaragua, Dept. Chinandega, Corinto. Brenning 175.

Acalypha oblancifolia Lundell, Wrightia 5: 243 (-244). 1976.
Guatemala.

Acalypha obtusifolia Pax & Hoffm., Pflanzenreich IV, 147, xvi:
147. 1924.

Costa Rica. Known from the original collection only, Tonduz 6823.

Acalypha persimilis Muell. Arg., Linnaea 34: 25. 1865.

In this group of species, the pistillate bracts are very characteristic. In *A. persimilis*, pistillate bracts are only 3-4 mm long (including teeth) and rather close together, the teeth are very narrow and acute.

Mexico, Durango. Palmer 504 (MO), fig. 10, p. 4.

Guatemala, Greater Antilles, Fl. Guatemala 6: 40. 1949.

Acalypha phleoides Cav., Icon. Pl. 6: 42, pl. 569, f. 2. 1801.
Mexico, Chihuahua. Le Seur Mex-83 (MO), fig. 12, p. 4.
Guatemala.

Lobes of styles might be mistaken for teeth of bracts, but
the teeth of bracts bear long gland-tipped hairs.

Acalypha pittieri Pax & Hoffm., Pflanzenreich IV, 147, xvi: 18.
1924. known from the original collection only, Costa Rica,
Cocos Island. Pittier 16246.

Blades 5-nerved at base, crenate-serrate. Pistillate flo-
wers on pedicels. Racemes 7 cm long.

Acalypha poiretii Sprengel, Syst. 3: 879. 1826.

S. Mexico (MO), Guatemala ?, tropical S. A.

Acalypha polystachya Jacq., Pl. Hort. Schoenbr. 2:64, pl. 246.
1797. Mexico, Costa Rica (MO), Fl. Guatemala 6: 41. 1949.
Panama (FSU).

Nicaragua:

Dept. Leon, Volcan Momotombo. Hall & Bockus 7797 (BM,
FLAS, GH, MO, NY, SEYM, SMU, UC, UCA), Fig. 3, p.
6.

Dept. Managua, Managua. Seymour 6279 (SEYM).

Dept. Masaya, Park Nacional. Stevens 4254 (MO).

Acalypha porcina Standley & Williams, Ceiba 3: 208. 1953.

Type: Nicaragua, Dept. Esteli, Esteli. Standley 20251
(EAP); dupl. (F).

Panama.

Acalypha porphyrantha Standley, Journ. Arn. Arb. 11: 32.

1930. Fl. Guatemala 6: 34. 1949 treats this species as a
synonym of *Acalypha firmula* Muell. Arg.

Honduras (MO).

Acalypha pseudo-alopecuroides Pax & Hoffm., Pflanzenreich
IV, 147, xvi: 86. 1924.

S. Mexico, Honduras, Fl. Guatemala 6: 42. 1949.

Acalypha radinostachya Donn. Smith, Bot. Gaz. 54: 243. 1912.

For description, see Pflanzenreich IV, 147, xvi: 49. 1924.

Known from original collection only, Costa Rica, Prov.

Costa Rica, Prov. Limon, Llanuras de Santa Clara. Donnell Smith 6849. Suffruticose.

Acalypha retifera Standley & Williams, Ceiba 3: 209. 1953.
Honduras.

Acalypha salvadorensis Standley, Journ. Wash. Acad. Sci. 14: 96. 1924.

Salvador, San Salvador. Calderon 1741 (MO), fig. 9, p. 4. Pistillate bracts large, 5 mm long, shallowly toothed, obscuring flowers, conspicuously larger than in *A. persimilis* and *A. subviscida*. Spikes erect, surpassing leaves.

Acalypha schiedeana Schlechter, Linnaea 7: 384. 1832.

Mexico (FLAS); Honduras, Tegucigalpa. Burch 5463 (MO), fig. 31, p. 21; Costa Rica.

Nicaragua:

Dept. Esteli, Salto de Estanzuela. Hall 7680 (FLAS, GH, MO, SEYM, SMU, UCA).

Dept. Leon, Volcan Momotombo. Neill 7339 (BM, FLAS, GH, MO, MSC, NY, REED, SEYM, SMU, UC, UCA).

Dept. Managua, Managua. Neill 1079 (SEYM, UCA).

Dept. Masaya, Lake Masaya. Seymour 3308 (SEYM).

Acalypha septemloba Muell. Arg., Flora 55: 27. 1872.

Type: Costa Rica, Cartago. Friedrichsthal 1354, Fl. Guatemala 6: 43. 1949. *Acalypha irazuensis* Kuntze, Rev. Gen. 616. 1891.

Costa Rica, Panama, Fl. Panama 54: 306. 1967.

Acalypha setosa A. Rich. in Sagra. Hist. Cuba 3: 204. 1850.

Florida (FLAS), Mexico (MO), British Honduras, Guatemala, Honduras, W. I., nw S. A.

Nicaragua, Dept. Managua. Zelaya 269 (BM, ENAG, F, GH, MO, NY, SEYM, SMU, UC, WDP).

Dept. Granada, Volcan Mombacho. Atwood & Neill AN48 (MO, SEYM, UCA), Fig. 4, p. 6; Dudey & Moore 1924 (VT).

Acalypha skutchii I. M. Johnston, Journ. Arn. Arb. 19: 120.

1938. Mexico, Guatemala, Fl. Guatemala 6: 43. 1949.

Costa Rica (MO). In some characters like *A. tenuicauda*, but pistillate spikes terminal. In *A. tenuicauda*, spikes are all axillary.

Acalypha subviscida S. Watson, Proc. Amer. Acad. 21: 440.

1886. Mexico, State Morelos, Cuernavaca. Pringle 3191 (MO), fig. 8, p. 4. Guatemala.

Similar to *A. salvadorensis* in habit, but bracts (pistillate) 2-3 mm long, strikingly smaller than in *A. salvadorensis*, and not crowded but having flowerless intervals.

Acalypha tenuicauda Pax & Hoffm., Pflanzenreich IV, 147, xvi:

149. 1924. Costa Rica, Prov. San Jose, El General.

Skutch 2487 (MO), fig. 23, p. 15.

Guatemala. Styles red.

Acalypha trachyloba Muell. Arg., Flora 55: 25. 1872.

Mexico, Guatemala, Fl. Guatemala 6: 45. 1949.

A. leptopoda also has pistillate spikes on long slender peduncles but has only a few bracts in a head. *A. trachyloba* has many bracts and stipules reflexed.

Acalypha triloba Muell. Arg., Linnaea 34: 23. 1865.

Guatemala. Petioles mostly 0.5-3.5 cm long.

Acalypha unibracteata Muell. Arg., Linnaea 34: 160. 1865.

S. Mexico (FSU), British Honduras (FSU), Guatemala, Salvador.

Nicaragua, Dept. Zelaya, Corn Is. Atwood 4356 (B, BM, ENAG, FLAS, GH, MO, NY, REED, SEYM, SMU, UC).

Longer petioles 3-8 mm long, usually 4-5 mm long.

Acalypha villosa Jacq., Sel. Stirp. Amer. 254, pl. 183, f. 61. 1763.

British Honduras (FSU) to Brazil, Fl. Panama 54: 302. 1967. All spikes are axillary, some nearly but not really terminal. (Angelo). *A. costaricensis* has similar leaves, but unlike *A. villosa*, it has pinnately nerved blades.

Acalypha wilkesiana Muell. Arg. in DC., Prodr. 15, pt. 2: 817.

1866. Extensively cultivated. In cultivation, leaves vary from lanceolate to orbicular. Out of cultivation, blades usually suborbicular. Petioles 1-3(-5) cm long. Florida (FLAS).

Nicaragua: Salas, Juan B. Lista Especies de la Flora Nicaraguense 20. 1966.

Croton adpersus Bentham, Pl. Hartweg. 51. 1840.

Croton botryocarpus Croizat, Field Mus. Bot. 22: 445. 1942.
S. Mexico, Guatemala.

Croton aguilarii Lundell, Phytologia 1: 401. 1940.

Guatemala. Type: Guatemala, Peten, La Libertad. Coll.
M. Aguilar 463.

Croton asteroides Lundell, Phytologia 1: 402. 1940.

Type: British Honduras, El Cayo District, Vaca. Gentle
2218 (MICH).

Croton atwoodianus F. Seymour, species nova.

Named in honor of Mr. John T. Atwood, Jr., my companion in several expeditions to Nicaragua, a specialist in Orchidaceae; collector of thousands of specimens in Nicaragua; author of "A Floristic Study of Volcan Mombacho, Department of Granada, Nicaragua", 1976, a master's thesis in Michigan State University.

Frutex 1m altus, pilis albis stellato-tomentosis. Petiolo 6-6.5 cm longo, dense stellato-piloso, eglanduloso. Lamina obtusa, deltoido-ovata, basi rotundata vel breviter cordata, 5-nervia, grosse irregulatim crenato-dentata, ca. 3 dentis per cm, novellis fere albis, minute stellatis super subtusque. Venis fere prominulis subtus. Inflorentia brevis unisexualis, 1-1.5 cm longa; staminatis spicis terminalibus; pistillatis spicis axillaribus. Capsulo ovoido, glabro, flavo, 2 X 6 mm.

Type: Nicaragua, Dept. Managua, Managua. Robbins 6092 (MO). Fig. 47, p. 26. Isotypes: B, BM, ENAG, GH, NY, SEYM, SMU, UC.

Florida, Levy County, Williston. R. H. Strang (FLAS).

Croton axillaris Muell. Arg., Linnaea 34: 126. 1865.

Type: Nicaragua, Granada Fl. Guatemala 6: 67. 1949.
Costa Rica (US).

Nicaragua, Dept. Esteli, Salto de Estanzuela. Seymour 7725 (SEYM).

Dept. Boaco, Teustepe. Seymour 2420b (SEYM).

Some blackish hairs as in *C. cortesianus*. Blades somewhat hairy above as beneath. Pistillate flowers and fruit unknown. Inflorescences "axillary and terminal".

The distinction between this species and *C. pittieri* is very unsatisfactory. The length of petioles used in the key is not sufficient. Perhaps it is a synonym of *C. pittieri* Pax, in which case *Croton axillaris* Muell. Arg. is the name to be used.

- Croton bilbergianus Muell. Arg., *Linnaea* 34: 98. 1865.
Mexico to Panama (FLAS, FSU), Costa Rica (US).
British Honduras (MO).
- Croton brevipes Pax, *Bot. Jahrb.* 33: 290. 1903.
Original collection: Rio del Convento, Disquis Valley.
Pittier 12117.
Costa Rica (FSU, MO), Panama (US).
Similar in outline of leaf to *Acalypha ferdinandii* and *A. lancetillae* and *A. apodanthes*.
- Croton callistanthus Croizat, *Journ. Arn. Arb.* 21: 84. 1940.
Guatemala (US).
Costa Rica, Prov. Cartago. R. R. Smith 2201 (FLAS).
Nicaragua, Dept. Esteli, El Bosque. Neill 7347 (FLAS, SEYM, UCA).
Miraflores. Neill N232 (MSC).
- Croton ceanothifolius Standley & Williams, *Ceiba* 3: 117. 1952.
Type: Nicaragua, Dept. Chontales, "Juticalpa". Standley & Williams 9287(F); dupl. (EAP).
- Croton ciliato-glanduliferus Ortega, *Hort. Matr. Dec.* 51: 1797.
Mexico (FLAS, FSU), Honduras (FSU, US).
Inflorescences 4.5-7 cm long, when well developed.
- Croton comayaguanus Standley & Williams, *Ceiba* 3: 118. 1952.
Honduras. Blades usually attenuate-acuminate, rarely rounded at tip.
- Croton comes Standley & Williams, *Ceiba* 1: 148. 1950.
Honduras.
- Croton cortesianus HBK., *Nov. Gen. & Sp.* 2: 83. 1817.
Mexico, Municipio La Trinitaria. Breedlove & Raven 8348 (FSU), fig. 32, p. 21.
Mexico (FLAS, FSU), Honduras (US).
Nicaragua: Dept. Jinotega, 5 miles E of El Jocote. Croat 42875 (MO).
Dept. Esteli. Molina 7230 (US).
4 miles S of Esteli. Dwyer et alii 447, 453 (MO).
ca. 4 miles W of El Jocote. Croat 42844 (MO).
Laguna de Miraflores. Neill N237 (SEYM).
Salto de Estanzuela. Neill 1167 (SEYM, UCA).
Blades pinnately veined at base (Angelo). Like *C. axillaris*, this species has blackish hairs on branches. Unlike *C. axillaris*, its blades are glabrous above.

Croton costaricensis Pax in Pittier, Prim. 2: 231. 1900.

Honduras, Costa Rica (US).

Staminate spikes not sessile (Angelo).

Croton fantzianus F. Seymour, species nova.

Named in honor of Dr. Paul R. Fantz, formerly of the University of Florida, now of the Fairchild Gardens, author of a monograph (unpublished) of Clitoria, presented for his doctoral thesis.

Frutex vel arbor. Ramis novellis lepidotis ut laminis et sepalis. Petioli 2-4.5 cm longi. Foliae congestae ad apicem ramorum. Petioli et calyces cum lepidis similibus lepidis laminarum. Lamina major, 6-8 cm longa, 5-8 cm lata, elliptico-ovata ad suborbicularis, profunde anguste cordata, fere obtusa ad apicem, supra lepidata, lepidotes minutae albae orbiculares ad centralem rubrae, subtus denser albida. Racemi axillares, 1-1.5 cm longi.

Type: Nicaragua, Dept. Nueva Segovia, Dipilto. Budier 6390 (FLAS). Fig. 48, p. 28. Isotypes: BM, ENAG, GH, MO, NY, SEYM, SMU, UC.

Nicaragua, Dept. Esteli, Condega. Croat 42833 (MO).

Croton flavens L., Syst. ed. 10: 276. 1759.

Bahamas (FLAS), Jamaica (FLAS), Dominica (FLAS, FSU, MO). Honduras. Reported by Standley as new to Central America, Journ. Arn. Arb. 11: 32. 1930.

For description, see Fl. Jamaica, Fawcett & Rendle, 2: 279. 1920.

"A low aromatic shrub, densely stellate-tomentose; leaves oblong-ovate, acute or acuminate, rounded or subcordate at the base; flowers in dense stout racemes." Standley in Fl. Yucatan, Field Mus. Bot. 3: 320. 1930.

Small tree. Leaves ovate-lanceolate to ovate, 2-10 cm, stellate-tomentose. Inflorescence terminal, 2-5 cm long. Fl. Cuba 3: 69. 1953.

Croton fragilis HBK., Nov. Gen. & Sp. 2:75. 1817.

Description in Contr. U. S. Nat. Herb. 23: 613. 1923.

S. Mexico, Guatemala (US), nw. S. A.

Inflorescences 2-15 cm long, typically 7-8 cm long (Angelo). A very variable species, as there may or may not be glands on the petiole; blades may be entire or serrulate, green or glabrous above; inflorescences may be terminal or axillary.

Croton fragrans HBK., Nov. Gen. & Sp. 2: 81. 1817.
Panama (US).

Croton glabellus L., Sp. Pl. ed. 2, 1425. 1763.

Mexico (US), British Honduras (FLAS, FSU), Guatemala
(FLAS, US), Honduras (US).

Costa Rica, Prov. Puntarenas, Palmar Norte de Osa. Allen
5716 (FSU), fig. 15, p. 9.

Croton glandulo-sepalus Millsp., Field Mus. Bot. 2: 419. 1916.
Yucatan, British Honduras.

Croton glandulosus L., Syst. ed. 10, 1275. 1759.

Mexico, Guatemala, Honduras, Costa Rica, Panama (US).
Nicaragua:

Dept. Chinandega, Cosiguina Volcano. Howell 10285 (US).

Corinto. Maxon, Harvey & Valentine 7217 (US).

Dept. Managua, Managua. Chaves 236 (US).

Rene 69 (US).

Dept. Granada, Granada. Maxon, Harvey & Valentine 7630 (US);

Nichols 1136 (ENAG, GH, MO, SEYM, SMU);

Neill 2680 (SEYM, UCA).

Croton grosseri Pax, Bot. Jahrb. 33: 290. 1903.

Costa Rica, Pittier 1206. Known from the original collection only.

Croton guatemalensis Lotsy, Bot. Gaz. 20: 353, pl. 25. 1895.

Croton eluteroides Lotsy, Bot. Gaz. 20: 353, pl. 25. 1895.

In the original descriptions, the principal difference between these two proposed species seems to be the length of the spikes, longer than the leaves in *C. guatemalensis* and shorter than the leaves in *C. eluteroides*. This seems an inadequate basis for distinguishing species, since the length of spikes is sometimes very variable.

Mexico (FSU), British Honduras, Guatemala, Honduras, Salvador, Costa Rica (US).

Nicaragua, Dept. Chontales, between Boaco cut off and Acoyapa. Bunting & Licht 704 (US).

This species is much confused with *C. niveus* Jacq. and *C. reflexifolius* HBK. See Croizat, Field Mus. Bot. 22: 447. 1942.

Croton heterochrous Muell. Arg., Linnaea 34: 121. 1865-66.

Blades entire but stellate pubescence gives appearance of minute teeth in some cases. (Angelo). Honduras (MO).

Nicaragua, Dept. Madriz, Somoto. Molina 27231 (US).

Croton hircinus Vent., Jard. Malm. 50. 1803.

Croton allenii Standley, Ann. Mo. Bot. Gard. 26: 289. 1939.
Panama, Cocle. McDaniel & Cooke 14779 (FSU), fig. 38, p. 26.

Panama only (US), Venezuela (MO). Blades toothed, ovate.

Croton hirtus L'Her., Stirp. Nov. 17. 1784.

Hairs stellate, but widely spreading from stem.

Mexico (FLAS, US), Honduras (US), Costa Rica (FLAS),
Panama (FSU, US).

Panama, Prov. Panama, Canita. Tyson & Smith 4148
(FSU), fig. 1, p. 6.

Nicaragua:

Dept. Zelaya, Puerto Cabezas. Molina 14808 (US).

Dept. Rio San Juan, San Bartolo. Seymour 6153 (B, BM,
DUKE, ENAG, FLAS, GH, MICH, MO, NY, SEYM, SMU,
UC, WDP).

Dept. Esteli, Esteli. Dwyer et alii 477 (MO).

Dept. Matagalpa, Matagalpa. Zelaya 2283 (ENAG, FLAS,
SEYM, SMU).

Dept. Managua, Managua. Seymour 6295 (ENAG, MO, SEYM).
Neill 7381 (UCA), 7493 (GH, MO, SEYM, SMU, UCA).

Dept. Masaya, Lake Masaya. Seymour 3315 (SEYM).
Parke Nacional. Neill 4611 (UCA).

Croton hoffmannii Muell. Arg., Linnaea 34: 86. 1865.

Pistillate spikes terminal; flowers distinct, not clustered.
Costa Rica (MO, US), Panama (FSU).

Nicaragua: Salas 20. 1966.

Croton humilis L., Syst. ed. 10: 1276. 1759.

For description, see Contr. U. S. Nat. Herb. 23: 616. 1923.

Blades 2-6 cm long; racemes 3-5 cm long.

Texas, Florida, Mexico (FLAS, US), Yucatan (MO), Jamaica (FLAS).

For description, see Fl. Jamaica 4: 283. 1920.

Nicaragua: Salas 20. 1966.

Croton jalapensis Croizat, Field Mus. Bot. 22: 449. 1942.

Remarkably similar to *C. hircinus* and *C. quercetorum*. See key, p. 25. Endemic in Guatemala.

Croton jimenezii Standley & Valerio, Fl. Costa Rica 18: 604. 1937. For description, see same.

Costa Rica, Prov. Heredia, between Volcan Barba and Volcan Irazu. Godfrey 66146a (FSU), fig. 39, p. 26.

Croton jimenezii, cont.

The type lacks pistillate parts.

Blades entire, pinnately or palmately veined. Petiole with no conspicuous glands (Angelo). Flowers not clustered as in *C. panamensis*.

Croton juigalpensis Standley & Williams, Ceiba 3: 209. 1953.
Honduras (US).

Nicaragua:

Dept. Esteli, Cerro Las Animas. Standley 20296. Cited with original description.

Dept. Chontales, Juigalpa. Standley 9433, Type (F); dupl. (EAP); Standley 9217.

Croton jutiapensis Croizat, Field Mus. Bot. 22: 450. 1942.

Pedicels of staminate flowers 1-3 mm long (Angelo). Larger blades 1-3(-4) cm wide. Pistillate flowers sessile or pedicels 1 mm long (Angelo).

Mexico (US), Honduras (US), Guatemala.

Nicaragua, Dept. Managua, 20 miles NE of Managua. Webster, Miller & Miller 12463 (MO).

Croton lasiopetaloides Croizat, Field Mus. Bot. 22: 450. 1942.

Type: Guatemala, mountains west of Aguacatan, on the road to Huehuetenango. Standley 81219.

Croton limnocharis Croizat, Field Mus. Bot. 22: 451. 1942.

Guatemala, endemic, Fl. Guatemala, 6: 74. 1949.

Similar to *C. pungens* in which pistillate flowers are sessile; in *C. limnocharis* pistillate pedicels are 2 mm long.

Croton lobatus L., Sp. Pl. 1005. 1753.

Florida (FLAS), British Honduras, Guatemala (MO), British Honduras to Salvador and Panama, Fl. Guatemala 6: 75. 1949. Antigua (FLAS, FSU), Brazil (FSU).

Croton lotorius Croizat, Journ. Arn. Arb. 26: 185. 1945.

Known from the type only, Guatemala, Huehuetenango, between Santa Ana Huista and forest of Rancho Lucas. Steyermark 51332.

Croton lundellii Standley, Carnegie Inst. Wash. Publ. 461: 67. 1935. Type from Guatemala, Campeche, Tuxpena.

Blades large, sparsely irregularly toothed, sparsely stellate-hairy above, densely so beneath, or stellate hairs scale-like. Some inflorescences terminal, some acillary (Angelo).

Croton lundellii Standley, cont.

Mexico, Guatemala (MO), US).

Nicaragua: Dept. Esteli, Limay. Neill 1194 (SEYM), fig. 17, p. 11.

Croton nitens Sw., Prodr. Veg. Ind. Occ. 100. 1797-1806.

Costa Rica, Prov. Puntarenas, Canto de Osa, Gulfo Dulce Area. Allen 5213 (US), fig. 13, p. 9. Shrub or small tree. British Honduras, District Toledo, Big Falls. Proctor 35836 (MO).

Longer petioles 5-10 cm long, scaly not hairy, without glands. Larger blades 13-17 cm long, 5.3-6.7 cm wide. Scales with red center on petiole and midrib beneath. Blades densely scaly beneath with white scales. Stem densely red-scaly. Blades pinnately nerved. Staminate spikes 5-7 cm long, axillary; pedicels 2 mm long. Pistillate spikes 5 cm long, axillary, few-flowered. Capsules 8 mm thick, scaly.

Croton niveus Jacq., Enum. Pl. Carib. 32. 1760.

Mexico, Tamaulipas, Los Coyotes. Le Seur 589 (US), fig. 18, p. 11.

Mexico (FLAS, US), Salvador (US), Honduras (US), Costa Rica (US), Panama (US).

Nicaragua:

Dept. Managua, Managua. Chaves 391 (US).

Rio Santa Clara. Neill 2866 (SEYM, UCA).

Dept. Chontales, Route 7, between Boaco cutoff and Acoyapa. Bunting & Licht 704 (US).

Croton olanchanus Standley & Williams, Ceiba 1: 149. 1950.

Guatemala ?, Honduras.

Similar to Croton xalapensis. The following key distinguishes the two species.

- A. Staminate and especially pistillate flowers on long pedicels; pistillate pedicels 4-8 mm long; staminate pedicels up to 6 mm long; blades 9.5-16 cm wide, 3-5-nerved at base; petioles 9-14 cm long; blades deeply cordate (4 cm); glands of petiole sessile Croton olanchanus
- A. Staminate and pistillate flowers on short pedicels; blades 2-6 cm wide; petioles 2-3 cm long; basal nerves strong but essentially pinnately nerved, cordate; glands of petiole on stipès Croton xalapensis

Croton ortholobus Muell. Arg., Flora 55: 9. 1872.

Photo of type specimen in Harvard Herbaria.

Costa Rica, prope Cartago. Friedrichsthal 1417.

Blades coarsely toothed, about 4 teeth per cm. (Angelo).

Not in Guatemala as sometimes reported. Flora Guatemala 6: 76. 1949.

Croton pagiveteris Croizat, Journ. Arn. Arb. 21: 85. 1940.

Type: Guatemala. Seler 2776 (GH).

Mexico, Guatemala (US).

Croton panamensis (Klotzsch) Muell. Arg. in DC. Prodr. 15(2): 546, fig. 9. 1866.

At least some petioles 5-20 cm long, shorter on young leaves only.

Mexico (FLAS), Honduras; Costa Rica (FSU, US), Panama (FLAS, FSU, US). Panama, Cocle, Caimito. McDaniel & Cooke 14815 (FLAS), fig. 40, p. 26.

Nicaragua:

Dept. Jinotega, Lago de Apanas. Croat 43000 (MO).

Dept. Nueva Segovia, Las Manos to Ocotal. Harriman 14609 (FLAS).

Dept. Esteli, Llano 4 de Mayo. Neill 7355 (GH, MO, SEYM, SMU, UCA).

El Bosque. Neill 7347 (FLAS, GH, MO, SEYM, SMU, UCA).

El Paraiso. Atwood & Neill AN245 (MO, MSC, SEYM).

Miraflores. Neill N232 (GH, MO, MSC, SEYM, UCA).

Dept. Matagalpa, La Fundadora. Hall & Bockus 7937 (B, BM, FLAS, GH, MO, MSC, NY, REED, SEYM, SMU, UC, UCA).

Seeds 5 X 3.5 mm; in *C. callistanthus* seeds are 3 X 3 mm.

Croton payaquensis Standley, Journ. Wash. Acad. Sci. 14: 97. 1924.

Inflorescences "axillary and some are terminal". (Angelo). Guatemala (MO), Honduras, Salvador (US).

Nicaragua:

Dept. Chinandega, Volcan Cosiguina. Neill 7098 (SEYM).

Dept. Leon, Paneloya. D'Arcy 10412 (MO).

Santa Rosa. Williams & Molina 42430 (US).

Croton petensis Lundell, Phytologia 1: 406. 1940.

As pistillate flowers are unknown, the difference between this species and *Croton lundellii* are not clear.

British Honduras, Orange Walk Dist. near Guatemala Border. Winzarling viii-12 (US).

Croton pittieri Pax in Pittier, Prim. Fl. Costaricensis 2: 328. 1900.

Costa Rica, "Carre" Las Concavas. Lankester 879 (US), fig. 35, p. 23. Sacaris, Cerro de Pretl 333 (MO). Dark stellate hairs on stem and inflorescence.

Croton pluvialis Standley & Williams, Ceiba 3: 119. 1952.

Type: Nicaragua, Jinotega. Standley 11034 (F).
Nicaragua: Dept. Jinotega, W of Jinotega, Cerro de la Cruz.
Standley 10187 (EAP, F, US), fig. 36, p. 23.
Petioles 6-8 mm long.

Croton pseudo-niveus Lundell, Phytologia 1: 449. 1940.

Mexico, State Sinaloa, Los Labrados. Mexia 921 (MO), type collection. Examined.
Panama, Prov. Los Santos, Pocri. Dwyer 1124 (FSU), fig. 19, p. 11.
For description, see also Ann. Mo. Bot. Gard. 54:252. 1967..

Croton punctatus Jacq., Coll. Bot. 1: 166. 1787; Icon. Pl. Rar. 3: 19, pl. 621. 1789; Muell. Arg. in DC., Prodr. 15(2): 540. 1866.

Although probably perennial, this species appears shrubby. Texas (FLAS) to N. C. (FLAS), Florida (FLAS), Mexico (MO), British Honduras, Honduras (FSU), Costa Rica, Panama (FSU, US).
Nicaragua, Dept. Zelaya, Bluefields. Hamblett 620 (B, ENAG, SEYM).
El Bluff. Marshall & Neill 6512 (ENAG, FLAS, GH, MO, SEYM, SMU).

Croton pungens Jacq., Coll. 4: 217. 1791. Icon. Pl. Rar. 3: 19, pl. 622. 1794; Muell. Arg. in DC., Prodr. 15(2): 540. 1866.

Croton standleyi Steyermark, Field Mus. Bot. 22: 151. 1910.

Panama, Chiriqui, El Hato del Volcan. McDaniel 10077 (FSU), fig. 37, p. 23. Panama (US).

Similar to Croton xalapensis, but C. pungens has both pistillate and staminate flowers in lower nodes of inflorescence. Fl. Panama 54: 257. 1967. Similar to C. limnocharis also, but in C. limnocharis pistillate pedicels are 2 mm long. In C. pungens, pistillate flowers are subsessile.

Croton pyramidalis Donn. Smith, Bot. Gaz. 35: 7. 1903.

British Honduras, District Toledo, San Jose. Croat 24445 (FSU), fig. 16, p. 11.

S. Mexico, Guatemala, Honduras (MO, US).

Blades palmately veined. (Angelo). Fruiting pedicels 5-10 mm long, thicker than in *C. niveus*.

Croton pyriticus Croizat, Journ. Arn. Arb. 26: 186. 1945.

Costa Rica (MO).

Nicaragua, Dept. Esteli, Cerro Quiabu. Neill 7758 (BM, FLAS, GH, MO, NY, SEYM, SMU, UC, UCA).

Llano 4 de Mayo. Neill 7354 (GH, MO, SEYM, SMU, UCA).

Fruit 2 cm long, stellate-hairy in patches. Seeds 1.5-1.6 cm long. (Angelo).

Croton quercetorum Croizat, Field Mus. Bot. 22: 452. 1942.

The description of this species is remarkably similar to that of *C. jalapensis* Croizat, published in the same article. See key, p. 25.

Croton reflexifolius HBK., Nov. Gen. & Sp. 2: 68. 1817.

Blades under high magnification red-dotted above and more so beneath. Capsules tuberculate, hispid (Contr. U. S. Nat. Herb. 23: 610), whereas in *C. niveus* they are smooth, densely scaly. Some inflorescences terminal. (Angelo).

Mexico, British Honduras (FSU), Guatemala, Honduras, Costa Rica (US).

Croton repens Schlechter, Linnaea 19: 237. 1847.

Mexico, British Honduras (FSU, US), Guatemala, Honduras

(FSU, MO), Salvador (US). Honduras, Dept. Comayagua,

Siguatopeque. Clewell 3155 (FSU), fig. 24, p. 18.

Nicaragua, Salas 20. 1966.

Croton rhamnifolius HBK., Nov. Gen. & Sp. 2: 75. 1817.

"The typical form of the species has a wide distribution in tropical America", Fl. Costa Rica 606. 1937.

Mexico, Costa Rica (US), W. I., S. A.

Hairs on upper surface of blades stellate. (Angelo). A report that they are simple is in error. Blades entire or nearly so. Petioles 1-2 cm long, although sometimes reported as elongate and sometimes as short. Blades ovate, 4-7 cm long, acute, densely stellate-tomentose beneath.

Croton schiedeanus Schlechter, Linnaea 19: 243, fig. 9(E). 1847.

This species is sometimes treated as a synonym of *Croton glabellus* L.

Mexico (FLAS), British Honduras (FSU), Costa Rica (FSU,

MO, US), Panama (US). Costa Rica, Prov. Cartago, Turrialba. Godfrey 66183 (FSU), fig. 14, p. 9.

Nicaragua: Dept. Matagalpa, Calabazas. Seymour 2589 (ENAG, FLAS, MO, SEYM, SMU).

Racemes conspicuously long (6-12 cm) with flowers fallen except at tip.

Croton segoviarum Standley & Williams, Ceiba 3: 211. 1953.
Honduras (US).

Nicaragua, Dept. Jinotega. Standley 9620: type (F); dupl. (EAP). Cited with original description.

Dept. Esteli. Condega. Standley 20375.

Esteli. Standley 20209, 20277.

The numbers above cited with the original description.

Dept. Esteli, Pueblo Nuevo. Williams & Molina 42390 (US), fig. 33, p. 23.

Similar to *Croton cortesianus* but young twigs hispid, lacking dark hairs.

Croton simiarum Standley & Williams, Ceiba 3: 212. 1953.

Nicaragua, Dept. Jinotega, E of Jinotega. Standley 10824;
Type (F); dupl. (EAP).

Croton skutchii Standley, Field Mus. Bot. 22: 86. 1940.

Costa Rica, Prov. San Jose, vicinity of El General. Skutch 4377 (MO), co-type. Examined. Slender tree 27 m, staminate flowers white. In clearings.

Croton steyermarkianus Croizat, Journ. Arn. Arb. 21: 86. 1940.

Inflorescence terminal. Glands not surely discernible.

Type: Costa Rica. Skutch 1936 (US).

Capsule tomentose, not hispid.

Croton suyapensis Molina, Ceiba 1: 259. 1951.

British Honduras, El Cayo District, Mountain Pine Ridge.

McDaniel 14462 (FSU). Honduras (US).

Nicaragua: Dept. Matagalpa, Matagalpa. Molina & Molina 30501 (MO).

Axis of inflorescence densely hispid. Blades palmately veined. (Angelo).

Croton tenuicaudatus Lundell, Phytologia 1: 451. 1940.

For description, see Fl. Panama 54: 253. 1967.

Costa Rica (MO), Panama.

Croton tonduzii Pax in Pittier, Prim. Fl. Costaricensis 2: 330. 1900.

Costa Rica (MO, US); endemic.

Blades with 3 main nerves at base and 2 weak ones. Pistillate spikes 10-20 cm long. No staminate spikes available. Angelo. Blades have been described as having a "pubescence of minute scales". It might easily be said that the pubescence is of stellate hairs beneath, almost glabrous above. Petioles 3.5-6 cm long. Fruit and flower-buds essentially sessile. Capsules with hairs similar to those on leaves, 5-7 X 10-12 mm. Angelo.

Croton trinitatis Millsp., Field Mus. Bot. 2: 57. 1900.

Croton tragioides Blake, Contr. U. S. Nat. Herb. 24:11. 1922.

Mexico, British Honduras, Costa Rica (US), Panama (FLAS, FSU, US). Panama, Prov. Panama, Canita. Tyson & Smith 4139 (FSU), fig. 2, p. 6.

Nicaragua:

Dept. Zelaya, Comarca del Cabo, Bilwaskarma. Seymour 5860 (ENAG, FLAS, GH, MO, SEYM, SMU).
Puerto Cabezas. Molina 14761 (US).
Waspan. Atwood 3623 (SEYM).

Dept. Chontales, San Miguelito. Shank & Molina 4587 (US).
Santo Tomas. Seymour 6311 (SEYM, MO).

Dept. Rio San Juan, Castillo. Atwood & Nelson 5181 (ENAG, MO, NY, SEYM, SMU).

Croton triumfettoides Croizat, Journ. Arn. Arb. 21: 87. 1940.

In the Fl. of Panama, this species is treated as a synonym of Croton panamensis.

Type of C. triumfettoides: Costa Rica. Lankester K26 (A).
Costa Rica (MO), Brazil (MO).

Glands of petiole conspicuous, stipitate, about 2 mm long. Head of gland varies from disk-shaped to nearly cylindrical. Inflorescence terminal. Angelo.

Croton verapazensis Donn. Smith, Bot. Gaz. 54: 242. 1912.

Type: Guatemala, Santa Rosa. Tuerckheim 11.2297.

Mexico (US); Chiapas. Webster, Miller & Miller 12966 (MO). One large blade, coarsely toothed. Petioles 2.5-4 cm long. Flowers clustered.

Croton xalapensis HBK., Nov. Gen. & Sp. 2: 85. 1817.

Croton pseudo-xalapensis Croizat, Journ. Arn. Arb. 21: 85. 1940.

Croton pseudo-xalapensis var. cobanensis Croizat, Journ. Arn. Arb. 21: 86. 1940.

Endemic in Mexico, Croizat, Journ. Arn. Arb. 21: 86. 1949. Included here with hesitation because of many reports of its occurrence in Central America.

Mexico (FSU), Guatemala, Honduras (FSU, MO), Salvador, Costa Rica.

Mexico, Municipio Ixtapa. Breedlove 11871 (FSU), fig. 34, p. 23.

Essentially pinnately nerved, Ceiba 1: 150. 1951.

Fruiting pedicels none or 1 mm long. Blades stellate-hairy above and beneath, sometimes rather densely beneath, 5-10(-13) cm wide. Inflorescences not axillary but all terminal. Angelo.

EXCLUDED SPECIES.

Croton draco Schlechter, Linnaea 6: 360. 1831.

Often confused with Croton panamensis. Many specimens from Central America have been so identified, but according to Croizat, it occurs in Mexico only. Journ. Arn. Arb. 21: 87. 1940.

Croton gossypiifolius Vahl, Symb. Bot. 2: 98. 1794.

Sometimes reported from Central America, but "essentially a Venezuelan and Trinidad endemic". Croizat, Journ. Arn. Arb. 21: 87. 1940.

DOUBTFUL SPECIES.

Croton turrialva Kuntze, Rev. Gen. 614. 1891 in syn. Oxydectes turrialvae Kuntze, loco cito.

Known with certainty only from original collection, Costa Rica, Volcan de Turrialba. Kuntze 2238.

NEW SPECIES.

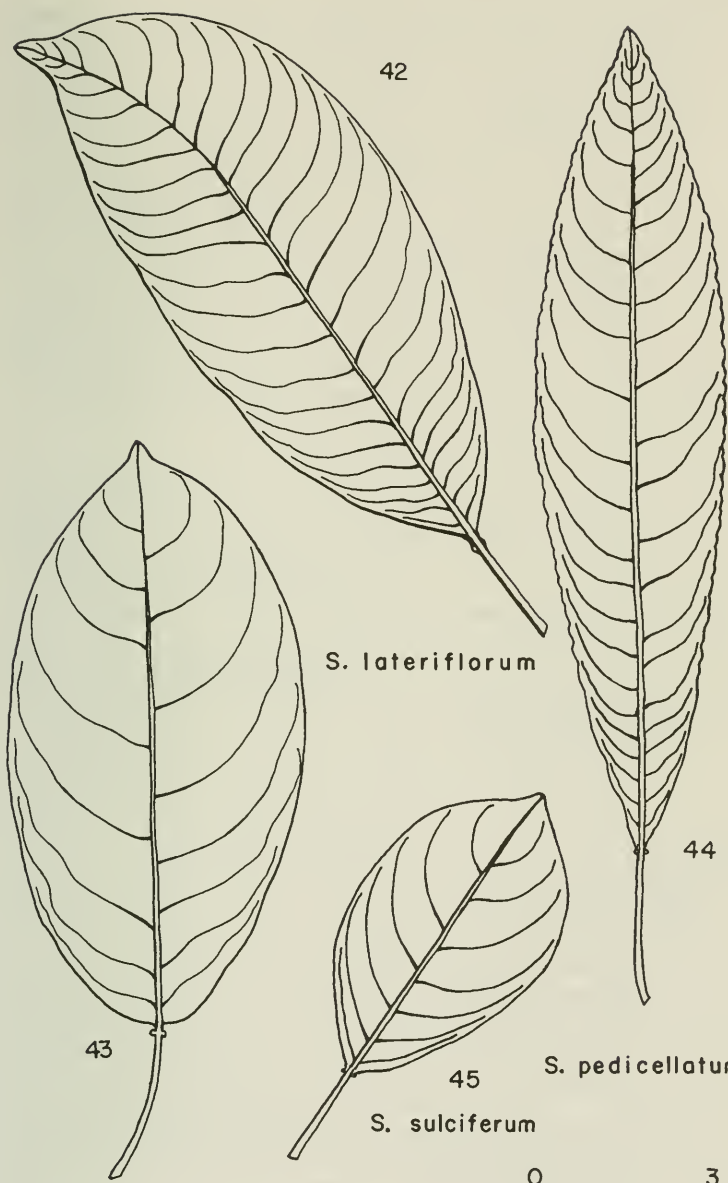
Acalypha chordantha F. Seymour, pp. 17, 29.

Croton atwoodianus F. Seymour, pp. 12, 37.

Croton fantzianus F. Seymour, pp. 10, 39

SAPIUM: KEY TO SPECIES
IN CENTRAL AMERICA

- A. Spikes more than 1 on the same twig B.
- B. Side-veins many, at almost right angles to midrib, almost straight near midrib; blades 9-12 cm long, 3-5 cm wide C.
- C. Blades at tip bearing a gland or swelling, acuminate; principal side-veins 2 mm apart; petioles 2-3 cm long; glands of petiole 2, near summit; p. 54
. Sapium aucuparium Jacq.
- C. Blades at tip flat, abruptly, shortly acuminate; principal side-veins 2-3 mm apart; petioles 4 cm long; spike up to 15 cm long; p. 55 Sapium jamaicense Sw.
- B. Side-veins arched-ascending D.
- D. Blades 10-20 cm long, 4-8 cm wide, 2.5 times as long as wide; side-veins 11-17 on each side, 5-15 mm apart; glands of petiole conic; spikes, at least some of them, borne singly, below summit of twig; p. 55, fig. 42, p. 51
. Sapium lateriflorum Hemsley
- D. Blades 5-8 cm long, 2.5-4 cm wide, twice as long as wide; principal veins 12-13 on each side, 4-10 mm apart; glands of petiole cylindric, very close to attenuate base of blade; spikes in clusters, (2-) commonly 4 at or near summit of twig; p. 57, fig. 45, p. 51 . . .
. Sapium sulciferum Pittier
- A. Spike 1 on a twig, terminal E.
- E. Petioles with no glands near summit; glands sometimes on blades F.
- F. Petioles 5-8 mm long; blades lanceolate or oblanceolate, 8-11 cm long, 2.5-3.5 cm wide, 3 or more times as long as wide, caudate-acuminate; glands saucer-shaped on upper surface of blade at base; p. 58
. Sapium tuerckheimianum P. & H.
- F. Petioles 1.5-3 cm long; blades widely elliptic, less than 3 times as long as wide G.
- G. Blades with no glands above and no more than a vestige of glands on base beneath, 13-18 cm long, 5-7 cm wide, more than 2 times as long as wide; p. 55
. Sapium eglandulosum Ule
- G. Blades with 2 glands on margin at base, 5-7 cm long, 4-5 cm wide, less than 2 times as long as wide; p. 57
. Sapium pittieri Huber
- E. Petiole with 2 glands near summit H.



42

S. lateriflorum

44

S. pedicellatum

43

45

S. sulciferum

S. pachystachys



H. Capsules sessile or subsessile I.

I. Blades with conspicuous gland or swelling at tip, 2-4 times as long as wide, 5-16 cm long, 2-4 cm wide; petioles 1.5-4.5 cm long J.

J. Tip of blades long, slender, curved, serrate; blades 9-16 cm long, 2.3-4 cm wide, 4 times as long as wide; petioles 2-4.5 cm long; principal side-veins 8-10 mm apart, curved; capsules 5 mm long, thick; p. 55 Sapium caudatum Pittier

J. Tip of blade not long, not slender, not curved; blades 5-12 cm long, 2.5-3.5 cm wide, sinuate-dentate or near tip serrate; principal side-veins 4-7 mm apart, straight near midrib, then abruptly curved; capsules 10 mm long, 15 mm thick; petioles 1.4-2 cm long; seeds with red pseudo-aril; p. 55 Sapium giganteum Pittier

I. Blades with no conspicuous gland or swelling at tip; side-veins few, 6-15 on each side K.

K. Blades 4-5 times as long as wide, 6-13 cm long, 1.3-2.5 cm wide; petioles 0.5-1.5 cm long; spikes 10 cm long; glands of petiole conical, erect, not divergent; blades finely distinctly serrate; capsules 10 X 13 mm; p. 56 Sapium moritzianum Klotzsch

K. Blades 2-3 times as long as wide; spikes unisexual L.

L. Principal side-veins 15 on each side; blades 8.5-18 cm long, 3.5-6.5 cm wide; p. 56 Sapium mammosum Lundell

L. Principal side-veins 6-10 on each side, curved-ascending; blades 8-15 cm long, 2.2-6.5 cm wide, abruptly tipped; petioles 0.5-1.3 cm long; staminate spikes very slender; capsules 10 mm in diameter; seeds with red aril; p. 55 Sapium guatemalense Lundell

H. Capsules on pedicels; pedicels 5-10 mm long M.

M. Blades with conspicuous gland or swelling at tip N.

N. Blades obtuse or rounded and abruptly tipped, rounded to cuneate at base, 2-3 times as long as wide O.

O. Blades abruptly tipped, 6-11 cm long, 2-4.5 cm wide, almost thrice as long as wide; glands of petiole on stout stipes, very conspicuous; side-veins about 15 on each side, curved, at about right angle to midrib; seeds with red aril; p. 57 Sapium schippii Croizat

O. Blades obtuse, not abruptly tipped, ovate to elliptic, short and rather wide, 3-7 cm long, 1.3-3 cm wide, about twice as long as wide; glands of petiole cylindrical P.

- P. Spikes up to 14 cm long; blades ovate, 2-3 cm wide, widely cuneate at base; p. 56 . . . Sapium oligoneurum S. & P.
- P. Spikes 1-3 cm long; blades mostly obovate, 1.3-3 cm wide, cuneate at base; capsules larger, up to 13 mm long; fruiting pedicels 2.5-4 mm long; aril red; p. 55
 Sapium itzanum Lundell
- N. Blades acute or acuminate, 3-5 times as long as wide, 1.5-4 cm wide; glands of petiole cylindrical Q.
- Q. Blades narrow, 8-11 cm long, 1.5-2 cm wide, about 5 times as long as wide on flowering twigs; petioles about 1 cm long; spikes 8 cm long; capsules up to 10 mm long, smooth; seeds warty; fruiting pedicels 5-10 mm long; p. 55, fig. 41, p. 54 . . . Sapium biglandulosum (L.) M. A.
- Q. Blades wider, 5-16 cm long, 2-4 cm wide, 2-4 times as long as wide; principal side-veins 7-11 mm apart; blades on flowering twigs obovate, 7-14 cm long, 2-4 cm wide; some of them more than thrice as long as wide; petioles 1.5-3 cm long; flowering spikes up to 22 cm long; capsules pear-shaped, 8-12 mm thick; fruiting pedicels 4-5 mm long; p. 57, fig. 46, p. 54 Sapium thelocarpum S. & P.
- M. Blades with no conspicuous gland or swelling at tip R.
- R. Side-veins many; blades obtuse to sharp-pointed; spikes bisexual or staminate only S.
- S. Glands of petiole subglobose; blades oblong-lanceolate, 6-12 cm long, 2.5-3.5 cm wide; petioles 2.5-3.5 cm long; side-veins many, at almost right angle to midrib; fruiting pedicels very short; seeds 10-13 mm long; p. 56 Sapium macrocarpum M. A.
- S. Glands of petiole elongate-cylindrical; seeds 5-7 mm long T.
- T. Blades elliptic-lanceolate, 4-9 cm long, 1.5-3 cm wide; petioles (0.5-)1-3.5 cm long; fruiting pedicels 6-8 mm long; capsules 6-8 mm long; seeds tuberculate; p. 57, fig. 44, p. 51 Sapium pedicellatum Huber
- T. Blades lanceolate, 7-18 cm long, 3-6 cm wide; glands on margin of blade; petioles up to 4 cm long; fruiting pedicels 5-7 mm long; capsules 10 mm long; seeds smooth; p. 55 . . Sapium izabalense Lundell
- R. Side-veins few, remote, 6-10 on each side, curved-ascending; petioles 1-3.5 cm long; stigmas 2-lobed; seeds with red aril or unknown; blades 2-3 times as long as wide U.
- U. Spikes bisexual; blades 8-9 cm long, 4-5 cm wide, oval-elliptic, tip obtuse; principal side-veins 6-14 mm apart; spikes 8-13 cm long, staminate part 7 mm thick; p. 57, fig. 43, p. 51 Sapium pachystachys S. & P.

U. Spikes unisexual; blades 8-18 cm long, obovate to elliptic-oblong, acute or rounded at base, usually shiny, tip obtuse; side-veins remote; capsules 8 mm in diameter, on short thick pedicels; seeds 6 mm in diameter; p. 56 Sapium nitidum (Monachino) Lundell

SAPIUM IN CENTRAL AMERICA
ANNOTATED LIST

Sapium aucuparium Jacq., Enum. Pl. Carib. 31. 1760; non Jacq., Select. Amer. Hist. 249, pl. 158. 1763.

For description, see Ann. Mo. Bot. Gard. 54: 324. 1967.

The nomenclature is complicated by Jacquin's using this name for one species in 1760 and for a different species in 1763.

See Croizat, Journ. Arn. Arb. 24: 174-5. 1943.

Costa Rica (MO), Panama (US), Cuba (FLAS).

Sapium biglandulosum (L.) Muell. Arg., Linnaea 32: 116. 1863.

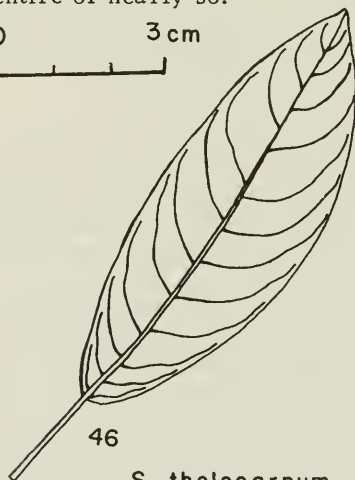
Sapium aucuparium Jacq., Select. Amer. Hist. 249, pl. 158. 1763, non 1760.

British Honduras, Panama (FSU, US). Type: Panama (US).

Panama, Prov. Los Santos, Las Tablas. Dwyer 2495 (FSU), fig. 41, p. 54.

Easily recognized by narrow blades, and petioles 5-10 mm long. Angelo. Fruiting pedicels 5-10 mm long. Blades entire or nearly so.

0 3 cm
|-----|



S. thelocarpum



S. biglandulosum

Sapium biglandulosum, continued.

I have seen no specimen in which the blades were "coarsely crenate".

Sapium caudatum Pittier, Contr. U. S. Nat. Herb. 20:127. 1918.

Type: Panama, Canal Zone, Gamboa. Coll. Pittier (US).

Glands of petiole 2; gland or swelling sometimes at tip of blade.

Sapium eglandulosum Ule, Bot. Jahrb. 35: 673, fig. 2A. 1905.

Panama.

Sapium giganteum Pittier, Contr. U. S. Nat. Herb. 20: 128.

1918. Type: Panama, Prov. Colon, near Fato. Pittier 414 (US).

"Closely allied to *S. caudatum*" but leaves smaller, apical appendages longer, more slender. Capsules sessile, 10 mm long, 15 mm in diameter; pseudo-aril red; seeds 5 X 5.8 mm.

Sapium guatemalense Lundell, Wrightia 5(4): 76. 1975.

Guatemala.

Sapium itzanum Lundell, Wrightia 5(4): 77. 1975. Guatemala.Sapium izabalense Lundell, Wrightia 5: 346. 1977. Guatemala.Sapium jamaicense Sw., Adnot. Bot. 62. 1829.

Sapium anadenum Pittier, Contr. U. S. Nat. Herb. 12:164.

1908. *Sapium pleiostachys* Schumann & Pittier in Pittier, Contr. U. S. Nat. Herb. 12:164. 1908.

Mexico, Guatemala, Honduras, Costa Rica (FSU),

Panama (FSU), Jamaica, Cuba (FLAS).

Blades 15-17 cm long, 5-7 cm wide. Side-veins many but not close, ca 5 mm apart. Pflanzenreich 52: 205.

As there is much misunderstanding of this species, I quote from Fawcett & Rendle in Fl. Jamaica 2: 325. 1920. Leaves oblong-elliptical or elliptical; petioles with small sessile oblong glands; spikes in axils of topmost leaves at apex of branch; ovary sessile. Quoted by Fawcett & Rendle who add: Leaves 7-22 cm long, oblong-elliptical or elliptical, apex rounded, abruptly shortly acuminate, base obtuse to wedge-shaped, margin entire or wavy or obscurely denticulate ... nerves numerous (to thirty on each side), about 2 mm apart, bending upwards near margin, prominent; petiole 4 cm long ... Spikes ... to 15 cm long ... Capsule globular, 7-8 mm in diameter. Seed about 4 mm long, roundish-lens-shaped, roughly net-veined.

Sapium lateriflorum Hemsley in Hook. Icon. sub pl. 2680. 1901.

Type: Mexico (US).

Mexico (MO), British Honduras, Guatemala, Costa Rica (FSU).
Cuba, Trinidad Mountains, San Blas-Buenos Aires. Gonzales 586 (FLAS), fig. 42, p. 51.

Side-veins 10 mm apart. Blades large or small. Glands of petiole 2, wide at base. Gland or swelling none at tip of blade.

Sapium macrocarpum Muell. Arg., Linnaea 32: 119. 1863.

Sapium mexicanum Hemsley in Hook. Icon. Pl. IV, 27, pl. 2680. 1901.

Mexico, Guatemala.

Glands of petiole subglobose; none at tip of blade. Side-veins about 1 cm apart. Seeds nearly 1 cm long. Contr. U. S. Nat. Herb. 23: 652. 1923.

Sapium mammosum Lundell, Wrightia 5(4): 77. 1975.

British Honduras.

Sapium moritzianum Klotzsch, Seem, Bot. Voy, Herald 100.

1853. Synonym of Sapium biglandulosum (L.) Muell. Arg. according to Fl. Panama 54: 327. 1967. Pittier made it a var. of Sapium aucuparium Jacq., 1763, non 1760. Contr. U. S. Nat. Herb. 20: 128. 1918. But spikes are terminal, solitary, and side-veins are arcuate.

Blades linear, 7-8 mm wide, but description, Contr. U. S. Nat. Herb. 20 says 1.5-2.5 cm wide. Glands of petiole conical. Stipules fimbriate, reniform.

Sapium nitidum (Monachino) Lundell, Amer. Midl. Nat. 29:477.

1943.

Guatemala (US), Honduras (FLAS).

Side-veins 1.5 cm apart.

Sapium oligoneurum Schumann & Pittier, Contr. U. S. Nat. Herb.

12: 168, pl. 17. 1908.

Mexico, Guatemala, Honduras, Salvador, Costa Rica (MO).
Nicaragua: Dept. Granada, Mombacho Volcan. Maxon, Harvey and Valentine 7806 (US).

Blades elliptic, sometimes distinctly toothed. Side-veins 5-10 mm apart. Blades 3-7 cm long, 2-3 cm wide.

It is doubtful whether S. oligoneurum and S. sulciferum are distinct species. Having 1 or more than 1 spikes on the same

twig may be a variation within the same species.

Sapium pachystachys Schumann & Pittier, Contr. U. S. Nat. Herb. 12: 168, pl. 16. 1908.

Costa Rica (MO), Panama. Costa Rica, Prov. Heredia, Sarapiquí, Hartshorn 1025 (MO), fig. 43, p. 51; Hartshorn 1001 (MO).

Nicaragua: Dept. Chinandega, Chinandega. Maxon, Harvey & Valentine 7186 (US).

Sapium pedicellatum Huber, Bull. Herb. Boiss. II, 6:352. 1906.

Mexico, Salvador (especially), Honduras, Costa Rica (MO). Mexico, State Colima, Santiago to Huizcolate. Stevens & Fairhurst 1858 (MO), fig. 44, p. 51.

For description, see Contr. U. S. Nat. Herb. 23:651. 1923.

Sapium pittieri Huber, Bull. Herb. Boiss. II, 6: 35. 1906.

Costa Rica. Glands on base of leaf are distinctive.

Side-veins distant, 10-15 mm apart. Blades oblong, 10-18.5 cm long, 6-8 cm wide.

For description, see Pittier, Contr. U. S. Nat. Herb. 12: 169. 1908.

Sapium schippii Croizat in Lundell, Amer. Midl. Nat. 29: 477.

1943. Known from the type only: British Honduras, near sea-level, Toledo District, Forest Home. Schipp 1049.

Sapium sulciferum Pittier, Contr. U. S. Nat. Herb. 12: 169.

1908. Type: Costa Rica, La Palma. Tonduz 12428 (US). Honduras (FLAS), Costa Rica (MO).

Nicaragua: Dept. Granada, Volcan Mombacho. Atwood 77147 (FSU, SEYM).

Dr. Lyman B. Smith of the U. S. National Herbarium has very kindly examined the type specimen of Sapium sulciferum Pittier in that herbarium and informed me "that it had 4 spikes on branchlets." 7 Sept. 1978. See note under Sapium oligoneurum.

Sapium thelocarpum Schumann & Pittier, Contr. U. S. Nat.

Herb. 12: 166, pl. 13. 1908.

Costa Rica, La Verbena, near San Jose. Tonduz US 578901 (US); type.

Nicaragua:

Dept. Esteli, Llano 4 de Mayo. Neill 7353 (GH, MO, SEYM, SMU, UCA), fig. 46, p. 54.

Road to Cusmapa. Atwood & Neill AN273 (MSC, SEYM).

Cerro Santa Rosa. Neill 7787 (MO, SEYM, SMU, UCA).

Dept. Matagalpa, Between Aranjuez and Peor es Nada. Molina 22969 (MO).

Dept. Chontales, Santo Tomas. Neill 7398 (GH, MO, SEYM, SMU, UCA).

Dept. Managua, Casa Colorada. Maxon, Harvey & Valentine 7460 (US).

To clarify an understanding of this species, I quote from the original description by Schumann & Pittier, loco cito: "leaves of floral twigs ... long cuneate or rounded at base ..." In the accompanying photographic illustration, plate 13, the leaves might be called attenuate or acuminate at base. Further, the original description reads "larger secondary nerves rather distant, arcuate, forming a fine, prominent network"

Sapium tuerckheimianum Pax & Hoffmann, Pflanzenreich IV, 147, xiv, 68:61. 1919.

Known from the type only: Guatemala, Cubilquitz, Alta Verapaz. Tyerckheim II. 941.

ABBREVIATIONS not already in common use.

Bth., Bentham

ENAG, Herbarium of the Escuela Nacional de Agricultura y Ganaderia, Managua, Nicaragua

Is., island

M. A., Muell. Arg.

P. & H., Pax & Hoffmann

S. A., South America

SEYM, Herbarium of Frank C. Seymour

S. & P., Schumann & Pittier

S. & W., Standley & Williams

UCA, Herbarium of the Universidad Centro-americana, Managua, Nicaragua

WDP, Herbarium of St. Norbert College, West De Pere, Wis.

W. I., West Indies

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NOTES ON NEW AND NOTEWORTHY PLANTS. CXXIII

Harold N. Moldenke

AEGIPHILA HOEHNEI var. *VENEZUELENSIS* Mold., var. nov.

Haec varietas a forma typica speciei laminis foliorum supra lucidis perspicue reticulatis basaliter acutis pilis parvissimis simplicibus non pustulatis recedit.

This variety differs from the typical form of the species in having its coriaceous mature leaf-blades basally acute, the upper surface very conspicuously reticulate, very shiny, with very sparse and widely scattered simple non-pustular-based hairs.

The type of the variety was collected by Ronald Liesner (no. 4083) at the edge of the forest along the road in a low area 8 km. northeast of San Carlos de Río Negro, 1°57'N., 67°3'W., at 120 meters altitude, Amazonas, Venezuela, on December 1, 1977, and is deposited in my personal herbarium. The collector describes the plant as a liana, the fruiting-calyx green, the fruit yellowish, and records the local vernacular name, "laurel de orihero".

CLERODENDRUM SCHMIDTII var. *GLANDULIFERUM* Mold., var. nov.

Haec varietas a forma typica speciei laminis foliorum subtus perspicue resinoso-glanduliferis glandulis squamoidis crateriformibus aureis recedit.

This variety differs from the typical form of the species in having the lower leaf-surface conspicuously glandular with golden, resinous, scale-like, rather crateriform, sessile glands.

The variety is based on Larsen, Santisuk, & Warncke 2746 "common all over 'Northern' along roads and trails from 200--700 m." altitude, in deciduous scrub jungle, 12 km. southeast of Fang along the Fang to Chiengrai trail, 19°56'N., 99°18'E., at 500 m. altitude, Thailand, on July 26, 1968, and is deposited in my personal herbarium.

PAEPALANTHUS ELONGATUS var. *GLABRESCENS* Mold., var. nov.

Haec varietas a forma typica speciei foliis angustissimis 1 mm. latis vaginisque subglabratis vel glabris recedit.

This variety differs from the typical and all other named varieties of the species in having its very narrow (1 mm. wide, as in var. graminifolius Herzog) leaves and the sheaths glabrous or subglabrous.

The type of the variety was collected by Gert Hatschbach (no. 36772) in a wet sandy campo on highway GO-12, 5--10 km. south of Alto Paraiso, Goiás, Brazil, on May 24, 1975, and is deposited in the United States National Herbarium at Washington.

PAEPALANTHUS ELONGATUS var. *MAJOR* Mold., var. nov.

Haec varietas a forma typica speciei foliis coriaceis usque ad

25 cm. longis 2--3 mm. latis recedit.

This variety differs from the typical and all other named varieties of the species in having its leaves coriaceous, firmly erect, uniformly to about 25 cm. long and 2--3 mm. wide.

The type of the variety was collected by Léa Monteiro S. (no. 230) at São Tomé das Letras, at 1400 m. altitude, in southern Minas Gerais, Brazil, on June 5, 1971, and is deposited in my personal herbarium.

PREMNA ANNULATA var. **MACLUREI** Mold., var. nov.

Haec varietas a forma typica speciei annulis obsoletis foliis parvis ellipticis 4--7 cm. longis 2--3 cm. latis apicaliter obtusis basaliter acutis non lucidis recedit.

This variety differs from the typical form of the species in its twining stems being without obvious nodal annulations and the leaves being smaller, elliptic, 4--7 cm. long, 2--3 cm. wide, not shiny, apically blunt, and basally acute.

The type of the variety was collected by F. A. McClure (no. 832) in a thicket at Hue, Annam, Vietnam, on September 29, 1921, and is deposited in the United States National Herbarium at Washington.

PREMNA INVOLUCRATA var. **THAILANDICA** Mold., var. nov.

Haec varietas a forma typica speciei inflorescentiis bracteolis caducis vel obsoletis recedit.

This variety differs from the typical form of the species in having the inflorescence bractlets apparently early caducous or obsolete.

The type of the variety was collected by Robert Merrill King (s.n.) 15 km. north of Saraburi, province of Saraburi, Thailand, on June 15, 1963, and is deposited in the United States National Herbarium at Washington.

BOOK REVIEWS

Alma L. Moldenke

"THE LIMITS OF ALTRUISM: An Ecologist's View of Survival" by Garrett Hardin, iii & 54 pp., 7 b/w tab. & 3 fig. Indiana University Press, London & Bloomington, Indiana 47401. 1977. \$10.00.

The author shared these and other ideas in lectures and discussions at this university as Patten Foundation Lecturer. He claims that altruism does exist — along with other human motivations — but only "on a small scale, over the short term, in certain circumstances, and within small, intimate groups". No One World with Universal Brotherhood can avoid redissolving into an assemblage of tribes (nations). These are sad conclusions that I do not want to believe, but I cannot fault Hardin's logic. Ecologically Hardin makes very important points: no civilization has ever recovered to at least its previous level after ruining its environment; no area can prosper despite all forms of aid if its population exceeds the carrying capacity of its environment; no longer are there large predators nor as many pathogenic micro-predators limiting human population size, yet social controls have not been substituted in the most needed parts of the world. Selection is not for the good of the species but of its germ lines; species survival is the byproduct. These ideas, of course, are not original with the author, but his organization and development of them has his effective stamp on them, making the reading of this little book well worthwhile.

"MICROBIAL ECOLOGY" by R. Campbell, iv & 148 pp., 53 b/w fig. incl. 15 microscpic photo. & 21 tab. Halsted Press of John Wiley & Sons, Toronto & New York, N. Y. 10016. 1977. \$9.75 paperbound.

"This book is an attempt [highly successful] to describe the activities and the distribution of micro-organisms on the basis of both chemical transformations that they mediate and the environments in which they [algae, protozoa, bacteria, fungi as aerobes or anaerobes, heterotrophs or chemo- or photo-autotrophs] live." There are clearly explained chapters on microbial conversions of carbon, nitrogen and other elements in the environment and on the structure and dynamics of microbial populations in water, in soil and in the air.

"ECOLOGICAL ANIMAL PARASITOLOGY" by C. R. Kennedy, ix & 163 pp., 35 b/w fig. & 54 tab. Halsted Press of John Wiley & Sons, 198

New York, N. Y. 10016. 1975. \$11.95.

This book "is intended primarily for undergraduates as a text to accompany a unit course on ecological parasitology or to supplement and complement courses on parasitology with other approaches....[showing effectively] how host and parasite interact at the population level." This study also makes needed and interesting reading for teachers of biology on the secondary school level. An appendix has a summary of the classification and life cycles of the most important parasites considered in the text.

"EPIDEMICS OF PLANT DISEASE. Mathematical Analysis and Modeling" edited by Jürgen Kranz, x & 170 pp., 46 b/w fig. & 12 tab. Springer-Verlag, Heidelberg, D-1000 Berlin 33 & New York, N. Y. 10010. 1974. \$24.60.

This study is printed as Ecological Studies No. 13. For the plant pathologist, the ecologist and advanced students in these fields, crop sciences and other pathologies this book provides "practical procedures, such as experiments in coding techniques, reduction of data, computer programs, the particular scope of multiple regression analysis in the study of the progress of epidemics, disease increase and severity, disease cycles, crop losses" and finally simulation of epidemics. Of course, "projecting uses for accurate simulators is easier than making them."

"THE STORY OF PINES" by Nicholas T. Mirov & Jean Hasbrouck, xi & 148 pp., 1 b/w map, 11 line draw. & 44 photo. Indiana University Press, London & Bloomington, Indiana 47401. 1976. \$7.95.

Many readers of this journal will associate the senior author's name with "The Genus Pinus" of 1967, a 600-page treatment by Ronald Press. In similar more cursory and limited vein but no less admirably of these trees, the author and his wife describe the needles, wood types, paleogeological record, their mystical veneration by different groups, their economic importance, and pine forests natural and man-made. There is a list of pine species and their common English names. The writing style reveals the authors' admiration of these trees and so sustains reader interest.

"ENVIRONMENTAL PHYSIOLOGY OF DESERT ORGANISMS" edited by Neil F. Hadley, ix & 283 pp., 81 b/w fig. incl. 10 photo. & 13 tab. Published by Dowden, Hutchinson & Ross, Inc., Stroudsburg, Pa. 18360 and distributed by Halsted Press of John Wiley & Sons, Inc., New York, N. Y. 10016. 1975. \$21.00.

The 17 interesting chapters of this careful eco-physiological study are the papers presented earlier by leaders at a symposium appropriately conducted at Arizona State University which is surrounded by the Sonoran Desert. They are oriented toward "an interdisciplinary coverage of principles and concepts underlying the adaptational biology of desert organisms, with emphasis placed on groups or topics not previously subjected to review....[and] on studies that reflected application of innovative techniques". The first section is on desert species and dry heat, e.g. "Adaptations of Desert Lichens to Drought and Extreme Temperatures"; the second section is on adaptations at the cellular and molecular levels, e.g. "Photosynthetic Adaptations to High Temperature"; and the third section is on desert resources and species requirements, e.g. "Desert Expansion and the Adaptive Problems of the Inhabitants". The last paper, by the editor and leader of the symposium, is a fine summarizing synthesis and an outlook for future research.

"CELLS, MOLECULES AND TEMPERATURE — Conformational Flexibility of Macromolecules and Ecological Adaptations" by V. Ya Alexandrov & translated from the Russian by V. A. Bernstam, xi & 330 pp., 74 b/w fig. & 25 tab. Springer-Verlag D-1000 Berlin 33, Heidelberg & New York, N. Y. 10010. 1977. \$39.60.

This really excellent treatment is printed as Ecological Studies 21 and provides for the numerous English reading scientists and students of the world (who still have trouble even with the Cyrillic alphabet) access to the years-long research of Dr. Alexandrov and his group in the Komarov Botanical Institute in Leningrad. "In living organisms all physico-chemical processes responsible for the functional activities of cells are, to a greater or lesser extent, dependent on temperature....due to the ...thermodynamic and kinetic constants that determine directions and rates of chemical reactions, conformational transitions of biological macromolecules, phase transitions of lipids, changes in the structure of water, etc." The beginning of the book deals with the genotypic and modificational changes of thermoresistance of cells responding to fluctuations in ambient temperature, indicating the conformational flexibility of protein macromolecules. The body of the book deals with "temperature adaptations of protein macromolecules" especially the studies of the author's group which indicate that for normal functioning of proteins and nucleic acids their macromolecules and also for aggregate states of fatty acids the general state of semistability or semilability must be maintained. A very full bibliography includes over 500 Russian works, many not "caught" in English-language abstracts.

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Skeletonweed in Eastern United States

by

Clyde F. Reed

Skeletonweed or gum-succory (Chondrilla juncea L.) is a vigorous perennial composite, native to Europe and western Asia, where it is of comparatively importance, being only rarely mentioned as attaining the status of a weed. It was probably introduced into Eastern United States from Europe in the early nineteenth century as a weed-seed in grains.

The purpose of this paper is to review the introduction and spread of skeletonweed in Eastern United States, to provide a complete description of the plant, with an illustration, to describe its life-cycle, to discuss ways being tried for control and eradication of this noxious weed, and to provide an annotated list of herbarium specimens collected in the area studied.

Introduction and spread of skeletonweed

For more than 100 years skeletonweed has been collected in Eastern United States, usually as a weed of waste lots, along roadsides and railroads and to a limited extent in fields and pasturelands. Most of the early records of skeletonweed in this region are from weedy situations, as vacant lots, filled-in areas and along roadsides. In the last 30 years it has become more frequent along railway right-of-ways, as Wilmington, Delaware to Cape Charles, Virginia; from Baltimore to Washington, D.C., and then to Fredericksburg and southward; Washington, D.C. up the C. & O. R.R. along the Potomac River to Allegany County, Maryland; along other railroad to Front Royal, westward into West Virginia; along railroads in southern New Jersey; in any of these areas becoming vast patches. Entire shaley hillsides and upland pasturelands in western Virginia and eastern West Virginia have been taken over by this weed.

During World War I (about 1917) skeletonweed was introduced into the Riverina region of Australia and thence spread to all the major wheat-producing regions of that continent, causing an economically serious weed problem. It was first found in Western Australia at Ballidu in 1963. Much research and experimentation has been carried in Australia during the past two decades in an effort to control this weed by chemical and biological means. (See bibliography).

Skeletonweed has been recently introduced into western United States, probably from Australia, and now covers vast areas from Washington and Idaho southward, thus becoming an economically important weed there also. Several United States governmental agencies have begun to study ways to control or eradicate this plant, especially in the wheat-growing areas of western United States.

Description and Illustration

Chondrilla juncea L.

Skeletonweed, Gum-succory

Biennial or perennial, with taproot, forming a rosette of leaves the first year; stem 0.3-1.5 m. tall, virgate branching, bristly-hairy or hispid, herbage otherwise glabrous; stems and roots exude white gum basal leaves runcinate-pinnatifid to nearly entire, often deciduous, 5-13 cm. long, 1.5-3 cm. broad; cauline leaves few, reduced, linear, 2-10 cm. long, 1-8 mm. broad; flowering heads sessile or short-pedunculate 1-1.5 cm. long, scattered on nearly leafless branches; involucre white-tomentose, cylindrical, 9-12 mm. high, of several narrow linear equal phyllaries and a row of small bractlets at base; ray-flowers bright yellow; achenes terete, the body about 3 mm. long, several-ribbed, smooth below, roughened at summit by little scaly projections, from which arise an abrupt slender beak; pappus copious, of very fine soft capillary bright-white bristles. Fl. July-Sept.

Fields, roadsides, waste places, shaley hillsides and along railroads.

Native to Eurasia, from Iberian Peninsula through southern Europe Asia Minor and the Caspian Sea region to the Altai Mountains and eastward to Mongolia; North Africa (Algeria and Tunisia); introduced widely in Australia and North America (Eastern United States from New York and New Jersey to Virginia and Georgia, west to Michigan; western United States from Washington and Idaho and southward).

Life-cycle of Skeletonweed*

Skeletonweed requires a habitat well-exposed to sublight and a well-drained soil, either sandy or shaley, and rather acid. The most frequent habitats in Eastern United States where the author has observed stands have been in Coastal Areas on sand dunes, sandy wastes and fields in Piedmont Areas along railways on ballast, and in the mountainous regions on shaley hillsides and well-drained pasturelands.

Skeletonweed seed germinate shortly after the seeds are produced, in October and November in the Northern Hemisphere, in April or May in Australia, forming a rosette of lance-shaped juvenile leaves which may vary from slightly lobed to progressively more deeply lobed or dentate. Tips of the lobes always point towards the base of the leaf. Rosettes can grow, under most favorable conditions, to a diameter of 37 cm. or more and vary from dark green to purplish in color. Plants remain in the rosette stage over winter.

In the spring, an erect stiff stem, branched almost from the base develops from the center of the rosette. For the most part the stem is smooth except for a thick covering of bristles for about 10 cm. just above the rosette. Leaves along the flowering scape are few, widely spaced, strap-shaped to sometimes linear, and unlobed. Plant parts when broken exude a whitish acrid juice. Rosette-leaves die off as flowering commences in mid-summer. Stem-leaves are persistent almost

* Cuthbertson, E.G. Bull. 68, N.S.W. Dept. Agric., Agric. Res. Inst., Wagga Wagga. 1967.

to maturity, and then fall, leaving a lax bare skeleton-like twiggy stem by late autumn. The small flower-heads occur either singly or in groups of twos or threes at the tips and along the branched stems. Flower-heads consist of 8-12 florets, each with one bright yellow straplike petal. Each floret produces a single achene, roughened near its apex by small toothlike projections and surmounted by a crown of five fused scales. A slender beak as long as or longer than the achene arises from the crown and bears a pappus of numerous toothed bristles. Marked plants have produced from 2,000 to 15,000 achenes per plant per season.

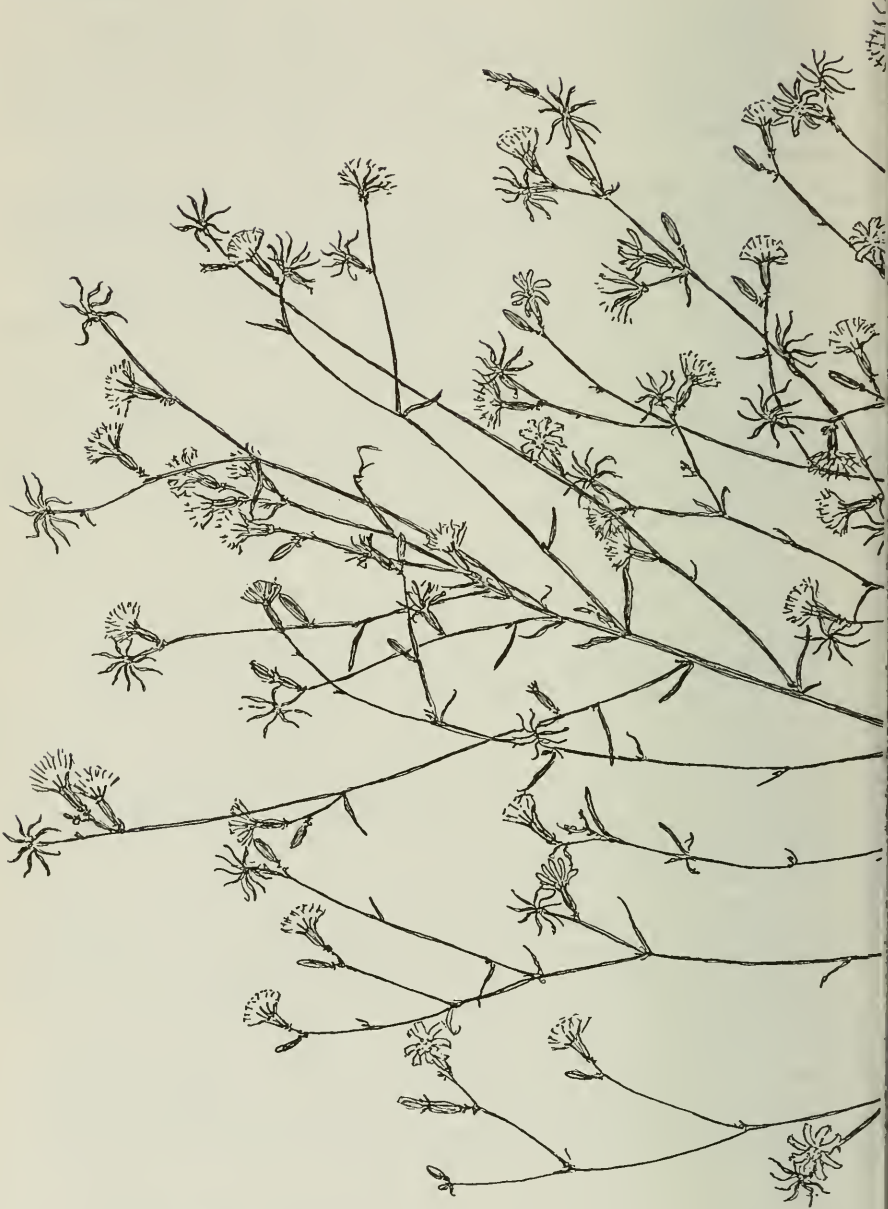
Germination of seeds may be as high as 90 per cent, but actual capacity to germinate seems to be influenced by ecological conditions during the ripening period. Seeds germinate best at about 23° C (75° F) and decline to 4.5° C (40° F) and 35° C (95° F), giving a wide range of temperature for germination. Seeds are small and do not survive if buried more than 2.5 cm. deep. Light, oxygen-availability and good soil-drainage are the prime factors affecting germination of seeds.

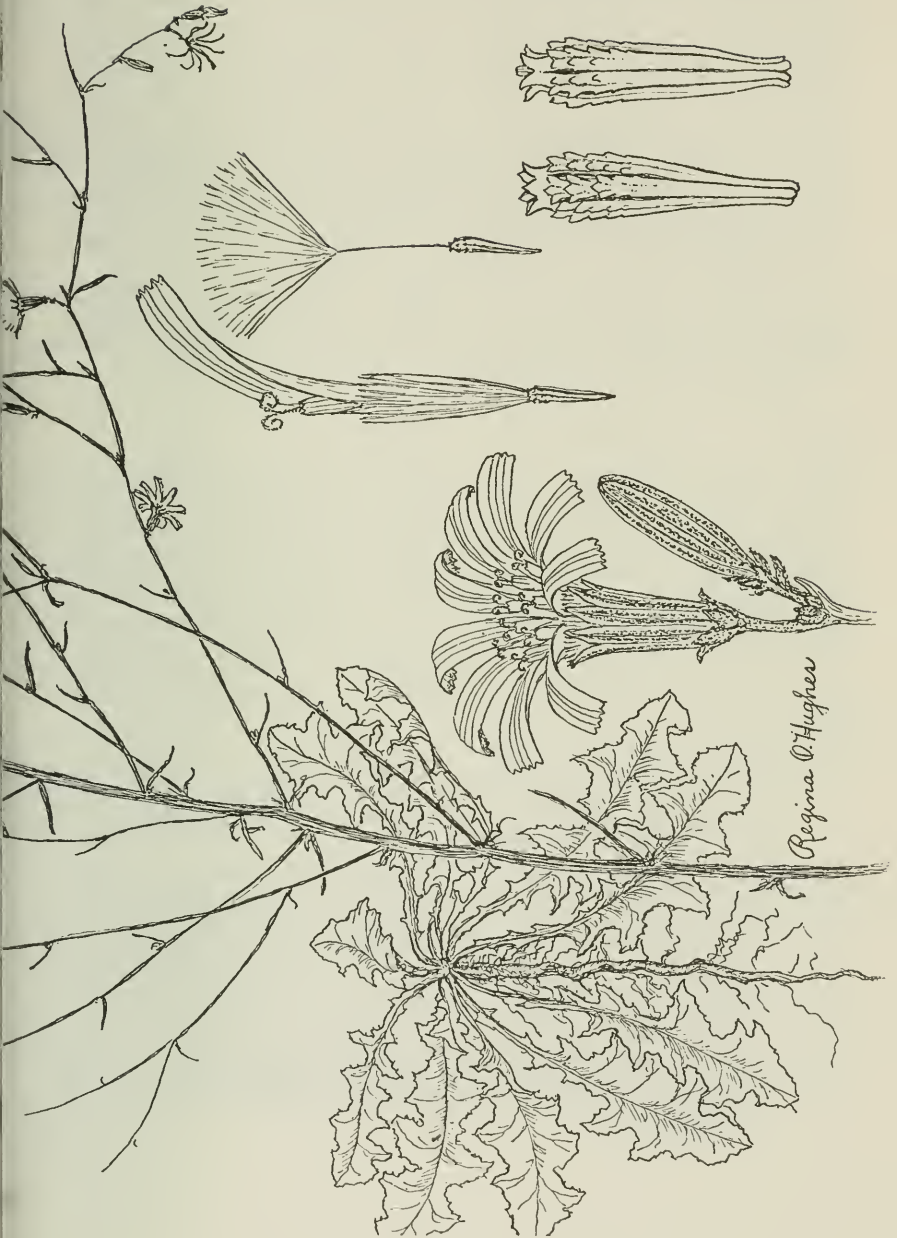
After germination, skeletonweed develops a long branching taproot, often penetrating the soil almost vertically for 1-2 meters. The taproot remains more or less the same thickness for its entire length, and divides only occasionally in the upper layers of soil. Fine branch-roots occur at intervals and lateral roots may be produced in the surface layers of the soil. Normally, root development is rapid, particularly in light, sandy soils.

In many areas, skeletonweed follows a perennial growth pattern. At the beginning of the growing season, one to several new rosettes form on the crown of the parent plant. However, if during the season, plants are damaged by drought, new rosettes form whenever effective rain is available and almost immediately send up flowering stems which die back in the autumn. Rosettes may also form on lateral roots at short distances from the main plant, especially in sandy soils.

Established plants have remarkable regenerative ability, and damage to removal of the crown by cultivation or browsing only stimulates regrowth. Root buds form on the main axis below the point of damage, as well as on the lateral roots. Regrowth of this kind from plants cut off 80 cm. below the surface is not uncommon, and experiments have indicated that plants cut off 1.5 m. below the surface would eventually grow to the surface.

Root fragments, cut or broken off during cultivation, produce new plants, provided growth conditions are favorable. Pieces up to 23 cm. long with the crown have up to 70 per cent chance of producing new plants. Smaller root fragments without the crown may regenerate in favorable moderately damp soils. Desiccation kills most root pieces in dry soils.





Regina O. Hughes

Seeds may be spread by wind, water, animals or man. It has been calculated that each flowering stem bears about 200 flowers per season, with a potential seed production of about 1700 million seeds per acre. In Australia in studied plots the average weed population under wheat was more than 800,000 rosettes per acre. Seeds are particularly well-adapted to wind dispersal because of the persistent parachute-like pappus. Most seeds fall close to the parent plant but they may be carried many miles by the wind, especially along railways and roadsides. The toothed seeds adhere to wool and other hairs of animals, to hooves and other animal structures, and may be carried long distances. Movement of stock and other agricultural products and machinery by rail helps spread the seeds. Seeds are often seen floating on quiet waters, where germination can take place and these seedlings can transplant successfully after 1 or 2 weeks of total immersion.

Man is probably the most important single agent in the spread of skeletonweed. Traditional wheat farming methods, roadside mowing techniques and well-drained railway embankments all have contributed to the rapid spread of this weed.

Methods for control or eradication

Successful eradication or control programs of any plant depend on knowledge of its life-cycle -- how it reproduces, how it reacts to environmental changes and how efficiently to adapt to different habitats. For annuals, preventing seeding is the simplest method of control. Also cultivation methods which encourage early germination make it possible to kill seedlings by subsequent tillage practices. For perennials, seed production can be curtailed by removing flowering portions of the plant, or destroying the seedling growth around the existing infestation, but eradicating the parent plants which can produce seed year after year is also necessary when economically possible.

- I. Mechanical Methods of hoeing, mowing, burning and cultivation help destroy seedlings and shallow-rooted plants and reduce seed-production, but only promote fragmentation and vegetative regeneration of deep-rooted well-established plants, as in skeletonweed.
- II. Crop-rotation and use of competing crops, as lucerne, are considered the most effective and least expensive methods for controlling skeletonweed. A suitable cropping sequence prevents the development of specific weed groups so characteristic of monoculture, while at the same time increasing crop vigor and helping to maintain soil fertility. Crops which compete for water, light and mineral nutrients included in the rotation cause the weeds to become less vigorous and fewer in numbers. Lucerne, subterranean clover and pulse crops have proven useful in controlling skeletonweed. Such crops usually outpace this weed and become dense enough to provide its own shading and protection.

- III. Grazing animals, especially sheep, greatly reduce plant density of skeletonweed. In fact, investigations reveal that excessive cultivation and the absence of stock on farms was the main cause of skeletonweed getting out of hand in Australia. Sheep as close grazers clean up low-growing weeds as skeletonweed better than cattle. Fortunately, skeletonweed is palatable and nutritious from the rosette stage up until the flowering stage is well-developed.
- IV. Chemicals available for eradication of skeletonweed are expensive. But more important, such chemicals sterilize the soil for growth of crop-plants and can not be applied on a large scale. Some chemicals applied along railways as herbicides have had little effect on eradication of skeletonweed.
- V. Successful pasture establishment and subsequent pasture management can give adequate control of skeletonweed. As a sun-loving plant, skeletonweed is ill-equipped to withstand competition from sward-forming plants, as pure clover swards. Overgrazing leads to pasture degeneration, while undergrazing permits selected grazing of species and promotes grass dominance, both of which encourage survival of skeletonweed. Continuously grazed fallow keeps this weed in the rosette stage. Rhizomatous perennating plants such as skeletonweed need only to replace that proportion of their total population which is equal to their annual death rate to maintain population levels. In skeletonweed, such replacement occurs by seed, by multiple rosette production and by regeneration of root-fragments cut during cultivation. If these techniques are sufficient to achieve replacement, then total destruction of seeding capacity has no biological control effect on established populations.
- VI. Biological control by use of insects, several of which are known to eat skeletonweed, has proven to be of only minor importance. Insect populations usually decline as the weed population declines. Also, it is necessary to maintain a small weed population to maintain the insect population. So that complete eradication is never quite attained.

Insects under study for possible biological control of skeletonweed include a buprestid stem and root borer (*Sphenoptera faveola* Gebl.), a tortricid moth (*Oporopsamma wertheimsteini* Rbl.), aphids (*Uroleucon chondrillae*), an eriophylid gall-mite (*Aceria chondrillae* Can. -- Wapshere, 1971 and Morschel, 1972), *Chondrillobitium blattnyi* Pint. and the Chondrilla gall-midge (*Cystiphora schmidtii* -- Morschel, 1972). There have been studies to determine the degree of effective biological control of skeletonweed by the use of the insects (*Sphenoptera faveola* and *Oporopsamma wertheimsteini*) which feed on the material stored in the overwintering rhizomes.

VII. Biological control by parasitic fungi has been suggested and is being experimented with (Carter, 1972). Throughout the natural range and within introduced populations of skeletonweed, the rust-fungus, Puccinia chondrillina Bubak & Sydow, has been reported. This fungus appears on the young rosettes in autumn and spring as uredosori, and severe infestations can occur in the field leading to the death of the rosette. When the flower shoots develop in mid-spring, the uredosori appear on them and are replaced by teleutosori which produce the over-wintering spores by July (France) onward. A heavily infested plant is, at the end of the season in September, completely covered by brown extruding sori, at which time few buds appear and the plant dies before seeding. The rust does not attack the underground portion of the plant which remains to produce new rosettes in autumn and spring. These new rosettes often become attacked by new uredosori.

Other fungi being studied for control: Ascochyella chondrillina Sacc. and Leveillula taurica (Lev.) Arnaud (Wapshere, 1971). Many other fungi have been reported on living and dead portions of skeletonweed.

A list of the species of fungi and literature citations describing them follows for those persons interested in researching the possibility of them for biological control of skeletonweed.

Puccinia chondrillina Bubak & Sydow Chondrilla Rust,
the most widespread of the fungi naturally found on skeletonweed.

Syn.: Uredo chondrillae Opiz (nom. nud.)

Bullaria chondrillina (Bubak & Syd.) Arth. & Mains

Puccinia chondrillae Corda (p.p.)

Puccinia prenanthis (Pers.) Fuckel (p.p.)

Arthur, J.C. Manual of Rusts in United States and Canada.
438 pp. 1934. (D.C., Md. Va.).

Arthur, J.C. and E.B.Mains North. Amer. Flora, 7(7): 482-515. 1922. (D.C., Md., Va.).

Beltran, F. Real Soc. Espanol. Hist. Nat., Spec. 50th. Anivers.: 242-271. 1921. (Spain-on lvs., st. and invo.)

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Bremer, Hans, H. Ismen, G. Karel, H. Ozken & M. Ozkan Istanbul Univ. Fac. Sci., Rev. Ser. B. 12: 307-334. 1947.

Bubak, Fr. and J.E. Kabat Oesterr. Bot. Zeitschr. 55: 73-79. 1905. (Austria, Tyrol).

Constantineanu, I.C. Jassy Univ. (Rumania). Ann. Sci., 10: 314-460. 1920. (Rumania - on living stems).

Gamalitskaia, N.A. Akad. Nauk Kirgiz SSR, 175 pp. 1964. (Cent. Tien-shan, Tadzhik, SSR).

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- Pospelov, A.G., N.G. zaprometov and A.A. Domasheva Fungi of the Kirghiz SSR, Frunze, 128 pp. 1957.
- Ranojevic, N. Hedwigia, 77: 233-242. 1938. (Macedonia)
- Saccardo, P. Sylloge Fungorum, 17: 311-312. (Germany, Italy, Bohemia, France, Portugal - on leaves, petioles & stems).
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Darluca filum (Biv.) Cast. in Sacc.

d'Almeida, J.V. and M. Souza da Camara Bol. Soc. Broteriana (Coimbra), 24: 150-213. 1909. (Portugal).

Saccardo, P. Sylloge Fungorum, 13: 305. 1898. (leaves).

Unamuno, P.L.M. Bol. R. Soc. Espan. Hist. Nat. 31(2): 85-96. 1931. (Spain).

Ascochyatella chondrillina Petrak

Hruby, J. Zemled. Misul, Sofia, 2(3): 65-85. 1930. (Bulg.).

Puccinia flosculosorum (Alb. & Schw.)

Winter, G. Hedwigia, 19: 33-45, 53-60. 1880. (Europe).

Sclerophoma chondrillina

Hruby, J. Hedwigia, 68: 161-190. 1928. (Europe).

Phyllosticta chondrillina Gz. Frag.

Gonzalez Fragoso, R. Rev. Real Acad. Cien. (Madrid), 15: 681-702, 709-738. 1917. (Spain - on dead leaves).

Plenodomus chondrillae Died.

Diedicke, H. Ann. Mycol. 9: 137-141. 1911. (Germ. - on dead stems).

Erysiphe communis (Wallr.) Link

Bontea, V. Parasitic and Saprophytic Fungi of Rumania. 637 pp. 1953.

Leptosphaeria mirabilis Niessl

Niessl, G.v. Hedwigia, 20: 97-100. 1881.

Saccardo, P. Sylloge Fungorum, 13: 305. 1898. (stems).

Leptosphaeria bella Pass.

Saccardo, P. Sylloge Fungorum, 13: 305. 1898. (stems).

Macrosporium commune Rabenh.

Moskovetz, S. Bull. Jard. Bot. Kieff, 16: 17-87. 1933. (Ukraine).

Dothidea appendiculata Delacroix

Syn.: Dothidella appendiculata (Delacr.) Har. & Briard.

Diplochorella appendiculata (Delacr.) Theiss. & Syd.

Roumeguere, C. Rev. Mycol. 13: 123-134. 1891. (France).

Theissen, F. and H. Sydow Ann. Mycol., 13: 149-748. 1915.

Saccardo, P. Sylloge Fungorum, 13: 305. 1898. (stems).

Cladosporium herbarum Link

Moskovetz, S. Bull. Jard. Bot. Kieff. 16: 71-87. 1933. (Ukraine).

Phoma chondrillae Hollos

Picbauer, R. Verh. Naturf. Ges. Brunn., 69 (1937): 29-45. 1938. (Czechoslovakia).

Saccardo, P. Sylloge Fungorum, 22: 886-887. 1913. (Hungary - on dead stems).

Phoma herbarum West

Moskovetz, S. Bull. Jard. Bot. Kieff. 16: 71-87. 1933. (Ukr.).

Metasphaeria trichostoma (Pass.) Sacc.

Engler u. Prantl Nat. Pfl.-fam. 1: 434. (Italy - stems).

Roumeguere, C. Rev. Mycol. 10: 141-149, 185-193. 1888.

(Italy - on dry stems and branches).

Metasphaeria eburnea (Niessl) Sacc.

Engler u. Prantl Nat. Pfl.-fam. 1: 434. (Germany - stems).

Saccardo, P. Sylloge Fungorum, 13: 305. 1898. (stems).

Pyrenopeziza compressula Rehm

Saccardo, P. Sylloge Fungorum 13: 305. 1898. (leaves).

Pyrenophora trichostomella Sacc.

Saccardo, P. Sylloge Fungorum 13: 305. 1898.

Diaporthe orthoceras (Fr.) Nitscke

Saccardo, P. Sylloge Fungorum 13: 305. 1898. (stems).

Phomopsis lactucae forma chondrillae Syd.

Lavitaika, Z.H. Kiev Univ. Naukovi Zapysky, 8(6): 27-45.

1949. (Ukraine).

Annotated Herbarium Specimens of Skeletonweed in Eastern United States, 1874 - 1978

DELAWARE.

Kent Co.: Along roadsides, Smyrna, north end of town. Aug. 13,1908. Bayard Long & S.S. van Pelt. (ANSP); Smyrna. Aug. 16,1908. E.B. Bartram. (ANSP).Sussex Co.: Sandy fields near Milford. Aug. 12, 1897. A. Commons

5. (ANSP, NY); common in sand dunes along Atlantic Ocean at

Lewis. Sept. 10, 1974. Reed 96197; July 30, 1957. Reed 38940;Sept. 18, 1971. Reed 91898.

DISTRICT OF COLUMBIA.

Washington, D.C. Georgetown, D.C. July 29, 1874. J.J. Carter.

(ANSP); Washington. fl. July 13, 1879, rust on leaves, May 10,

1877. Lester F. Ward. (Reed); weed of wasteland, vacant lot inMt. Pleasant. Sept. 2, 1901. Lyster H. Dewey 522. (NA); SoldiersHome, Washington. Sept. 16, 1896. C.D. Lippincott. (ANSP); Suit-land, Washington, roadside. Aug. 22, 1954. F.H. Sargent 6999.(U.Ga - 63065); Terra Cotta, D.C. Aug. 3, 1895. C.L. Pollard599. (U.Ga.-32700); Washington, D.C. 1888. Jesse H. Holmes. (Ariz).

MARYLAND.

Allegany Co.: Rocky shaley slopes, RR. siding west of LittleOrleans. Sept. 7, 1963. Hermann 19346. (US).

MARYLAND.

- Anne Arundel Co.: Annapolis Junction along C&O (B&O) RR. July 25, 1974. Reed 95682; along Brock Ridge Road along B&O RR., Annapolis Junction near Howard Co. line. July 30, 1974. Reed 95911.
- Baltimore City: Wastes, Baltimore. Miss K.A. Taylor 1622 (Reed), no date, about early 1900's.
- Calvert Co.: Cove Point, several sandy acres back from beach. July 14, 1974. Reed 95611; Sept. 10, 1974. Reed 96061; sandy beach along Chesapeake Bay, Cove Point. June 28, 1952. Reed 29303; July 14, 1974. Reed 95891 and 95895.
- Charles Co.: Exposed sandy bluff, Rock Point. July 17, 1921. Leonard and Killip 861. (US, rust on stems).
- Dorchester Co.: Sandy wastes near Galestown. June 29, 1973. Reed 94467.
- Kent Co.: Chestertown. Aug. 7, 1900. E.G. Vanatta. (ANSP).
- Montgomery Co.: Yard of Glen Echo School. Sept. 3, 1927. O.M. Freeman. (NA); along B&O RR tracks at Dickerson. Sept. 19, 1974. Reed 96303.
- Prince Georges Co.: Laurel. Aug. 29, 1905. C.S. Williamson. (ANSP); roadsides, Rt. US 301 at Rt. US 50, 9 mi. N of Upper Marlboro. July 14, 1974. Reed 95884; along C&O (B&O) RR at Beltsville and Rt. US #1. July 25, 1974. Reed 95656; July 30, 1974. Reed 95920; 1 mi. S of Bladensburg. Aug. 27, 1944. E.C. Leonard 19939. (U.Ga.-34356); along B&O RR tracks at Rt. US #1 near Muirkirk. July 22, 1974. Reed 96390.
- Queen Annes Co.: Abandoned farmstead, 0.25 mi N of junction of Rts. 305 and 301, W of Hope. Oct. 1, 1971. J. Massey and H. Massey 3090. (UNC-CH).
- Talbot Co.: Sandy soil, Chesapeake Bay Shore near Claiborne. Sept. 8, 1927. Hugh E. Stone. (ANSP); dry pasture, Tilghman Point. Sept. 20, 1943. E.C. Earle 3843. (ANSP); in tall grass, in weedy fields, 3.5 mi. WNW of Longwoods. Sept. 6, 1942. E.C. Earle 3736. (ANSP); edge of fields near Tuckahoe River near Matthews. July 30, 1957. Reed 38924.
- Washington Co.: Along B&O RR, 7 mi east of Hancock. Aug. 14, 1955. Reed 36206.
- St. Marys Co.: Sandy beaches, Point Lookout State Park. Aug. 3, 1969. Reed 82754.
- Wicomico Co.: Wastes along RR in Salisbury. Aug. 22, 1974. Reed 96374; along RR, at Wilson St at Rt. 13, Salisbury. Aug. 8, 1976. Reed 100902; Salisbury. July 4, 1904. J.J. Carter 280. (ANSP); wastes along RR at Fruitland, Rt. 13, Aug. 22, 1974. Reed 96376; wastes, Sharptown, Rt. 313. June 29, 1973. Reed 94465.

NEW JERSEY.

Atlantic Co.: Sparingly adventive in filled-in land, Vintnor. Sept. 16, 1916. K.K.Mackenzie 7370. (ANSP, NY).

Cape May Co.: Waste ground, Cape May City. Aug. 6, 1917. Witmer Stone. (ANSP); fallow sandy field, E of Cape May C.H. Sept. 11, 1938. Bayard Long 53076. (ANSP, GH); bayside road, Cold Spring. June 13, 1923. O.H.Brown. (ANSP); roadside, Fishing Creek. Sept. 18, 1916. O.H.Brown. (ANSP); Pierces Point, Green Creek. July 14, 1918. O.H.Brown. (ANSP); dry sandy soil at Sea Isle Junction, PRR. July 18, 1931. W.H.Witte. (ANSP); along RR, Wildwood Junction. June 22, 1919. O.H.Brown. (ANSP); common in old fields, Rt. 47 at 12-mile marker, just S of Bidwells Creek. July 31, 1975. Reed 98018; 'Cape May Co.' July 18, 1931. W.H.Wille. (NY).

Cumberland Co.: Roadside wastes, Rt. 548, near Mauricetown. July 31, 1975. Reed 98006; common in fallow fields and sandy wastes Rt. 548 near Mauricetown. July 31, 1975. Reed 98004; wastes in Bridgeton, Rt. 49. July 31, 1975. Reed 98000.

NEW YORK.

Tompkins Co.: Dryden, dry gravelly knoll, SE of Mud Pond. Aug. 13, 1919. K.M.Wiegand, s.n. (GH).

PENNSYLVANIA.

Bedford Co.: Ore mine shale, alt. 1160 ft., $1\frac{1}{4}$ mi. NE of Cessna. Aug. 30, 1941. D.Berkheimer 2933. (ANSP); abandoned fields, alt. 1060 ft., $2\frac{1}{4}$ mi. SE of Five Forks. Aug. 3, 1945. D.Berkheimer 6344. (ANSP); roadsides, alt. 1012 ft., about $1\frac{1}{4}$ mi SSE of Artemas. July 22, 1947. D.Berkheimer 9000 (ANSP); abandoned field, alt. 1000 ft., $1\frac{1}{4}$ mi. NNE of Hewitt. Aug. 13, 1944. D.Berkheimer 5380. (ANSP).

Berks Co.: Old field 1 mi. SE of Albany. Aug. 15, 1952. Schaeffer 41679. (US); Boyertown. Aug. 17, 1913. E.B.Bartram 3360. (ANSP); open field, 1 mi E of Greenswald. Aug. 11, 1952. Schaeffer 41357. (ANSP); fields west of Umbrella Hill, 2.25 mi. W of Kutztown. Oct. 9, 1936. C.L.Gruber. (ANSP); Temple near Reading RR tracks. Aug. 13, 1966. W.C.Brumbach 5505. (ANSP); weed along RR, Monocacy. Sept. 3, 1951. Hans Wilkens 8327. (ANSP); old field 0.5 mi. NE of Trexler. Aug. 18, 1953. Schaeffer 44931. (ANSP); old field near Moselem. July 30, 1944. Hans Wilkens 7388. (ANSP); 3 mi. NW of Moselem. Sept. 4, 1915. W.H.Leibelsperger 351. (ANSP); upland field 0.8 mi. ENE of Plowville. July 27, 1967. W.C.Brumbach 5901. (ANSP); weedfield, alt. 330 ft., near Pennside. Aug. 23, 1942. D.Berkheimer 3401. (ANSP); dry old field, NE of Pricetown, very abundant locally. Aug. 18, 1935. Hans Wilkens 4173. (ANSP); dry sandy quarry, west of Reiffon. July 27, 1933. W.C.Brumbach 472-33. (ANSP); dry

open barren field, 1 mi. NW of Scarlets Mill P.O. Aug. 10, 1941. W.C.Brumbach 3307. (ANSP); dry grassy slope near White Bear Station (Scarlets Mill P.O.). Sept. 3, 1936. Hans Wilkens 4990. (ANSP); thicket on shale hill, Shillington. June 9, 1938. Hans Wilkens 5505. (ANSP).

Franklin Co.: Wooded dry shaley slope, SW of Claylick. Sept. 15, 1961. E.T.Wherry. (ANSP); shale bank along Rt. 274, 3 mi. NE of Doylesburg. Sept. 12, 1955. W.F.Westerfield 18500. (UNC-CH).

Lehigh Co.: Fallow field, 1 mi. NW of Lowhill. Aug. 17, 1950. Schaeffer 34295. (US); aug. 17, 1950. Schaeffer 34297. (ANSP); cinders just W of Walberts. Aug. 29, 1958. Schaeffer 59028. (ANSP, US); fallow field, 1.5 mi. SE of New Smithville. Aug. 13, 1951. Schaeffer (ANSP); 1.25 mi. W of Schnecksville. Aug. 28, 1951. Schaeffer 38046. (ANSP).

Montgomery Co.: Thicket slope, alt. 140 ft., NW of Glasgow. July 30, 1944. D.Berkheimer 5242. (ANSP).

VIRGINIA.

Arlington Co.: Wastes near Alexandria. June 12, 1877. A.S. (ANSP).

Augusta Co.: Along roadside, moist clay soil, junction of Rt. 460 and Rt. 46. Aug. 17, 1971. Craig L. Nessler 365. (Wm. & Mary Coll.).

Campbell Co.: Old RR bed between Lunch Station and Altavista. June 10, 1914. Juliet Faunteleroy 650. (US).

Caroline Co.: Sandy open slope, N of Golansville. Aug. 22, 1938. Fernald & Long 9225. (ANSP).

Clarke Co.: Rocky pasture above Shenandoah River, Trappist Monastery, 6 mi. E of Berryville. Aug. 12, 1951. F.J.Hermann 11722. (NA); limestone fields, Rt. 340 E of Boyce. July 20, 1975. Reed 102511; along N&W RR, Berryville. July 20, 1975. Reed 102509.

Dinwiddie Co.: Cinders of freight yard of N&W RR, spreading, Petersburg. July 21 and 25, 1939. Fernald & Long 10847. (US, ANSP); same locality, June 4, 1940. Fernald & Long 12209. (ANSP).

Fauquier Co.: In open pasture along trail from Overtop to Rattlesnake Mt. June 13, 1937. H.A.Allard 3008. (US).

Henrico Co.: Waste places and on RR ballast, Richmond. July 13, 1940. Fernald and Long 12502. (ANSP).

Northumberland Co.: On side of cultivated field, Rt. 202 at Rt. 619. July 29, 1971. C.L.Nessler & P.L.Busse 226. (Wm. & Mary Coll., UNC-CH).

Madison Co.: Big Meadows, 4 mi. S of Marksville, local in meadow, 1080 m. alt. Aug. 26, 1954. F.R.Fosberg 36029. (US).

Page Co.: Roadsides between Luray and base of Stony Man Mt. Aug. 31, 1913. Ivar Tidestrom 6717. (US, NA).

Prince William Co.: Along RR, common at Rt. US #1, Woodbridge, just south of Occaquan Creek. July 12, 1974. Reed 95560 and 96407; Aug. 9, 1969. Reed 82821; Oct. 19, 1977. (Reed obs.).

Rockingham Co.: On open hillside above Eaton Hollow Overlook, Shenandoah Nat. Park. Aug. 20, 1945. E.H.Walker 3805. (US).

Shenandoah Co.: Shale barrens, E of Mauertown, 3.5 mi S of Signal Knob. Aug. 10, 1941. H.A.Allard 9382. (US); along Southern RR tracks at Strasburg. July 20, 1975. Reed 102510.

Spotsylvania Co.: Fredericksburg. Aug. 20, 1891. Thos. C. Porter. (ANSP); weed along streets of Fredericksburg. Aug. 9, 1969. Reed 82803; also common along railroads in Fredericksburg.

Stafford Co.: Waste ground along Potomac River, at mouth of Aquia Creek, 3 mi SE of Stafford. Aug. 28, 1938. F.J.Hermann 9738. (NA); roadsides, Stafford Co. June 30, 1970. J.Miles Sharpley. (UNC-CH); wastes at Falmouth along Rt. US #1. Aug. 9, 1969. Reed 82805.

Warren Co.: In abandoned drive-in movie lawn, in open sunny dry soil, 0.1 mi. into Front Royal City limits on Rt. 522. Aug. 10, 1971. Craig L. Nessler 491. (Wm. & Mary Coll.) common along N&W RR, Front Royal. Aug. 14, 1975. Reed.

Westmoreland Co.: Dry ground, bay shore, mouth of Currioman Creek. Aug. 20, 1952. F.H.Sargent. (U.Ga.-47138); Kinsdale. Aug. 10, 1904. Ivar Tidestrom E-6962. (U.Ga.-18779).

WEST VIRGINIA.

Berkeley Co.: Along fencerows and in pastures, Imwood. Aug. 16, 1947. H.N.Moldenke 19174. (ANSP).

Grant Co.: Several acres over shale barrens and old fields, 1-2 mi. S of Petersburg, Rt. 220. Sept. 20, 1974. Reed 95968. (Rust).

Hardy Co.: Shale slopes, several hundred acres, along Baker Rock Road, off Rt. 220, 5-7 mi. S of Moorefield. Sept. 20, 1974. Reed 96186; shale ledges, just E of Durgon. Sept. 20, 1974. Reed 96137 (Rust).

GEORGIA.

Hall Co.: Piedmont Prov., along RR, leafy up to top of plant. July 12, 1955. W.P.Adams et al. 19106. (U.Ga.).

MICHIGAN.

Kalamazoo Co.: Vicksburg. Sept. 18, 1936. C.R.Hanes 3506. (NY); 1 mi. N of Comstock. Sept. 3, 1936. C.R.Hanes 3636. (CH).

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Tracaulon perfoliatum (L.) Greene in Maryland

by

Clyde F. Reed

The genus Tracaulon is represented in Maryland by three species, T. sagittatum (L.) Small, T. arifolium (L.) Raf. and T. perfoliatum (L.) Greene. Fernald (1950) remarks, regarding this species from eastern Asia, that T. perfoliatum is becoming established in nurseries in Pennsylvania and may become a troublesome weed. Sometimes classified as Polygonum spp.

The nurseries referred to are in York County, Pennsylvania. So, it was not surprising to find in 1968 large stands of Tracaulon perfoliatum along Deer Creek, at The Rocks, Harford County, Maryland. Harford County is the next county south of York County on the west side of the Susquehanna River. Later, the author found it further down Deer Creek near Darlington along Glenville Road and at Schweers Landing on the Susquehanna River.

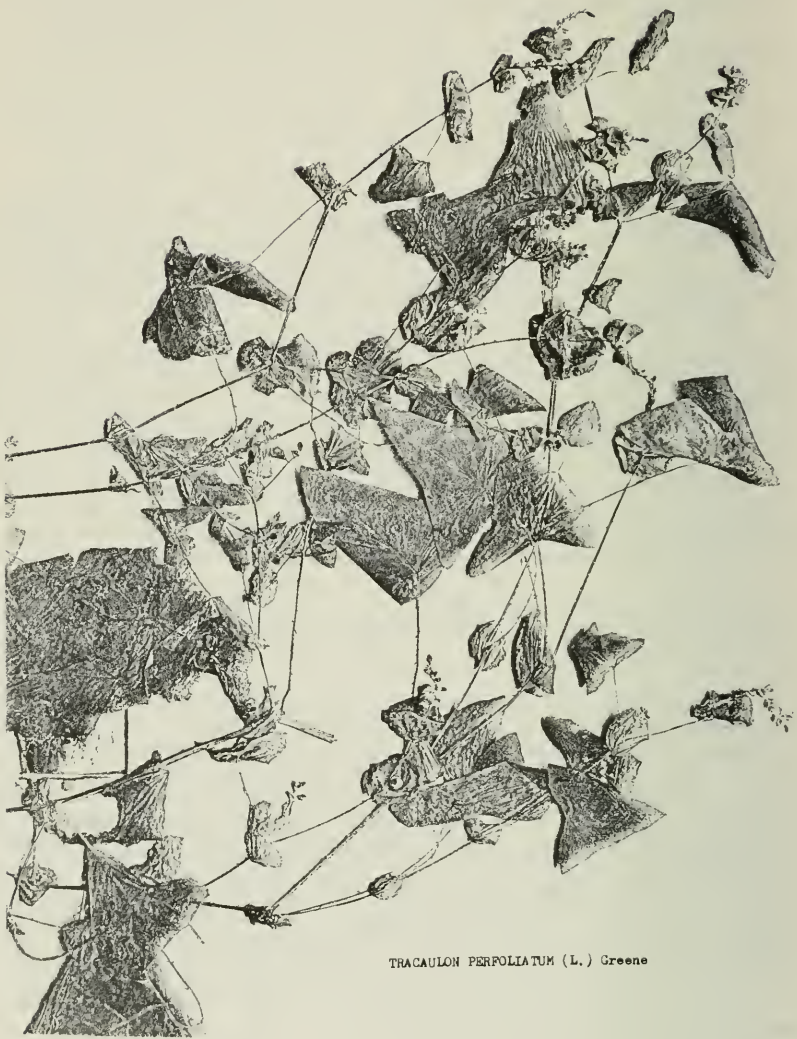
More recently this troublesome weed has been found by the author near Cub Hill not far from the Big Gunpowder Falls, along Jones Falls near Bare Hills, and along Upper Beckley Road near Brick Stone Road in northern Baltimore County, and near Manchester in Carroll County, Maryland.

In 1977, I considered this weed a menace and included it in my book, 'Economically Important Foreign Weeds, potential problems in the United States, USDA Agric. Handbook No. 498: 233, with the following description and noted.

Scandent glabrous annual herb; stems much-elongate, branched, 1-2 m. long, sometimes longer; stems, petioles and along veins beneath leaves retrorsely prickly; blades glaucous or pale green, 3-6 cm. long and as wide at the truncate to shallowly cordate base, acute or subacute at apex, margins minutely retrorsely scabrous; petioles nearly as long as blades; sheaths scarcely tubular, the dilated leaflike limb orbicular, perfoliate and green; spikes 1-2 cm. long, subtended by an orbicular, leaflike bract, the pedicels short; perianth 3-4 mm. long, pale greenish-white, the segments broadly elliptic, becoming fleshy and blue in fruit; fruit 5 mm. in diameter, inflated with the dried perianth more or less persistent; achene indurate, about 3 mm. in diameter, nearly globose, exclusive of the persistent base, smooth, shining black, or reddish-black under magnification.

Weedy in damp areas, along streams, gullies, spreading to gardens, fields and edge of woods and thickets.

Native to Eastern Asia (Japan, where it is a harmful weed throughout; Korea, China, Taiwan, S.E. Asia and India). In the United States it is known at least at this time in southeastern Pennsylvania and north-eastern Maryland, but is spreading rapidly southward.



TRACAUON PERFOLIATUM (L.) Greene

Annotated specimens of Maryland records

- Harford County: Numerous plants along Deer Creek, near The Rocks, picnic grounds. Aug. 5, 1968. Reed 85672-B; common, forming dense scratchy thickets along Deer Creek, St. Clair Bridge Road and Holy Cross Road. June 5, 1971. Reed 91655; Deer Creek State Park, The Rocks, June 5, 1971. Reed 91644 and 91649; common along Deer Creek near Cherry Hill Road, The Rocks. July 17, 1971. Reed 91513 (seeds cited as 91573); dense thickets along Deer Creek at Rt. 161, opposite Glenville Road, near Darlington. Aug. 11, 1977. Reed 102816; also in gardens here.
- Baltimore County: Weed in garden, Cub Hill, near Big Gunpowder Falls. June 24, 1977. Reed 100813; same locality. June 24, 1978. Reed 101841; same locality. Oct. 16, 1977. Reed 102108; thicket along Jones Falls, north of Bare Hills along Falls Road. Oct. 23, 1978. Reed 102111; along creek, Upper Beckley Road, near Brick Stone Road, northern Baltimore County. Oct. 18, 1978. Reed 102110.
- Carroll County: Along creek near Manchester, off Hanover Pike. Oct. 18, 1978. Reed 102112.

This weed has become a troublesome plant in less than ten years, at least along the Deer Creek in Harford County, especially in the Deer Creek State Park where picnickers and campers are being annoyed by the dense thickets of scratchy stems, petioles and leaves. The fruits are blue and quite attractive, perhaps so to birds, and so probably account for its rapid distribution to the Gunpowder and Jones Falls drainages in Baltimore and Carroll Counties in Maryland. The Manchester site is not far from the drainages of the Patapsco River, and the fruits could be carried to the Monocacy and Potomac drainages within a few miles. Also the buoyancy of the blue bladder-like perianth about the seed allows the seed to float downstream. This is one weed that should be exterminated before it gets distributed any further in Eastern United States.

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Reed Herbarium,
10105 Harford Rd.
Baltimore, Maryland

NOTES ON NEW AND NOTEWORTHY PLANTS. CXXIV

Harold N. Moldenke

ERIOCAULON PELLUCIDUM f. *ROLLANDII* (Rousseau) Mold., comb. nov.

Eriocaulon rollandii Rousseau, Bull. Jard. Bot. Brux. 27: 372. 1957.

CALLICARPA STAFFII Mold., nom. nov.

Premna cauliflora Stapf, Trans. Linn. Soc. Lond. Bot. 4: 215. 1894 [not *Callicarpa cauliflora* Merr., Philip. Journ. Sci. Bot. 7: 338--339. 1912].

CALLICARPA HAVILANDII var. *HISPIDA* Mold., var. nov.

Haec varietas a forma typica speciei recedit ramis ramulisque petiolisque pedunculisque pedicellis calycibusque dense longiterque hispidis, pilis fulvis rectis rigidis ca. 5 mm. longis.

This variety differs from the typical form of the species in having its branches, branchlets, petioles, peduncles, pedicels, inflorescence-branches, and calyxes densely and conspicuously long-hispid with fulvous, stiffly divergent, straight hairs about 5 mm. long

The type of the variety was collected by Shohei Kokawa and Mitsuru Hotta (no. 1245) between Kanpong Silam and the summit of Mount Silam, Lahad Datu District, at 870 meters altitude, Sabah, Malaysia, on November 15, 1969, and is deposited in the herbarium of the Forest Department at Sandakan, Sabah.

CALLICARPA KINABALUENSIS var. *GIBOTII* Mold., var. nov.

Haec varietas a forma typical speciei laminis foliorum coriaceis percrassis minoribus ellipticis 7--11 cm. longis 4--7 cm. latis supra bullato-rugosis subtus densissime stellato-tomentosis recedit.

This variety differs from the typical form and all other named subspecific taxa of this species in its leaf-blades being coriaceous, very stiff and hard, regularly elliptic, apically acute, basally rounded, bullate-rugose above, and very densely stellate-tomentose beneath, mostly 7--11 cm. long and 4--7 cm. wide during anthesis.

The type of this variety was collected by Aban Gibot (SAN.55432) in whose honor it is named, in a montane forest at 8000 feet altitude on Mount Tambayukan, Ranau District, Sabah, Malaysia, on May 19, 1970, and is deposited in the herbarium of the Forest Department at Sandakan, Sabah. The collector describes the plant as an herb with "greenish and yellowish" flowers [=greenish-yellow?].

FLORA
OF THE PRAIRIE PROVINCES

Bernard Boivin

Part IV

(concluded)

Order 73. ARALES

Inflorescence much reduced and functioning like a single flower. Flowers small and crowded into a receptacle-like rachis termed "spadix". Inflorescence subtended and more or less enveloped by a bract termed "spathe". These two structures exhibit a very wide range of morphological variation.

- a. Terrestrial; normal flowers present 127. Araceae
aa. Floating aquatics; flowers highly reduced and normally absent 128. Lemnaceae

127. ARACEAE (ARUM FAMILY)

Type family of the order. Flowers with the normal components of perianth, stamens and/or ovary. Spathe usually petaloid and showy.

- a. Leaves trifoliolate 3. Arisaema
aa. Simple.
b. Leaves ensiform 1. Acorus
bb. Broadly cordate 2. Calla

1. ACORUS L. CALAMUS

Flowers perfect. Perianth of 6 segments.

1. A. Calamus L. -- Sweetflag (Belle-Angélique, Radote) -- Long, ensiform leaves tufted, mostly around 1 m high, with a somewhat off center midnerve. Spathe seemingly continuing the stem in the manner of some Scirpus or Juncus, the stem-part triangular-flattened, the spathe-part flat and not enclosing, but equitant. The stem-spathe unit is leaf-like, with the spadix arising at an angle from the junction. Early summer. Freshwater shallows. -- sMack, NS-BC, US, Eur.

2. CALLA L. WATER-ARUM

Flowers all or mostly perfect. Perianth lacking.

1. C. palustris L. -- Calla, Wild Calla (Choucalles) -- Spathe showy, nearly white ventrally, green dorsally, 3-6 cm long, oblong to broadly ovate, long-caudate at tip. Leaves around 1 dm across, broadly ovate, alternate on an elongate rhizome. Somewhat fleshy, especially the stem and petioles. Early summer. Bogs and marshy shores. -- Mack-Aka, L-NF, NS-BC, US, Eur.

Symplocarpus foetidus (L.) Nutt. was reported from Winnipeg by Scoggan 1957 on the basis of a specimen preserved at the Manitoba Provincial Museum in Winnipeg. It is a sample of Lysichiton americanum Hultén & St John and in all likelihood came either from a garden or from a planting in the wild. An earlier report of Jackson 1922 is not substantiated by any specimen that Scoggan or ourself could locate and is herewith discounted as improbable.

3. ARISAEMA Mart.

INDIAN TURNIP

Flowers unisexual. Perianth absent. Spadix prolonged beyond the flower-bearing base.

1. A. triphyllum (L.) Schott var. triphyllum (A. atrorubens (Aiton) Blume) -- Jack-in-the-Pulpit, Indian Turnip (Petit pêcheur, Oignon sauvage) -- Perennial herb from a corm, with 1-2 large, basal, trifoliate leaves. Leaflets up to 2 dm long, ± ovate, the lateral ones strongly asymmetrical. Spathe less than 1.5 dm long, hooded, brown-purple with the reticulate nervation outlined in pale green. Late spring and early summer. Rare in rich deciduous woods: Emerson and Dufferin. -- NB-sMan, US.

Grades eastward into var. Stewardsonii (Britton) Stevens with a spathe tapered at base into the peduncle, its tube more strongly corrugated, the throat striped in white and purple on the inner face, the hood green.

128. LEMNACEAE

DUCKWEED FAMILY

Free-floating aquatics, very small and normally sterile, reproducing mainly by budding. Inflorescence, when present, reduced to 2-3 minute flowers. Staminate flower reduced to a stamen. Pistillate flower reduced to an ovary. The leaf-like structure is termed "thallus". Flowering very rare or very rarely observed.

The recently published monograph of Lemnaceae by E.H. Daubs, Ill. Biol. Mon. 34: 1-118, 1965, is not to be trusted, especially its distribution maps. These are made up mainly of imaginary dots, mostly equidistant. We have also come across a few similar maps in some other genera, Arnica, Lupinus, Rumex,

etc. Such maps may have the outward appearance of paintaking scholarship, but they lack its substance, the essential dot to specimen correlation.

- a. Rootlets fascicled 1. Spirodela
 aa. Rootlets none or only one per leaf-like unit 2. Lemna

1. SPIRODELA Schleiden

Roots in a small fascicle arising at the near end and underneath the leaf-like thallus.

1. S. polyrhiza (L.) Schleiden -- Duckweed, Water-Flaxseed -- (Lentille d'eau) -- Smallest in our flora but for Lemna minor. Thalli about 5 mm across, leaf-like, clustered, green above with an off center purple spot and radiating purple nerves; purple below, the cluster of rootlets attached opposite the purple spot. Free floating at the surface of quiet waters in company of Lemna minor and normally less abundant than the latter. -- NS-BC, US, (CA), Eur, (Afr, Oc).

2. LEMNA L.

DUCKWEED

Rootless or the root arising from the far end of the thallus.

- a. Rootlet present 2. L. minor
 aa. Absent; thalli larger and connected by stipe-like bases 1. L. trisulca

1. L. trisulca L. -- (Canillée, Cannetée) -- Floating under water and forming loose, open networks up to 1 dm across. Thalli 4-10 mm long, lanceolate, green, finely white-punctate, seemingly trilobed when budding. Stipe about as long as the limb. Quiet waters. -- K-Aka, NS-BC, US, (CA), Eur, (Afr, Oc).

2. L. minor L. -- Duckweed (Lentille d'eau, Merde de grenouille) -- Our smallest plant, its thallus only 1-3 mm long and growing in clusters less than 1 cm across. Rootlet 1-2 cm long, simple and pendant from under the far end of the thallus, the latter pale green and nerveless. Free floating at the surface of quiet waters, often in huge numbers towards the end of the summer. -- K-Aka, SPM, NS-BC, US, (CA, SA).

Order 74. TYPHALES

Reduced type of the preceeding order. Flowers unisexual and often without perianth, hence reduced to an ovary or stamen(s). Fruit an achene. Spathe green and leaf-like, fugaceous.

- a. Flowers in globose heads 129. Sparganiaceae

aa. In dense, cylindrical heads 130. Typhaceae

129. SPARGANIACEAE (BURREED FAMILY)

Perianth of 3-6 tepals. Monotypic.

1. SPARGANIUM L. GOOSE-GRASS

Aquatic herbs with the flowers in globose heads in a moniliform inflorescence on a sinuous rachis.

- a. Stigmas 2, the style being bifid 1. S. eurycarpum
 aa. Only one stigma, the style entire.
- b. Fruiting head 1.2 cm wide or less, the beaks 1.5 mm long or less; staminate heads only 1-2; inflorescence simple.
- c. All heads (or peduncles) axillary; beaks 0.5-1.5 mm long 7. S. minimum
- cc. At least one of the pistillate heads borne half way up an internode 8. S. hyperboreum
- bb. Fruiting head larger, up to 3.5 cm wide, the beaks mostly over 1.5 cm long; staminate heads 2 or more, except S. glomeratum.
- d. Inflorescence of 2 or more branches, each bearing 2 or more heads.
- e. Styles all or mostly bifid 1. S. eurycarpum
- ee. Styles entire 2. S. americanum
- dd. Inflorescence simple and spiciform to racemiform below.
- f. Pistillate heads (or their peduncles) all axillary 2. S. americanum
- ff. At least one pistillate head borne about half way up an internode or opposite a leaf or bract.
- g. Staminate heads only 1-2, less numerous than the pistillate ones and contiguous to the upper pistillate head; in fruit the rachis is barely, if at all, prolonged beyond the upper pistillate head 3. S. glomeratum
- gg. Staminate heads more numerous and forming a moniliform inflorescence on a very long rachis which persists in fruit.
- h. Leaves 5-10 mm wide; beaks 2.5-3.0 mm long. Normally an emersed and erect plant 6. S. multipedunculatum
- hh. Leaves mostly narrower, less than 7 mm wide.

- i. Normally submerged with only the inflorescence protruding above water; beaks \pm 2 mm long; lower head usually pedunculate 5. S. angustifolium
- ii. Normally emerged and stiffly erect; beaks (2)-4 mm long; all or nearly all heads sessile or nearly so 4. S. chlorocarpum

Aquatic plants of shallow waters and exundated shores are normally subjected to drastic ecological variations and may respond by equally drastic morphological adaptations, hence their identification may present some unusual difficulties. This is especially the case with our species of Sparganium and their identification is largely based on characters drawn from the inflorescence. The following general characterizations may help the beginner. One species is rarely introduced, S. glomeratum, and is readily spotted by the different arrangement and ratio of pistillate and staminate heads. Two species, S. hyperboreum and S. minimum, are generally smaller with smaller heads and shorter beaks. The largest species, S. eurycarpum, has rather long stigmas and most of them are paired (always single in our other species). Also the inflorescence is branched (simple in the others, except sometimes S. americanum) and the mature achene is obconical (ovoid to ellipsoid or fusiform in the other species). The other four species center around S. americanum and will be discussed under the latter name.

Our treatment will be found to be fairly congruent with those of Fernald 1950 and Gleason 1952. But there are quite a few dissonances with the more recent text and illustrations of Hitchcock 1969.

Sterile leaves of submerged forms are often mistaken for Vallisneria. In Sparganium the leaf cells are unusually large, mostly 0.5-1.0 mm long and 0.2-0.3-(0.5) mm wide, thus their outline is readily observed by the unaided eye. In Vallisneria they are only 1/10 as big and barely detectable with a hand lens.

1. S. eurycarpum Eng. -- Styles all or mostly bifid, the stigmatic branches 2-3 mm long. Largest and coarsest, mostly around 1 m high, the leaves around 1 cm wide. Style, including the stigmas, about 5 mm long. Achene obconical, truncate at summit. Early summer. Muddy shores. -- NF-(SPM), NS-BC, US.

Porsild 1943 extended the range to Fort Norman, Mackenzie, but we have found no justifying specimen at CAN or elsewhere.

2. S. americanum Nutt. (S. androcladum (Eng.) Morong; S. fluctuans (Morong) Rydb.) -- The variable and nondescript species of the genus: styles entire, of middle size, and the heads

(or branches, or peduncles) axillary. Not quite so coarse as the first. Heads numerous, both the staminate and pistillate, the fruiting ones 1.5-2.5 cm across. Beaks 2-(4) mm long. Achene fusiform, usually with a faint constriction around the middle. First half of summer. Mostly around sloughs and shores with a fluctuating water level. -- (L-SPM), NS-0, S-BC, US.

Usually subdivided further into three species. Lesser plants with shorter stigmas, perianth and anthers, smaller heads, etc. are then termed S. fluctuans. The correspondingly larger plants are then S. androcladum, while the more average plants are retained as S. americanum.

Morphologically S. americanum is a central type and is best detected by elimination. If its inflorescence is branched, it is usually separated from S. eurycarpum on the basis of the number of stigmas or the shape of the achene.

If the inflorescence is a single zigzag spike (racemose or not at base) of heads, it is placed in S. americanum if all the pistillate heads are axillary, the lower 1-(2) being usually pedunculate while the others are sessile. Typically the heads are all sessile and axillary or nearly so in S. chlorocarpum, but for the lowermost head which is borne halfway up the internode. In S. angustifolium the lowermost head is also interaxillary, but it is commonly pedunculate, although it may be sessile. And in S. multipedunculatum, a somewhat broader-leaved species, the lowermost head is typically pedunculate and axillary, while the next head is sessile and interaxillary.

The variation in size of fruiting heads is not random but there are broad zones of overlap. The smaller heads belong to S. angustifolium, the larger ones to S. multipedunculatum.

The leaves are narrower in S. angustifolium and S. chlorocarpum, mostly 3-5 mm wide. They are broader in S. americanum and S. multipedunculatum, the main ones mostly ± 7 mm wide. The spacing of the nerves is related to the width of the leaves.

S. angustifolium is typically a submerged plant with long and flaccid leaves reaching the surface. The others are normally shore plants. S. chlorocarpum has a rather short stem, the leaves are stiff and somewhat channelled, and the beaks tend to be over 3 mm long. S. multipedunculatum tends to be of average height and S. americanum is the tallest of the series.

All these characters vary and not always in unison. It may be that specific rank is not justified for all these taxa. But we are retaining the present classification for want of a better one.

3. S. glomeratum Laest. -- Inflorescence very short, of 3-6 pistillate heads and only 1-2 staminate ones. About as large

as the last. Rachis of the inflorescence not prolonged beyond the upper pistillate head, or prolonged by only a few mm, hence the staminate head(s) is contiguous with the upper pistillate one. Lower head often borne opposite a leaf. Fruiting heads crowded, about 1.5 cm across. Beaks 1.5-2.0 mm long. First half of summer. A rare and apparently introduced plant of quiet waters: Glenevis. -- Aka, L, (Q)-O, Alta-BC, US, Eur.

The following localities have been checked: Big Delta (DAO), College (DAO), Goose Bay (DAO), Black Sturgeon Lake (SFS), Glenevis (ALTA, DAO), Graham Island (DAO), Kathlyn Lake (DAO), and from Minnesota.

4. S. chlorocarpum Rydb. (var. acaule (Beeby) Fern.; S. acaule (Beeby) Rydb.) -- Stem short, usually only 1-3 dm high, much overtopped by at least as much again by the stiff and nearly erect leaves. Sometimes submerged and with flaccid leaves, but normally emerged and the leaves carinate and \pm conduplicate. Lowest head typically sessile and borne half way up the internode or sometimes opposite a leaf. Fruiting heads 1.5-2.5 cm across, all sessile or subsessile. Mid summer. Frequent in wet places and shallow water. -- L-SPM, NS-O, S-BC, US.

5. S. angustifolium Mx. -- Goose-Grass (Rubanier) -- The common submerged aquatic type with the leaf tips floating at the surface and the inflorescence partly emerged. Sometimes stranded and erect, the leaves then rounded on back. Lowest bract usually some 50% broader towards the base and also quite often membranous margined. Lowest head on an obvious peduncle which arises half way up an internode. Fruiting heads 1.2-2.0 cm across. First half of summer. Common in quiet waters, usually in less than 1 m deep. -- (G, K)-Mack-Aka, L-SPM, NS-(PEI)-NB-BC, US, (Eur).

6. S. multipedunculatum (Morong) Rydb. (S. simplex AA.) -- Like a larger version of S. chlorocarpum. Stem taller and not so conspicuously overtopped by leaves. Fruiting heads 2-3 cm wide, the lower one often pedunculate and axillary, the second one usually sessile and interaxillary. First half of summer. Near water's edge. -- (Mack)-Y-Aka, NF-(SPM), NS-PEI-(NB)-Q-(O)-Man-BC, US.

The name S. simplex Hudson has largely fallen into disuse. British botanists now use S. emersum Rehm. and North-Americans generally prefer S. multipedunculatum. We have not yet investigated the basis for regarding the American plants as a distinct species. Authors of the last century used S. simplex in quite a broad sense and older records should not be accepted without checking the justifying sheets.

In a recent paper J.L. Reveal (Taxon 19: 796-7. 1970) has clearly pointed out that S. simplex Hudson is superfluous, hence illegitimate, and the correct name for the European plant is

S. emersum Rehm. With this nomenclature we agree. Then Reveal proceeds to distinguish the American plants as S. emersum var. multipedunculatum (Morong) Reveal without explaining the basis for his taxonomy, although there is a hint that he may have accepted the treatment of Hitchcock 1969.

The recent treatment by Hitchcock 1969 does not dovetail well with our own sorting. Hitchcock would recognize S. simplex as widespread in North America along with a var. multipedunculatum equally widespread. The discrepancy with our text is perhaps only a matter of names, S. simplex sensu Hitchcock being partly equivalent to our S. americanum. The latter taxon is not mentioned by Hitchcock although it seems to be a part of his illustration of S. simplex.

7. S. minimum (Hartm.) Fries -- Heads few and only about 1 cm across. Stem rather thin and weak. Leaves variable, usually less than 5 mm wide. Just before mid summer. Shallow and cool waters. -- seK-Mack, Aka, L-(NF), NS-(PEI)-NB-BC, US, Eur.

8. S. hyperboreum Laest. -- Like the last but the style and stigma shorter, neither over 0.3 mm long, and the heads not all axillary. Just before mid summer. Shallow, acid, cold waters. -- G, K-Aka, L-SPM, NS, Q-nO-nMan, (swAlta), Eur.

130. TYPHACEAE

(CATTAIL FAMILY)

Flowers further reduced to their stamens or ovary and a number of subtending bristles. Monotypic.

1. TYPHA L.

CATTAIL

Staminate and pistillate flowers borne in separate parts of the spike. Spathe soon deciduous.

- a. Leaves all or mostly 1.0-1.5 cm wide 1. T. latifolia
 aa. Narrower, only (0.4)-0.5-0.8-(1.0) cm
 wide 2. T. angustifolia

1. T. latifolia L. -- Cattail, Bulrush (Quenouille, Mas-sette) -- A conspicuous and taller marsh plant, with a compact and dark brown inflorescence \pm overtopping its foliage. About 1.5 m high. Inflorescence continuous, the pistillate part 1.0-1.5 dm long, becoming 2.0-2.5 cm thick at maturity, the staminate part shorter. Early summer. Common in ditches and in marshy shallows, not very tolerant of alkali. -- seK-Aka, NF, NS-BC, US, (CA), Eur.

IX. T. glauca Godron -- Hybrid of our two species and growing with its parents; more or less variable and intermediate in height, width and length of the leaves and pistillate spikes, and discontinuity of the staminate spike. Rare: Vita, Otterburne. -- NS, Q-Man, US, (CA), Eur).

2. T. angustifolia L. -- Cattail (Quenouille, Massette)
 -- Quite similar to the first and often growing with it. Somewhat taller. Leaves narrower and overtopping the inflorescence. Pistillate part of the inflorescence 1-2 dm long, paler brown, becoming 1.0-1.5 cm thick at maturity. Staminate spike usually longer and separated from the first by an interval of 1.5 cm or more. First half of summer. Rare in marshy places: Gimli, Otterburne, Vita. -- NS-seMan, US, Eur, (Afr).

This species is perhaps currently extending its range.

Sub-class 4. ACHENIDAE

Carpels free, or only one, maturing into one-seeded achenes.

- a. Carpels 4 or more.
 - b. Carpels very numerous 131. Alismataceae
- bb. Only 4 carpels.
 - c. Leaves opposite 136. Zannichelliaceae
 - cc. Alternate, but the upper sometimes opposite.
 - d. Flowers 2 on an axillary rachis
 135. Ruppiaceae
 - dd. Flowers more numerous and forming a
 terminal spike 133. Potamogetonaceae
- aa. Carpel solitary.
 - e. Leaves all basal 134. Lilaeaceae
 - ee. Borne on the stem.
 - f. Leaves opposite 137. Najadaceae
 - ff. Alternate 132. Zosteraceae

Order 75. ALISMATALES

Monotypic.

131. ALISMATACEAE (WATER-PLANTAIN FAMILY)

With numerous free carpels maturing into as many achenes and obviously resembling Ranunculus, but the flowers trimerous, with 3 sepals and 3 petals.

- a. Carpels disposed in a single verticil 1. Alisma
- aa. Not verticillate and more numerous in a dense
 globose head; flowers larger 2. Sagittaria

1. ALISMA L.

WATER-PLANTAIN

Fruit a verticil of achenes.

- 1. A. Plantago-aquatica L. (var. americanum R. & S., var.

brevipes (Greene) Farw., var. parviflorum (Pursh) Farw.; A. brevipes Greene; A. Geyeri Torrey; A. gramineum K.C. Gmelin. A. subcordatum Raf.; A. triviale Pursh) -- Water-Plantain, Mud-Plantain (Plantain d'eau, Flûteau) -- Leaf nervation of (5)-7 longitudinal main nerves connected ladder-wise by numerous small nerves. Annual or tufted perennial with the leaves all basal and ovate, varying to nearly linear. Panicle lax, its branching verticillate. Flowers less than 1 cm across, white to pinkish. Summer. Frequent on muddy shores and shallows. -- (NF), NS-BC, US, (CA), Eur, (Afr).

Quite variable and often subdivided in 2 to 5 species. Commonly the name A. Plantago-aquatica will be restricted to the paleocean plants and the neogean ones will then be called A. triviale. The latter may be further restricted to plants with larger leaves and flowers, while A. subcordatum will designate smaller-flowered plants, A. lanceolatum the narrower-leaved plants, and A. gramineum the very narrow-leaved and \pm submerged plants. All characters grade into one another and appear to be neither geographically restricted nor clearly correlated. Much of the variation in leaf width is obviously related to water levels. The degree of branching of the inflorescence and the number of grooves on the back of the achene have also been adduced as diagnostic criteria. The grooving of the back of the achene is perhaps related to maturity. Submature achenes usually show two grooves between three dorsal ridges. Fully mature achenes are more likely to exhibit a single central ridge. The branching will vary with the size of the inflorescence and in more vigorous plants the lower branches may bear 2-(3) verticils of flowers, while in smaller plants all branches will bear a single terminal verticil or umbell of flowers.

The flower colour is not always obvious in herbarium specimens and is rarely anything but white or nearly so. Anthers vary in size but not always the way they are expected to.

As long as we cannot correlate clearly these various diagnostic character, we are inclined to regard Alisma Plantago-aquatica as a single plastic species with four main ecological forms.

Here is our understanding of the variation within this species. Usually it is an annual plant. Seeds deposited on the mud in the fall will germinate under water the following spring and will produce filiform or narrowly ribbon-like leaves. These leaves are more or less evanescent. If the water level remains high, the later leaves will also be ribbon-like, but longer and larger, up to 1 cm wide, and will resemble those of Vallisneria or Sparganium angustifolium. If the water level is slow in receding, the later leaves will likely be lanceolate, but if the water recedes earlier the leaves will grade

to lanceolate then to ovate by flowering time. More vigorous plants will tend to produce ovate to cordate leaves that may be up to 1.0-1.5 dm long, they will also tend to develop a basal corm that will often overwinter and produce rather vigorous plants the following season.

Earlier leaves are more or less evanescent and herbarium specimens showing transitional forms are not common since most plants are collected when they are already flowering or fruiting and the water level has already completely or largely receded.

Our understanding of the variations of this species may be expressed at the rank of form as follows.

1. *F. Plantago-aquatica*. Leaves emerged and narrowly ovate to oval or cordate, (3)-5-12-(15) cm long, (2)-3-8-(12) cm wide.

2. *F. emersum* Boivin. Plants at first submerged, and producing filiform leaves, these evanescent and, as the water level recedes, replaced by \pm lanceolate leaves, (2)-4-6-(8)cm long, (0.5)-1.0-2.0-(3.0) cm wide. Forma nova, in primis submersa, deinde emersa et foliis \pm lanceolatis. Typus: M.-Victorin 20410, Québec, Longueuil, sur les grèves du Saint-Laurent, en face de l'île Plate, 29 sept. 1924 (QFA). Paratypi varii in QFA servantur.

3. *F. vallisneriifolium* Boivin. Plants submerged all summer, producing long and flaccid leaves partly floating at the surface, up to 1 m long, mostly 5-10 mm wide. Forma nova, foliis partim fluitantibus, ad 1 m long., saepius 5-10 mm lat. Typus: Louis-Marie, Québec, Longueuil, 1 sept. 1924 (QFA 1786). Paratypi varii servantur in QFA.

4. *F. filiforme* Boivin. Foliage completely submerged all summer, the inflorescence tending to be partly emersed. Leaves \pm filiform, 1-3 mm wide. Forma nova, omnino submersa vel inflorescentia partim emersa, foliis angustissimis, 1-3 mm lat. Typus: Cinq-Mars & Raymond 615, Québec, co. Iberville, Sabrevois, bords vaseux du Richelieu, 29 août 1953 (QFA). Paratypi inveniuntur in QFA.

2. SAGITTARIA L.

ARROWHEAD

Like Alisma, but with more numerous carpels in a globose head.

- a. Lower flowers subsessile 1. S. rigida
 aa. All flowers on similarly elongated pedicels.
 b. Bracts deltoid to elliptic, shorter than the
 sepals 2. S. latifolia
 bb. Bracts triangular-lanceolate to linear-
 lanceolate and longer than the sepals; achene

beak very short 3. S. cuneata

1. S. rigida Pursh -- Scape \pm arched and rather sharply bent at the base of the inflorescence, the latter erect. Leaves overtopping the inflorescence, mostly lanceolate and usually cuneate at base. Pedicels dimegueth, the flowers of the lowermost verticil being pistillate and subsessile, the other flowers staminate and borne on pedicels 1-3 cm long. Mid summer. Muddy shores and shallow receding waters; Sanford and in the extreme southeast corner. -- Q-sMan, US, (Eur).

2. S. latifolia W. var. latifolia (var. obtusa (Muhl.) Wieg.) -- Wapato, Arrowhead (Wapatou, Flèche d'eau) -- Inflorescence a raceme of verticillate flowers, sometimes compound at the base. Herbage glabrous. Leaf conspicuously sagittate, with the basal lobes about as long as the body of the blade. Nervation as in Alisma, but the main nerves more numerous, some of them recurved and ending in the tip of the lobes. Flowers white, showy, 2-4 cm across. Achene 2.5-3.5 mm long, conspicuously winged, its beak mostly 1.0-1.5 mm long and horizontally deflexed. Mid summer. Marshy places and shallow waters. -- NS-BC, US.

In the southeastern USA, barely entering Ontario, there is a pubescent var. pubescens (Muhl.) J.G. Sm. Otherwise S. latifolia is quite a variable plant, like the first, and many extremes of variation and ecological forms have received names, usually at the varietal level.

3. S. cuneata Raf. -- Wapato -- Similar but tending to be smaller. Petals \pm 2 cm long. Achene only 2.0-2.5 mm long, flattened rather than winged, its beak subapical, erect, 0.1-0.4 mm long. Mid summer. Around sloughs and along creeks. -- (K-Y), L, (NF), NS, NB-BC, US.

Order 76. APONOGETONALES

Flowers borne on one side of a flattened axis or spadix.

132. ZOSTERACEAE (EELGRASS FAMILY)

Flowers much reduced, bearing only one tepal and either one stamen or one carpel.

1. ZOSTERA L. EELGRASS

Monoecious.

1. Z. marina L. -- Eelgrass, Grass-Wrack (Mousse de mer, Herbe à Outardes) -- Quite similar to a narrow-leaved Potamogeton with a very flat stem but without stipules. Lower leaves with a tubular sheathing base. Inflorescences not obvious,

superficially similar to a leaf and about as wide, the leaf-like spathe folded over the spadix. Leaves 3-4 mm wide and mostly over 1 dm long. Early summer. Submerged in sheltered sea-coast shallows just below tide level: Churchill. -- G, K, (Aka), L-NF-(SPM), NS-Q-(nO)-nMan, BC, US, Eur.

The neogean plants are said to differ by their narrower leaves with fewer nerves, but this reported difference did not come out clearly in the material at hand.

Order 77. POTAMOGETONALES

Flowers more or less reduced like the last but subverticillate in a terminal spike, not on a spadix.

- a. Carpel solitary; leaves all basal 133. Lilaeaceae
- aa. Carpels 4; stem leafy.
 - b. Inflorescences terminal; achenes sessile 132. Potamogetonaceae
 - bb. Inflorescences axillary; achenes very long stipitate 134. Ruppiaceae

133. POTAMOGETONACEAE (PONDWEED FAMILY)

Submerged aquatics with spikes of tetramerous flowers. Perianth lacking. No spathe or spadix.

1. POTAMOGETON L. PONDWEED

The only genus. Stipules present, usually elongate, fused together to form a sheath, sometimes also fused with the leaf base to form a sheathing base similar to the leaf-sheath of the Grasses.

The emphasis of our treatment is deliberately on habit and gross morphology; this should be adequate for positive identification of full grown colonies and the bulk of herbarium material. Many diagnostic characters have been derived from the details of the flowers and fruits, from the anatomy of stems and leaves; these will be found in monographs and manuals of aquatic plants; they should provide for the positive identification of sterile shoots, fragments, and even seeds from an animal stomach or winter buds from a muddy bottom.

- a. Leaves minutely serrulate.
 - b. Leaf blade divergent from the summit of its sheathing base 4. P. Robbinsii
 - bb. Leaves diverging right from the node and free from the stipular sheath 5. P. crispus
- aa. Entire.
 - c. Floating leaves absent or similar to the submerged ones.

- d. Leaves narrow, less than 4 mm wide Group A
- dd. Broader Group B
- cc. Leaves dimorphic, the floating ones different from the submerged.
 - e. Submerged leaves reduced to their coarse and elongated petioles 15. P. natans
 - ee. Submerged leaves with distinct limb and often sessile Group B

Group A

Leaves all submersed and narrow.

- a. Leaf with fused stipules forming a sheath and ligule, like a Grass, the blade divergent from near the middle or the summit of the sheath.
 - b. Leaves linear, (3)-5-(8) mm wide 4. P. Robbinsii
 - bb. Leaves filiform and narrower.
 - c. Stigma borne on the side of a short and broadly triangular beak; leaf tips attenuate 3. P. pectinatus
 - cc. Stigma broad and sessile on the top of the achene; leaf tips acute to rounded.
 - d. Leaf and stipules adnate for 2 cm or less, the sheath margins also fused along the ventral side 1. P. filiformis
 - dd. Main leaves and their stipules adnate for 2-5 cm into a broader sheath which is open ventrally 2. P. vaginatus
 - aa. Leaf free from the stipules and diverging from the node.
 - e. Stem very flat and over 1 mm wide, more than half as wide as the leaves 6. P. zosteriformis
 - ee. Stem not so flat or narrower.
 - f. Achene 3-4 mm long; leaves 2-4 mm wide with a conspicuous whitish midnerve 10. P. obtusifolius
 - ff. Achene shorter; leaves narrower (except sometimes P. Friesii).
 - g. Spike 3-5 mm long, on a peduncle less than 1 cm long 7. P. foliosus
 - gg. Spike and peduncle longer.
 - h. Larger leaves 2-3 mm wide, rounded and mucronate at tip 8. P. Friesii
 - hh. Larger leaves not so wide and usually acute 9. P. pusillus

Group B

Leaf blades broad, over 5 mm wide and often dimorphic.

- a. Leaves sessile, cordate or clasping at base, all submerged.

- b. Leaves linear and of uniform width, (3)-5-(8) mm wide 4. P. Robbinsii
- bb. Leaves ovate to narrowly lanceolate, the main ones at least 1 cm wide.
- c. Stipules 2.5 cm long or more, conspicuous and persistent 16. P. praelongus
- cc. Shorter, 2 cm long or less, and evanescent or soon reduced to fibrous shreds.....
- 17. P. perfoliatus
- aa. Leaves rounded or cuneate at base, often petiolate or dimorphic.
- d. Submerged leaves 2 cm wide or more, often petiolate; stipules 3 cm long or more.
- e. Leaves conduplicate-falcate, with 12 or more longitudinal nerves to each half of the limb 13. P. amplifolius
- ee. Leaves straight and flat or crisp-margined; longitudinal nerves fewer (P. illinoensis)
- dd. Leaves narrower and mostly sessile; stipules less than 4 cm long.
- f. Peduncle about twice as thick as the stem; leaves (2)-3-5-(8) cm long 14. P. gramineus
- ff. Peduncle barely, if at all, thicker than the stem; submerged leaves usually longer.
- g. Floating leaves present, 2-3 times wider than the submerged ones, the latter less than 1 cm wide 11. P. epihydrus
- gg. Floating leaves usually lacking, or if present about as wide as the submerged ones, the latter mostly 1.0-1.5 cm wide 12. P. alpinus

1. P. filiformis Pers. (var. borealis (Raf.) St. John, var. Macounii Morong; P. interior Rydb.) -- Of a bushy growth and dark green to blackish, being very branchy with numerous filiform leaves longer than the internodes. Leaves mostly around 1 dm long and usually less than 1 mm wide, acute to obtuse at tip, adnate to the sheath of stipules for less than 2 cm, the latter also fused on the ventral side for at least part of their length when young, forming a tube mostly less than 1 mm wide. Inflorescence \pm moniliform with the lowest cluster remote, the lowest internode being about as long as 1/3 of the inflorescence. Achene 2-3 mm long. Stigma broad and flat, sessile on the summit of the achene. First half of summer. A bottom dweller, usually in shallow waters, quiet to fast flowing, over sandy bottom. -- G-Y-(Aka, L)-NF, NS-(PEI)-NB-BC, US, Eur.

Spikes of american plants average smaller, the internodes tending to be shorter (= var. borealis). But this is only a statistical variant as the range of variation is nearly the same

on both sides of the Atlantic. Another commonly recognized variety is the larger-leaved var. Macounii, an extreme of variation of sporadic occurrence.

2. P. vaginatus Turcz. -- Like the first but the sheaths broader and obvious, the main ones usually 2-5 mm across, the edges free on the ventral side, but the leaf adnate for 3-8 cm. Leaf blades 1-2 mm wide, obtuse or rounded and mucronulate at tip. Inflorescence with more numerous and nearly equidistant clusters. Achenes larger, 3.0-3.5 mm long. Early summer. Usually in cold and quiet water less than 1 m deep. -- seK-Y-(Aka, L)-NF, NS-(PEI), Q-Alta-(BC, US, Eur).

3. P. pectinatus L. -- Sago -- Achene produced into a short conical beak, less than 1 mm long, bearing the stigma on one side. Leaves mostly around 1 mm wide, adnate to the stipular sheath for 1-3 cm, tapered to a long, acute tip. Sheaths less than 1 mm across, tightly enclosing the stem or subtended branch. Inflorescence like P. vaginatus. Achene 3.0-3.5 mm long. Early summer. Quiet, muddy waters. -- (Mack)-Y-(Aka), NF-SPM, NS-BC, US, (CA, SA), Eur, (Afr, Oc).

4. P. Robbinsii Oakes -- Foliage conspicuously pectiniform, the leaves stiff, distichous, divergent at about a 45° angle and closely set. Not very branchy. Leaves dark green, long linear, less than 1 dm long and less than 1 cm wide, adnate to the stipular sheath for less than 1 cm, finely serrulate, but the serrations deciduous. Sheaths overlapping, disintegrating to whitish fibers. Inflorescence usually a lax corymb of spikes. Early fall or perhaps usually sterile. Mostly in quieter and calcareous waters around 1 m deep. -- NS, NB-BC, US.

Rare or perhaps merely overlooked because it is a bottom dweller and commonly sterile. For our area we know of no specimens other than those at DAO. The localities are: Bissett, Wildnest River, Limestone Lake and Glenevis.

5. P. crispus L. -- Usually sterile, but the leaves serrulate and ± oblanceolate. Stems pinkish, strongly contrasting the dark green leaves, the latter crisp-margined, all alike and submerged, with only 3 longitudinal nerves, and free from the stipules. Achene weakly contracted into a beak more than half as long as the body. Shortly before mid summer. Locally naturalized in larger rivers: Saskatoon and The Elbow at Calgary. -- (NS), Q-O, S-BC, US, Eur.

6. P. zosteriformis Fern. (P. compressus AA.; P. zosterifolius AA.) -- Stipules especially obvious, whitish, about as wide as the leaves, although shorter, and free from one another and from the leaves. Stem strongly flattened. Leaves ribbon-like, 1-2 dm long and 2-4 mm wide, obtusish and short-acuminate at tip. Early summer. Clear, quiet water, up to 1½ m deep. -- Mack, (Aka), NS, NB-BC, US.

Quite similar to the paleoagean *P. compressus* L. (or *P. zosterifolius* Schumacher), the two differing in a number of minor ways, of which the more obvious is in the stipules. In the American plant the conspicuous stipules are nearly white and persist most of the summer. In the European plant the stipules are much less colour-obvious and soon they disintegrate.

7. *P. foliosus* Raf. (var. *macellus* Fern.) -- Spike and peduncle shortest. Herbage of this and the next three species quite similar to *P. zosteriformis* but much smaller throughout; stem strongly flattened but less than 0.5 mm wide, etc. Resembles *P. pusillus*, but in the latter the 3-4 upper pairs of leaves are opposite. Leaves usually all alternate except the uppermost pair, acute at tip, without basal glands. Stipules 1 cm long or less, filmy and fragile, but not disintegrating to fibrous shreds. Achene with a narrow and undulate dorsal wing. Early summer. Quiet streams and larger lakes. -- sMack, NS-BC, US, (CA).

The range was extended to Yukon by Roland 1947, repeated by Boivin 1967. But Yukon was not included in the range by Roland 1966 and one may suppose that the 1947 report may have been based on some misidentification or due to a lapsus calami.

8. *P. Friesii* Rupr. -- Like the last but the achenes rounded on back and the larger leaves somewhat more than 2 mm wide. Glands usually present at the base of the leaf. Stipules 1 cm long or less, soon disintegrating to whitish fibrous remnants. Spike 7-15 mm long, on a peduncle 1.5-5.0 cm long. Achene 2-3 mm long. Early summer. Freshwater lakes. -- seK-(Mack), Aka, (L)-NF, NS-PEI-(NB)-Q-O-(Man)-S-Alta-(BC), US.

9. *P. pusillus* L. var. *pusillus* (var. *minor* (Biv.) Fern. & Schub., var. *mucronatus* (Fischer) Graebner; *P. Berchtoldii* Fieber, var. *polyphyllus* (Morong) Fern.) -- A middling type in relation to the next and the last three. Leaves less than 1 dm long, 2 mm wide or less, acute to obtuse or mucronulate at tip, with a pair of prominent, and somewhat translucent basal glands, these sometimes obscure. Stipules 0.5-1.5 cm long, filmy, often evanescent, but not disintegrating to shreds. Achene not ridged on back. Early summer. Sloughs and slow moving waters. -- G, sMack-(Y)-Aka, L-(NF), NS-BC, US, (CA), Eur, (Afr) -- Var. *pseudorutilus* Benn. (var. *rutiloides* (Fern.) Boivin; *P. strictifolius* Benn.) -- Stipules with stronger nerves, soon disintegrating to fibrous shreds. Basal foliar glands usually lacking. -- seK-(Mack-Y), Q-O-(Man)-S-(Alta), US.

According to R.R. Haynes in *Rhodora* 76: 598-9. 1974 var. *pseudorutilus* has priority at varietal rank, hence the nomenclature adopted above. Both of our varieties are largely sympatric, but var. *pseudorutilus* seems less widely distributed.

10. *P. obtusifolius* Mertens & Koch -- Like the last with

larger leaves and a more conspicuous midrib, whitish and about 0.5 mm wide towards the base. Leaves less than 1 dm long, rounded and mucronulate at tip, with a pair of bulging, marginal and translucent glands at base. Stipules rather conspicuous, 1-2 cm long, at least half as wide as the leaves, whitish and filmy, not disintegrating to fibers. First half of summer. Small ponds and quiet waters. -- (NF), NS, (NB)-Q-BC, US, Eur.

Our only known Manitoba (TRT) collection was originally reported as P. Friesii by Baldwin 1953 and Scoggan 1957.

11. P. epiphydrus Raf. (var. Nuttallii (C. & S.) Fern.) -- Stem and petioles strongly flattened, about 4 times wider than thick. Leaves dimorphic, the submerged ones ribbon-like, distichous, 1-2 dm long and 5-10 mm wide. Achene with a narrow dorsal wing and concave sides. Mid summer. Mostly in lakes, rare: Lily Pond and other lakes in the southeast corner, then at The Pas and Denare Beach. -- Aka, L-SPM, NS-S, BC, US, (Eur).

12. P. alpinus Balbis var. subellipticus (Fern.) Ogden -- (var. tenuifolius (Raf.) Ogden) -- The whole plant tinged reddish-brown, growing in acid waters which are often also tinged red. Stem almost invariably simple. Leaves narrowly lanceolate, the upper gradually longer and commonly around 1 dm long, about twice as long as the lower. Upper leaves \pm rounded at tip. Floating leaves usually lacking, if present shorter than the submerged leaves, \pm oblanceolate, tapered to a petiole which is usually less than half as long as the blade. Body of the achene 3.0-3.5 mm long. Mid summer. Frequent in boggy creeks. -- G, K-Mack-(Y)-Aka, L-NF, NS-BC, US.

The typical phase is European and differs in a weak sort of a way by its smaller fruits and longer leaves. Body of the achene 2-3 mm long. Upper submerged leaves usually 1.2-1.5 dm long.

12X. P. alpinus X gramineus -- Has been reported from Churchill. -- (O-nMan).

13. P. amplifolius Tuck. -- Submerged leaves largest, conduplicate-falcate and petiolate, the upper 1-2 dm long, 3-5 cm wide, broadly lanceolate. Floating leaves often present, with a much longer petiole and rather like those of P. natans except for the finer and more numerous nerves. Stipules 5-12 cm long. Mid summer. Deeper lake waters at Bisset, Limestone Narrows, and possibly elsewhere. -- NF, NS, NB-eMan, BC, US.

The basis for the Saskatchewan reports by Breitung 1959 and Russell 1944, 1954 was a collection by O.C. Furness from Waskesiu Lake (SASK). It has been revised to P. natans.

13X. P. methyensis Ar. Benn. -- Hybrid of the following, possibly with the preceding. Submerged leaves sessile, the upper about 2 dm long and 2 cm wide, flat and with 7-9 nerves,

the lower leaves gradually smaller down to about half. Stipules 3-6 cm long. Methye Portage. -- NS, S.

This unusual collection (CAN) looks like a hybrid of dubious parentage. P. gramineus could be one of the parents, but the other is less obvious. It might be P. amplifolius or P. illinoensis if either were known from the area around Methye Portage.

14. P. gramineus L. (var. graminifolius Fries; P. heterophyllus AA.) -- Leaves strongly dimorphic, the submerged ones light green, less than 1 cm wide and mostly around 5 cm long, the floating ones at least twice as broad. Stem rather thin, strongly contrasting the thick and short peduncle. Usually strongly branching, and often very much so, the leaves then dimegueth, the rameal ones being only half as long as the stem leaves. Mid summer. Stagnant waters. -- (G), K-Aka, L-SPM, NS-(PEI)-NB-BC, US, Eur.

P. illinoensis Morong (P. angustifolius AA.; P. lucens AA.) -- Rather similar to P. amplifolius but the leaves not quite so large, narrowly lanceolate, flat and with fewer nerves. Submerged leaves all sessile or the upper on a petiole usually under 2 cm long. Peduncle thickened and often very long. Late summer and early fall. Still waters, 2-3 m deep. -- sMack, (NS), Q-0, (BC), US, (CA).

This species was originally included in our text because of earlier Manitoba reports later discounted by Cody and Porsild in the Blue Jay 25: 28-29. 1967. An entry by Moss 1959 was merely speculative. While this species is not definitely known to occur in our area, its known distribution surrounds us in such a way that it appears likely to turn up in the eastern or northern parts. On a speculation we have retained it in the key and in the text, although unnumbered.

15. P. natans L. -- (Epi d'eau, Herbe à la Perchaude) -- Submerged leaves reduced to their petiole (0.5)-1.0-(2.5) dm long, the floating ones elliptic. Stem typically simple. Petioles longest, longer than the blades, becoming thinner, paler and a bit crooked in the last few millimeters near the junction with the blade. Stipules 4-10 cm long, pale and conspicuous. Leaves all or mostly subcordate at base. Summer. Quiet waters of muddy-bottomed lakes, up to 3 m deep. -- (G), sw-Mack, Aka, NF, NS-BC, US, (SA), Eur, (Afr, Oc).

16. P. praelongus Wulfen -- Leaves all submerged, the longer ones at least 1 dm long and shallowly cordate-clasping at base. Stem very light green to whitish, usually simple or nearly so. Leaves up to 2 dm long, lanceolate or narrower, crisp, rounded at tip. Peduncle usually 1-3 dm long. Early summer. Deeper (up to 5 m) lake waters. -- (G, swK)-Mack, (Aka, L-NF), NS-BC, US, (CA), Eur.

17. *P. perfoliatus* L. var. *Richardsonii* Benn. (*P. Richardsonii* (Benn.) Rydb.) -- Like the last with the leaves smaller, not over 1 dm long and deeply cordate clasping. Stem often branchy above and bearing many inflorescences. Stipules soon disintegrating into a group of whitish fibers. Leaves distichous, \pm lanceolate and crisp-margined. Early summer. Common and ubiquitous submerged aquatic. -- Mack-Aka, L, NS, NB-BC, US.

In our variety the leaves are more elongate, commonly 5-10 cm long, \pm lanceolate, broadest at the clasping base, gradually tapered to the acute tip, crisp-margined; stipules soon turning whitish and disintegrating to fibrous remnants. Grades imperceptibly into, and only arbitrarily separable from, the more eastern and Old World var. *perfoliatus* (including var. *bupleuroides* (Fern.) Farw.) with suborbicular to elliptic leaves 2-5 cm long, usually obtuse or rounded at tip, little if at all crisp-margined; stipules filmy and evanescent.

134. LILAEACEAE

(LILAEA FAMILY)

Flower reduced to a single stamen and/or ovary. Fruit a single achene which arises from an ovary possibly unicarpellate or perhaps compound of 3 carpels.

1. LILAEA Humb. & Bonpl.

Some of the flowers subtended by a small appendage which is either a bract or a lone sepal. Flowers partly unisexual. Pistillate flowers of two kinds, those from the lower part of the spikes have sessile stigma, those from among the leaf bases have filiform styles longer than the leaf sheaths.

1. *L. scilloides* (Poiret) Haum. -- Inconspicuous and soft, pale green, tufted herb. up to 3 dm high. Leaf with a whitish sheath 2-5 cm long. Flowers mostly in greenish spikes borne on scapes about half as high as the leaves. Fruits from the basal flowers 3-pronged at summit. Summer. Mud of drying arroyos and shores; rare or overlooked. -- sS-sAlta-BC, wUS, (CA, SA).

We have seen Canadian specimens from Bélanger (DAO), Spring Valley (DAO), Trossachs (DAO, MT), Cypress Hills in Alberta (DAO), Manyberries (DAO, GH), Alberni (CAN, GH, UBC, V) and Pitt River (GH, UBC, V).

The relationships of this monotypic family are in much doubt. In a recent paper K. Larsen, Bot. Not. 119: 496-7. 1966, has given a plausible argument for placing it near *Triglochin*.

135. RUPPIACEAE

(DITCH - GRASS FAMILY)

Perianth lacking. Carpels many, becoming very long stipitate at maturity.

1. RUPPIA L.

DITCH - GRASS

Inflorescence a spike reduced to 2 flowers on a filiform rachis which elongates greatly. Flower of 2 stamens and of 4 or more carpels.

- a. Leaves 1-2 dm long; sheaths 1.5-4.0 cm long
 2. R. occidentalis
 aa. Leaves and sheaths shorter 1. R. maritima

1. R. maritima L. -- Ditch-Grass, Widgeon-Grass (Persil d'eau, Rupelle) -- Carpel on a filiform stipe which elongates to 0.5-2.0 cm at maturity. Habitally similar to Potamogeton pusillus, with filiform leaves and stipular sheaths, but the leaf adnate to the sheath and the reduced inflorescences axillary. Peduncle of the inflorescence 1-5 cm long, rarely longer, little if at all coiled. Achene ovoid, about 2 mm long. Early summer. Alkaline slough at Mortlach and possibly also elsewhere. -- L-SPM, NS-0, S, wBC, US, (CA), Eur.

For our area we have been able to check the Mortlach (DAO) collection, but the Lestock (DAO) specimen reported by Russell 1937, 1944 and Breitung 1957 has been revised to R. occidentalis.

2. R. occidentalis Watson -- The filiform peduncle of the inflorescence well over 1 dm long and soon becoming spirally coiled, the numerous coils about 1 cm in diam. Stipe of the fruit 1-6 cm long. Early to mid summer. Alkaline sloughs, in shallow to deeper (2 m) water. -- Aka, sMan-S-(Alta-BC), US.

"

Order 78. NAIADALES

Perianth lacking, each flower subtended a sheath-like bract. Stamen solitary and the inconspicuous flower otherwise reduced to its bare essentials.

- a. Carpels many; leaves not broader at the base
 135. Zannichelliaceae
 aa. Carpel solitary; leaves with a broadened base
 136. Najadaceae

136. ZANNICHELLIACEAE (ZANNICHELLIA FAMILY)

Leaves opposite. Carpels usually 4.

1. ZANNICHELLIA L.

HORNED PONDWEED

Perennial with axillary flowers.

1. Z. palustris L. -- Horned Pondweed (Alguette, Chenille) -- Resembling Potamogeton pusillus with opposite leaves and

axillary flowers. Leaves filiform, less than 1 dm long. Achenes usually 4, oblanceolate; somewhat falcate. Early to mid summer. Quiet alkaline waters. -- seK, Aka, (NF), NS-BC, (US, SA), Eur, (Afr.).

"

137. NAIADACEAE (NAIAD FAMILY)

Very much reduced type: each flower reduced to either a single stamen or a single carpel containing a single ovule.

"

1. NAIAS L. NAIAD

Base of the flower enclosed in a tubular sheath.

1. N. flexilis (W.) Rostk. & Schmidt -- Submerged aquatic with opposite leaves, ribbon-like, but dilated at base into a broadly ovate blade. Annual, mostly around 1 dm long. Leaves 1 mm wide or less, finely serrulate. Fruit axillary, ellipsoid, with a filiform beak about half as long. Early summer. Rare or overlooked in freshwater lakes; a bottom dweller. -- NF, NS, NB-BC, US, Eur.

Rarely collected in Manitoba and Saskatchewan, and the few collections are very widely scattered. It could be a rare plant, but it is an inconspicuous bottom dweller and we speculate that it has been largely overlooked. First reported from our area by Macoun 1888 on the basis of a Fort Pitt (CAN) collection that we have checked in 1962. A second report in Can. Field-Nat. 45: 100. 1931 proved to be a typical hip-pocket specimen of some sterile herb from Hill Island Lake (CAN). It has been revised to Stellaria calycantha but the leaves are verticillate and Galium might be a better guess. A second collection is our own (DAO) in 1955 some 30 miles north of Candle Lake. These records were overlooked by Russell 1937, 1944, 1954 and Breitung 1957, but acknowledged by Boivin 1967. A more recent report by Argus 1968 from Big Sandy Lake has not been checked. From Manitoba we have seen only the two collections (DAO) reported by Scoggan 1957.

ARTIFICIAL KEY

This artificial key to the Monopsids is supplementary to the more or less natural keys that will be found at the beginning of the Folliculids (page 4) and of the Achenidae (page 169).

- a. Very small plants, free floating in water and not rooted, normally sterile 128. Lemnaceae, p. 162
- aa. Plants anchored by a root system.
 - b. Leaves opposite or verticillate Group A
 - bb. Alternate or all basal, rarely lacking.

- c. Flowers with normal perianth present.
 - d. Ovary superior (or semi-inferior in Zygadenus) Group B
 - dd. Inferior Group C
- cc. Perianth absent or reduced to a single petal or to some very small bracts or mere bristles or setae.
 - e. Nearly all terrestrial plants, the perianth lacking or insignificant and replaced by scaly bracts or the whole inflorescence subtended by a large perianth-like bract Group D
 - ee. Both perianth and bracts much reduced or lacking; nearly all submerged aquatics...Group E

Group A

Leaves opposite or verticillate.

- a. Terrestrial with only 2 (opposite) or 3 (verticillate) large leaves.
 - b. With only 1 flower or the flowers few and umbellate 119. Liliaceae, p. 7
 - bb. With a terminal raceme 123. Orchidaceae, p. 25
- aa. Submerged aquatics with numerous small leaves.
 - c. Leaves 3-10 cm long; carpels and achenes 2-4 136. Zannichelliaceae, p. 181
- cc. Shorter leaves; fruit a single carpel or a compound ovary.
 - d. Perianth lacking; fruit a single carpel; leaves much enlarged at base. 137. Naiadaceae, p. 182
 - dd. Normally sterile and the leaves of uniform width 115. Hydrocharitaceae, p. 5

Group B

Herbs with normal and obvious flowers and a superior compound ovary.

- a. Perianth small and chaffy 124. Juncaceae, p. 40
- aa. Perianth large or at least with one of the verticils petaloid.
 - b. Carpels free or nearly so.
 - c. Carpels numerous, maturing into so many achenes 131. Alismataceae, p. 169
 - cc. Only 3-6 carpels.
 - d. Flowers in an umbel 114. Butomaceae, p. 4
 - dd. In a raceme.
 - e. Raceme bracted. 116. Scheuchzeriaceae, p. 6
 - ee. Bractless 118. Juncaginaceae, p. 7

- bb. Carpels fused into a compound ovary.
 f. Sepals green; petals blue. 117. Commelinaceae, p. 6
 ff. Sepals similar to the petals and more
 or less of the same color.
 g. Leaves long, stiff and sharp-pointed,
 like so many bayonets ... 121. Agavaceae, p. 24
 gg. Leaves mostly smaller and not
 spinescent 119. Liliaceae, p. 7

Group C

Like Group A, but the ovary inferior.

- a. Deeply submerged aquatic with long, flaccid
 ribbon-like leaves 115. Hydrocharitaceae, p. 5
 aa. Terrestrial with firm leaves.
 b. Flowers strongly zygomorphic .. 123. Orchidaceae, p. 25
 bb. Flowers regular.
 c. Stamens 3; herbage glabrous.. 120. Iridaceae, p. 22
 cc. Stamens 6; herbage villous
 122. Hypoxidaceae, p. 24

Group D

Flowers in dense spikes and closely wrapped or covered by one or more bracts or the whole spike when young partly wrapped into a \pm enclosing bract (= spathe); nearly all terrestrial plants; fruit variable, but mostly of 2 or more fused carpels.

- a. Individual flowers subtended by scally bracts.
 b. Stem solid, mostly triangular .. 125. Cyperaceae, p. 55
 bb. Hollow and cylindrical; each floret subtended by
 a pair of opposite bracts 126. Gramineae, p. 158
 aa. Inflorescence very compact, subtended and often
 more or less surrounded by a bract.
 c. Inflorescence of 2 or more globular heads
 129. Sparganiaceae, p. 164
 cc. Flowers in a single spike.
 d. Bract showy and persistent all summer
 127. Araceae, p. 161
 dd. Deciduous at anthesis 130. Typhaceae, p. 168

Group E

Perianth and bracts lacking or reduced to 4 minute sepals or a single petal. Fruit is usually a single achene, or else a group of not more than 6 achenes.

- a. Leaves all basal 134. Lilaeaceae, p. 180
 aa. Stem leafy.

- b. Inflorescence an emerged spike
 133. Potamogetonaceae, p. 173
- bb. Inflorescence not a spike, often submerged.
- c. Carpels 4, maturing into an umbel-
 liform group of achenes 135. Ruppiaceae, p. 180
- cc. Pistillate flower reduced to a
 single carpel which remains
 enclosed in the leaf sheath;
 leaves larger 132. Zosteraceae, p. 172

ADDENDA AND CORRIGENDA

Pages 3 and 4 -- The pagination in the key refers to the manuscript. The printed equivalents are as follows.

Achenidae 169	Juncales 797 = 40
Cyperales 808 = 55	Liliales 763 = 7
Graminales 879 = 158	Agavales 782 = 24
Arales 976 = 161	Page 4:
Typhales 980 = 163	Orchidales 783 = 25
Butomales 758 = 4	Iridales 780 = 22
Juncaginales 762 = 6	Haemodorales 783 = 24
Scheuchzeriales 761 = 6	Butomaceae 758 = 4
Commelinales 761 = 6	Hydrocharitaceae 759 = 5

Page 11, line 10 from the bottom -- For "1-2 mm" read "1-2 dm".

Pages 41 and 45 -- Juncus effusus L. is to be added as follows: On page 41, lines 4 and 5 from the bottom should be amended to read as follows:

- cc. Inflorescence borne in the upper quarter.
- d. Tepals (1.5)-2.0-3.0-(4.0) mm high 7a. J. effusus
- dd. Perianth larger, the tepals 4.0-6.0 mm
 high 8. J. arcticus

And on page 45 the following description should be added.

7a. J. EFFUSUS L. -- Soft Rush, Bog-Ruch (Jonc à mèches, Têtes de femme) -- Similar to the next, but coarser and forming dense tussocks, yet the flowers smaller. Stems (6)-8-10-(12) dm high, mostly 2-3 mm thick, stiffly erect, often more than 100 to a clump, clothed at base with brown and bladeless sheaths. Inflorescence compact to very lax, (1)-3-5-(10) dm long. Tepals mainly green, but the margin hyaline and usually with a submarginal line in reddish brown. Capsule small, 2 mm high, brown, usually overtopped by the perianth. First half of summer. Very wet places, mostly at the edge of ponds and streams; rare: Yellowhead Pass. -- (Aka), NF-(SPM), NS-O, swAlta-BC, US, (SA), Eur, (Afr, Oc).

The only known collection (DAO) was made in 1971 along an old road. Said roads runs on top of an abandoned railway grade built in the last century. We speculate that the clump of Juncus effusus was inadvertently introduced long ago with earth fill during the construction of the railway embankment.

Page 43 -- JUNCUS COMPRESSUS Jacq. -- Also at Mink River, Man. (Herb. Krivda) and North Pine River (Herb. Krivda), both collected by M.E. Tyler and presumably duplicated in the Brandon University herbarium.

Page 77 -- Carex sitchensis Prescott is to be inserted as follows in the key.

- c. Scales exerted, being longer than the perigynia.
 - z. Lowermost spikelet (5)-8-(12) cm long and drooping on very long pedicels 108a. C. sitchensis
 - zz. Lowermost spikelet ascending to erect and usually shorter.
 - d. Perigynia ...

Page 84 -- The key to group J is faulty, it should read as follows.

- a. Terminal spike gynandrous 88. C. misandra
- aa. Staminate or androgynous.
 - b. Spikelets red brown, mostly over 1 cm long 87. C. petricosa
 - bb. Spikelets black, mostly 1 cm long or shorter 89. C. atrofusca

Page 146 -- Insert the following paragraph between C. aperta and C. aquatilis.

108a. C. sitchensis Prescott -- Very tall and coarse, its thin and drooping spikelets longest. Usually 1.0-1.5 m high and its deep brown base 1 cm thick or more. Coarsely and deeply stoloniferous. Main leaves (2)-4-6-(8) mm wide, its sheath more or less tinged in red on the ventral side. Inflorescence 2-3 dm long, overtopped by the lowest bract. Spikelets 5-8, of which the upper 2 or 3 are usually staminate, the lowermost strikingly thin and long, becoming moniliform towards the base. Scales broadly lanceolate, somewhat narrower and about half longer than the perigynia, the latter much as in C. aquatilis for size, shape, lack of ventral or dorsal nerves and the mere suggestion of a stipe, about 0.1 mm long. First half of summer. Marshy flats along creeks and around lakes. Cavell Lake. -- sAka, wcAlta-BC, wUS.

Page 142, line 26 -- For "narrowly lanceolate", read "broadly lanceolate".

Page 145 -- The following hybrid was recently detected among specimens formerly filed (DAO) with C. halophila.

103X. C. ungavensis Lep. -- Hybrid of C. Bigelowii X C. salina. About 3 dm, rather coarse and generally similar to C. Bigelowii, but the spikelets longer and the achene sometimes notched. Plant base not deeply rooted and deep red brown at base. Bracts much overtopping the inflorescence. Staminate spikelet mostly 2-3 cm, the pistillate ones mostly 3-4 cm long. Scales blackish with a thin paler midnerve. Churchill. -- (G, L), Q-nMan.

Page 145 -- Carex lenticularis Mx. has been confirmed (DAO) for northeastern Alberta. At GH all BC specimens were revised to C. Kelloggii. We are now inclined to think that the western limit of C. lenticularis is roughly coincident with that of the precambrian outcrops.

Page 146 -- Carex nebraskensis Dewey -- A collection from Morley, Alberta cited as C. Jamesii by Macoun 1888 has been located at GH; the inflation of some of the perigynia was obviously caused by a parasite and the specimen has been revised to C. aquatilis Wahl.

Pages 148-9 -- Carex salina Wahl. -- Both varieties described appear to belong in our area. Some Churchill (DAO) collections have been checked as var. salina, others as var. subspathacea. A Drummond collection (GH) of var. salina probably comes from York Factory. This last collection is labelled "Cumberland House's and Hudson's Bay", but no doubt came from the Hudson Bay coast and presumably from York Factory. Var. salina is also represented from Churchill in the Krivda herbarium.

Some intermediates between C. aquatilis and C. salina occur in our area and elsewhere and some of these could be of hybrid origin. They may be filed as X C. halophila Nyl. and will comprise on the one hand larger plants with most of the characters of C. salina, but with grooved achenes, on the other hand smaller plants with the appearance of C. salina, but the achenes lacking a groove.

The distinction of C. aquatilis vs. C. salina var. salina is usually simple enough because of difference in habitat and because C. aquatilis is often taller (salina: 2-4-(6) dm), its leaves often wider (salina: 1-3 mm), its inflorescence usually longer (salina: 6-15 cm, excluding the bracts), its spikelets commonly longer (salina: 1-2-(3) cm), its scales light brown to

purple-black (salina: deep brown to blackish). But smallish specimens of C. aquatilis do not stand out clearly from the run-of-the-mill C. salina var. salina. Positive identification of C. salina requires liberating a mature seed (not always easy and not always mature) to check for the presence of a groove or notch. On occasion the groove may be shallow and some inflorescences may carry a mixture of grooved and ungrooved achenes.

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SOME NOVELTIES FROM SABAH

Harold N. Moldenke

PREMNA OBLONGIFOLIA var. ANGUSTATA Mold., var. nov.

Haec varietas a forma typica speciei laminis foliorum minoribus angustioribus suboblongis 3—7.5 cm. longis 1.5—2.5 cm. latis recedit.

This variety differs from the typical form of the species in having its leaf-blades smaller, more regularly oblong or suboblong, mostly only 3—7.5 cm. long and 1.5—2.5 cm. wide.

The type of the variety was collected by H. Sinanggul (SAN.57292) in the Bukit Silam Research Forest, Lahad Datu District, Sabah, Malaysia, at about 1000 feet altitude, on October 17, 1966, and is deposited in the herbarium of the Forest Department at Sandakan, Sabah.

TEIJSMANNIODENDRON SIMPLICIFOLIUM var. CORDIFOLIUM Mold., var. nov.

Haec varietas a forma typica speciei foliorum laminis basaliter cordatis recedit.

This variety differs from the typical form of the species in having the base of the leaf-blades decidedly cordate.

The type of the variety was collected by A. Gibot along the Simpang trail, Ranau District, Sabah, Malaysia, on September 18, 1967, and is no. 60725 in the herbarium of the Forest Department at Sandakan, Sabah. The collector notes that the type tree was 50 feet tall, the trunk with a girth of 37 inches.

TEIJSMANNIODENDRON SUBSPICATUM var. PARVIFOLIUM Mold., var. nov.

Haec varietas a forma typica speciei foliorum laminis parvioribus 5—9 cm. longis 2.3—4.5 cm. latis recedit.

This variety differs from the typical form of the species in its smaller leaves, the blades of which are when mature only 5—9 cm. long and 2.3—4.5 cm. wide.

The type of the variety was collected by W. Meijer (SAN.39328) on the ultrabasic soil of Ulu Karamuak, at an altitude of 2000 feet, Tavail Plateau, Sandakan District, Sabah, Malaysia, on August 3, 1963, and is deposited in the herbarium of the Forest Department at Sandakan, Sabah.

VITEX SECUNDIFLORA var. LONGIPES Mold., var. nov.

Haec varietas a forma typica speciei petiolulis usque ad 15 mm. longis recedit. This variety differs from the typical form of the species in its petiolules on the larger leaflets 10—15 mm. long and all the leaflets being plainly petiolulate.

The type of the variety was collected by F. R. Muin Chai (SAN.26696) at Mile 8, Section R.3, on the Kennedy Bay main road to Takun, 350 ft. alt., Lahad Datu Dist., Sabah, Nov. 5, 1961, deposited at Sandakan, Sabah.

A BIBLIOGRAPHY CONCERNING FOSSIL PLANTS OF EGYPT

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This bibliography includes about 300 entries. Over 200 of them are published outside Egypt. Many also are old belonging to the last century and are not available in Egyptian libraries. Moreover works concerned with fossil plants are not always published in botanical journals but many appear in other specialized journals especially those dealing with geological subjects. The aim of this paper is therefore to cite publications concerned with Egyptian fossil plants, which I have already compiled during the past few years, and have them all in one easily accessible place in literature. The titles of these publications are, by themselves, to some extent informative concerning the corresponding subjects considered. However, it is intended in a forthcoming paper to give abstracts of all these publications together with illustrations of all fossil plants described in them.

The fossil plants mentioned and described in the publications included in this bibliography belong to the various divisions of the plant kingdom. However, the main attraction (expressed in the number of publications which is over 35) to workers was the petrified forests and fossil wood which occur in various places in Egyptian deserts.

Publications concerned with plants used or utilized by ancient Egyptians are not included in the present bibliography. They fall in fact under Palaeoethnobotany rather than under Palaeobotany. Those who are interested in these plants may refer to the four volumes on the 'Flora of Egypt', published by Thäckholm (1941-1956), which include reference to a large number of publications dealing with these plants.

Many of the publications cited here were obtained from Krüsel's (1924) paper, from the bibliographies published by El-Keldani (1941), Avnimelech (1965, 1969), Tralau (1974), and also from the 'World Report on Palaeobotany I-IX' edited by Boureau (1956-1973). All these works are included in the bibliography below.

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ADDITIONAL NOTES ON THE GENUS PETREA. IX

Harold N. Moldenke

PETREA Houst.

Additional bibliography: Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 605. 1927; Babu, Herb. Fl. Dehra Dun 20. 1977; Croat, Fl. Barro Colorado 46, 732, 735, 873, 874, 876, & 913. 1978; Mold., Phytologia 42: 292—318, 470—500, & 509. 1979.

PETREA ARBOREA H.B.K.

Additional bibliography: Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 605. 1927; Mold., Phytologia 42: 300—304, 315, 475, 481, 486, 490, & 492. 1979.

Knuth (1927) cites from Venezuela the following collections: Carabobo: Humboldt & Bonpland s.n.; Pittier 8774. Federal District: Jahn 343; Moritz 191; Otto 570; Pittier 7853; Wagener 293. Miranda: Pittier 6063. He states that the Pittier 8774 was taken from cultivated material. He lists the vernacular names, "Maria", "Santa Lucia", and "tostadito".

PETREA ASPERA Turcz.

Additional bibliography: Croat, Fl. Barro Colorado 46, 732, [734], 735, 873, 874, & 876, fig. 479. 1978; Mold., Phytologia 42: 300, 304—307, 310, 313, 315, 317, 473, 475, & 493. 1979.

Additional illustrations: Croat, Fl. Barro Colorado [734], fig. 479. 1978.

Croat (1978) says that on Barro Colorado island this species is "Abundant in the canopy and at the edge of the forest over the lake; one plant grows as an epiphyte from a large ant nest..... Flowering and fruiting throughout the year, often in synchronous waves throughout the forest". He gives its general distribution as "Widespread in tropical America from northern Mexico to southern Brazil; Cuba, West Indies; widely cultivated. In Panama, known from tropical moist forest in the Canal Zone, San Blas, Veraguas, Los Santos, Panamá, and Darién." Actually this distribution is erroneous — the species is not known from north of El Salvador [and even this record is doubtful!], not at all from Cuba or the West Indies, nor south of Mato Grosso, Brazil. He cites Croat 9432, as well as Avilas 14 and Shattuck 412 which I have previously (and apparently erroneously) reported as P. volubilis L.

Emended citations: PANAMA: Barro Colorado Island: Avilas 14 (Cz); Shattuck 412 (Cz).

PETREA BREVICALYX Ducke

Additional bibliography: J. A. Clark, Card-Ind. Gen. Sp. Var. Pl. issue s.n. 1933; Mold., Phytologia 42: 311. 1979.

PETREA GLANDULOSA Pittier

Additional bibliography: Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 605. 1927; Mold., Phytologia 42: 312—313 & 475. 1979.

Knuth (1927) reports the vernacular name, "penitente", for this species in Venezuela.

PETREA VOLUBILIS L.

Additional bibliography: Babu, Herb. Fl. Dehra Dun 20. 1977; Croat, Fl. Barro Colorado 735 & 913. 1978; Mold., Phytologia 42: 473, 476, 477, & 480—494. 1979.

Croat (1978) has examined the Avilas 14 and Shattuck 412, previously cited by me in this series of notes as P. volubilis, and reports that they definitely are P. aspera Turcz. Petrea volubilis is, therefore, unknown to date from Barro Colorado island. Babu (1977), however, reports it "a common ornamental climber in gardens and parks" in Dehra Dun, India.

PETREA VOLUBILIS f. **ALBIFLORA** (Standl.) Standl.

Additional bibliography: Mold., Phytologia 7: 450. 1961; H. F. MacMillan, Trop. Plant. & Gard., ed. 5, 122. 1962; Esteva, Arb. Ornament. Trop. 355. 1969; Lowden, Taxon 19: 845. 1970; Mold. in Menninger, Flow. Vines 338, pl. 191. 1970; Mold., Fifth Summ. 1: 82 & 367 (1971) and 2: 597, 898, & 968. 1971; Mold., Phytologia 23: 426. 1972; Rouleau, Taxon Index Vols. 1-20 part 1: 280. 1972; Mold., Phytologia 25: 242 (1973) and 42: 316, 492, & 494. 1979.

Illustrations: Mold. in Menninger, Flow. Vines pl. 191 (in color). 1970.

Chittenden (1956) lists this plant as cultivated in England, saying "fl. white". Esteva (1969) reports it both cultivated and escaped in Venezuela. Miller (1935) found it in Barbados gardens, noting that it "differs from the purple petrea only in that its leaves are pale green, it is more easily grown as a shrub, and its flowers are white and last only about 4—7 days" — it is possible that his plant may have been P. kohautiana f. alba (Freeman & Williams) Mold., as is probably also the case with the "P. volubilis white flowered" of MacMillan (1962).

The Ruiz-Terán & López-Palacios 10870, distributed as P. volubilis f. albiflora, actually is P. kohautiana f. alba (Freeman & Williams) Mold.

Additional citations: CULTIVATED: Pennsylvania: J. W. Peterson J.890 (Ba).

PETREA VOLUBILIS var. **PUBESCENS** Mold.

Additional synonymy: Petrea mexicana Humb. & Bonpl. apud Steud., Nom. Bot., ed. 1, 606. 1821 [not P. mexicana Willd., 1841]. Petrea arborea var. pubescens Mold., Phytologia 42: 492—493, nom. nud. 1979.

Additional bibliography: Langman, Select. Guide Lit. Flow. Pl. Mex. 515. 1963; Mold., Résumé Suppl. 15: 3 (1967) and 17: 7. 1968;

Mold., Fifth Summ. 1: 72, 80, 83, 85, 88, 91, 101, & 367 (1971) and 2: 595, 598, & 898. 1971; A. L. Mold., *Phytologia* 23: 319. 1972; Mold. in Woodson, Schery, & al., *Ann. Mo. Bot. Gard.* 60: 82, 87, & 147. 1973; Mold., *Phytologia* 28: 450 (1974), 31: 378 (1975), 34: 263 (1976), 36: 45 (1977), and 42: 304 & 492--493. 1979.

This variety differs from the typical form of the species in having the leaf-blades conspicuously and more or less densely pubescent on both surfaces when young or only beneath when mature.

Recent collectors describe this plant as a twining or shrubby vine, 10--30 feet long, or even as a small tree, the "flowers papery", and the "bracts" lavender or lilac [obviously referring to the calyx and fruiting-calyx]. The corollas are described as "blue" on Breedlove 9926, Laughlin 178, Rzedowski 7346, and Ventura A. 3218, "purple" on Chiang 343, Moore 2536, and Surapat 43, and "dark but brilliant ultramarine" on Gregory 589.

Recent collectors have found this plant growing on wooded slopes, in and around thickets, in high trees at river edges, in open dry woodland, on slopes with Quercus, in dry woodland with limestone outcrops, on the sides of barrancas, on dry rocky hills, in matorral on flat ground, in sandy rocky "pardo" soil in Manilkara woods, and in full sun on limestone soil, at altitudes of 400--2000 m., flowering from January to May and in September, in fruit in March. Rzedowski encountered it on "ladera caliza con vegetación de bosque tropical deciduo, planta trepadora". Worthington found it growing in an area of 78-inch rainfall and notes that his no. 6967 was used in an experiment to preserve the natural color of the inflorescence by drying it "immediately in cotton wool", but the color was gone in a month and the experiment judged "a failure". Read reports that in Florida it "blooms several times per year, [the] deep purple corolla early falling, leaving the lighter blue calyx persistent with the developing fruit".

Vernacular names reported for the variety are "chorreque", "cuera de zapo", "flor de Jesús", "manto de Jesús", and "raspa-guacal".

The Jerabek s.n. [June 1945], cited below, is a mixture with Vitex agnus-castus L., while Linden 18 is a mixture with Quercus xalapensis Humb. & Bonpl.

Material of this variety has often been identified as typical P. volubilis L., as "P. volubilis Jacq.", and as P. arborea H.B.K. On the other hand, the Moldenke & Jayasuriya 28131 seems better regarded as typical P. volubilis; Mahdi s.n. [4/6/1967] and s.n. [24/4/1965] have subglabrous leaves.

Additional & emended citations: MEXICO: Chiapas: Breedlove 9016 (Ml), 9925 (Ac); Laughlin 178 (Ld); H. E. Moore 2536 (Ba); D. C. Saunders 43 (Ld); Souviron & Erlanson 68 (W--1586243). Guerrero: Crisman & Willis 200 (Au--247326). Oaxaca: Seler & Seler 1777 (W--1205489). Puebla: Nicolas s.n. [X.1908] (W--1159320). San Luis Potosí: J. Rzedowski 7339 (Ip), 7346 (Ip). Tamaulipas: Bark-

ley 17M174 (Au--121222). Veracruz: F. Chiang 343 [Rec. Inf. D005713] (E--2069123, Mi); Cox 850 [Herb. Cox 642] (Oa); Linden 18 in part (Mi); Ventura A. 3218 (Au--303916, Mi). GUATEMALA: Chiquimula: D. P. Gregory 589 (Ld). El Quiché: Heyde & Lux 2973 (W--58252, W--480109, W--1323176). Progreso: Popenoe 954 (W--1080609). Santa Rosa: Kellerman 7738 (W--2441980). Department undetermined: C. C. Deam 6092 (Mi). HONDURAS: Colón: Record & Kuylen s.n. [Olanchito] (W--1315435); Severén 19 (W--1209928). Comayagua: J. B. Edwards P.586 (Ca--522767, F--688135, W--1588678); P.601 (W--688152--isotype, W--1588669--type). El Paraíso: Barkley & Barkley 40156 (Ld). Morazán: C. V. Morton 7080 (W--2023246). EL SALVADOR: San Salvador: Calderón 268 (W--1151280); Renson 234 (W--399529); P. C. Standley 22755 (W--1138486). COSTA RICA: Guanacaste: Tonduz s.n. [Herb. Inst. Physico-geogr. Nat. Costaric. 13843] (W--577877, W--577878, W--1323170), s.n. [Herb. Inst. Physico-geogr. Nat. Costaric 16655] (W--578873). Puntarenas: Lankester s.n. [Jan. 1926] (W--1266801). JAMAICA: D. Hummel s.n. [29/4/1958] (S). INDIA: West Bengal: Mukherjee s.n. [16.3.68] (Ld). CULTIVATED: California: Jerabek s.n. [Balboa Park, Jan. 1945] (Sd--34943), s.n. [Pacific Beach, April 1945] (Sd--36096), s.n. [June 1945] (Sd--36463). Egypt: Mahdi s.n. [6/9/1961] (Gz), s.n. [6/11/1963] (Gz, Gz, Gz), s.n. [12/7/1964] (Gz, Gz), s.n. [24/4/1965] (Gz, Gz), s.n. [4/6/1967] (Gz, Gz, Gz); V. Thäckholm s.n. [30/10/1959] (Gz). El Salvador: M. C. Carlson 503 (Ca--703622). Florida: Gifford & Totten s.n. [January 1, 1941] (Hi--22562); R. W. Read X-1-55 (Ft--2205). Hawaiian Islands: Judd, Bryan, & Neal s.n. [Sept. 25, 1937] (Mu); A. R. Moldenke 96 [H. N. Moldenke 21869] (Z). Sri Lanka: Collector undetermined s.n. [Royal Bot. Gard., May 1887] (Pd); Worthington 6967 (P, Pd). Thailand: Surapat 43 (W--2450874).

ADDITIONAL NOTES ON THE GENUS PETITIA. IV

Harold N. Moldenke

Herbarium acronyms used in this paper, as in all preceding ones in this and other series of notes in PHYTOLOGIA, are explained in full in my "Fifth Summary of the Verbenaceae...." (1971), pages 795--801.

PETITIA Jacq.

Additional synonymy: Petatia Dod & Fortuna, Bol. Jard. Bot. Moscoso 2 (3): 16, sphalm. 1975.

Additional & emended bibliography: P. Br. in Sloane, Civil Nat.

Hist. Jamaic., ed. 1, 265. 1756; Jacq., Select. Stirp. Amer. Hist. 17—18. 1768; P. Br. in Sloane, Civil Nat. Hist. Jamaic., ed. 2, imp. 1, 265. 1789; Raensch., Nom. Bot., ed. 3, 36 & 173. 1797; Batsch, Tabl. Aff. Reg. Veg. 193. 1802; Pers., Sp. Pl. 1: 338 & 358. 1817; Roem. in L., Syst. Veg., ed. 15 [Stuttg.], 95. 1820; Steud., Nom. Bot. Phan., ed. 1, 606. 1821; Spreng. in L., Syst. Veg., ed. 16, 1: 418 (1825) and ed. 16, 5: 521. 1828; Sweet, Hort. Brit., ed. 2, 417. 1830; Endl., Gen. Pl. 636. 1838; D. Dietr., Syn. Pl. 1: 430. 1839; Sweet, Hort. Brit., ed. 3, 551. 1839; Meisn., Pl. Vasc. Gen. 2: 199. 1840; Spach, Hist. Nat. Veg. Phan. 9: 227. 1840; Steud., Nom. Bot. Phan., ed. 2, 1: 309. 1840; Voigt, Hort. Suburb. Calc. 473. 1845; Schau., Linnaea 20: 483. 1847; Schau. in A. DC., Prodr. 11: 614, 627, 638, 639, & 647. 1847; Schnitzl., Iconogr. Fam. Nat. 2: 137 Verbenac. [3]. 1856; Buek, Gen. Spec. Syn. Candoll. 3: 73, 105, 338, & 365. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 46 & 386 (1893) and imp. 1, 2: 477. 1894; Dalla Torre & Harms, Gen. Siphonog., imp. 1, 432. 1904; A. R. Northrop in J. I. Northrop, Naturalist Bahamas 180, 204, & 211. 1910; Wangerin, Justs Bot. Jahresber. 53 (2): 645. 1925; Mold., Brittonia 1: 415 & 416. 1934; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 568. 1941; Mold., Alph. List Cit. 1: 308. 1946; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 46 & 386 (1946) and imp. 2, 2: 477. 1946; Hansford, Sydowia 9: 72. 1955; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 46 & 386 (1960) and imp. 3, 2: 477. 1960; Hansford, Sydowia Ann. Myc., ser. 2, Beih. 2: 693 & 696. 1961; Dalla Torre & Harms, Gen. Siphonog., imp. 2, 432. 1963; Little & Wadsworth, Common Trees P. R. [U. S. Dept. Agr. Agric. Handb. 249:] 476 & 482—483, fig. 228. 1964; Dandy, Reg. Veg. 51: 121. 1967; Bovey, Morton, Baur, Diaz-Colon, Dowler, & Lehman, Weed Sci. 17: 540. 1969; Anon., Agricult. Ind. 35: 174. 1971; Anon., Biol. Abstr. 52 (15): B.A.S.I.C. S.187. 1971; Mold., Biol. Abstr. 52: 8221. 1971; Mold., Fifth Summ. 1: 6, 30, 93, 97, 101, 103, 105, 107, 110, 336, 382, 407, 417, 429, 430, & 434—436 (1971) and 2: 594, 595, 610, 757, 792, & 897. 1971; Mold., Phytologia 21: 146—148 & 510. 1971; M. Young, Weed Abstr. 20: 17. 1971; C. D. Adams, Flow. Pl. Jamaic. 627, 635, & 833. 1972; Alemán Frías, Aurich, Ezcurra Ferrer, Gutiérrez Vázquez, Hortsmann, López Rendueles, Rodríguez Graquitena, Roquel Casabella, & Schreiber, Die Kulturpfl. 19: 422. 1972; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 8, 879 & 1043. 1973; P. Br. in Sloane, Civil Nat. Hist. Jamaic., ed. 2, imp. 2, 265. 1972; D'Arcy & Keating, Brittonia 25: 223. 1973; Hocking, Excerpt. Bot. A.21: 115. 1973; Howard, Journ. Arnold Arb. 54: 461. 1973; J. Hutchins., Fam. Flow. Pl., ed. 3, 487 & 950. 1973; López-Palacios, Revist. Fac. Farm. Univ. Andes 9 (13): 47. 1973; Mold., Phytologia 25: 242 & 509 (1973), 26: 508 (1973), and 27: 356. 1973; León & Alain, Fl. Cuba, imp. 2, 2: 280 & 311—312. 1974; Little, Woodbury, & Wadsworth, Trees P. Rico 2 [U. S. Dept. Agr. Agric. Handb. 449]: 854. 1974; A. L. Mold., Phytologia 29: 171. 1974; Dod & Fortuna, Bol. Jard. Bot. Moscú 2 (3): 16. 1975; Kooiman, Act. Bot. Neerl. 24: 462. 1975; Mold., Phytologia 29:

510 (1975) and 31: 27, 235, 379, 380, 394, & 406. 1975; Molina R., Ceiba 19: 96. 1975; Zimmerm. & Ziegler in Zimmerm. & Milburn, Transp. Pl. 1 [Pirson & Zimmerm., Encycl. Pl. Physiol., ser. 2, 1:] 502. 1975; Hocking, Excerpt. Bot. A.28: 170. 1976; Mold., Phytologia 33: 510 (1976) and 34: 253, 276, & 508. 1976; López-Palacios, Fl. Venez. Verb. 153 & 651. 1977; Mold., Phytologia 40: 488 & 510. 1978.

The Schnitzlein (1856) reference in the bibliography above is often cited as "1843-1870", but the page here involved was actually issued in 1856. Similarly, the Endlicher (1838) reference is often cited as "1836-1856", but the page involved here was issued in 1838.

Dalla Torre & Harms (1904) recognize 4 or 5 species in this genus and divide it into Sect. 1 Eupetitia Briq. and Sect. 2 Scleeroon Briq. The latter section, however, is now regarded as belonging to Citharexylum B. Juss. León & Alain (1974) recognize only 2 species, both West Indian.

Schauer (1847) cites Swartz s.n. from Jamaica, Jacquin s.n., Bredemeyer s.n., and Bertero s.n. from Puerto Rico and Hispaniola, and Swartz s.n. in Herb. Willdenow 1148, the type collection of Citharexylum melanocardium Sw.

Hansford (1961) lists Petitia as host for the fungus, Meliola ambigua Pat. & Gaill., based on Ciferri 2578 bis from the Dominican Republic.

PETITIA DOMINGENSIS Jacq.

Additional synonymy: Petatia domingensis Dod & Fortuna, Bol. Jard. Bot. Moscoso 2 (3): 16. 1975. Citharexylum melanocum Broughton ex Powell, Econ. Bot. 31: 417. 1977.

Additional & emended bibliography: P. Br. in Sloane, Civil Nat. Hist. Jamaic., ed. 1, 265. 1756; Jacq., Hist. Stirp. Amer. 14: pl. 182, fig. 6. 1763; Jacq., Select. Stirp. Amer. Hist. 17-18. 1788; P. Br. in Sloane, Civil Nat. Hist. Jamaic., ed. 2, imp. 1, 265. 1789; Rausch., Nom. Bot., ed. 3, 36 & 173. 1797; Pers., Sp. Pl. 1: 338 (1817) and 3: 358. 1819; Steud., Nom. Bot. Phan., ed. 1, 202 & 506. 1821; Spreng. in L., Syst. Veg., ed. 16, 1: 418 (1825) and ed. 16, 5: 521. 1828; Sweet, Hort. Brit., ed. 2, 417. 1830; D. Dietr., Syn. Pl. 1: 430. 1839; Sweet, Hort. Brit., ed. 3, 551. 1839; Steud., Nom. Bot. Phan., ed. 2, 1: 309. 1840; Voigt, Hort. Suburb. Calc. 473. 1845; Buek, Gen. Spec. Syn. Candoll. 3: 73, 105, & 338. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 46 & 386 (1893) and imp. 1, 2: 477. 1894; A. R. Northrop in J. I. Northrop, Naturalist Bahamas 180, 204, & 211. 1910; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 46 & 386 (1946) and imp. 2, 2: 477. 1946; Hansford, Sydowia 9: 72. 1955; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 311. 1957; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 46 & 386 (1960) and imp. 3, 2: 477. 1960; Hansford, Sydowia Ann. Myc., ser. 2, Beih. 2: 696. 1961; Little & Wadsworth, Common Trees P. R. [U. S. Dept. Agr. Agric. Handb. 249:] 476 & 482-483, fig. 228. 1964; Bovey, Morton, Baur, Diaz-Colon,

Dowler, & Lehman, *Weed Sci.* 17: 540. 1969; Anon., *Biol. Abstr.* 52 (15): B.A.S.I.C. S.187. 1971; Mold., *Biol. Abstr.* 52: 8221. 1971; Mold., *Fifth Summ.* 1: 30, 93, 97, 99, 101, 103, 105, 107, 110, 336, 382, 407, 417, 429, 430, & 434—436 (1971) and 2: 594, 595, 610, 792, & 897. 1971; Mold., *Phytologia* 21: 147—148. 1971; M. Young, *Weed Abstr.* 20: 17. 1971; Alemán Frías, Aurich, Ezcurrea Ferrer, Gutiérrez Vázquez, Horstmann, López Rendueles, Rodríguez Graquitená, Roquel Casabella, & Schreiber, *Die Kulturpfl.* 19: 422. 1972; C. D. Adams, *Flow. Pl. Jamaic.* 635 & 833. 1972; P. Br. in Sloane, *Civil Nat. Hist. Jamaic.*, ed. 2, imp. 2, 265. 1972; Farnsworth, *Pharmacog. Titles* 8 (8): xvi. 1973; Hocking, *Excerpt. Bot.* A.21: 115. 1973; Howard, *Journ. Arnold Arb.* 54: 461. 1973; J. Hutchins., *Fam. Flow. Pl.*, ed. 3, 487 & 950. 1973; Mold., *Phytologia* 27: 510. 1974; Alain in León & Alain, *Fl. Cuba*, imp. 2, 2: 311 & 312. 1974; Little, Woodbury, & Wadsworth, *Trees P. Rico* 2 [U. S. Dept. Agr. Agric. Handb. 449]: 854. 1974; Dod & Fortuna, *Bol. Jard. Bot. Moscoso* 2 (3): 16. 1975; Kooiman, *Act. Bot. Neerl.* 24: 462. 1975; Mold., *Phytologia* 31: 379, 380, 394, & 406. 1975; Zimmerm. & Ziegler in Zimmerm. & Milburn, *Transp. Pl.* 1 [Pirson & Zimmerm., *Encycl. Pl. Physiol.*, ser. 2, 1]: 502. 1975; Hocking, *Excerpt. Bot.* A.28: 170. 1976; Mold., *Phytologia* 34: 253 & 276. 1976; Powell, *Econ. Bot.* 31: 417. 1977; Mold., *Phytologia* 40: 488. 1978.

Emended illustrations: Little & Wadsworth, *Common Trees P. Rico* [U. S. Dept. Agr. Agric. Handb. 249:] 483, fig. 228. 1964.

Recent collectors describe this species as a bush, 1.5—3 m. tall, large shrub, or small tree, 5—8 m. tall, the leaves opposite, slightly viscid, and aromatic, the corolla 4-lobed, the filaments and style white, the anthers black, and the fruit fleshy, at first green, then red or black at maturity. They have found it growing on beaches and the sides of foothills, in transition to pineland areas, in montane forests, and in pinelands on limestone, in marshes behind dunes, on dry limestone hillsides and palm-broadleaf savannas, and in scrub forests on dogtooth limestone, at altitudes of sealevel to 1400 meters, flowering from February to April, June, August, and December, fruiting in June. They record the vernacular names, "capa", "English pigeon berry", and "fiddlewood". Sweet (1830) calls it the "netted-leaved callicarpa" and asserts that it was introduced into cultivation in England in 1826 from Jamaica.

Bancroft 24 is accompanied by a wood sample. Dawson 26558, Eggers 4201, and Leonard 4833 exhibit unusually narrow leaves approaching those of var. ekmani Mold., but not as narrow nor of the unusual shape of the latter taxon. Harris 9213 in the United States National Herbarium exhibits one 2-foliolate and one 3-foliolate leaves.

Molina (1975) records the species from Honduras, but if it occurs there it is most probably in cultivation, although he does not say that this is the case.

Alain (1974) reports that of this plant the "Madera dura y resistente, empleada en construcciones y mueblería [in Cuba]. Flores muy olorosas, melíferas". Bovey and his associates (1969) also report

that the tree is resistant to picloram herbicide spray even when rates up to 80 pounds were used.

Northrop (1910) reports the species from Andros and Grand Cayman islands. Adams (1972) asserts that in Jamaica it is "Common in secondary thickets, pastures and woodland on limestone", at altitudes of 10 to 2300 feet, and there flowering and fruiting "all the year". He cites Adams 6302, Harris 8776, and Proctor 8665 from Jamaica and reports it also from the Bahamas, Greater Antilles, Cayman Islands, and "cultivated elsewhere".

Hansford (1955, 1961) reports P. domingensis as host to the fungus, Meliola petitiae Hansf., based on Ciferri 2822 from the Dominican Republic.

Material of P. domingensis has been misidentified and distributed in some herbaria as Callicarpa hitchcockii Millsp. On the other hand, most of the collections hereinafter cited as var. poepigii (Schau.) Mold. were previously distributed and/or cited by me as typical P. domingensis.

Re-examination of some of the previously cited material shows the following, at least, represent the typical form, in addition to those cited below: Abbott 559, 2173, & 2215, Ekman H.2185, Faris 190 & 351, W. Harris 9213, León 12045b, E. C. Leonard 3843 & 4833, Leonard & Leonard 11575, 12527, 13913, & 15276, Maxon & Killip 1497, G. S. Miller 1328, Rose, Fitch, & Russell 3938, and Wright, Parry, & Brummel 355. The rest need re-examination.

Additional & emended citations: BAHAMA ISLANDS: Andros: Dawson 26558 (W--2458818). Cat: Byrne 125 (Ws). Grand Bahama: D. S. Correll 40624 (N); Gillis 7791 (Ba). New Providence: Burch 4201 (N); O. Degener 19061 (Ba). North Eleuthera: D. S. Correll 41156 (N, N). JAMAICA: C. D. Adams 6302 (Mu); Bancroft 24 (W--1555652); Crosby & Anderson 1118 (N); Webster 5115 (W--2227627). GREAT GOAT ISLAND: W. Harris 9213 (A, B, Bm, F--212232, N, W--524656). TORTUE: Leonard & Leonard 11575 (N, W--1450500), 12527 (N--photo, V, W--1451280, Z--photo), 13913 (A, W--1452494), 15276 (K, W--1453550). HISPANIOLA: Dominican Republic: Allard 14241 (W--1958272); Schiffino 102 (W--1781212). PUERTO RICO: Burch 3480 (N); Little 13080 (W--2633020); Vélez 771 (Lv). CULTIVATED: Colombia: Cuatrecasas 23088 (W--2817212); Duque-Jaramillo 4624a (N). Florida: Gillis 8689 (Ba).

PETITIA DOMINGENSIS var. EKMANI Mold.

Additional bibliography: Mold., Biol. Abstr. 52: 8221. 1971; Mold., Fifth Summ. 1: 103 (1971) and 2: 594 & 897. 1971; Mold., Phytologia 21: 148. 1971; Hocking, Excerpt. Bot. A.21: 115. 1973.

PETITIA DOMINGENSIS var. POEPPIGII (Schau.) Mold.

Synonymy: Petitia poeppigii Schau. in A. DC., Prodr. 11: 639. 1847. Petitia poeppingii Schau. ex Junell, Symb. Bot. Upsal. 4: 92, sphalm. 1934. Petitia poeppigii Jacq. ex Mold., Feddes Rep-

ert. Spec. Nov. 42: 238, in not. 1937; Prelim. Alph. List Inv. Names 33, in syn. 1940. Petitia poeppiggi Schau. ex Roig, Dicc. Bot. 2: 1076, in syn. 1953.

Bibliography: Schau. in A. DC., Prodr. 11: 639 & 647. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 338. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 46 (1893) and imp. 1, 2: 386 & 477 (1894) and imp. 2, 1: 46 (1946) and imp. 2, 2: 386 & 477. 1946; Hill & Salisb., Ind. Kew. Suppl. 10: 68. 1947; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 46 (1960) and imp. 3, 2: 386 & 477. 1960; Mold., Fifth Summ. 2: 595. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 312. 1974; Mold., Phytologia 31: 379, 380, & 406. 1975; Hocking, Excerpt. Bot. A.28: 170. 1976; Mold., Phytologia 34: 253. 1976.

Hitherto I have regarded this more or less pubescent-leaved plant as not worthy of nomenclatural recognition, but I now feel, after 50 years of examination of a long series of specimens, that it does deserve such recognition, albeit not on the specific level as thought by Schauer (1847). Time has not permitted me to re-examine all the collections previously cited by me as P. dominicensis to determine which of them should be transferred here, but those cited below definitely belong here. The variety is based on Poeppig s.n. from Las Piedras, Camaguey, Cuba, collected in February 1824 and deposited at Berlin. Several isotypes have been photographed by me and copies of the photographs have been deposited in various herbaria.

Recent collectors refer to the plant as a small shrub, 2 m. tall, or a small, spreading, branching tree, to 8 m. tall, the leaves clustered at the tips of the branches, the flowers fragrant, the fruit subglobose, orange-red or red. They have encountered it in coastal thickets and pastures, along brooks and rivers, in woods, open pinewoods, and among Pinus occidentalis, on shores and serpentine barrens, in thickets on otherwise open grassland, and in xerophytic formations, at altitudes of sealevel to 500 meters, flowering from February to April and June to November, fruiting in May, August, and September. It is reported as "very abundant" in the Dominican Republic. The vernacular names, "capa" and "guayo", are reported for it.

The corollas are said to have been "white" on Killip 43923, "cream" on Proctor 10926, "greenish-cream" on Valeur 981, and "pale-yellow" on Ekman 9316.

Most of the collections cited below were previously cited by me under typical P. domingensis Jacq. before the validity of this taxon was established and were so distributed. Material has also been misidentified and distributed in some herbaria as Guettarda sp. in the Rubiaceae.

Citations: BAHAMA ISLANDS: Cat: Coker 423 (N). Eleuthera: Correll & Hill 45101 (N). Mangrove: Coker 224 (N). New Providence: Curtiss 136 [March 26] (A, B, Bm, Cb, Cb, Cb, Cb, Cm, E-118704, Ed, Es, F-144030, G, K, L, Le, Mu-3978, N, N, P, Vt, W-428641), 136 [May 18] (A, B, Bm, Cb, Cb, Cb, Cb, Cm, E-118704, Ed, Es, F-144030)

[to be continued]

BOOK REVIEWS

Alma L. Moldenke

"FLORA DEL AVILA — Flora y Vegetación de las Montañas del Avila, de la Silla y del Naiguatá" by Julián A. Steyermark & Otto Huber, 971 pp., 18 color photos, 308 line-drawn plates, hundreds of diagnostic key character sketches, & fold-in map of "Parque Nacional El Avila". Published by the Sociedad Venezolana de Ciencias Naturales, Caracas, Venezuela. 1978. Available through the senior author at the Instituto Botánico, Apto. 2156, Caracas. 150 bolivares or \$35.00 paperbound.

Funding for this excellent and comprehensive study came from the Vollmer Foundation and the Ministerio del Ambiente y de los Recursos Naturales Renovables which made possible the use of better than usual Latin American quality paper, binding, type setting and plate reproduction. The text is so "clean" that when an unorthodox spelling for *Stachytarpheta* appeared I wrote to the senior author, a long-time friend and fine taxonomist, questioning why he "chose" to use it. It was just a slip! This thorough text deserves this careful presentation. The Spanish is easy to read and the keys to use.

The range of the Flora consists of the beautiful mountains to the north of Caracas, separating that city from the sea. It has lured such European, American and local botanists over the past few centuries as Bredemeyer, Bonpland, Humboldt, Vargas, Karsten, Pittier, Steyermark, Vareschi, Aristeguieta, Tamayo, Lasser, and others. Introductory chapters discuss the history of botanical exploration in the region, the geology, geomorphology, vegetation formations and phytogeographical relationships with the flora both to the north and south and to introduced and cultivated species. The balance of the book comprises the systematic treatment. This rich flora will be of great use to botany and ecology students, teachers and botanically-oriented visitors to the area.

"AUSTRALIAN FERNS AND FERN ALLIES with Notes on Their Cultivation" by David L. Jones & Stephen C. Clemesha, 294 pp., 59 color photos, 253 b/w fig. with line draw. A. H. & A. W. Reed Ltd., Sydney, Wellington 1976, & London, with Chas. E. Tuttle Co., Rutland, Vermont 05701 as U. S. distributor since 1978. \$22.50.

This is a very well prepared book about a subject whose growing popular interest has exceeded — until the recent appearance of this fine, general and accurate study — any availability of practical illustrated and descriptive treatment of the 312 species in 101 genera of pteridophytes for the Australian public. The introductory chapters describe fern structure, life cycles, cultivation, propaga-

tion, hybridization and cultivars. The bulk of the text consists of concise descriptions, special habitat or ecological notes, distinguishing features, possible confusing species, distribution and cultivation. There are line drawings showing diagnostic features for each species and many beautifully clear color photographs very well printed. Consequently the book will be useful within and far beyond the shores of "down under".

"HANDBOOK OF BULBS AND PERENNIALS FOR THE SOUTHERN HEMISPHERE"

Third Edition Revised by Richmond E. Harrison, 282 pp., 80 color photos & 343 b/w illus. R. E. Harrison & Co., Ltd., Palmerston North, New Zealand, with Chas. E. Tuttle as U. S. distributor in Rutland, Vermont 05701. 1971. \$11.95.

This fine handbook, along with the "Handbook of Trees and Shrubs for the Southern Hemisphere" (previously favorably reviewed in this journal), are known as "The Garden Twins" and have been depended upon for many years because of their excellent encyclopedia-like coverage. Not only are they of value to amateur and professional gardeners, horticulture students and others with related interests in Australia, New Zealand, South Africa and South America, but also to those in the northern hemisphere who naturally have to make adjustments in blooming times and often colder winters. One of the author's goals has been "to encourage and stimulate the raising of new varieties of hardy bulbs and perennials by selection and hybridising, so that Australia may add a larger quota to the world's introduction of 'things beautiful'." For each of the hundreds of plants presented there is given scientific name, family, derivation of name, common name, the species and varieties in cultivation and their places of origin, appearances and growing conditions. The text explains the retarding of hyacinth blooms necessary as they are changed from a Holland to a southern hemisphere residence. There are lists of plants for the seaside, for different colored borders, for sunken gardens, for shady places, for blooming times, etc.

"KNOW YOUR ROCK GARDEN PLANTS AND DWARF BULBS" by K. D. Gillanders,

G. M. Paterson & E. R. Rotherham, 103 pp., 78 color photos & 16 b/w illus. A. H. & A. W. Reed Ltd., Sydney, Wellington & London, with Chas. E. Tuttle Co., Rutland, Vermont 05701 as U.S. distributor. 1973. \$16.50.

For rock garden aficionados, horticulture students and nurserymen anywhere in the world this book proves to be a delightful, accurate source of information about a few hundred "plants that have proved to be ideal subjects for rock gardening". There are instructions for setting up a rock garden, a series of plant lists for sunny or shaded positions, for wall growing, silver foliage, etc., and a bibliography. Even the arm-chair gardener will enjoy the outstanding color photographs.

PHYTOLOGIA

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7

PLANTS COLLECTED ON THE SANDWICH ISLANDS BY GEORGE BARCLAY
HAWAIIAN PLANT STUDIES 89

Harold St. John

Bishop Museum, Honolulu, Hawaii, Box 6037, 96818, USA.

George Barclay was born at Huntley, Aberdeenshire, Scotland, but the date is unknown. He was trained as a gardener, and was employed in the Royal Gardens, Kew. On the recommendation of Robert Brown, he was appointed botanical collector for the voyage of H.M.S Sulphur, under Capt. F. N. Beechey who was soon replaced by Capt. Sir Edward Belcher.

On this world voyage, they visited the Hawaiian Islands three times. On July 9, 1837 they arrived at Honolulu, then on the 26th left for Kauai. They returned to Honolulu on June 10th, 1839, and on the 16th they departed from Kauai. In 1840 they briefly touched at the islands.

Evidently Barclay's days on shore were few, but he made good collections, totalling some 90 species of plants from Oahu and Kauai. His labels state the month, and the year, and often the habitat, the stature, and the color of the flowers. These details were seldom recorded by botanists of his time.

His plant specimens are preserved in the herbarium of the British Museum of Natural History in London. He did not publish anything on botany. There is a book on the botany of the voyage of the Sulphur, by George Bentham (1844-1846), but it includes only the plants collected in Fiji.

ENUMERATION
PTERIDOPHYTA

Lycopodiaceae

Lycopodium cernuum L. 1235, Woahu (=Oahu), mountains, rich loam, July 1837. 1339; Atooi (=Kauai), hills, rich mould, July 1837.

Psilotaceae

Psilotum nudum (L.) Griseb. 1234, Woahu, moist vegetable soil, July 1837.

Ophioglossaceae

Ophioglossum falcatum (Presl) Fowler, 1233, Woahu, on trees & rocks, decayed vegetable soil, July 1837; Sandwich Islands, without other data.

Grammitaceae

Amphoradenium tamariscinum (Kaulf.) Copel. Woahu, without other data.

Polypodiaceae

Polypodium Thunbergianum C. Chr. Woahu, on vegetable soil and rocks, July 1837.

Pteridaceae

Pteridium aquilinum (L.) Kuhn, var. *decompositum* (Gaud.) Tryon, 1225, Woahu, shady habitat, rich loam soil, July 1837.

Vittariaceae

Vittaria rigida Kaulf. 1232, Woahu, moist habitat, rich loam soil, July 1837.

Dennstaedtiaceae

Microlepia setosa (Sm.) Alston, 1228, Woahu, moist habitat, rich loam soil, July, 1837.

Lindsaeaceae

Sphenomeris chinensis (L.) Maxon, 1229, Woahu, wet ravines, rich loam soil, July 1837.

Thelypteridaceae

Christella cyatheoides (Kaulf.) Holttum, 1226, Woahu, wet ravines, rich loam soil, July 1837.

C. glabra (Brack.) Ktze. 1220, Woahu, wet ravines, rich loam soil, July 1837.

C. nuda Underw. Woahu, no other data.

Aspleniaceae

Asplenium acuminatum H. & A. 1218, Woahu, moist and shady habitat, July 1837.

A. enatum Brack. 1223, Woahu, upon trees, in thicket upon the mountains, July 1837.

A. horridum Kaulf. without data.

A. nidus L. 1230, Woahu, moist habitat, rich loam soil, July 1837.

Athyriaceae

Athyrium Macraei (Hook. & Grev.) Copel. 1221, Woahu, thickets on mountains, rich loam soil, July 1837.

Nephrolepidaceae

Nephrolepis exaltata (L.) Schott, 1227, Woahu, wet ravine, rich loam soil, July 1870.

Blechnaceae

Doodia Kunthiana Gaud. Sandwich Is., without other data.

PHANEROGAMAE

MONOCOTYLEDONES

Gramineae

Chrysopogon aciculatus (Retz.) Trin. 1216, Woahu, mountains, gravelly soil, July 1837.

Cyperaceae

Carex wahuensis C. A. Mey. 1215, Woahu, mountains, gravelly soil, July 1837; 1323, Atooi, marshes, loam soil, July 1837.

Gahnia Beecheyi Mann, Atooi, without other data.

G. globosa Mann, 1206, Woahu, elevated habitat, common soil, July 1837.

Scirpus paludosus A. Nels. 1205, Woahu, moist habitation, common soil, July 1837.

Liliaceae

Dianella sandwicensis H. & A. 1241, Woahu, shady ravines, rich loam soil, July 1837; Atooi, used for dying

logwood colour.

Smilax sandwicensis Kunth, "Aka awa," used for tying the rafters of houses together. Atooi.

Dioscoreaceae

Dioscorea bulbifera L. 1305, Woahu, Honolulu, hillside, common, July 1837. It is called "hoy" by the natives who dry the tubers and use them as arrow root and upon the whole it make no despicable substitute.

DICOTYLEDONES

Piperaceae

Peperomia tetraphylla (Forst. f.) H. & A., var. *parvifolia* (C. DC.) Deg. & Deg. Atooi, 1837.

Piper methysticum Forst. f. 1312, Woahu, rich mould soil, cultivated, July 1837, "awa."

Urticaceae

Pipturus albidus (H. & A.) Gray, Oahu, 1837.

P. Helleri Skottsb., Atooi, 1837.

Loranthaceae

Korthalsella complanata (V. Tiegh.) Engler, 1274, Woahu, growing upon *Acacia* no. 1273, July 1837.

K. Remyana v. Tiegh. Atooi, "lama," The fruit is eaten, and the wood is used for buildings. -These data seem confused.

Santalaceae

Santalum ellipticum Gaud. 1289, Woahu, hills, rich soil, July 1837.

Chenopodiaceae

Chenopodium oahuense (Meyen) Aellen, Woahu, meadows, rich mould soil, July 1837.

Amaranthaceae

Amaranthus viridis L. Woahu, open field, loam soil, July 1837.

Charpentiera ovata Gaud. "pa pala," fruit used for making necklaces.

Lauraceae

Cassytha filiformis L. Woahu, parasite, abundant, July 1837; 1332, Atooi, hills, parasite, July, 1837.

Capparaceae

Cleome sandwicensis Gray, Woahu, hills, July 1837.

Cruciferae

Lepidium o-waihiense C. & S. Woahu, mountains, July 1837.

Rosaceae

Osteomeles anthyllidifolia (Sm.) Lindl. 1287, Woahu, abundant on the hills near Honolulu, July 1837.

Leguminosae

Acacia Koa Gray, Woahu, mountains, July 1837.

Canavalia galeata (Gaud.) Vogel, Woahu, hillsides, light brown soil, July 1837.

Cassia Gaudichaudii H. & A. 1284, Woahu, hills, rich loam soil, 20 ft. tree, July 1837.

Leucaena leucocephala (Lam.) de Wit, Woahu, hills, rich

mould soil, 20 ft. trees, July 1837.

Tephrosia purpurea (L.) Pers. Woahu, hills, loam soil,
July 1837.

Oxalidaceae

Oxalis corniculata L. 1300, Woahu, meadows, rich soil,
July 1837.

Zygophyllaceae

Tribulus cistoides L. 1243. Woahu, open fields, July
1837.

Euphorbiaceae

Aleurites moluccana (L.) Willd. 1261, Woahu, loam soil,
July 1837. There is an oil extracted from the fruit
which is called "Kuk Kui oil" and has of late become
an article of export from the Sandwich Islands.
Several mills have been recently erected at Woahu
for bruizing the nuts.

Euphorbia Arnottiana Endl. Atooi, July 26, 1837.

E. hirta L. 1286. Woahu, meadows near Honolulu, common,
July 1837.

Phyllanthus sandwicensis Muell.-Arg. 1276, Woahu,
high land, rich loam soil, July 1837.

Celastraceae

Perrottetia sandwicensis Gray, Woahu, various habitats,
rich loam soil, July 1837.

Sapindaceae

Dodonaea sandwicensis Sherff, Atooi, 1837.

Malvaceae

Hibiscus tiliaceus L. Atooi, 1837.

H. Youngianus Gaud ex H. & A. 1242, Woahu, various
habitats, July 1837.

Sida fallax Walp.

Sterculiaceae

Waltheria indica L. 1245, Woahu, various habitats; and
second sheet, open fields, July 1837.

Flacourtiaceae

Xylosma hawaiiense Seem. isotype, "Rouk kui," Woahu,
wet ravines, July 1837.

Thymeleaceae

Wikstroemia Degeneri Skottsbs., 1259, "Kaulé," Woahu,
mountains, loam soil, July 1837.

W. oahuensis (Gray) Rock, 1317, Atooi, hilly
habitat, rich mould soil, July 1837.

Myrtaceae

Metrosideros polymorpha Gaud., var. *glaberrima* (Lévl.)
St. John, 1252, Woahu, hills, rich loam soil, July
1837; 1316, Atooi, moist and sheltered habitat,
rich loam soil, July 1837.

M. polymorpha Gaud., subsp. *incana* (Lévl.) Skottsbs.,
1251, Woahu, hills, rich loam soil, July 1837.

Onagraceae

Ludwigia octivalvis (Jacq.) Raven, Atooi, July 1837.

Epacridaceae

Styphelia Tameiameiae (Cham.) F. Muell., Atooi.

Apocynaceae

Alyxia olivaeformis Gaud. Atooi, "Maile," used for beads, July 1837.

Rauvolfia sandwicensis A. DC. Atooi, July 1837.

Convolvulaceae

Ipomoea brasiliensis (L.) Sweet, Atooi, marshy habitat, rich soil, flowers rose coloured, July 1837.

I. congesta R. Br., 1340, Atooi, meadows, soil rich mould, July 1837.

I. congesta R. Br., albino, 1333, Atooi, lowland, soil rich, July 1837.

Boraginaceae

Cordia subcordata Lam. Woahu, soil clayey, 20 ft. tree, July 1837.

Verbenaceae

Verbena litoralis HBK. Woahu, July 1837.

Labiatae

Phyllostegia glabra (Gaud.) Benth., var. *Macraei* (Benth. in A. DC.) Sherff, Atooi, July 1837.

Solanaceae

Solanum aculeatissimum Jacq. Woahu, meadows, common, July 1837.

S. kauaiense Hbd., Atooi, July 1837.

Gesneriaceae

Cyrtandra paludosa Gaud., var. *paludosa*, Woahu, mountains, July 1837, three sheets.

C. Garnotiana Gaud., Woahu, July 1837.

Rubiaceae

Bobea elatior Gaud. Atooi, hills, soil rich, July 1837.

B. Hookeri Hbd. Woahu, high land, rich loam soil, July 1837.

Gouldia terminalis (H. & A.) Hbd., forma *terminalis*, Woahu, hills, rich mould soil, July 1837.

Hedyotis Schlechtendahliana Steud., var. *Schlechtendahliana*. 1253, mountains, soil loam, July 1837.

Morinda citrifolia L. Woahu, July 1837; Atooi, July 1837.

Psychotria Fauriei (Lévl.) Fosb. Woahu, mountains, soil loam, July 1837.

Lobeliaceae

Cyanea Grimesiana Gaud. Woahu, hills, rich mould soil, flowers white, July 1837.

Rollandia parvifolia Forbes, Atooi, July 1837.

(Lobeliaceae) Atooi, stem, leaves, and buds of *Clermontia*; loose flowers of *Rollandia*.

Goodeniaceae

Scaevola Gaudichaudiana Cham. Woahu, mountains, soil rich loam, flowers white, July 1837.

- Scaevola Taccada (Gaertn.) Roxb., var. Fauriei (Lévl.)
 St. John, Atooi, hills, soil rich mould, shrub 1 foot
 high, flower white, July 1837.
- S. Taccada (Gaertn.) Roxb., var. sericea (Vahl) St. John,
 1326, Atooi, hills, loam soil, July 1837.

Compositae

- Aster sandwicensis (Gray) Hieron. Woahu, July 1837.
- Bidens sp. Atooi, July 1837. Stem, leaves. Perhaps a
 form of B. sandwicensis Less., det E. E. Sherff.
- Erigeron canadensis L. Atooi, July 1837.
- Lipochaeta succulenta (H. & A.) DC., var. Barclayi Sherff,
 cited by Sherff in 1933, type.

DISCUSSION

Barclay's collection of Hawaiian plants, as now found in the British Museum of Natural History, includes 90 species. Of these 41 have the collector's numbers, these ranging from 1,205 to 1,340, that is a run of 125 numbers. This shows that 84 numbers are missing. These specimens may still be in the London museum, though the writer doubts it, or may have been lost, or all or some of them may be in another herbarium.

By 1837 Honolulu was a well developed trading port. Through the advent of boats, people, animals, and merchandise, there was transport for exotic weeds. Barclay's collection contained weed species of Chrysopogon, Amaranthus, Leucaena, Oxalis, Euphorbia, Waltheria, Ludwigia, Verbena, Solanum, and Erigeron, a total of 10 species, several of which were recorded as common.

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A New Species of Melochia from the Planalto of Bahia, Brazil

Aaron Goldberg

Melochia longidentata A. Goldberg, sp. nov., sectionis Mougeotiae prope M. hasslerianam Chod. sed primarius in dentibus calycis longissimis et ad apicem angustissimis, calyce corollam aequante, et in inflorescentiis axillaribus parvis contractis paucifloris differt.

Herba erecta 0.25-0.5 m. alta, pilis simplicibus ad 3 mm. longis, etiam in calyce aliquot glandulosis. Foliorum petioli 0.5-2.5 cm. longi, laminae 2.0-6.5 cm. longae, 1.0-3.3 cm. latae, lanceolato-ovatae, basi rotundatae apice acutae. Inflorescentiae axillares 1-1.5 cm. longae, floribus subsessilibus, 2-4 per inflorescentiam. Calyx 8-10 mm. longus, non accrescens, dentibus 7-9 mm. longis basi 1.2 mm. latis. Petala flava, 9.5-10 mm. longa ad 2.6 mm. lata. Forma longistyla: Stamina ad 4.1 mm. longa, pistillum ad 6.8 mm. longum. Forma brevistyla: Stamina ad 6.8 mm. longa, pistillum ad 4.5 mm. longum. Fructus globosus ad 6.4 mm. diametro, rostro ad 2 mm. longo; dehiscens secus totam suturam ventralem et tertia ad mediam partem secus suturam dorsalem atque septicide incompletus.

For ready comparison with other species the following description is in the style used in my monograph of Melochia in Contributions from the United States National Herbarium, vol. 34: 191-363. 1968.

An erect herb 0.25-0.5 m. high, 2 mm. wide, usually branching, the branches not basal, root not thickened, the stems and petioles moderately pilose, hairs simple, straight, extending laterally, 2.0 mm. long, also shorter, curved, and arranged in a line along the stem; internodes 1-7 cm. long.

Stipules 3-7 mm. long, 0.3-1.0 mm. wide, deltoid-acuminate, ciliate; petiole 0.5-2.5 cm. long; lamina 2.0-6.5 cm. long, 1.0-3.3 cm. wide, lanceolate-ovate, the base rounded, the apex acute, both surfaces sparsely pilose, hairs simple, appressed, 0.5-2 mm. long, irregularly crenate-serrate, serrations 1-3 mm. wide, 0.5-2.0 mm. high, costa prominent, pairs of lateral veins 7-10, straight, parallel, at about 45° angle to the costa, one pair of veins basal.

Inflorescences axillary, 1-1.5 cm. long, in the axils of 1-6 upper leaves, peduncle 0-0.3 cm. long, leaf subtending the inflorescence frequently reduced, flowers 2-4 per inflorescence, subsessile, the pedicels 1(-2) mm. long; bracts 4.5-6.0 mm. long, 0.5-1.0 mm. wide, linear, ciliate, the hairs 1-2 mm. long.

Calyx 8.0-10.0 mm. long, 3.7 mm. wide at the apex of the connate part, not accrescent, pilose, the hairs simple, 0.2-1.0 mm. long and a few uniseriate, 0.3 mm. long, with an apical gland; the teeth very long, 7.0-9.0 mm. long, 1.1-1.2 mm. wide at the base, deltoid-acuminate, filiform toward the apex, the sinus between the teeth acute to narrowly rounded; petals bright yellow,

9.5-10.0 mm. long, 1.8-2.6 mm. wide, oblanceolate-cuneate.

Longistylous form: Stamens 3.8-4.1 mm. long, the filaments united up to the anthers, loosely adnate to the corolla for 1 mm., the anthers 1.2-1.3 mm. long, 0.6 mm. wide, oblong, emarginate at the apex for 0.3 their length; pistil 6.5-6.8 mm. long, the styles 4.9 mm. long, united for 1 mm., papillose for 0.7 mm. at the apex, the ovary globular, 1 mm. in diameter, sericeous, narrowing to a stipe 0.4 mm. long.

Brevistylous form: Stamens 6.0-6.8 mm. long, the filaments free for 3 mm., the anthers similar to those above; pistil 3.2-4.5 mm. long, the styles 2.1-2.2 mm. long, united for 1 mm., papillose for 0.5 mm. at the apex, the ovary globular, sericeous.

Fruit 7-8 mm. long, of which the rostrum is 1-2 mm., 5.0-6.4 mm. wide, globular, obtusely pentagonal, the sulci between the carpels shallow, extending 0.2 the way to the center of the fruit, pilose, the hairs simple, 1.5-3.0 mm. long; dehiscence all along the ventral suture and 0.3-0.5 way along the dorsal suture, also incompletely septicial; seeds immature, 2.4 mm. long, 1.7 mm. wide, generally 2 per locule.

Flowering and fruiting specimens collected in March.

Type Locality: The type was collected by W. R. Anderson, M. Stieber and J. H. Kirkbride, Jr., no. 36957, on the Planalto do Brasil, Estado de Bahia, in shrubby woods on gently sloping hills, ca. 13 km. S. of Cocos and 3 km. S. of Rio Itaguari, at 560 m. elevation. The specimens were distributed by the New York Botanical Garden. I have examined those sent to the U. S. National Herbarium and to the Instituto de Botanica del Nordeste, Corrientes, Argentina and designate the former as type.

This species is close to Melochia hassleriana Chod. but differs primarily in having very long calyx teeth, the calyx being as long as the corolla, and in having short, contracted, few-flowered, axillary inflorescences. Only the calyx teeth of M. morongii Britt., in the section Pyramis, extend into the range of those of M. longidentata.

CONTRIBUTION TO THE LICHEN FLORA OF URUGUAY XII.
LICHENS FROM NUEVA PALMIRA, COLONIA DEPARTMENT.

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Historia Natural. Montevideo URUGUAY.

The present paper is part of the study of the lichen flora from the marginal forests of the De La Plata and Uruguay rivers. The below mentioned species were collected near Nueva Palmira Town, Colonia Department, SW Uruguay.

The collection sites were as follow:

ARROYO SAUCE: 1/2 Km N of Nueva Palmira, marginal forest on the S bank in his confluence with the Uruguay river.

PICADA ALBERTANO: cross of the Arroyo de las Víboras by the Highway 21, 13 km SE from Nueva Palmira.

RIO URUGUAY: the specimens were collected from trees which border the banks of the river facing Nueva Palmira.

The numbers belong to the author's numbering system and are deposited in his private herbarium.

Anaptychia diademata (Tayl.) Kurok.

ARROYO SAUCE: on Rapanea laetevirens, 4832, on Populus nigra, 4860; RIO URUGUAY: on Salix humboldtiana, 4806, on Erythrina crista-galli, 4817.

Bacidia alutacea (Kremp.) Zahlbr. var. minarum Malme.

ARROYO SAUCE: on Sapium longifolium, 4855; PICADA ALBERTANO: on Melia azedarach, 4769, on Salix humboldtiana, 4777; RIO URUGUAY: on Salix humboldtiana, 4813.

Buellia callispora (Nyl.) Stein.

ARROYO SAUCE: on Sapium, 4848.

Caloplaca commixta (Malme) Zahlbr.

PICADA ALBERTANO: on Salix humboldtiana, 4778.

Caloplaca erythrantha (Tuck.) Zahlbr.

ARROYO SAUCE: on Sapium longifolium, 4851, 4854; RIO URUGUAY: on Salix humboldtiana, 4812; PICADA ALBERTANO: on Salix humboldtiana, 4776, on Acacia farnesiana, 4791.

Caloplaca granularis (Müll. Arg.) C. Sambo.
RIO URUGUAY: on wooden post of a wharf, 4823.

Caloplaca mülleri (Vain.) Zahlbr.
PICADA ALBERTANO: on stones at roadside, 4784.

Caloplaca xanthaspis (Kremp.) Magn.
ARROYO SAUCE: on Sapium longifolium, 4845.

Caloplaca xanthobola (Kremp.) Zahlbr.
PICADA ALBERTANO: wooden post of a bridge, uncommon, 4780. New to Uruguay.

Candelaria concolor (Dicks.) Arn.
ARROYO SAUCE: on Populus nigra, 4863; PICADA ALBERTANO: on wooden fence post, at roadside, 4781, on Scutia buxifolia, 4880.

Candelaria fibrosa (Fr.) Müll. Arg.
ARROYO SAUCE: on shrubs, 4828 pro parte, 4830; PICADA ALBERTANO: on Acacia farnesiana, 4795.

Dirinaria applanata (Fée) Awast.
ARROYO SAUCE: on Rapanea laetevirens, 4838, on Blepharocalyx, 4850, 4857; RIO URUGUAY: on Erythrina cristagalli, 4820.

Glyphis cicatricosa Ach. f. confluens (Zenk.) Zahlbr.
ARROYO SAUCE: on Sapium longifolium, 4844; PICADA ALBERTANO: on myrtaceous tree, 4787.

Graphina dealbata (Nyl.) Müll. Arg.
ARROYO SAUCE: on Rapanea laetevirens, 4841. New to Uruguay.

Graphina nylanderiana Zahlbr.
ARROYO SAUCE: on Sapium longifolium, 4846.

Parmelia borrierina Nyl.
PICADA ALBERTANO: on wooden fence post, at roadside, det. M. Hale, 4760. New to Uruguay.

Parmelia microsticta Müll. Arg.
ARROYO SAUCE: on shrubs' branches, 4831; PICADA ALBERTANO: on Acacia farnesiana, 4790.

Parmelia subpraesignis Nyl.
ARROYO SAUCE: on Rapanea laetevirens, 4833, on Populus nigra, 4861; PICADA ALBERTANO: on Sapium longifolium, 4766, on Salix humboldtiana, 4772; RIO URUGUAY: on wooden post of a wharf, 4825. New to Uruguay.

Parmelina lindmanii (Lynge) Hale.
PICADA ALBERTANO: on Scutia buxifolia, 4798.

Parmelina pilosa (Stizb.) Hale.
ARROYO SAUCE: on Populus nigra, 4859; PICADA ALBERTANO: on Sapium longifolium, 4767, on Acacia farnesiana, 4804.

RIO URUGUAY: on Salix humboldtiana, 4807.

Parmotrema austrosinense (Zahlbr.) Hale.

ARROYO SAUCE: on wooden fence post, vid. M. Hale, 4868.

Parmotrema cetratum (Ach.) Hale.

PICADA ALBERTANO: on Sapium longifolium, 4803.

Parmotrema reticulatum (Tayl.) Choisy.

PICADA ALBERTANO: on wooden fence post, 4763; RIO URU-

GUAY: on Erythrina crista-galli, det. M. Hale, 4815, on wooden post of a wharf, 4826.

Pertusaria cinerella Müll. Arg.

PICADA ALBERTANO: on Melia azedarach, 4770.a.

Pertusaria megapotamica Malme.

ARROYO SAUCE: on Sapium longifolium, 4853; PICADA AL-

BERTANO: on Melia azedarach, 4770.b. pro parte; RIO URU-

GUAY: on Salix humboldtiana, 4811. Formerly known in Uruguay only from the type locality: Magnusson 1950:215.

Fhaeographina arechavaletae Müll. Arg.

ARROYO SAUCE: on Sapium longifolium, 4849; PICADA ALBERTANO: on Melia azedarach, at roadside, 4773.

Fhaeographis pezizoidea (Ach.) Müll. Arg.

PICADA ALBERTANO: on Melia azedarach, 4770.b. pro parte

Phlyctella brasiliensis (Nyl.) Nyl.

PICADA ALBERTANO: on myrtaceous tree, 4788, on Scutia buxifolia, 4797. New to Uruguay.

Physcia alba (Fée) Müll. Arg. var. obsessa (Mont.) Lynge.

ARROYO SAUCE: on Rapanea laetevirens, 4843, on Populus

nigra, 4858; PICADA ALBERTANO: on Sapium longifolium,

4761, on myrtaceous tree, 4789, on Acacia farnesiana,

4801; RIO URUGUAY: on Salix humboldtiana, 4810, on

Erythrina crista-galli, 4818, on wooden post of a wharf, 4822 a & b.

Physcia carassensis Vain.

ARROYO SAUCE: on shrubs' branches, 4829 pro parte.

Physcia syncolla Tuck.

ARROYO SAUCE: on Dodonea viscosa, 4834, on Rapanea lae-

tevirens, 4842, on Sapium longifolium, 4852; PICADA

ALBERTANO: on Sapium longifolium, 4762, on Melia azeda-

rach, 4768, on Salix humboldtiana, 4775, on Acacia

farnesiana, 4793; RIO URUGUAY: on Salix humboldtiana,

4814.

Pyxine cocoes (Sw.) Nyl.

RIO URUGUAY: on Tipuana tipa, scarce, 4821. New to Uruguay.

Pyxine endoleuca (Müll. Arg.) Vain.

ARROYO SAUCE: on Rapanea laetevirens, scarce, 4839.

Ramalina celastri (Spreng.) Krog. & Swinsc.

ARROYO SAUCE: on Rapanea laetevirens, 4871; PICADA ALBERTANO: on Salix humboldtiana, 4774, on wooden fence post at roadside, 4785, on Sapium longifolium, 4802; RIO URUGUAY: on Salix humboldtiana, 4809, on wooden fence post of a wharf, 4827.

Ramalina complanata (Sw.) Ach.

ARROYO SAUCE: on wooden fence post, 4866, on Rapanea laetevirens, 4870.

Sphinctrina depressa Magn.

ARROYO SAUCE: on shrubs' branches, growing on Pertusaria sp., 4829 pro parte. Formerly known in Uruguay only from type locality: Magnusson 1950: 213.

Teloschistes chrysophthalmus (L.) Th. Fr. var. cinereus Müll. Arg.

ARROYO SAUCE: on shrubs, 4828 pro parte; PICADA ALBERTANO: on Acacia farnesiana, 4792, 4796.

Xanthoria candelaria (L.) Arn.

PICADA ALBERTANO: on wooden post of a bridge, 4779.

Xanthoria parietina (L.) Th. Fr.

PICADA ALBERTANO: on Acacia farnesiana, 4794.

ACKNOWLEDGMENT.

To Dr. M. E. Hale, Jr. for help in many ways.

SUMMARY

39 lichens species collected in the marginal forests of the Uruguay river (near Nueva Palmira Town) are listed. The following species are added to the known flora of Uruguay: Caloplaca xanthobola, Parmelia borre-rina, P. subpraesignis, Phlyctella brasiliensis and Pyxine cocoes.

LITERATURE CITED.

Magnusson, A. H. 1950. Lichens from Uruguay. Meddel. Göteborgs Bot. Trädgård 18: 213-237.

Additional Notes regarding Tracaulon perfoliata (L.) Greene

Clyde F. Reed

The earliest published paper dealing with Tracaulon perfoliata in Eastern North America is that by Moul (1948). The plant is said to have been introduced at the Joseph B. Gable Rhododendron Nursery at Stewartstown, York Co., Pennsylvania, sometime after 1919. This weed became a troublesome plant there for several years, and attempts to destroy it with 2-4 D failed at that time. Evidently the plant had come in with seeds from Eastern Asia. (Tracaulon perfoliata is native to China, India, Manchuria, Korea, Taiwan, Japan and the Philippine Islands).

Moul also states that Dr. Joseph Ewan had reported this weed at the Glenn Dale Plant Introduction Garden, in Prince Georges County, Maryland, introduced with seeds from Nanking, China, in 1937. Since both Morrison and Gable were experimenting and hybridizing Rhododendrons at this time, it is possible seeds of Tracaulon perfoliata could have gotten to Gable from the Glenn Dale infestation. Eventually, Ewan reported, the Glenn Dale infestation was eradicated.

Hickman and Hickman (1978) reported colonies of this weed at Swathmore College, and at several other Pennsylvania localities. Some of these might have been due to spreading along with Rhododendrons purchased from the Gable Nursery. The Gable hybrids are famous and quite wide-spread.

In early May of this year, the author visited the Gable Nursery and found T. perfoliata growing along roadsides, edge of fields and stream-banks. Then, following several roads out of Stewartstown down into northern Maryland (Harford and Baltimore Counties), he found large growths of this weed along roadside slopes from the highway solid up to the edge of cultivated fields. The headwaters of the Deer Creek is not far south of Stewartstown and the flood-plain there was solid with seedlings, several hundred acres. Several hundred plants collected.

In Baltimore County, along York Road from Maryland Line to Cockeysville, many roadside embankments are solid with this weed; perhaps more widely spread here and in similar situations by roadside mowers. North of and to the west of Reisterstown to the Liberty Dam Area, this weed and Japanese honeysuckle form competitive stands along Hanover Pike and Westminster Pike in Carroll County. About 35 localities studied.

At present there are several thousand acres of this weed in northern Maryland, and it is spreading fast toward the Patapsco and Potomac River drainages. At present, nothing is being done to control it.

Moul, Edwin T. A dangerous weedy Polygonum in Pennsylvania. Rhodora, 50: 64-66. 1948.

Hickman, J.C. and C.S. Hickman Polygonum perfoliatum: A recent Asiatic adventive. Bartonica, No. 45: 18-23, 2 figs. 1978.

NOTES ON NEW AND NOTEWORTHY PLANTS. CXXV

Harold N. Moldenke

AEGIPHILA CATATUMBENSIS Mold., sp. nov.

Frutex scandens; ramis ramulisque tetragonis dense puberulis; foliis ovato-oblongis chartaceis 9--12 cm. longis 5.5--6.5 cm. latis abrupte breviterque acuminatis integris basaliter rotundis supra subglabris subtus pubescentibus; inflorescentiis terminalibus paniculatis angustis ubique dense puberulis vel breviter fusco-pubescentibus.

Liana; branches and branchlets apparently slender, conspicuously tetragonal, densely fuscous-puberulent; leaves decussate-opposite; petioles slender, about 1 cm. long, densely fuscous-puberulent; leaf-blades chartaceous, somewhat lighter green beneath, ovate-oblong, when mature 9--12 cm. long and 5.5--6.5 cm. wide, apically very abruptly short-acuminate, marginally entire, basally rounded, subglabrous above except for the puberulent larger venation, rather densely but obscurely fuscous-puberulent beneath, the vein reticulation subprominent on both surfaces, especially so above; inflorescence terminal, narrow-paniculate, composed of 2--4 pairs of very short-pedunculate cymes, densely fuscous or flavidous-puberulent or short-pubescent throughout; cymes densely many-flowered, about 1.5 cm. long and 2 cm. wide, the peduncles about 5 mm. long; pedicels 1 mm. long; calyx conic, externally densely short-pubescent with antrorse appressed hairs, the rim subtruncate, usually shallowly and rather irregularly dentate or lobulate, pale-green; corolla hypocrateriform, greenish-white; filaments white; anthers medium-brown.

The type of this species was collected by J. de Bruijn (no. 1431) in the primary forest along the Río Catatumbo between Boca Río de Oro and the frontier with Colombia, about 100 km. west-northwest of Santa Barbara-San Carlos del Zulia, Zulia, Venezuela, at 0--100 meters altitude, on November 7, 1967, and is deposited in the United States National Herbarium at Washington. The collectors describe the plant as a liana, the stem grayish-brown, the twigs dull dark-green with brownish hairs; leaves papery, glossy medium-green above, dull and paler beneath.

LIPPYA BROMLEYANA Mold., sp. nov.

Frutex fastigiatus 3 m. altus, foliis ellipticis brevipedunculatis crassiusculis aromaticis 2.5--4 cm. longis 1.5--2 cm. latis spicaliter subacutis basaliter breviter acuminatis supra glabris nitidisque subtus minutissime puberulis dense resinoso-punctatis; inflorescentiis axillaribus solitariis capitatis longipedunculatis; pedunculis filiformibus adscendentibus glabris 3 cm. longis; bracteis foliaceis ovatis 1 cm. longis 5 mm. latis glabris apicaliter acutis; corollis parvis rubello-purpureis.

A fastigiate shrub to about 3 m. tall; branches and branchlets

slender, dark-brown, very densely but obscurely puberulent or subglabrescent; leaves decussate-opposite, small; petioles sub-filiform, 2--5 mm. long, very obscurely puberulent or subglabrescent; leaf-blades thin when young, but rather thick on maturity, elliptic, 2.5--4 cm. long, 1.5--2 cm. wide, apically subacute, basally shortly acuminate, the margins appressed-serrulate, glabrous and shiny above, densely but very obscurely puberulent and very densely resinous-punctate beneath, aromatic, dark- or mid-green above, paler beneath; inflorescence axillary, capitate, solitary, long-pedunculate; peduncles filiform, ascending, about 3 cm. long, glabrous; heads leafy-bracted, subglobose, rather small, 1.5--2 cm. long and wide; bracts foliaceous, very conspicuous, ovate, about 1 cm. long and 5 mm. wide, apically acute, glabrous, spreading or reflexed, more or less hiding the flowers and completely hiding the fruit; corolla hypocrateriform, small, about 1 cm. long in all, dull reddish-purple.

The type of this distinctive species was collected by R. M. Harley, S. J. Mayo, R. M. Storr, T. S. Santos, and R. S. Pinheiro (in Harley 19226) in a region of open scrub to closed low woodland in the drier areas, 19.5 km. southeast of Morro de Chapéu, on highway BA.052 to Mundo Novo, by the Rio Ferro Doiço, at about 900 m. altitude, in an area of waterworn horizontally bedded sandstone at the soil surface, with damp sand, sedge marsh, exposed rock, and waterfalls. Bahia, Brazil, on March 2, 1977, and is deposited in the herbarium of the Jardim Botânico, Rio de Janeiro, Brazil. The species has much the aspect of L. pseudo-thea (A. St.-Hil.) Schau. and L. rhodocnemis Mart. & Schau., but is easily distinguished from these by its leaf characters.

ADDITIONAL NOTES ON THE GENUS PETITIA. V

Harold N. Moldenke

PETITIA DOMINGENSIS var. POEPPIGII (Schau.) Mold.

Additional bibliography: Mold., Phytologia 43: 277--278. 1979.

Additional & emended citations: BAHAMA ISLANDS: New Providence: Curtiss 136 [May 18] (G, K, L, Le, Mu--3978, N, N, P, Vt, W--428641); Ledin 260 (N). CAYMAN ISLANDS: Cayman Brac: Millspaugh 1164 (B, F--611624, N). Grand Cayman: Crosby, Hesperheide, & Anderson 40 (Ld, Mi). CUBA: Camaguey: Poeppig s.n. [Las Piedras, Febr. 1824] (B--type, B--isotype, B--photo of type, Br--isotype, Cb--isotype, Cb--isotype, E--119129--isotype, K--photo of type, Mu--1423--isotype, N--isotype, N--photo of type, N--photo of isotype, N--photo of isotype, P--isotype, S--photo of type, V--isotype, X--isotype, Z--photo of type, Z--photo of isotype, Z--photo of isotype); Roig, Luaces, & Arango s.n. [Herb. Roig 823] (Es).

Havana: Herb. Sauvalle s.n. (N); León 7671 (N). Las Villas: Alain 3964 (W--2288251, Z); Britton, Britton, & Cowell 10244 (N); Combs 169 (B, E--118706, F--357978, G, Io--33784, K, Ka--61168, N, W--1431129); R. A. Howard 6588 (N, W--1844107); León 9584 (W--1047956); León & Clément 6688 (Ha, N); León & Loustalot 9542 (N); Rowe 8389 (A, N). Oriente: Ekman 4679 (B, S), 9316 (N, S, W--2113441); López Figueiras 438 (W--2287282); N. Taylor 319 (N); C. Wright 428 [Herb. Sauvalle 1783] (B, Bm, Hv, Hv, K, L, N, P, Pa, Ph, Tl, W--58033), 428 [1856-7] (Cb, D--612068, G, K), 428 [Jan.-Jul. 1859] (G), 428 [1859, 1860] (E--118700, S), 428 [1860] (Ca--936793, D--612069, E--118705, N, Os, V), 428 [1860-4] (G, Os, S, T, T, V), 1353 (B, Br), 1353 [Jan.-Jul. 1859] (G, K), 1353 [1860] (Cb, Cb, D--612067, E--118701, N, Os, X). Pinar del Río: Ekman 1863 [Herb. Roig 3094] (Es, S). ISLA DE PINOS: Jennings 669 (N), 676 (Cm, N); Killip 42961 (W--2111967), 43923 (W--2176022), 44168 (W--2176199), 44898 (W--2112971); C. V. Morton 10120 (W--2350726), 10154 (W--2350753). HISPANIOLA: Dominican Republic: Ekman H.12648 (B, Ld, N, S, W--1711565); Fuertes 195 (B, Bm, Cb, Cb, Cb, Cp, E--706520, Ed, F--385167, G, K, L, Le, Le, Lu, Mu--4244, N, Ol, P, P, S, Ut, W--658264); Howard & Howard 8848 (N, W--21108641); J. J. Jiménez 955 (W--1882921), 2133 (W--1957798); Türckheim 3633 (N); Valeur 273 (A, Cb, Cb, E--983932, F--715205, Mi, Mi, N, S, W--1273663), 981 (K, K, W--1557112). Haiti: Buch 977 (B); Ekman H.85 (Ld); Nash & Taylor 1395 (B, F--450757, N), 1396 (N, W--792217, W--792218); Proctor 10926 (W--2229142).

PETITIA URBANII Ekm. in Urb., Arkiv Bot. 21A (5): 94. 1927.

Additional & emended bibliography: A. W. Hill, Ind. Kew. Suppl. 8: 178. 1933; Hill & Salisb., Ind. Kew. Suppl. 10: 168. 1947; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 311--312, fig. 133. 1957; Anon., Biol. Abstr. 52 (15): B.A.S.I.C.S. 187. 1971; Mold., Biol. Abstr. 52: 8221. 1971; Mold., Fifth Summ. 1: 97 & 101 (1971) and 2: 594 & 897. 1971; Mold., Phytologia 21: 148. 1971; Alemán Frías, Aurich, Ezcurra Ferrer, Gutiérrez Vázquez, Horstmann, López Rendueles, Rodríguez Graquitená, Roquel Casabella, & Schreiber, Die Kulturpfl. 19: 422. 1972; Farnsworth, Pharmacog. Titles 8 (8): xvi. 1973; Hocking, Excerpt. Bot. A.21: 115. 1973; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 311--312, fig. 133. 1974.

Additional & emended illustrations: Alain in León & Alain, Fl. Cuba, imp. 1, 4: 311, fig. 133 (1957) and imp. 2, 2: 311, fig. 133. 1974.

Alain (1957) lists this species from "Tortuga", but this is not the Tortuga Island off the northern coast of South America. Instead, it is the Ile de la Tortue, Haiti.

ADDITIONAL NOTES ON THE GENUS PITRAEA. V

Harold N. Moldenke

For a detailed explanation of the herbarium acronyms used in this and all others in my series of notes on this and other genera, see my Fifth Summary 2: 795--801 (1971).

PITRAEA Turcz.

Additional bibliography: Feldman & Gracia, *Phytopath. Zeit.* 90: 87--90. 1977; López-Palacios, *Fl. Venez. Verb.* 503 & 652. 1977; Anon., *Roy. Bot. Gard. Kew Lib. Curr. Awaren.* 9: 23. 1978; Feldman & Gracia, *Biol. Abstr.* 66: 2922. 1978; Mold., *Phytologia* 40: 263, 466, 506, & 516. 1978; A. L. Mold., *Phytologia* 40: 361. 1978; Prosperi & Cocucci, *Kurtziana* 12/13: 78. 1979; Rogerson, Becker, & Prince, *Bull. Torrey Bot. Club* 106: 62. 1979.

López-Palacios (1977) places the genus Phelloderma Miers in the synonymy of Priva Adans., but this is incorrect -- it clearly belongs in the synonymy of Pitraea.

PITRAEA CUNEATO-OVATA (Cav.) Caro

For bibliography see under the genus as a whole.

Feldman & Gracia (1977) report finding the alfalfa mosaic virus (AMV) on this host in Mendoza, Argentina, as well as on Origanum vulgare, Convolvulus arvensis, Physalis viscosa, P. mendocina, and Chenopodium album.

ADDITIONAL NOTES ON THE GENUS PSEUDOCARPIDIUM. I

Harold N. Moldenke

For a detailed explanation of the herbarium acronyms used in this and all others in my series of papers on this and other genera, see my Fifth Summary 2: 795--801 (1971).

PSEUDOCARPIDIUM Millsp.

Additional synonymy: Pseudocarpium Millsp. ex Mold., *Résumé Suppl.* 3: 35, in syn. 1962.

Additional & emended bibliography: Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 1, 2: 1213--1214. 1895; Millsp., *Feddes Repert. Spec. Nov.* 7: 285--286. 1909; A. R. Northrop in J. I. Northrop, *Naturalist Bahamas* 180, 204, & 211. 1910; Fedde & Schust., *Justs Bot. Jahresber.* 53 (1): 1077 (1932) and 57 (2): 404. 1938; Jacks. in Hook. f. & Jacks., *Ind. Kew.*, imp. 2, 2: 1213--1214. 1946; Metcalfe & Chalk, *Anat. Dicot.* 1035, 1037, & 1041. 1950; Angely,

Cat. Estat. Gen. Bot. Fan. 17: 5. 1956; Mold., Phytologia 7: 91--104 (1959) and 7: 112--118, 123, 293, 300, & 305. 1960; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 1213--1214. 1960; Mold., Biol. Abstr. 35: 1465 & 2177. 1960; Mold., Phytologia 7: 321, 326, & 511. 1961; Hocking, Excerpt. Bot. A.5: 45. 1962; F. A. Barkley, List Ord. Fam. Anthoph. 76 & 201. 1965; Mold., Phytologia 12: 6. 1965; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 927. 1966; J. J. Jiménez, Cat. Fl. Doming. Supl. 1: 219. 1966; Kundu & De, Bull. Bot. Surv. India 10: 406. 1968; Anon., Torrey Bot. Club Ind. Am. Bot. Lit. 3: 309. 1969; Mold., Fifth Summ. 1: 6, 93, 97, 99, 103, & 368 (1971) and 2: 604, 614, 618, 713, 716, 719, 723, 727, 731, 758, & 906. 1971; Alemán Frías, Aurich, Ezcurra Ferrer, Cutiérrrez Vázquez, Hortsmann, López Rendueles, Rodríguez Graquintena, Roquel Casabella, & Schreiber, Die Kulturpfl. 19: 422. 1972; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 8, 951. 1973; Farnsworth, Pharmacog. Titles 8 (8): xvii. 1973; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 280 & 314--316, fig. 136. 1974

PSEUDOCARPIDIUM AVICENNIOIDES (A. Rich.) Millsp.

Additional & emended bibliography: Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 1213. 1895; Millsp., Feddes Repert. Spec. Nov. 7: 285. 1909; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 1213. 1946; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 314 & 315. 1957; Mold., Phytologia 7: 96--98. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 1213. 1960; Mold., Biol. Abstr. 35: 1465. 1960; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 97 (1971) and 2: 713 & 906. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 314 & 315, fig. 136. 1974.

Additional & emended illustrations: Alain in León & Alain, Fl. Cuba, imp. 1, 4: 315, fig. 136 (1957) and imp. 2, 2: 315, fig. 136. 1974.

Recent collectors have encountered this species in coastal thickets and at altitudes up to 100 meters, flowering in July and November.

Additional citations: CUBA: Oriente: Alain 838 (W--2287997); Clémente 2236 (W--2288435); León 12375 (W--2289347); Morton & Alain 8944 (W--2285076).

PSEUDOCARPIDIUM DOMINGENSE (Urb. & Ekm.) Mold.

Additional bibliography: Fedde & Schust., Justs Bot. Jahresber. 57 (2): 404. 1938; Mold., Phytologia 7: 99--100. 1959; Hocking, Excerpt. Bot. A.5: 45. 1962; J. J. Jiménez, Cat. Fl. Doming. Supl. 1: 219. 1966; Mold., Fifth Summ. 1: 103 (1971) and 2: 716 & 906. 1971.

Recent collectors describe this species as a shrub, to 4 m. tall, with ascending branches and gray or grayish-green fruit, and have found it growing in open thickets on limestone, at 50--100 m. altitude, flowering and fruiting in June and November. The corollas are said to have been "blue" on Liogier 16914 and Liogier & Liogier 23322.

Additional citations: HISPANIOLA: Dominican Republic: A. H. Lic-

gier 16914 (N, W--2801652, Z); Liogier & Liogier 23322 (N). Haiti: Ekman H.4532 (Ld), H.6996 (Ld), H.7096 (Ld), H.8489 (Ca--608087--isotype).

PSEUDOCARPIDIUM ILICIFOLIUM (A. Rich.) Millsp.

Additional & emended bibliography: Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 1213. 1895; Millsp., Feddes Repert. Spec. Nov. 7: 285 & 286. 1909; A. R. Northrop in J. I. Northrop, Naturalist Bahamas 180, 204, & 211. 1910; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 1213. 1946; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 314, 315, & 545. 1957; Mold., Phytologia 7: 100--102. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 1213. 1960; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 97 & 368 (1971) and 2: 719 & 906. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 314 & 315. 1974.

Northrop (1910) records this species from Andros island in the Bahamas, but this is an error. The species on Andros is P. wrightii Millsp.

PSEUDOCARPIDIUM MULTIDENS (Urb.) Mold.

Additional & emended bibliography: Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1077. 1932; Mold., Phytologia 7: 102--104. 1959; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 97 (1971) and 2: 723 & 906. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 314--316. 1974.

PSEUDOCARPIDIUM PUNGENS Britton

Additional & emended bibliography: Alain in León & Alain, Fl. Cuba, imp. 1, 4: 314, 316, & 545. 1957; Mold., Phytologia 7: 104 (1959) and 7: 112. 1960; Mold., Biol. Abstr. 35: 1465 & 2177. 1960; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 97 (1971) and 2: 906. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 314 & 316. 1974.

PSEUDOCARPIDIUM RIGENS (Griseb.) Britton

Additional & emended bibliography: Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 1214 (1895) and imp. 2, 2: 1214. 1946; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 314, 316, & 545. 1957; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 1214. 1960; Mold., Phytologia 7: 112--114. 1960; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 97 (1971) and 2: 727 & 906. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 314 & 316. 1974.

Recent collectors have encountered this species on serpentine barrens and "charrascales", at 300--400 m. altitude, flowering and fruiting in July.

Additional citations: CUBA: Oriente: Carabia 3581 (N); León & Alain 19277 (W--2289718); León, Clémente, & Howard 20388 (W--2289792); Morton, Alain, & López F. 8783 (W--2284939).

PSEUDOCARPIDIUM SHAFERI Britton

Additional synonymy: Pseudocarpidium shaferi Britton ex Moldenke apud Hocking, Excerpt. Bot. A.5: 45. 1962.

Additional & emended bibliography: Alain in León & Alain, Fl. Cuba, imp. 1, 4: 314, 316, & 545. 1957; Mold., Phytologia 7: 114-115. 1960; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 97 (1971) and 2: 614 & 906. 1971; Alemán Frías, Aurich, Ezcurra Ferrer, Gutiérrez Vázquez, Horstman, López Rendueles, Rodríguez Graquitená, Roquel Casabella, & Schreiber, Die Kulturpfl. 19: 422. 1972; Farnsworth, Pharmacog. Titles 8 (8): xvii. 1973; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 280 & 314-316. 1974.

PSEUDOCARPIDIUM WRIGHTII Millsp.

Additional synonymy: Pseudocarpium wrightii Millsp. ex Mold., Résumé Suppl. 3: 35, in syn. 1962.

Additional & emended bibliography: Millsp., Feddes Repert. Spec. Nov. 7: 285-286. 1909; Alain in León & Alain, Fl. Cuba, imp. 1, 4: 314, 316, & 545. 1957; Mold., Biol. Abstr. 35: 2177. 1960; Mold., Phytologia 7: 115-118. 1960; Hocking, Excerpt. Bot. A.5: 45. 1962; Mold., Fifth Summ. 1: 93, 97, 99, & 368 (1971) and 2: 614, 713, 727, 731, & 907. 1971; Alain in León & Alain, Fl. Cuba, imp. 2, 2: 314 & 316. 1974.

Recent collectors describe this species as a small arborescent shrub or multitrunked shrubby tree, 2-6 m. tall, the trunk to 15 cm. in diameter at breast height, the leaves coriaceous, the flower-buds blue, and the fruit green, yellow-green, or greenish-yellow. They have encountered it on rocks and on limestone rock outcrops, on valley slopes, in serpentine soil, scattered over rock-flats, in pitted or dense wooded coppices, and "in thorn-scrub on dogtooth limestone platforms at the seashore", flowering from May to July and in September, fruiting in January, June, and July. Hill refers to it as "locally common".

The corollas are said to have been "deep-blue" on Howard 5027, "light-blue" on Webster & al. 76, "midnight-blue" on Correll 43489, "blue-violet" on Gillis 8045, and "blue-purple with white spots on the lower petal" on Howard & al. 115.

The Gillis 8045 & 9803, cited below, are said to have come from shrubs introduced from Andros island.

Additional citations: BAHAMA ISLANDS: Andros: Correll & Proctor 47866 (N); S. R. Hill 3357 (N); J. Popenoe s.n. [Nov. 16, 1965] (Ft--2207). North Andros: Correll, Sauleda, Stevenson, Miller, & Fehling 49328 (N). South Andros: D. S. Correll 43489 (N). CUBA: Havana: León 5215 (W--2289133). Las Villas: Hodge & Howard 5027 (Ca--913805); R. A. Howard 5027 (Mi); Howard, Briggs, Kamb, Lane, & Ritland 5 (Ca--999021), 115 (Ca--999113, Mi); C. V. Morton 10507 (W--2350980), 10510 (W--2350983); Webster, Dressler, Jones, Schubert, & Wilson 76 (N). CULTIVATED: Florida: Gillis 8045 [FG-65-332] (Ba, Ft--2599), 9803 (Ba).

ADDITIONAL NOTES ON THE GENUS RECORDIA. II

Harold N. Moldenke

The herbarium acronyms used in this and all others in my series of generic notes are fully explained in my Fifth Summary 2: 795--801 (1971).

RECORDIA Mold.

Bibliography: Mold., *Phytologia* 1: 99--101, 104, & 105, fig. 13. 1934; Anon., *Field Mus. News* 5 (12): 3. 1934; J. E. Clark, *Card-Ind. Gen. Sp. Var. Pl. issue* 144 (2 cards). 1934; Mold., *Phytologia* 1: 171--174. 1935; *Record, Trop. Woods* 44: 41. 1935; A. W. Hill, *Ind. Kew. Suppl.* 9: 233 & 305. 1938; Mold., *Revist. Sudam. Bot.* 6: [15] & 24--25. 1939; Mold., *Known Geogr. Distrib. Verbenac.*, ed. 1, 40 & 99. 1942; Mold., *Alph. List Cit.* 1: 59. 1946; Mold., *Known Geogr. Distrib. Verbenac.*, ed. 2, 97 & 195. 1949; Mold., *Alph. List Cit.* 3: 968 (1949) and 4: 1010 & 1117. 1949; Angely, *Cat. Estat. Gen. Bot. Fanerog.* 17: 6. 1956; Herter, *Revist. Sudam. Bot.* 10: 260. 1956; Anon., *U. S. Dept. Agr. Bot. Subj. Ind.* 15: 14359. 1958; R. C. Foster, *Contrib. Gray Herb.* 184: 170. 1958; Mold., *Résumé* 114, 407, 424, & 468. 1959; F. A. Barkley, *List Ord. Fam. Anthoph.* 76 & 203. 1965; Mold., *Phytologia* 12: 6. 1965; Airy Shaw in J. C. Willis, *Dict. Flow. Pl.*, ed. 7, 955. 1966; Anon., *Torrey Bot. Club Ind. Am. Bot. Lit.* 3: 304 & 306. 1969; Mold., *Fifth Summ.* 1: 5, 6, & 183 (1971) and 2: 756 & 906. 1971; Airy Shaw in J. C. Willis, *Dict. Flow. Pl.*, ed. 8, 981. 1973; Troncoso, *Darwiniana* 18: 297, 301, 304, 370--372, & 411, fig. 24 & 25. 1974.

RECORDIA BOLIVIANA Mold.

For bibliography see under genus as a whole.

Illustrations: Mold., *Phytologia* 1: 105, fig. 13. 1934; Troncoso, *Darwiniana* 18: 371 & 372, fig. 24 & 25. 1974.

Recent collectors refer to this species as a "small tree in lane near river covered with hanging white flowers, faintly scented, attracting quantities of butterflies and moths; very hot and dry, then tremendous storms and floods roll in, almost flat vegetation dense, soil sandy", and have found it growing at 500--600 m. altitude, flowering in January and November.

Troncoso (1974) notes that "Recordia parece ser un género dioico, los dos ejemplares estudiados (Werdermann 2707 y Troll 969) presentan los óvulos abortados (reducidos a sus tegumentos) lo cual indicaría que se tratan de ejemplares masculinos. Por otra parte el hecho de no haberse hallado material con fruto apoyaría también esta conjetura. Pertenece a la subfamilia Verbenoideae como lo establece Moldenke, pero su ubicación en la tribu Petreeae Briq., debe considerarse provisoria hasta no conocerse bien la estructura del fruto." She cites Troll 969 and Werdermann 2707 in

the Berlin herbarium and J. Steinbach 7240 and 7296 in the Lillo herbarium.

Additional citations: BOLIVIA: Santa Cruz: Brooke 5958 (N, S); J. Steinbach 7240 (Ed--isotype, Ra--30/2719--isotype), 7296 (Ed, N, Ra--30/2717, Ut--97617); Troll 969 (B, Mu).

ADDITIONAL NOTES ON THE GENUS REHDERA. II

Harold N. Moldenke

For a detailed explanation of the herbarium acronyms employed in this paper and in all the other papers in my series of notes in this journal, see my Fifth Summary 2: 795--801 (1971).

REHDERA Mold.

Bibliography: Blake, Proc. Biol. Soc. Wash. 34: 45. 1921; P. C. Standl., Contrib. U. S. Nat. Herb. 23: 1237 & 1239. 1924; P. C. Standl., Journ. Wash. Acad. Sci. 14: 243. 1924; A. W. Hill, Ind. Kew. Suppl. 7: 50. 1929; Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1071. 1932; P. C. Standl., Trop. Woods 37: 37. 1934; J. A. Clark, Card-Ind. Gen. Sp. Var. Pl. issue 149 (7 cards), 1935; Mold., Feddes Repert. Spec. Nov. 39: 47--55, pl. 196. 1935; Record, Trop. Woods 46: 35. 1936; C. L. Lundell, Carnegie Inst. Wash. Publ. 478: 75. 1937; A. W. Hill, Ind. Kew. Suppl. 9: 67, 233, & 305. 1938; P. C. Standl., Field Mus. Publ. Bot. 18: 1013. 1938; Mold., Revist. Sudam. Bot. 6: [15] & 25--27. 1939; Mold., Prelim. Alph. List Inv. Names 17. 1940; Calderón & Standl., Fl. Salvador., ed. 2, 235. 1941; Mold., Alph. List Inv. Names 14. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 18, 20--23, & 99. 1942; Mold., Alph. List Cit. 1: 58, 88, 177, 204, 316, 318, & 319. 1946; Reko, Bol. Soc. Bot. Mex. 4: 35. 1946; Mold., Alph. List Inv. Names Suppl. 1: 5. 1947; Mold., Alph. List Cit. 2: 337, 340, 390, 426, 447, 502, & 503 (1948), 3: 679 & 821 (1949), and 4: 1000, 1040, 1041, 1048, 1053, 1069, & 1070. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 32, 36--40, & 195. 1948; Angely, Cat. Estat. Gen. Bot. Phanerog. 17: 6. 1956; Herter, Revist. Sudam. Bot. 10: 260. 1956; Anon., U. S. Dept. Agr. Bot. Subj. Ind. 15: 14359. 1958; Mold., Résumé 38, 42, 44, 45, 47, 256, 257, 259, & 468. 1959; Langman, Select. Guide Lit. Flow. Pl. Mex. 515 & 1010. 1964; F. A. Barkley, List Ord. Fam. Anthoph. 76 & 203. 1965; Mold., Phytologia 12: 6. 1965; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 956. 1966; Anon., Gen. Costa Ric. Phan. 10. 1966; Fournier, Imp. Tree Fam. Costa Ric. 13. 1966; Mold., Résumé Suppl. 16: 3. 1968; Anon., Torrey Bot. Club Ind. Am. Bot. Lit. 3: 304 & 306. 1969; Gibson, Fieldiana Bot. 24 (9): 179 & 221--224, fig. 43. 1970; Lowden, Taxon 19: 23. 1970; Mold., Fifth Summ. 1: 5, 6, 73, 80, 82, 84--86, 88, 434, & 435 (1971) and 2: 617, 786,

& 906. 1971; Rouleau, Taxon Index Vols. 1-20 part 1: 315. 1972; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 8, 982. 1973; Molina R., Ceiba 18: 48 & 66 (1974) and 19: 96. 1975; Mold., Phytologia 31: 378 & 379 (1975), 40: 488 & 510 (1978), and 41: 450 & 510. 1979.

REHDERA PENNINERVIA Standl. & Mold.

Additional synonymy: Citharexylum pinninervium Standl. ex Mold., Feddes Repert. Spec. Nov. 39: 50, in syn. 1935; Prelim. Alph. List Inv. Names 17, in syn. 1940. Rehdera pinninervia (Standl. ex Mold.) Standl. & Mold. ex Mold., Fifth Summ. 2: 617, in syn. 1971. Rehdera penninervis Standl. & Mold. ex Mold., Fifth Summ. 2: 617, in syn. 1971.

Bibliography: Mold., Feddes Repert. Spec. Nov. 39: 50--51. 1935; C. L. Lundell, Carnegie Inst. Wash. Publ. 478: 75. 1937; A. W. Hill, Ind. Kew. Suppl. 9: 233. 1938; Mold., Revist. Sudam. Bot. 6: 25--26. 1939; Mold., Carnegie Inst. Wash. Publ. 522: 194--195. 1940; Mold., Prelim. Alph. List Inv. Names 17. 1940; Mold., Suppl. List Common Vern. Names 16. 1940; Mold., Alph. List Inv. Names 15. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 20 & 99. 1942; Mold., Phytologia 2: 111. 1944; Mold., Alph. List Cit. 1: 32 (1946), 2: [327] (1948), and 4: 1069. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 36 & 195. 1949; Mold., Résumé 42, 257, & 468. 1959; Gibson, Fieldiana Bot. 24 (9): 222. 1970; Mold., Fifth Summ. 1: 80, 82, & 435 (1971) and 2: 617, 786, & 906. 1971; Mold., Phytologia 40: 488. 1978.

Recent collectors describe this species as a shrub or tree, 4--41 m. tall, the trunk to 60 cm. in diameter at breast height, the bark gray, finely fissured, the nodes enlarged, the leaf-scars "facing forwards", the leaves decussate, with transparent glands and with a distinctive odor when crushed, the flowers aromatic, the calyx green, and the fruit green or greenish-red. They have found it growing in high or low forests, wet or dry tropical woods, on rocky hills and broken ridges, on savannas with trees and shrubs, on the borders of lakes, in acahual, corozal, and zapotal on pinal trails, along riverbanks, in hogback hammocks, covering the ruins in ramonal, along roadsides, on wooded limestone hillsides, and in "upland sapodilla forests in heavy clay soil over calcareous substratum", at 140--600 m. altitude, flowering from September to January, and fruiting from October to March. Eglar refers to it as "occasional".

The corollas are said to have been "white" on Contreras 1864, 7098, 7198, 7296, & 9556, Molina 15656, Ortíz 65 & 1434, and Proctor 29603 and "yellow" on Ortíz 1916. A wood sample accompanies Ortíz 65 and is MADw23127 at the Forest Products Laboratory, Madison, Wisconsin. Vernacular names reported for the species are "hinge hinge", "palo blanco", "papelillo", "raspa sombrero", "roble del mico", and "roble de meco".

Gibson (1970) separates the two taxa accepted by her in this genus as follows:

Leaf-blades usually obtuse or rounded apically, rarely acute or short-acuminate; fruiting-calyx sinuately denticulate.....

R. trinervis.

Leaf-blades apically acuminate or long-acuminate; fruiting-calyx subtruncate.....R. penninervia.

Material of R. penninervia has been misidentified and distributed in some herbaria as Citharexylum sp. or even as Moraceae.

Additional citations: MEXICO: Chiapas: Pennington & Sarukhán K. 9533 (N). GUATEMALA: El Petén: H. H. Bartlett 12317 (Au-isotype, Ca--72689--isotype, Ca--593672--isotype, Ca--593778--isotype, Du--353989--isotype, Ld--isotype); Contreras 1864 (Ld, S), 5434 (N), 6829 (Au--278532, Ld, Ld, W--2558715), 7196 (Au--279677, Ip, Ld, Ld), 7198 (Ld, Ld, S), 7296 (Au--278968, Ld, Ld), 9556 (Ld, Ld), 10352 (Ld, Ld, W--2795423); Egler 42-248 (Sm); C. L. Lundell 16696 (Au--228034, Ld), 16747 (Au--228033, Ld, N, S), 16765 (Au--228035, Ld, S); Molina R. 15656 (N); Ortiz 65 [tree no. 16, cod. 8311] (N, Ws), 539 (N), 1434 (N), 1916 (N). BELIZE: Contreras 7098 (Au--280484, Ld, Ld); Gentle 5204 (Au--224733, Ld, Ld, Mi, N, S, W--2572680), 6987 (Au--239640, Ld, Ld, Ld, Ld, W--2480331); Liesner & Croat 1568 (W--2800457); Proctor 29603 (Ld), 29888 (Ld).

REHDERA TRINERVIS (Blake) Mold.

Additional synonymy: Citharexylum macaodripin Standl. ex Calderón & Standl., Fl. Salvador., ed. 2, 236, in syn. 1941.

Bibliography: Blake, Proc. Biol. Soc. Wash. 34: 45. 1921; P. C. Standl., Contrib. U. S. Nat. Herb. 23: 1237 & 1239. 1924; P. C. Standl., Journ. Wash. Acad. Sci. 14: 243. 1924; A. W. Hill, Ind. Kew. Suppl. 7: 50. 1929; Fedde & Schust., Justs Bot. Jahresber. 53 (1): 1071. 1932; P. C. Standl., Trop. Woods 37: 37. 1934; Moldenke, Feddes Repert. Spec. Nov. 39: 52--54, pl. 196. 1935; A. W. Hill, Ind. Kew. Suppl. 9: 233. 1938; P. C. Standl., Field Mus. Publ. Bot. 18: 1013. 1938; Mold., Revist. Sudam. Bot. 6: 26--27. 1939; Mold., Carnegie Inst. Wash. Publ. 522: 195. 1940; Mold., Prelim. Alph. List Inv. Names 16 & 17. 1940; Calderón & Standl., Fl. Salvador., ed. 2, 236. 1941; Mold., Alph. List Inv. Names 14 & 15. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 18, 21--23, & 99. 1942; Mold., Phytologia 2: 111. 1945; Mold., Alph. List Inv. Names Suppl. 1: 5. 1947; Mold., Alph. List Cit. 1: 58, 88, 177, 204, 228, 229, 316, 318, & 319 (1946), 2: 337, 340, 390, 426, 447, 502, & 503 (1948), 3: 679 & 821 (1949), and 4: 1000, 1040, 1041, 1048, 1051, 1053, & 1070. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 32, 37, 38, 40, & 195. 1949; Mold., Résumé 38, 44, 45, 47, 256, 259, & 468. 1959; Langman, Select. Guide Lit. Flow. Pl. Mex. 515. 1964; Mold., Résumé Suppl. 16: 3. 1968; Gibson, Fieldiana Bot. 24 (9): 222--224, fig. 43. 1970; Mold., Fifth Summ. 1: 73, 84, 85, 88, 434, & 437 (1971) and 2: 906. 1971; Molina R., Ceiba 19: 96. 1975; Mold., Phytologia 41: 450. 1979.

Illustrations: Mold., Feddes Repert. Spec. Nov. 39: pl. 196.

1935; Gibson, Fieldiana Bot. 24 (9): 223, fig. 43. 1970.

Gibson (1970) reduces R. mollicella Standl. & Mold. to synonymy under R. trinervis, but I still feel that the two taxa are separate, albeit perhaps not on a specific level. She cites R. trinervis from "Dry, brushy, often rocky plains and hillsides, 200--800 meters; Baja Verapaz; Chiquimula; Jutiapa. Mexico; Honduras; El Salvador; Nicaragua; Costa Rica."

Recent collectors describe R. trinervis as a shrub or tree, 3--15 m. tall, the trunk to 25 cm. in diameter at breast height, the branches many, arching, very leafy, and the flowers fragrant. They have encountered it in forests and advanced deciduous forests, as well as in matorrales on rocky hills, at altitudes of 125--1300 m., flowering from May to July, fruiting in July and December. Molina comments that it is "frequent". The corollas are said to have been "white" on Molina 14321, "green" on Molina 7075, and "pale-green" on Lundell & Lundell 7812.

Vernacular names reported for this species are "llyao", "sacuisilche", and "saquilzciché". Material has been misidentified and distributed in some herbaria as Schoepfia sp. in the Olacaceae. On the other hand, the Allen & Armour 7107, Molina R. 1432, 13008, & 14350, Tonduz 13792 [Herb. Inst. Physico-geogr. C.R.; Pittier], and Williams, Molina R., Williams, & Molina 42882, distributed as and in some cases previously cited by me as typical R. trinervis, actually are better regarded as f. mollicella (Standl. & Mold.) Mold.

Additional citations: MEXICO: Quintana Roo: Lundell & Lundell 7812 (Au--192508, Ld, Ld, Ld, N, Se--165559, Ws). Yucatán: G. F. Gaumer 24096 (Gg--160621); Gaumer & sons 23502 (Du--188792--isotype, Gg--160231--isotype); Lundell & Lundell 7587 (Ld). HONDURAS: Comayagua: Molina R. 7075 (W--2400821), 10984 (N). Cortés: Molina R. 13008 (N). COSTA RICA: Alajuela: Brenes 12690 [13030] (N, Si). Guanacaste: J. T. Howell 10193 (Gg--272294); Jiménez M. 2164 (N, W--2626586).

REHDERA TRINERVIS f. MOLLICELLA (Standl. & Mold.) Mold., Phytologia 41: 450. 1979.

Bibliography: Mold., Feddes Repert. Spec. Nov. 39: 51--52. 1935; J. A. Clark, Card-Ind. Gen. Sp. Var. Pl. issue 149. 1935; A. W. Hill, Ind. Kew. Suppl. 9: 67 & 233. 1938; Mold., Revist. Sudam. Bot. 6: 25. 1939; Mold., Prelim. Alph. List Inv. Names 16 & 17. 1940; Mold., Alph. List Inv. Names 14 & 15. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 20 & 99. 1942; Mold., Alph. List Cit. 2: 605. 1948; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 36 & 195. 1949; Mold., Résumé 42, 257, & 468. 1959; Gibson, Fieldiana Bot. 24 (9): 222 & 224. 1970; Lowden, Taxon 19: 23. 1970; Mold., Fifth Summ. 1: 80, 86, & 434 (1971) and 2: 906. 1971; Rouleau, Taxon Index Vols. 1-20 part 1: 315. 1972; Molina R., Ceiba 18: 48 & 66. 1974; Mold., Phytologia 31: 378 & 379 (1975) and 41:

450. 1979.

Recent collectors describe this plant as a shrub or small tree, 3--12 m. tall, the leaves coriaceous and dark-green, the flowers fragrant, and the fruit brown-purple or black. They have found it growing in moist thickets along quebradas, on rocky slopes and riverbanks, on dry plateaus in chaparral, at the edge of bluffs, and in "matorral y breñales", at altitudes of 150--650 m., flowering in June, September, and December, fruiting in October and November. The corollas are said to have been "white" on Molina 14321 & 14350 and "cream" on Standley 9324. Allen & Armour refer to it as "occasional". Vernacular names reported for it are "chicharrón", "jicarillo", "llyayo", and "palillo". Pollen has been taken from Molina 14350 by M. Strick in 1972.

Molina (1974) has recorded this plant from Comayagua, Honduras. Gibson (1970), however, comments that "Since Standley and Moldenke described R. mollicella, numerous intermediate specimens from various localities have been collected, in which some of the smaller leaves appear triplinerved, but with 5--7 pairs of lateral veins in some larger leaves, these anastomosing near the margin or not. Standley 28593 from Honduras, Standley 9412 from Nicaragua, and Jiménez 312 from Costa Rica have leaves that are essentially glabrous but with 5--7 conspicuous pairs of lateral veins. Standley 28600 from Honduras has uniform small, triplinerved leaves, but they are densely pubescent beneath. Molina 14321 and 14350 from Honduras have most leaves triplinerved but all have patches of indument along the costae and most have sparsely scattered pubescence on the lower surface. Calyces of these intermediate specimens are usually glabrous, but a few on Molina 14321 are somewhat puberulent." It is possible that hybridity is involved here.

Material of R. trinervis f. mollicella has been misidentified and distributed in some herbaria as R. trinervis (Blake) Mold. in its typical form.

Additional & emended citations: GUATEMALA: Chiquimula: J. A. Steyermark 31547 (F--1037137, N). El Petén: H. H. Bartlett 12317 (F--652468--type, W--1571066--isotype). Jutiapa: J. A. Steyermark 31754 (F--1037124). Zacapa: J. A. Steyermark 29323 (F--1043325, N), 29352 (F--1042871). HONDURAS: Comayagua: Molina R. 14321 (Ld, N, W--2568449). Cortés: Molina R. 13008 (N). El Paraíso: Williams, Molina R., Williams, & Molina 42882 (N, W--2734939). EL SALVADOR: La Libertad: Allen & Armour 7107 (Ld, N). NICARAGUA: Chontales: P. C. Standley 9324 (N). COSTA RICA: Guanacaste: Tonduz 13792 [Herb. Inst. Physico-geogr. Nat. Costaric. 13792; Pittier 13792] (B, B, Cb, Cb, N, N, W--934960, W--938845).

ADDITIONAL NOTES ON THE GENUS RHAPHITHAMNUS. I

Harold N. Moldenke

A full explanation of the herbarium acronyms herein employed, as in all others of this series of notes in PHYTOLOGIA, will be found in my Fifth Summary 2: 795—801 (1971).

RHAPHITHAMNUS Miers, Trans. Linn. Soc. Lond. Bot. 27: 96. 1870.

Additional synonymy: Poppigia Bertero apud Hook. & Arn., Bot. Beech. Voy., imp. 1, 58. 1832. Poeppigia Bert. ex Spach, Hist. Nat. Veg. Phan. 9: 227. 1840 [not Poeppigia Kunze, 1828, nor Presl, 1830]. Poppigia Hook. & Arn. ex Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 605, in syn. 1894. Raphithamnus Miers ex Dalla Torre & Harms, Gen. Siphonog., imp. 1, 431. 1904. Rhaphithamnus Miers ex Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 486. 1906. Rhaphythamnus Speg., Bol. Acad. Nac. Cienc. Cordoba 25: 51. 1921. Raphitamnus Miers ex Mold., Revist. Sudam. Bot. 6: 27, in syn. 1939. Raphisthamnus Miers ex Mold., Revist. Sudam. Bot. 6: 27, in syn. 1939. Guayunia C. Gay ex Mold. apud Hill & Salisb., Ind. Kew. Suppl. 10: 251, in syn. 1947. Horbleria Pav. ex Mold. apud Hill & Salisb., Ind. Kew. Suppl. 10: 251, in syn. 1947. Volkaria A. Juss. ex Acevedo de Vargas, Bol. Mus. Nac. Hist. Nat. Chile 25: 48, in syn. 1951. Raphithamnus Herter, Revist. Sudam. Bot. 10: 260. 1956. Raphithamnus Dalla Torre & Harms ex Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 953, in syn. 1966. Rhaphitamnus B. D. Jacks. ex Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 989, in syn. 1973. Poeppigia "Bert. ex Fer." apud Troncoso, Darwiniana 18: 411, in syn. 1974. Rhaphidothamnus Phil., in herb.

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Chil. 2: pl. [6] sub Zenaida souleyetiana. 1854; R. A. Phil., Bot. Zeit. 14: 646. 1856; R. A. Phil., Fl. Juan Fern. 106. 1857; Buek, Gen. Spec. Syn. Candoll. 3: 104 & 503. 1858; Bocq., Adansonia, ser. 1, 2: 157 (1862) and ser. 1, 3: 223. 1863; Bocq., Rév. Verbenac. 157 & 223. 1863; Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 207. 1863; Miers, Trans. Linn. Soc. Lond. 27: 95--100 & 108, pl. 26. 1870; Benth. in Benth. Hook. f., Gen. Pl. 2: 1132--1136. 1876; F. Phil., Journ. Bot. Lond. 22: 209 & 210. 1884; Hook., Curtis Bot. Mag. 3: pl. 6849. 1885; Vesque, Ann. Sci. Nat. Paris, sér. 7, 1: 341. 1385; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 550. 1893; Briq. in Engl. & Prantl, Nat. Pflanzenfam., ed. 1, 4 (3a): 144 & 159. 1894; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704 & 1219. 1895; Estud. Fl. Islas Juan Fernand. 15 & 22. 1896; R. A. Phil., Anal. Univ. Chile 90: 624. 1896; Speg., An. Soc. Cient. Argent. 48: [Nov. Add. 1:] 242. 1902; Dalla Torre & Harms, Gen. Siphonog., imp. 1, 431. 1904; Macloskie in W. B. Scott, Rep. Princeton Univ. Exped. Patag. 8 (2): 681 & 693--694. 1905; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 486. 1906; Dalla Torre & Harms, Gen. Siphonog., imp. 1, 864. 1907; Reiche & Phil., Fl. Chil. 5: 272 & 305--306. 1910; M. Kunz, Anatom. Untersuch. Verb. 67--68. 1911; C. K. Schneid., Ill. Handb. Laubholz. 2: 590. 1911; Gilg in Engl., Syllab. Pflanzenfam., ed. 7, 314, fig. 413 G. 1912; Gandoger, Bull. Soc. Bot. France 60: 25. 1915; B. L. Robinson, Proc. Am. Acad. 51: 531. 1916; Skotts., K. Svensk. Vetensk. Handl. 56 (5): 293. 1916; Rivera, Estud. Fl. Bosq. Fray Jorge 17. 1917; Fedde & Schust., Justs Bot. Jahresber. 41: 387. 1918; Gilg in Engl., Syllab. Pflanzenfam., ed. 8, 318, fig. 413 G. 1919; Jaffuel & Pirion, Revist. Chil. Hist. Nat. 25: 387. 1921; Prain, Ind. Kew. Suppl. 5, imp. 1, 215. 1921; Speg., Bol. Acad. Nac. Cienc. Cordoba 25: 51 & 97. 1921; Skotts., Nat. Hist. Juan Fernand. 2 (2): 163. 1922; Wangerin, Justs Bot. Jahresber. 51 (1): 555. 1923; Gilg in Engl., Syllab. Pflanzenfam., ed. 9 & 10, 339, fig. 418 G. 1924; Wangerin, Justs Bot. Jahresber. 46 (1): 368 (1925) and 46 (1): 717 & 718. 1926; Fedde, Justs Bot. Jahresber. 46 (2): 678. 1929; Baeza, Nomb. Vulg. Pl. Silv. Chil., ed. 2, 21, 22, 86, 113, 123, 205, 264, & 265. 1930; F. Phil., Bol. Mus. Nac. Chil. 13: 105. 1930; Petrak, Justs Bot. Jahresber. 49 (2): 313 & 325. 1931; Bonstedt, Pareys Blumengärtn., ed. 1, 272 & 277--278. 1932; Fedde, Justs Bot. Jahresber. 49 (2): 492 (1932) and 51 (2): 353. 1933; Houard, Zoocé. Pl. Amer. Sud 351. 1933; Contrib. Etud. Peupl. Zool. Bot. Iles Pacif. 4. 1934; Espinosa, Revist. Chil. Hist. Nat. 37: 313. 1934; J. Hutchins., Fam. Flow. Pl., ed. 1, 2: 102. 1934; Junell, Symb. Bot. Upsal. 4: 49--52 & 213--214, fig. 91 & 92. 1934; Urb., Pl. Endem. Chil. 144. 1934; L. H. Bailey, Cat. Florists Handl. Verb. [mss.]. 1935; Skotts., Revist. Chil. Hist. Geogr. 78: 148. 1935; Diels in Engl., Syllab. Pflanzenfam., ed. 11, 339, fig. 432 G. 1936; Hambleton, Rev. Argent. Agron. 3: 171. 1936; Makins, Ident. Trees Shrubs 66 & 259, fig. 54 L. 1936; Mold., Feddes Repert. Spec. Nov. 42: 62--82. 1937; Looser, Rev. Univ. Chile 23: 249. 1938; Mold., Alph. List Common Names 2, 3, 11, 12, 14, 25, & 26. 1939;

Mold., Geogr. Distrib. Avicenn. [1], 29, & 41. 1939; Mold., Revist. Sudam. Bot. 6: [15] & 27--30. 1939; Mold., Prelim. Alph. List Inv. Names 15--18, 26, 36, 39, & 40. 1940; Mold., Suppl. List Common Vern. Names 6 & 15. 1940; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 2, 486. 1941; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 574. 1941; Mold., Suppl. List Inv. Names 7. 1941; Wangerin & Krause, Justs Bot. Jahresber. 60 (1): 785. 1941; Mold., Alph. List Inv. Names 13--15, 25, 36, 39, & 40. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 35, 42, 44, 74, 75, 88, & 99. 1942; Junell, Symb. Bot. Upsal. 4: 50. 1945; Mold., Phytologia 2: 111. 1945; Skotts., Pl. & Pl. Sci. Lat. Am. 151 & 152. 1945; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 550 (1946) and 2: 704 & 1219. 1946; Mold., Alph. List Cit. 1: 28, 36, 39, 46, 51, 59, 76, 98, 105, 113, 115, 120, 124, 135, 136, 161, 163, 164, 172, 177, 183, 190, 192, 194, 230, 244, 250, & 265. 1946; Hill & Salisb., Ind. Kew. Suppl. 10: 102, 114, 193, & 251. 1947; Mold., Alph. List Inv. Names Suppl. 1: 5. 1947; E. H. Walker, Contrib. U. S. Nat. Herb. 30: 402. 1947; Mold., Alph. List Cit. 2: 554, 564, 566, 593, 613, 619, 624, 626, & 640 (1948), 3: 668, 700, 713, 728, 736, 738, 750, 775, 807, 812, 813, 823, 824, 843, 894, 917, & 939 (1949), and 4: 1115. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 73, 101, 102, 105, 163, 166, 179, & 195. 1949; Metcalfe & Chalk, Anat. Dicot. 1031, 1032, 1035--1037, 1040, & 1041. 1950; Skotts., Medd. Göt. Bot. Träd. 18: 152. 1950; Acevedo de Vargas, Bol. Mus. Nac. Hist. Bot. Chile 25: 48--49. 1951; Skotts., Veg. Juan Fernand. Isls. 827, 835--837, 889, 890, 896, 902, 905, 907, & 912, pl. 59 (2) & 64 (1). 1953; Douin, Ann. Univ. Lyon., ser. 3, C.8: 82. 1954; Mold., Journ. Calif. Hort. Soc. 15: 85. 1954; Soukup, Biota 1: 29--30. 1954; Angely, Cat. Estat. Gen. Bot. Fanerog. 17: 6. 1956; Bean in Chittenden, Doct. Gard. 1756. 1956; Herter, Revist. Sudam. Bot. 10: 260. 1956; Skotts., Nat. Hist. Juan Fern. 1: 197, 208, & 377. 1956; Anon., Commonw. Mycol. Inst. Ind. Fungi Petrak Cum. Ind. 2: 279. 1957; Anon., U. S. Dept. Agr. Bot. Subj. Ind. 15: 14359. 1958; Mattoon, Pl. Buyers Guide, ed. 6, 236. 1958; Mold., Biol. Abstr. 32: 2353. 1958; Mold., Phytologia 6: 262. 1958; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 486. 1959; Kunkel, Bericht. Schwietz. Bot. Gesell. 69: 287--289. 1959; Kunkel, Willdenowia 2: 227. 1959; Mold., Phytologia 6: 501--502 (1959) and 7: 77. 1959; Mold., Résumé 121, 122, 126, 222, 226, 252--257, 259, 277, 282, 284, 297, 335, 336, 342, 393, 408, 416, 424, 425, 447, & 468. 1959; Mold., Résumé Suppl. 1: 15, 16, & 25. 1959; Muñoz Pizarro, Sin. Fl. Chil. 199, pl. 96 a & b. 1959; Encke, Pareys Blumengärtn., ed. 2, 445. 1960; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 550 (1960) and imp. 3, 2: 704 & 1219. 1960; J. F. Macbr., Field Mus. Publ. Bot. 13 (5): 611 & 688--689. 1960; Muñoz Pizarro, Espec. Pl. Descr. Phil. 109. 1960; Potz-tal in Encke, Pareys Blumengärtn., ed. 2, 439. 1960; Prain, Ind. Kew. Suppl. 5, imp. 2, 215. 1960; Goodspeed, Pl. Hunt. Andes 246. 1961; Runner, Rep. G. W. Groff Coll. 362. 1961; Hocking, Excerpt. Bot. A.5: 44. 1962; Kunkel, Arch. Meteor. Geophys. Bioklimat. 11 (3): 381. 1962; Dalla Torre & Harms, Gen. Siphonog., imp. 2, 431.

1963; Soukup, Biota 5: 38. 1964; F. A. Barkley, List Ord. Fam. Anthoph. 75, 76, 169, 174, 203, & 204. 1965; Hook. & Arn., Bot. Beech. Voy., imp. 2, [Cramer & Swann, Hist. Nat. Class. 39:] 42 & 58, pl. 11. 1965; Mold., Phytologia 12: 6. 1965; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 502, 902, 913, 953, & 963. 1966; Bartrum, Clim. Pl., ed. 2, 151. 1968; Encke, Schönst. Kalt Warmhauspfl. 396--397. 1968; Kunkel, Willdenowia 4: 350--352. 1968; Mold., Résumé Suppl. 16: 22, 23, 25, & 26 (1968) and 17: 3 & 12. 1968; H. Walt., Veget. Erde 2: 190 & 196. 1968; Anon., Torrey Bot. Club Ind. Am. Bot. Lit. 3: 304 & 306. 1969; Soukup, Raymondiana 3: 26 & 81. 1970; Balgooy, Blumea Suppl. 6: [Pl. Geogr. Pacif.] 71, 200, & 221. 1971; Heusser, Pollen & Spores Chile 62 & 82, pl. 58--669 & 58--670. 1971; Mold., Fifth Summ. 1: 5, 6, 192--194, 199, 368, 428--432, 435, 437, 474, & 487 (1971) and 2: 490, 604, 616, 617, 734, 735, 756, 768, & 906. 1971; Plowman, Gyllenhaal, & Lindgren, Bot. Mus. Leaflet. 23: 75. 1971; Anon., Commonw. Myc. Inst. Index Fungi 3: 824. 1972; Encke & Buchheim in Zander, Handwörterb. Pflanzennam., ed. 10, 74 & 442. 1972; Thanikaimoni, Inst. Franç. Pond. Trav. Sect. Scient. Techn. 12 (1): 203. 1972; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 8, 511, 569, 926, 937, 979, & 989. 1973; Mold., Phytologia 26: 509. 1973; Gibbs, Chemotax. Flow. Pl. 3: 1753 & 1754. 1974; Mold., Phytologia 28: 461, 462, & 511. 1974; Troncoso, Darwiniana 18: 297, 301, 302, 304, 380--382, & 411, fig. 29. 1974; Kooiman, Act. Bot. Neerl. 24: 463 & 465. 1975; Mold., Phytologia 31: 407 (1975) and 34: 260 & 509. 1976; Soukup, Biota 11: 21 & 22. 1976; Mold., Phytologia 36: 41 & 509. 1977; Veblen & Ashton, Vegetatio 36: 159. 1978.

Barkley (1965) mistakenly regards the genera Guayunia and Horberleria as valid — both are straight synonyms of Rhaphithamnus, never validly published under the present Code.

Troncoso (1974) comments that "Las semillas de Rhaphithamnus fueron descritas originariamente (Miers, op. cit. 1869) y por autores posteriores (Briquet, 1897 y Moldenke, 1939) como exalbuminadas. El estudio de las mismas me permitió diferenciar una nítida capa de albumen que rodea al embrión (ver. fig. 29, n). Esta capa es difícil de observar en material seco, de ahí probablemente que dicho carácter haya sido mal interpretado." Her material represented R. spinosus.

Bean (1956) describes the genus as one of "About 10 species of shrubs or trees natives of Chile". Briquet (1894) asserts that there is only "1 formenreiche Art in Chile". I accept two valid species with three subspecific taxa.

RHAPHITHAMNUS SPINOSUS (A. L. Juss.) Mold., Feddes Repert. Spec. Nov. 42: 69. 1937.

Additional & emended synonymy: Volkameria spinosa A. L. Juss., Ann. Mus. Hist. Nat. Paris 7: 76. 1806. Volkameria ramis inferioribus ternis, superioribus oppositis; foliis acuminatis, glabris; floribus solitariis, subsessilibus Lam., Encycl. Méth. Bot. 8: 691. 1808. Duranta umbilicata Miers, Trav. Chile 2: 530, nom.

nud. 1826. Citharexylon cyanocarpum Hook. & Arn., Bot. Beech. Voy., imp. 1, 58, pl. 11. 1832. Poppigia cyanocarpa Bert. ex Hook. & Arn., Bot. Beech. Voy. 58, in syn. 1832. Citharexylum verticillatum Klotzsch ex Walp., Repert. Bot. Syst. 4: 73, in syn. 1845. Poeppigia cyanocarpa Bert. ex Walp., Repert. Bot. Syst. 4: 73, in syn. 1845. Volkameria verticillata Ruiz & Pav. ex Walp., Repert. Bot. Syst. 4: 73, in syn. 1845. Citharexylum cyanocarpum Hook. & Arn. ex Schau. in A. DC., Prodr. 11: 609. 1847. Cytharexylon cyanocarpum Hook. & Arn. apud C. Gay, Hist. Fis. Polit. Chil. 5: 34. 1849. Citharexylum ovatum Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 207. 1863. Citharexylum psilacanthum Turcz., Bull. Soc. Imp. Nat. Mosc. 36 (2): 207. 1863. Pöppigia cyanocarpa Bert. apud Miers, Trans. Linn. Soc. Lond. Bot. 27: 96, in syn. 1870. Rhaphithamnus amoenus Miers, Trans. Linn. Soc. Lond. Bot. 27: 97—98. 1870. Rhaphithamnus buxifolius Miers, Trans. Linn. Soc. Lond. Bot. 27: 98—99. 1870. Rhaphithamnus cyanocarpus (Hook. & Arn.) Miers, Trans. Linn. Soc. Lond. Bot. 27: 96—97, pl. 26. 1870. Rhaphithamnus cyanocarpus var. pallida Miers, Trans. Linn. Soc. Lond. Bot. 27: 97. 1870. Rhaphithamnus parvifolius Miers, Trans. Linn. Soc. Lond. Bot. 27: 99. 1870. Duranta umbellata Miers ex Hook., Curtis Bot. Mag. 3: pl. 6849. 1885. Rhaphithamnus amoenus Miers apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704. 1895. Rhaphithamnus buxifolius Miers apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704. 1895. Rhaphithamnus cyanocarpus Miers apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704. 1895. Rhaphithamnus parvifolius Miers apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704. 1895. Rhaphithamnus serratifolius Miers apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704. 1895. Rhaphithamnus macracanthus Gandoger, Bull. Soc. Bot. France 60: 25. 1913. Rhaphithamnus macracanthus Gandoger apud Prain, Ind. Kew. Suppl. 5, imp. 1, 215. 1921. Rhaphithamnus cyanicarpus Miers ex Jaffuel & Pirion, Revist. Chil. Hist. Nat. 25: 387. 1921. Rhaphithamnus cyanocarpus Speg., Bol. Acad. Nac. Cienc. Cordoba 25: 51. 1921. Rhaphithamnus cyanocarpus Miers ex Houard, Zool. Pl. Amer. Sud 351. 1933. Rhaphithamnus cyanocarpus var. moorei Espinosa, Revist. Chil. Hist. Nat. 37: 313, nom. nud. 1934. Rhaphithamnus cyanocarpus Miers ex Hambleton, Rev. Argent. Agron. 3: 171. 1937. Citharexylon cyanocarpum Cham. & Schlecht. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Citharexylon mertensianum Rupr. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Citharexylon verticillatum Klotzsch ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Citharexylum coeruleum Dombey ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Duranta cyanea Lindl. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Guayunia spinosa

C. Gay ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Pöppigia cyanea Bert. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937. Raphithamnus myrtifolius Miers ex Mold., Feddes Repert. Spec. Nov. 42: 70, in syn. 1937. Raphithamnus pallidus Miers ex Mold., Feddes Repert. Spec. Nov. 42: 70, in syn. 1937. Raphithamnus rotundifolius Miers ex Mold., Feddes Repert. Spec. Nov. 42: 70, in syn. 1937. Volkameria uniflora Dombey ex Mold., Feddes Repert. Spec. Nov. 42: 70, in syn. 1937. Citharexylon cyanocarpa Hook. & Arn. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937; Mold., Prelim. Alph. List Inv. Names 15, in syn. 1940. Citharexylon cyanocarpon Hook. & Arn. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937; Prelim. Alph. List Inv. Names 15, in syn. 1940. Citharexylon cyanocarpum Hook. ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937; Prelim. Alph. List Inv. Names 15, in syn. 1940. Citharexylum verticillatum Don ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937; Prelim. Alph. List Inv. Names 18, in syn. 1940. Rhaphithamnus cyanocarpus (Bert.) Miers ex Mold., Feddes Repert. Spec. Nov. 42: 69, in syn. 1937; Prelim. Alph. List Inv. Names 39, in syn. 1940. Rhaphithamnus macranthus Gandoger ex Looser, Revist. Univers. Chil., sec. 3 [Cat. Pl. Vasc. Chil.] 23: 249, in syn. 1938. Raphithamnus parvifolius Miers ex Mold., Revist. Sudam. Bot. 6: 28, in syn. 1939. Citharexylon cyanocarpum C. Gay ex Mold., Prelim. Alph. List Inv. Names 15, in syn. 1940. Citharexylon cyanocarpum Schlecht. & Cham. ex Mold., Prelim. Alph. List Inv. Names 15, in syn. 1940. Citharexylon verticillatum Don ex Mold., Prelim. Alph. List Inv. Names 16, in syn. 1940. Rhaphithamnus cyanocarpa (H. & A.) Miers ex Mold., Suppl. List Inv. Names 7, in syn. 1941. Rhaphithamnus coriaceus Miers apud Hill & Salisb., Ind. Kew. Suppl. 10: 193, in syn. 1947. Rhaphithamnus myrtifolius Miers apud Hill & Salisb., Ind. Kew. Suppl. 10: 193, in syn. 1947. Rhaphithamnus pallidus Miers apud Hill & Salisb., Ind. Kew. Suppl. 10: 193, in syn. 1947. Rhaphithamnus rotundifolius Miers apud Hill & Salisb., Ind. Kew. Suppl. 10: 193, in syn. 1947. Volkaria spinosa A. Juss. ex Acevedo de Vargas, Bol. Mus. Nac. Hist. Nat. Chile 25: 48, in syn. 1951. Citharexylum cyanocarpum Hook. ex Mold., Résumé 252, in syn. 1959. Rhaphithamnus cyanocarpus Miers ex Mold., Résumé 342, in syn. 1959. Rhaphithamnus spinosus Walter, Veget. Erde 2: 190. 1968. Rhaphithamnus spinosus var. spinosus Kunkel, Willdenowia 4: 350. 1968. Raphithamnus cyanocarpus Miers ex Mold., Fifth Summ. 2: 616, in syn. 1971. Raphithamnus spinosus (Juss.) Mold., Fifth Summ. 2: 616, in syn. 1971. Raphithamnus spinosus (A. L. Juss.) Mold., Fifth Summ. 2: 616, in syn. 1971. Rhaphithamnus spinosus Mold., Fifth Summ. 2: 617, in syn. 1971. Rhaphithamnus spinosus (A. Juss.) Mold., Phytologia 28: 462, in syn. 1974. Volkameria uniflora Richard, in herb.

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58-669. 1971; Troncoso, Darwiniana 18: [381], fig. 29. 1974.

Recent collectors describe this plant as a shrub or small shrubby tree, 1.5--6 m. tall, many-stemmed, the stems arching, the young stems bristly with axillary spines, the leaves opposite or ternate, handsome, ovate, about 2 cm. long, pointed, entire, lustrous and dark-green above or the "young leaves glossy black-green", the flowers solitary or in pairs in the leaf-axils, 1.5 cm. long, nodding, and the fruit abundant, very decorative, spherical, blue or bright-blue to blue-purple, purplish, or violet, inedible. The corollas are said to have been "pale-blue" by Makins or "blue" by Wall & Sparre as well as on Aravena 18030 and Sparre 2251 & 2908, 13 mm. long and "pale-violet" by Philippi, "light-blue" on Kausel 2599, "clear-blue" on Morrison 17561, "blue-purple" on West 4727, and "white shading to pale-lilac" on West 4553.

Collectors have found the species growing in dense or open sunny woods, by streams in wooded ravines, in littoral or open forests, very wet rainforests, isolated groves, in Myrtaceae and Drimys woods and Nothofagus forests, on dry plains, along roadsides, and in open fields, at altitudes of 10--900 meters, flowering from September to March, fruiting from October to April and July.

Philippi (1856) notes that in this species the fruits are blue, while in R. venustus they are black. Plowman & al. (1971) report that the fruit is used as an antidote for Latua pubiflora poison in Chile. Makins (1936), Eyerdam, and West erroneously refer to the drupaceous fruits as "berries".

Philippi (1896) says that "Gay dice que se árbol; es por lo comun un arbusto ramificado desde la base que alcanza a lo sumo a la altura de 4 metros, i solo en casos escepcionales toma la forma de árbol....Es cierto, que las hojas son en la planta adulta mui enteras 'integerrimi", pero en la planta jóven i en los renuevos son aserradas en la mitad superior del borde."

Encke (1968) describes the species as "immergrüner, fieder-nerviger Sträucher oder Bäume mit glänzenden, fast sitzenden Blättern, kleinen Blüten und auffallenden, beerenartigen Früchten.. in Mittel- und Südchile zu Hause. Er bildet dort kleine, dicht-zweigige Büsche, die dicht mit kleinen, harten, glänzend dunkel-grünen Blättern besetzt sind und schon in der Jugend leicht blühen. Später sitzen sie dicht voll erbsengrosser, hellblauer Früchte." As to its cultivation, he says: "In England winterharter, bei uns [Germany] kleiner Kalthausstrauch, der im Winter mit Temperaturen von 3--10° vorlieb nimmt. Er wird durch Aussaat oder halb reife Stecklinge im Februar oder August bei mässiger Bodenwärme vermehrt. Im übrigen gleicht seine Pflege völlig der von Coprosma etwa."

Bartrum (1968) asserts that R. spinosus was introduced into English gardens by W. Lobb in 1843 and that it is even now grown in Cornwall, Devon, and Sussex. There is a specimen growing against a wall at the Royal Botanic Gardens, Kew, and another has attained tree-like size in a sheltered middle Sussex garden. Bailey (1935) listed only the Knap Hill Nursery as a source of seeds or plants,

and Mattoon (1958) also lists only a single source. Bean (1956) says that the species "is most satisfactory in the southwest counties [of England] and similar places. Its tenure is insecure in inland places, even against a wall. [It] thrives in loamy soil and is easily propagated by cuttings.... Beautiful in fr[uit]!" Macloskie (1905) avers that "The Indians [=Amerinds of Chile] rub pieces of its wood together in order to strike fire". Miers (1826) comments that it is "Conspicuous for its numerous bright green leaves, accompanied by golden spines and lilac flowers, intermixed with blue shining drupes".

Junell (1934) notes that "Wie sich aus Fig. 91 ergibt, liegt hinsichtlich de Gynäceumbaus grosse Übereinstimmung mit Citharexylum ilicifolium vor. Andererseits liegen aber auch gewisse Verschiedenheiten vor. Die Samenanlagen sind nämlich z.B. basal befestigt, und der Fruchtblattrand ist unter des Samenanlage als Obturator mit langen Drüsenzellen ausgebildet."

Troncoso (1974) has found a small shiny cap of albumen encircling the embryo. She cites as basis for this observation Diem 1705 from Neuquén, Argentina, and Werdermann 55 from San Pedro island, Chiloé, Chile.

Heusser (1971) describes the pollen as "monad, isopolar, radio-symmetric; tricolporate or tetracolporate (stephanocolporate), colpi of moderate length, marked by costae, pores or poroid areas, occurring equatorially, variable in size and definition, their outline somewhat ragged; subprolate, amb circular, subtriangular, or tetragonal; exine ca. 1.5 μ thick, tectate, columellae distinct, tectum foveolate; 55--82 x 48--67 μ ", based on Jiles P. SGO.57572.

Gibbs (1974) reports the HCl/methanol test negative, cyanogenesis absent from the leaves, and syringin doubtfully present. Spegazzini (1921) reports it as host to the parasitic fungi, Phyllosticta raphithamni and Rosellinia costesi. Veblen & Ashton (1978) report it as among the shrubs that took part in a mass movement into the forests due to earthquakes in the Andes of south-central Chile in 1960.

The following vernacular names have been reported: "amyán macho", "arayan de espino", "arrayán de espino", "arrayán espinudo", "arrayan macho", "arrayán macho", "arroyon espinado", "blaufrüchtiger Nadelstrauch", "chaguis", "common prickly-myrtle", "espinillo", "espino", "espino blanco", "espino negro", "guayun", "haumun", "hayún", "huayun", "nayún", "prickly-myrtle", "repu", "repu mayún", and "white thorn".

The type of Volkameria uniflora, listed in the synonymy above, is Dombey s.n. in the Richard herbarium at Paris.

There has been much discussion about the supposed occurrence of R. spinosus in Peru. In my original monograph of the genus in 1937 I cited an A. Cunningham s.n. collection at Kew from Port Laguna, Lambayeque, collected on November 25, 1868. Soukup (1954) says "De las tres Lagunas existentes en el dept. Lambeyeque, se trata de Lagunas, pueblito que no pasa de 200 almas situado en la

proximidad de la desembocadura del río Saña. A primera vista la vegetación demuestra que se trata del típico monte ribereño del Dr. Weberbauer. La búsqueda entre la actual carretera y el mar fue completamente estéril. El Rhaphithamnus exige bastante humedad que por cierto no encontrará en Lagunas. Para aclarar más el se interesante problema solicité la ayuda del Secretario de la Academia Chilena de Hist. Nat. de Chile, Sr. Gualterio Looser. Este pudo examinar el libro de Cunningham: Notes on the natural history of the Strait of Magellan and west coast of Patagonia made during the voyage of H. M. S. 'Nassau' in the years 1866, 67, 68, & 69. Edimburgo 1871. Según se desprende de la lectura del libro se puede afirmar: 1) Que Cunningham, por lo menos en mencionado año por la papeleta, no estuvo en el Perú. De Inglaterra se vinieron por el Atlántico hasta el estrecho de Magallanes y la Patagonia occidental chilena, sin seguir más el norte. Después regresaron a Europa por el estrecho. 2) Que en Chile, no lejos del estrecho de Magallanes existe un Puerto (o Port.) Laguna. Allí estuvo Cunningham, allí abunda de la especie en mención y Cunningham lo cita con el nombre Citharexylon cyanocarpum. De los expuesto se puede creer que Rhaphithamnus spinosus no crece en el Perú y que la localidad mencionada es error de la papelita." Macbride (1960), however, asserts that R. spinosus "probably" occurs in Tacna "since probably collected in Arica", Chile.

A letter to me from my longtime friend, Gualterio Looser, dated January 25, 1940, states, in part: "Fray Jorge: Se trata de una localidad el 'bosque de Fray Jorge' situado en la desembocadura del río Limarí, 30°45' lat. austral, en el litoral de Océano Pacífico (provincia de Coquimbo, Chile). No estoy en situación de mencionarle en el momento ejemplares de herbario de Rhaphithamnus spinosus coleccionados en ese lugar, porque los 2 principales herbarios de Santiago, están momentáneamente cerrados por ser época de vacaciones. Yo no tengo ejemplares de ese lugar, porque no lo he visitado. Pero la presencia de la especie mencionada en el bosque de Fray Jorge, es absolutamente segura, como lo prueban las citas siguientes en los trabajos de Federico Philippi: Una visita al bosque más boreal de Chile -- Boletín Museo Nac. de Chile 13: 96--109. 1930. Esta trabajo es una traducción de un artículo en inglés publicado originariamente en The Journal of Botany, London, July 1884, vol. 32: 202--211. En la traducción el pasaje sobre Rhaphithamnus está en la p. 105 y está mencionado bajo el nombre de Citharexylon cyanocarpum H. & Arn.

"Otro botánico que cita esta especie de Fray Jorge es Álvaro Rivera Matte en su trabajo 'Estudios sobre la flora del bosque de Fray Jorge' 27 pp., Santiago 1917. El pasaje sobre el Rhaphithamnus está en la p. 17.

"Por lo demás Ud., tácitamente, cita también esta localidad en sus trabajos, porque menciona la especie de la prov. de 'Coquimbo'. El bosque de Fray Jorge está en la provincia de Coquimbo y es el único punto de esa región, donde puede crecer el Rhaphithamnus.

"El bosque de Fray Jorge es una localidad famosa en la botánica Chilena, pues es un bosque 'relict' de la notohile subantártica y de carácter netamente higrófilo en medio de la vegetación muy xerófila y subdesértica del resto de la provincia de Coquimbo. En Fray Jorge debido a ciertas circunstancias topográficas y a abundantísimas neblinas que se levantan del océano, se ha conservado una flora con numerosos elementos subantárticos como Hymenophyllum, Asplenium magellanicum, Aetoxicum punctatum, etc., mientras que muchas de estas especies de carácter austral, no vuelven a encontrarse en todo Chile central, sino mucho más al sur, habiendo unhueco de varios centenares de kilómetros entre Fray Jorge y la estación más próxima.

"Como he dicho, la presencia de Rhaphithamnus spinosus en Fray Jorge, es absolutamente segura y además es el límite boreal. Hacia el norte sigue un largo desierto por toda la costa del Pacífico hasta cerce de Guayaquil en la República del Ecuador.

"Por todas estas consideraciones, creo sumamente dudosa la presencia de Rhaphithamnus spinosus en la costa del N. del Perú (Lambayeque) que Ud. cita.....y también, pero sin localidad determinada en Revista Sudamericana de Bot.....Creo que ese ejemplar de Dombey que Ud. menciona estará mal etiquetado y que probablemente lo habrá coleccionado en el sur de Chile, donde también anduvo. En la colecciones antiguas de plantas chilenas y peruanas hay numerosos errores, particularmente en las colecciones de Neé, Dombey, Haenke y otros."

In a letter to me dated August 5, 1940, Looser says "Refiriéndome a una de mis anteriores, copio al pié de la letra las etiquetas de los dos ejemplares más boreales de Rhaphithamnus spinosus (A. L. Juss.) Moldenke que se encuentran en el herbario del Museo Nacional de Historia Natural de Santiago y que fueron examinados por mí.

"1°. Rhaphidothamnus (sic G. L.)

Fray Jorge 30.1.83

ejemplar estéril sin nombre del colector, la etiqueta es da letra de R. A. Philippi. Fray Jorge es la localidad a que ya me ha referido en mis anteriores, situada en la provincia de Coquimbo. El coleccionista fué probablemente Federico Philippi. Cfr. el trabajo de ésta citado en mis anteriores.

"2°. Citharexylon cyanocarpum

Hook. et Arn.

Cuesta del Melon Sept. 1865

sin nombre del colector, letra de la etiqueta de R. A. Philippi. La Cuesta del Melón está en el límite de las provincias del Valparaíso y Aconcagua, más o menos a 32°35' lat. austral."

Looser also writes me that the Lechler "520a", cited by me in my monograph as from Arica, Chile, is actually from Arique in Valdivia province (lat. 39°), as is confirmed by the Stockholm specimen. Since it now seems definitely established that Fray Jorge (lat. 30°) is the northernmost station for this species and that specimens labeled and/or cited from Arica and from Peru are

actually not from those areas, Macbride's supposition that it occurs in Tacna must also be discounted.

Additional & emended citations: CHILE: Aconcagua: Bertero 1258 (F--869051); Kausel 2599 (Lg, N). Arauco: Aravena 10 (Ca--86128); Eights 11 (W--920016). Cautín: Claude-Joseph 596 (W--1057666), 4305 (W--1284493), 4836 (W--1343757, W--1421529); Kausel 4836 (S); Kunkel 101 (Z); Sparre 3191 (S), 3409 (S), 3428 (S), 3486 (S). Chiloe: Junge 57 (Mu), 71 [52] (B); Landrum 874 (Mi); Morrison 17561 (Ba, Ca--633090); Sparre 4441 (S). Concepción: Junge 2061 (Ba, Ug--8591); Rufz & Pavon s.n. (F--842447). Coquimbo: Ellenberg 4674a (Ac); Jiles 1688 (S); Sparre 2908 (S). Llanquihue: Erlanson & MacMillan 21 (W--1544751); Ljungner 1128 (Go), 1129 (Go); Looser 4000 (N); Flowman 2610 (Oa); Shannon & Shannon 37 (W--1544453); Skog 1082 (W--2705195); Sparre 3762 (S), 3904 (S), 4229 (S), 4273 (S), 4380 (S), 4527 (S); Wall & Sparre 23 (S), s.n. [14/1/47] (Ew), s.n. [16/1/47] (Ew, Ew); Werdermann 55 (Ca--238428, E--909970, F--549178, W--1233067); Yunge 52 (E--1028959). Magellanes: Cunningham s.n. [Port Laguna, Nov. 25, 1868] (K). Malleco: Sparre 3325 (S), 5142 (S). Valdivia: Aravena 18030 (Ca--665930); Beku 1181 (Ca--498615, E--1029342); Boelcke 223 (N); Buchtien s.n. [1896] (W--1177979), s.n. [Valdivia, 24.X.1904] (La, Vt, Ws); Eyerdam 10686 (W--2372168); Gunckel 84 (F--633777), 2442 (Ca--483155, E--1022708); H. Krause s.n. [Coral] (W--1690243); Lechler 520 ["520a"] (Bm, K, Ol, P, S, Us, V, X); R. A. Philippi 1294 (W--1323228), 1295 (W--1323229), s.n. [Jan. 1883] (F--640015), s.n. [San Juan] (W--616686), s.n. (Vt); Sargent s.n. [23.I.1906] (E--118669); Sparre 2251 (Ew), 4648 (S); E. Wall 23 [19/1/47] (Ew). Valparaíso: Claude-Joseph 3632 (W--1283456); Looser 3999 (N); Moldenke & Moldenke 19765 (Es, Lg, Mg, Mr, N, N, No, Ot, S, Sm); C. Skottsberg s.n. [10/4/1955] (S); J. West 4553 (Ca--561654); Wilkes, U. S. Expl. Exped. s.n. [Valparaíso] (W--58255); Zöllner 7829 (Ld). Mocha Island: Kunkel M.11 (Mu, Z). San Pedro Island: Werdermann 55 (Gg--34508). Talcán Island: Marticorena 1743 (Ac). Province undetermined: Claude-Joseph 2374 (W--1189126); Cuming s.n. (F--871235); Dombey 250 ["Perou"] (B--cotype, Cb--cotype, Dc--cotype, Le--cotype, P--cotype, P--cotype, P--cotype, P--cotype, P--cotype), s.n. ["Perou"; Herb. A. L. Jussieu 5025] (B--cotype, B--cotype, B--cotype, B--cotype, B--cotype, B--cotype, B--cotype, F--cotype, N--cotype, N--cotype, P--cotype); Pavon s.n. ["Perou"] (Cb), s.n. [Volk. unifl.] (N). ARGENTINA: Chubut: Burkart 19801 (N); A. Castellanos s.n. [Herb. Inst. Miguel Lillo 118405] (Gg--406034, S), s.n. [Herb. Inst. Miguel Lillo 118406] (S). Río Negro: Cordini s.n. [18.IX.1928] (W--1617357); J. West 4727 (Ca--562012). CULTIVATED: California: Jerabek s.n. [Golden Gate Park, May 1945] (Sd--47924); Walther 44 (Gg--170536), s.n. [Golden Gate

Park, March 1932] (Gg--193157). England: Rehder s.n. [Arb. Kew. March 1898] (Ur). LOCALITY OF COLLECTION UNDETERMINED: Collector undetermined s.n. (Z--photo); Herb. Canby s.n. [S. America] (Pa).

RHAPHITHAMNUS SPINOSUS f. ALBIFLORUS Kunkel, Willdenowia 4: 351. 1968.

Synonymy: Rhaphithamnus spinosus f. albiflora Kunkel ex Mold., Résumé Suppl. 17: 12, in syn. 1968.

Bibliography: Kunkel, Willdenowia 4: 351 & 352. 1968; Mold., Résumé Suppl. 17: 3 & 12. 1968; Mold., Fifth Summ. 1: 194 (1971) and 2: 617 & 906. 1971.

This form differs from the typical form of the species only in having pure white corollas. It is based on Kunkel s.n. from "Lumaco/Chile; Fundo Santa Clara", apparently in the province of Malleco, Chile, collected on October 26, 1958, and deposited at Berlin. Kunkel (1968) comments that "Die Form unterscheidet sich vom typischen R. spinosus (lila-blühend) durch die rein weisse Farbe der Blüten". It is not known from Mocha island as was previously erroneously reported by me.

Citations: CHILE: Malleco: Kunkel s.n. [26.X.1958] (Z--isotype).

RHAPHITHAMNUS SPINOSUS var. INERMIS Kunkel, Willdenowia 4: 351. 1968.

Synonymy: Rhaphithamnus spinosus f. inermis Kunkel ex Mold., Résumé Suppl. 17: 12, in syn. 1968. Rhaphithamnus spinosus f. pseudospinosus Kunkel ex Mold., Résumé Suppl. 17: 12, in syn. 1968.

Bibliography: Kunkel, Willdenowia 4: 351 & 352. 1968; Mold., Résumé Suppl. 17: 3 & 12. 1968; Mold., Fifth Summ. 1: 194 (1971) and 2: 617 & 906. 1971; Mold., Phytologia 34: 260. 1976.

This variety differs from the typical form of the species in having its branches and branchlets unarmed and is based on Kunkel M.202 from "Bergwald (Grate) am Cerro Pastene und der Laguna, selten", on Mocha island, Chile, collected in October 1958 and deposited in the Berlin herbarium. Kunkel (1968) remarks that "Die Äste und Zweige dieser Varietät sind stachellos und unterscheiden sich dadurch von der stacheligen var. spinosus". It has been found growing at 290 meters altitude and is described as a bush.

Citations: CHILE: Llanquihue: Grau s.n. [14.3.1968] (Mu). Mocha Island: Kunkel M.201 (Z), M.202 (Z--isotype), M.212 (Mu).

RHAPHITHAMNUS SPINOSUS f. MICROPHYLLUS Kunkel, Willdenowia 4: 351. 1968.

Synonymy: Rhaphithamnus spinosus f. dentatum Kunkel ex Mold., Résumé Suppl. 17: 12, in syn. 1968. Rhaphithamnus spinosus f. dentatus Kunkel ex Mold., Résumé Suppl. 17: 12, in syn. 1968. Rhaphithamnus spinosus f. microfolius Kunkel ex Mold., Résumé Suppl. 17: 12, in syn. 1968.

Bibliography: Kunkel, Willdenowia 4: 351. 1968; Mold., Résumé Suppl. 17: 3 & 12. 1968; Mold., Fifth Summ. 1: 192 & 194 (1971)

and 2: 617 & 906. 1971.

This form differs from the typical form of the species in its smaller leaves, the blades of which are only 0.8—1 cm. long and 0.3—0.7 cm. wide, the margins dentate. It is based on Kunkel M.199 from Cerro Victoria, at 120 m. altitude, on Mocha island, Chile, collected in October 1958 and deposited in the Berlin herbarium. The corollas are described as "lilac" in color when fresh and the fruit "dark-lilac". It has been collected in flower and fruit in January. Kunkel's proposed (later abandoned) f. dentatus is based on his M.200, also from Mocha island.

Citations: CHILE: Fresia Island: Heins 3064 (N). Mocha Island: Kunkel M.199 (Mu--isotype), M.200 (Z), M.203 (Z).

RHAPHITHAMNUS VENUSTUS (R. A. Phil.) B. L. Robinson, Proc. Amer. Acad. 51: 531. 1916.

Additional & emended synonymy: Citharexylum elegans Phil. apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 549. 1893. Citharexylum venustum Phil. apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 550. 1893. Rhaphitamnus longiflorus Miers apud Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 704. 1895. Citharexylon venustum Phil. ex Skotts. Nat. Hist. Juan Fernand. 2 (2): 163, in syn. 1922. Raphithamnus venustus (Phil.) Skotts. apud Wangerin, Justs Bot. Jahresber. 51 (1): 555. 1923. Rhaphithamnus venustus B. L. Robinson apud A. W. Hill, Ind. Kew. Suppl. 6: 173. 1926. Rhaphithamnus elegans Deless. ex Hill & Salisb., Ind. Kew. Suppl. 10: 193. 1947. Rhaphithamnus lucidus C. Gay ex Hill & Salisb., Ind. Kew. Suppl. 10: 193. 1947. Rhaphitamnus venustus (R. A. Phil.) B. L. Robinson ex Mold., Phytologia 31: 407, in syn. 1975. Rhaphithamnus venosus Gay, in herb.

Bibliography: R. A. Phil., Bot. Zeit. 14: 646. 1856; R. A. Phil., Fl. Juan Fern. 106. 1857; Miers, Trans. Linn. Soc. Lond. Bot. 27: 98--99. 1970; R. A. Phil., Anal. Univ. Chile 90: 624. 1896; Reiche & Phil., Fl. Chil. 5: 306. 1910; B. L. Robinson, Proc. Amer. Acad. 51: 531. 1916; Skotts., Nat. Hist. Juan Fernand. 2 (2): 163. 1922; Wangerin, Justs Bot. Jahresber. 51 (1): 555. 1923; Baeza, Nomb. Vulg. Pl. Silv., ed. 2, 120 & 265. 1930; Fedde, Justs Bot. Jahresber. 51 (2): 353. 1933; Mold., Feddes Repert. Spec. Nov. 42: 77--82. 1937; Mold., Alph. List Common Vern. Names 3, 11, & 17. 1939; Mold., Geogr. Distrib. Avicenn. 29. 1939; Mold., Revist. Sudam. Bot. 6: 28--29. 1939; Mold., Prelim. Alph. List Inv. Names 15, 26, 36, 39, & 40. 1940; Fedde & Schust., Justs Bot. Jahresber. 60 (2): 574. 1941; Mold., Alph. List Inv. Names 13, 25, 36, 39, & 40. 1942; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 42 & 99. 1942; Mold., Alph. List Cit. 1: 46, 51, 98, 190, 244, & 265. 1946; E. H. Walker, Contrib. U. S. Nat. Herb. 30: 402. 1947; Mold., Alph. List Cit. 2: 593 (1948) and 3: 736, 738, 750, 812, 843, 917, & 939. 1949; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 102 & 195. 1949; Acevedo de Vargas, Bol. Mus. Nac. Hist. Nat. Chile 25: 49. 1951; Skotts., Veget. Juan Fern. 827, 835--837,

905, 907, & 912, pl. 59 (2) & 64 (1). 1953; Douin, Ann. Univ. Lyon., ser. 3, C.8: 82. 1954; Skottsbo., Nat. Hist. Juan Fern. 1: 197, 208, & 377. 1956; Mold., Résumé 122, 253, 255, 297, 336, 342, & 468. 1959; Muñoz Pizarro, Sin. Fl. Chil. 199. 1959; Muñoz Pizarro, Espec. Pl. Descr. Phil. 109. 1960; Goodspeed, Pl. Hunt. Andes 246. 1961; Heusser, Pollen Spores Chile 62, pl. 58-670. 1971; Mold., Fifth Summ. 1: 194, 368, 429, & 431 (1971) and 2: 525, 604, 616, 617, & 906. 1971; Mold., Phytologia 28: 462. 1974; Troncoso, Darwiniana 18: 382 & 411. 1974; Mold., Phytologia 31: 407. 1975.

Illustrations: Skottsbo., Veget. Juan Fern. 836, fig. 9 a-c, & pl. 59 (2) & 64 (1). 1953; Heusser, Pollen Spores Chile pl. 58-670. 1971.

Recent collectors describe this species as a woody shrub or tree, 1.1--5 m. tall [or "20--30 m." according to Morrison, probably an error for feet], the trunk 5--20 cm. in diameter, spiny, the flowers with much nectar, much visited by hummingbirds, slender, sympetalous, the fruit purple or black, and have found it growing along trailsides in forests and quebradas, in the shade of deep virgin forests, on wooded slopes, and in thickets with Drimys and Fagara, at altitudes of 250--600 meters, flowering from September to May, fruiting in March and December. Solbrig and his associates refer to it as "rare". The corollas are said to have been "purple" on Solbrig & al. 3788 & 3903, "beautiful blue-purple" on Solbrig & al. 3802, "purple-lilac" on Morrison 17334, "violet" on Wagenknecht 18520, "red-violet" on Grandjot & Grandjot s.n., and "RHS Fan 2 Violet 83/A" on Peterson J.1127, while Philippi (1856) refers to them as "dark-violet".

Heusser (1971) describes the pollen of R. venustus as resembling that of R. spinosus "but without a tetracolporate type and appearing most commonly oblate-spheroidal; 53--62 x 50--75 μ ", based on E. Reed SGO.54860, collected in the Juan Fernandez islands in October of 1872.

Vernacular names reported for this species are "arayan macho", "arrayán macho", "espinillo", "juan bonita", and "juan bueno".

Goodspeed (1961) says that "On Masa Tierra in the brush on the trailside, a few hundred feet up I began to notice fallen flowers of a dark mulberry violet tint. They look extremely odd. Soon we came upon the plant which bore them. It was a tall tree belonging to the Verbena family and is known as Rhaphithamnus venustus. This species, closely related to the espino blanco or 'white thorn' of southern Chile, is the only tree native to the Juan Fernandez islands which has spines."

Skottsberg (1953) gives the following firsthand account of the species in its native haunts: "On both islands, common in the forests of Masatierra, especially on the higher humid slopes and ranging west to the south precipice of Cerro Chumacera. Much less frequent on Masafuera, observed from about 440 to 515 m. A middle-sized tree, 6--8 m tall with trunk to 40 cm in diam. Pl. 59: 2 illustrates an unusually large specimen, a good 10 m tall with the distance to the lowest limb 3 m, and a flattened trunk 46 and 26

cm in diam., respectively, 1.5 m above the ground. Bark often covered with foliaceous lichens. Branchlets slender, pendent (Pl. 64: 1), exposing the dark lilac-coloured flowers. Leaves small, firm, dark green, often attacked by Limacina. The tip of a resting shoot apex in August is seen in Fig. 9 a; bud naked, but densely hirsute, as are the young leaves. In Nov.--Dec. the flowers appear; inflorescence a 2-flowered dichasium, ending in a needle-like spine, which, however, is not always developed (Fig. 9b). Below the inflorescence is a serial accessory leaf-bud. As a rule, growth of the innovations is arrested in March, but they produce new leaves and flowers as late as in April or have stopped growing and end in a bud. Other branches of the same order are several dm long and carry axillary spines and accessory buds, and a second bud, barely visible in the leaf axil, may be present (Fig. 9 c); these spines, which bear 1--2 pair of minute scales, will not carry flowers. In the upper axils no spines had been formed. There is a difference between long vegetative 'prolongation' shoots and short vegetative-floral shoots." He reports that he brought seed back to Sweden and a few of these germinated there in 1919. In October, 1924, two live plants remained, but one of these died soon thereafter without having flowered, nor had the other one, still alive in 1952, flowered by then. The Peterson J.1127, cited below, was taken from cultivated material in California, grown from seeds collected by F. G. Meyer in the Juan Fernandez islands as M.9564. Douin (1954) records the species as cultivated in France. Macbride photographed an isotype of the species in the Vienna herbarium as his type photograph number 34319.

Troncoso (1974) cites R. A. Philippi s.n. [1904; Herb. San Isidro 3477] and M. R. Espinosa 36, both from the Juan Fernandez islands and both deposited in the San Isidro herbarium.

Additional & emended citations: JUAN FERNANDEZ ISLANDS: Masafuera: E. Reed s.n. [1869] (K); Skottsberg & Skottsberg 516 (Go, S, Us). Masatierra: Behn s.n. [14.II.1935] (Ca--657869); Chapin 1083 (Bi, G, N); G. T. Hastings 250 (Ca--66245, It, N, W--530177); Kubitzki 188 (Mu); Morrison 17334 (Ba, Ca--630249, Ew, Se--120458); Pisano & Montaldo 1430 (Ca--7286); Skottsberg & Skottsberg 11 (Bm, Go, K, Ol, P, S, Us, W--1093612), 11b (B, Bi, Bm, Cp, Go, S), 35 (W--2751174), 40 (Go, S, Us), 198 (N--photo, S, Z--photo), 625 (Go, S); Skottsberg & Sparre 287 (W--2751081); Solbrig, Moore, & Walker 3788 (Ba, S, W--2531342), 3802 (Ba, N, S, W--2531321), 3903 (Mi, W--2531344); Wagenknecht 18520 (Ca--656710). Island undetermined: Bertero 1498 (E--118670); Bock 51 (E--112116, F--857098, W--1594199); C. Gay s.n. [Juan Fernandez] (F--998383); Germain s.n. [Herb. Mus. Hist. Nat. Chile 54861] (N--photo); Grandjot & Grandjot s.n. [II.1936] (Mu); R. A. Philippi 788 [Macbride photos 34319] (F--976268--photo of isotype, Kr--photo of isotype, N--photo of isotype, W--photo of isotype). CULTIVATED: Pennsylvania: J. W. Peterson J. 1127 (Ba).

ADDITIONAL NOTES ON THE GENUS PRIVA. VI

Harold N. Moldenke

Since the publication of my monograph of this genus in 1936 and its five supplements (1954--1967) much additional information has become available to me and this is summarized in the present paper. Full explanation of the herbarium acronyms employed herein, as they were in the original monograph and the 5 previous supplements, as well as in all my series of generic notes in the present journal, will be found in my Fifth Summary 2: 795--801 (1971).

PRIVA Adans., Fam. Pl. 2: 505. 1763.

Additional & emended synonymy: Blairia Houst. ex L., Gen. Pl., ed. 1, 334, in syn. Jan. 1737; Adans., Fam. Pl. 2: 12 & 526. 1763 [not Blairia Gaertn., 1847, nor. Gled., 1751, nor L., Oct. 1737, nor Spreng., 1966]. Blaeria Houst. ex Spach, Hist. Nat. Veg. Phan. 9: 227. 1840 [not Blaeria L., 1737 & 1753]. Streptium Boiss., Fl. Orient. 4: 533, in syn. 1879; Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 1074, in syn. 1966. Blairia L. (Jan. 1737) apud Post & Kuntze, Lexicon 70, in syn. 1904. Busseria Loefl. apud Knuth, Feddes Repert. Spec. Nov. Beih. 43: [Init. Fl. Venez.] 604, in syn. 1927. Cavanitus Barkley, List Ord. Fam. Anthoph., ed. 2, 76 & 150, in syn. 1965. Tortula "Roxb. ex Willd." apud Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 1130, in syn. 1966. Blairia "Houst. ex Adans." apud G. Taylor, Ind. Kew. Suppl. 13: 18 & 149. 1966. Blairia Adans. apud Airy Shaw in J. C. Willis, Dict. Flow. Pl., ed. 7, 138, in syn. 1966.

Additional & emended bibliography: Dill. in Ray, Synop. Meth. Stirp. Brit., ed. 3, pl. 302, fig. 389. 1724; L., Crit. Bot. 17--19, 89, 90, 94, 111, & [275]. 1737; L., Gen. Pl., ed. 1, 334 & [387]. 1737; L., Meth. Sex. Gen. Pl. 17--19, 89, 90, 94, 111, [275], [300], & [304]. 1737; L., Gen. Pl., ed. 2, 12 & 26 (1742), ed. 3 ["2"], 10 (1743), and ed. 4, 10. 1752; L., Sp. Pl., ed. 1, imp. 1, 1: 19 & 112 (1753) and ed. 1, imp. 1, 2: 601. 1753; L., Syst. Nat., ed. 10, 2: 852. 1759; L., Sp. Pl., ed. 2, 28 & 471. 1762; Adans., Fam. Pl. 2: 12, 198, 505, & 594. 1763; L., Gen. Pl., ed. 6, 14. 1764; Crantz, Inst. Rei Herb. 1: 572. 1766; [Retz.], Nom. Bot. 11. 1772; Scop., Introd. Hist. Nat. 169. 1777; Jacq., Select. Stirp. Amer. Hist. 8. 1788; J. F. Gmel. in L., Syst. Nat., ed. 13, imp. 1, 2: 41 (1789) and ed. 13, imp. 2, 2: 41. 1796; Roesch., Nom. Bot., ed. 3, 3. 1797; Ruiz & Pav., Fl. Peruv. Chil. 1: 21. 1797; Vent., Tabl. Reg. Veg. 2: 322--323. 1799; Balbis, Cat. Pl. Hort. Taur., ed. 1, 48. 1804; Desf., Tabl. Écol. Bot., ed. 1, 54. 1804; Willd., Enum. Pl. Hort. Berol. 2: 633--634. 1809; Stokes, Bot. Mat. Med. 1: 39--40. 1812; Balbis, Cat. Stirp. Hort. Acad. Taur., ed. 2, 80. 1813; H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 224--225 (1817) and ed. quarto, 2: 277--279. 1818; Pers., Sp. Pl. 3:

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Gunawardena (1968) explains the derivation of the generic name, Priva, as "Priva, L[atin], privus, separate, private. Fr[uit] enclosed in a large calyx which is tubular and becomes inflated with fruit. Hence it is singular, apart."

Dalla Torre & Harms (1963) divide the genus as follows:

Sect. 1. Castelia Briq.

Sect. 2. Eupriva Schau.

Sect. 3. Aparinaria Schau.

Of these, Section 1 is now segregated as the genus Pitraea Turcz.

Voss (1895) regarded Priva as containing about 9 species; Cooke (1905) says "about 10" species "of the warm regions of both hemispheres"; Baker (1909) says "about 9" species which are "cosmopolitan in the warm regions of both hemispheres". Sanchez (1969) regarded it as having 20 species native to the war, regions of only America and Asia [ignoring the African taxa]. Alain, most recently (1974), gives 17 as the number of species "mainly of tropical regions". I recognize 21 species and 5 subspecific taxa. Pope (1968) avers that Priva is "common to the Hawaiian Islands", but this is untrue — the genus is not known from these islands at all. The plant Pope was referring to was probably Salvia occidentalis Sw. in the Lamiaceae.

Linnaeus, in his Genera Plantarum, regarded Kaempfera Houst. and Sherardia Vaill. as generic synonyms of Priva, but the former actually belongs in the synonymy of Ghinia Schreb. and the latter to that of Stachytarpheta Vahl. Willis (1966) places Phelloderma Turcz. in the synonymy of Priva, as does López-Palacios (1973), but Turczaninow's genus is a synonym of what is now segregated as the genus Pitraea Turcz. Willis also places Zapania Lam. and Zappania Zuccagni in the synonymy of Lippia Houst. and Burseria Loefl. in that of Verbena [Dorst.] L., but actually all three belong in the synonymy of Priva. He lists the homonym, Scorodonia Hill, as a synonym of Teucrium L. in the Lamiaceae. Blairia Adans. is listed by Airy Shaw (1966) as a synonym of Priva, but the Blairia listed by Adanson [Fam. Pl. 2: 198 & 526. 1763] is plainly credited by him to "Houst." The Blairia of Gleditsch

(1751), of Linnaeus (Oct. 1737), and of Sprengel (1966) is a synonym of Elaeria L. [or Kolbia Adans.] in the Vacciniaceae, while that of Gaertner (1847) is Phyla Lour.

López-Palacios (1975) asserts that only a single species of Priva, P. lappulacea (L.) Pers., is known from Venezuela, but that it is found there in practically every state and territory.

The Endlicher (1838) reference in the bibliography above is often cited as "1836-1856", but the page involved here was actually issued in 1838. The Boissier (1879) reference is often cited as "1875", but only pages 1-280 were issued in that year; pages 281-1276 appeared first in 1879. The dates of the Humboldt, Bonpland, and Kunth references were authenticated by Barnhart (1902). The Angely (1971) publication bears the incorrect titlepage date of "1970" and is often so cited. The Fong & al. (1972) reference is sometimes mis-cited to Lloydia volume "25" or "39".

Jackson (1932) records the fungus, Puccinia lantanae Farl. (1883), from various species of Lippia and Lantana and states that this is the proper name for the Puccinia privae Sydow (1907) recorded from Priva. He also gives as synonyms P. accedens Sydow (1902), Uromyces lantanae Speg. (1884), and Uromyces lippiae Speg. (1909). He says that "This very common micro-ferm has a wide distribution extending from Florida and Mexico throughout the West Indies and less commonly in Central America. In South America it is reported from Colombia, Trinidad, Ecuador, Argentina and Brazil. Mesospores often predominate in the sori and the species may at first be mistaken for a Uromyces" [as, apparently, it was by Spegazzini].

Greenway (1969) cites a "G. & K. 12886" and Verdcourt 1109 as undetermined Priva collections from Tsavo East National Park.

The Charette 1769, distributed as Priva, actually is Phryma leptostachya var. asiatica Hara in the Phrymaceae; Reveal & Atwood 3438 is Aloysia macrostachya (Torr.) Mold.; Rzedowski 10265 and Steyermark, Bunting, & Wessels-Boer 100326 are Salvia occidentalis Sw. in the Lamiaceae; and González Quintero 2241 is Teucrium vesicarium Mill. in the Lamiaceae.

PRIVA ADHAERENS (Forsk.) Chiov., Bull. Soc. Bot. Ital. 1923: 115. 1923.

Additional & emended synonymy: Verbena forskâhlei Raeusch., Nom. Bot., ed. 3, 3. 1797. Verbena forskaelii Vahl apud Mirb., Hist. Nat. Pl., ed. 2, 15: 233, in syn. 1805. Verbena forskalii Vahl apud Pers., Syn. Pl. 2: 138, in syn. 1806. Verbena forskhalei Vahl apud Poir. in Lam., Encycl. Méth. Bot. 8: 844, in syn. 1808. Verbena forskoalii Vahl apud E. Mey., Comm. Pl. Afr. Austr. 275, in syn. 1837. Priva forskahlei Vahl apud Boiss., Fl. Orient. 4: 533, in syn. 1879. Priva forskoalaei E. Mey. apud Kobuski, Ann. Mo. Bot. Gard. 13: 9, in syn. 1926. Priva forskoalei E. Mey. spud Kobuski, Ann. Mo. Bot. Gard. 13: 23, in syn. 1926. Priva dentata

L. Juss. ex Chiov., Fl. Somalia 1: 274, in syn. 1929. Priva forskalii E. Mey. apud Chiov., Fl. Somalia 1: 274, in syn. 1929. Priva adhaerens a. forskalii (Vahl) Chiov., Fl. Somalia 1: 274, in syn. 1929. Verbena forskoalaei Vahl apud Alston in Trimen, Handb. Fl. Ceyl. 6: 231. 1931. Priva adherens (Forsk.) Chiov. ex Glover, Prov. Check List Brit. Ital. Somal. 268. 1947. Priva adherens a. forskalii (Vahl) Chiov. apud Glover, Prov. Check List Brit. Ital. Somal. 268. 1947. Priva leptostachya Auct. ex Cuf., Bull. Jard. Bot. Brux. 32: Suppl. 794, in syn. 1962 [not P. leptostachya A. L. Juss., 1806, nor L., 1940, nor H. H. W. Pearson, 1966].

Additional & emended bibliography: Raesch., Nom. Bot., ed. 3, 3. 1797; Pers., Sp. Pl. 3: 348. 1819; Harv., Gen. S. Afr. Fl., ed. 1, 269. 1838; Schau. in A. DC., Prodr. 11: 533—534 & 556. 1847; Buek, Gen. Spec. Syn. Candoll. 3: 367, 494, & 507. 1858; Harv., Gen. S. Afr. Fl., ed. 2, 289. 1868; Boiss., Fl. Orient. 4: 533. 1879; Balf. f., Bot. Socotra 232—233 & 433. 1888; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 628. 1894; T. R. Sims, Sketch Check-list Fl. Kaffr. 62. 1894; J. G. Baker in Thiselt.-Dyer, Fl. Trop. Afr. 5: 285. 1900; Chiov., Fl. Somalia. 1: 274. 1929; Fedde & Schust., Justs Bot. Jahresber. 57 (2): 401. 1938; Mold., Geogr. Distrib. Avicenn. 29—32. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 45, 46, 50, 52, 53, & 99. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 628. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 109, 110, 117, 118, 122, & 195. 1949; Parsa, Fl. Iran 4 (1): 535. 1949; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 628. 1960; Hocking, Excerpt. Bot. A.12: 425. 1967; Mold., Phytologia 14: 394. 1967; Mold., Résumé Suppl. 15: 22 (1967) and 16: 25. 1968; Mold., Biol. Abstr. 49: 4199. 1968; Mold., Fifth Summ. 1: 211, 213, 238, 241, 244, 257, & 265 (1971) and 2: 600, 612, 613, 618, 639, 670, 736, & 905. 1971; Mold., Phytologia 25: 242 & 244 (1973) and 28: 109 & 461. 1974.

The Priva leptostachya of Jussieu, referred to in the synonymy above, is a synonym of P. cordifolia (L. f.) Druce, the homonym erroneously accredited to Linnaeus is Phryma leptostachya L. in the Phrymaceae, while that credited to Pearson is Priva meyeri Jaub. & Spach.

Harvey (1838, 1868) describes all the members of this genus, presumably including the present species (the only one he cites) as "Weed-like herbs.....resembling Verbena, with blue flowers". Evans describes the corollas of P. adhaerens as "blue-purple" and encountered the plant in waste ground and along grassy roadsides. Krauss (1845) found it abundant ["copiose"] near Natal Bay, flowering in October.

The Kassas, Mobarak, & Omar 773, distributed as P. adhaerens, actually is P. cordifolia var. abyssinica (Jaub. & Spach) Mold., while their nos. 1024 & 1025 are a member of the Lamiaceae.

Additional citations: SOUTH AFRICA: Natal: W. E. Evans 35 [30/9/1917] (Ed), 35 [2/10/1917] (Ed).

PRIVA AFRICANA Mold., Feddes Rept. Spec. Nov. 41: 36--37. 1936.

Additional & emended bibliography: Mold., Geogr. Distrib. Avicenn. 32. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 52 & 99 (1942) and ed. 2, 122 & 195. 1949; Anon., U. S. Dept. Agr. Bot. Subj. Index 15: 14358. 1958; Mold., Phytologia 14: 339. 1967; Van der Schijff, Check List Vasc. Pl. Kruger Natl. Park 81. 1969; Mold., Fifth Summ. 1: 252 & 257 (1971) and 2: 905. 1971.

Meeuse encountered this plant on "dry sparse thornveld on alkaline and probably calcareous soil in open places", flowering in April. The corollas on Meeuse 10222 are said to have been "pink" when fresh.

Van der Schijff (1969) found the species growing on grassveld and cites his nos. 2251, 3282, & 3508 from Kruger National Park.

Additional citations: SOUTH AFRICA: Transvaal: Meeuse 10222 (Mu); Stoop M.66 (Mu); I. C. Verdoorn 2069 (Mu).

PRIVA ANGOLENSIS Mold., Bol. Soc. Brot., ser. 2, 39: 131--132. 1965.

Additional bibliography: Anon., Biol. Abstr. 48: 8258. 1967; Hocking, Excerpt. Bot. A.11: 503. 1967; Mold., Biol. Abstr. 48 (18): B.A.S.I.C. S.181. 1967; Mold., Phytologia 14: 339--340. 1967; G. Taylor, Ind. Kew. Suppl. 14: 108. 1970; Mold., Fifth Summ. 1: 244 (1971) and 2: 905. 1971.

Additional citations: ANGOLA: Huila: E. J. Mendes 1650 (Z).

PRIVA ARMATA S. Wats., Proc. Amer. Acad. 25: 160. 1890.

Additional & emended bibliography: Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 347. 1906; Wangerin, Justs Bot. Jahresber. 54 (1): 1170. 1932; Mold., Geogr. Distrib. Avicenn. 14. 1939; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 2, 347. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 18 & 99 (1942) and ed. 2, 31 & 195. 1949; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 347. 1959; Mold., Phytologia 14: 340. 1967; El-Gazzar & Wats., New Phytol. 69: 483 & 485. 1970; Mold., Fifth Summ. 1: 73 (1971) and 2: 905. 1971; El-Gazzar, Egypt. Journ. Bot. 17: 75 & 78. 1974.

Additional citations: MEXICO: Nuevo León: Pringle 1931 (Ms--isotype).

PRIVA ASPERA H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 225. 1817.

Additional synonymy: Priva aspera Humb. & Bonpl. apud Steud., Nom. Bot. Phan., ed. 1, 873. 1821. Priva aspera Kunth apud Schau. in A. DC., Prodr. 11: 534. 1847.

Additional & emended bibliography: H.B.K., Nov. Gen. Sp. Pl., ed. folio, 2: 225 (1817) and ed. quarto, 2: 278--279. 1818; Steud., Nom. Bot. Phan., ed. 1, 873. 1821; Buek, Gen. Spec. Syn. Candoll. 3: 367 & 368. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 628. 1894; Barnhart, Bull. Torrey Bot. Club 29: 590. 1902; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 1, 347. 1906; Loes., Verh. Bot. Ver. Brand. 53: 80. 1912; Wangerin, Justs Bot. Jahresber. 54 (1): 1170. 1932; Mold., Geogr. Distrib. Avicenn. 3, 14--17, & 39. 1939; Durand & Jacks., Ind. Kew. Suppl. 1,

imp. 2, 347. 1941; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 18, 22, 23, 74, & 99. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 628. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 31, 36, 38, 39, 163, & 195. 1949; Durand & Jacks., Ind. Kew. Suppl. 1, imp. 3, 347. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 628. 1960; Mold., Phytologia 14: 340-342 & 394. 1967; Mold., Résumé Suppl. 16: 3. 1968; Gibson, Fieldiana Bot. 24 (9): 219. 1970; Mold., Fifth Summ. 1: 73, 80, 83, 85, 86, 88, 368, & 397 (1971) and 2: 612-614 & 905. 1971; Farnsworth, Pharmacog. Titles 7 (10): xiii. 1972; Fong, Trojánkova, Trojánek, & Farnsworth, Lloydia 39: 147. 1972; Mold., Phytologia 23: 415. 1972; Koolman, Act. Bot. Neerl. 24: 463 & 465. 1975; Molina R., Ceiba 19: 96. 1975.

Recent collectors describe this species as a perennial herb, 1-2 m. tall, with a woody caudex, the mature fruit black, fleshy, and lustrous. They have encountered it along streams, in wet thickets, secondary and mixed forests, small barrancas and gullies, in moist pastures, and on steep heavily wooded slopes, but most usually in cutover pine-oak forests, on grassy slopes with oaks, along open grassy roadsides in the Pinus-Quercus zone on steep hills, and on steep slopes with Quercus, Pinus, and Liquidambar or with Heliocarpus, Croton, and Erythrina, at altitudes of 950-2350 meters, flowering and fruiting from July to January. The vernacular name, "chile hueco", is recorded for it.

The corollas are said to have been "lavender" on Breedlove 14602 & 14712, Gentry 1735, and Roe & al. 1727, "lilac" on Molina 14622 and Williams & al. 42212, "pinkish" on Molina & Molina 25965, "pink" on Stevens & Fairhurst 2014, "purple" on Molina 22516 and Rzedowski 24694, "purplish-pink, the upper lip lined reddish" on McVaugh 17349, and "white" on Williams & Molina 20245.

Ton refers to the species as "common" in Chiapas, Mexico, but Stevens & Fairhurst found it to be "rare" in Nayarit.

The Humboldt, Bonpland, and Kunth publication dates used above have been authenticated by Barnhart (1902).

Loesener (1912) cites Seler 2679 from Chiapas. Material of P. aspera has been misidentified and distributed in some herbaria as Salvia tiliacea Vahl and as Labiatae. On the other hand, the Ventura A. 3840, distributed as P. aspera, actually is P. lappulacea (L.) Pers. and Ventura A. 5801 is P. lappulacea f. albiflora Mold.

Additional & emended citations: MEXICO: Chiapas: Breedlove 11837 (Ld), 14602 (Ld, Mi), 14712 (Ld, N), 29265 (Ld); Breedlove & Raven 13084 (Ld); Seler & Seler 2679 (W-120554); Ton 372 (Ws), 1085 (N), 1416 (Mi, N), 3337 (Ld, Mi). Chihuahua: Pringle 287 (Ca--169176, E--118775, W--154992); Townsend & Barber 422 (E--118772, W--347182). Guerrero: Hinton 9601 (Se--187249), 10687 (Se--187247). Jalisco: F. A. Barkley 35523 (Ld); Díaz Luna 216 (Mi); R. McVaugh 17349 (N); Edw. Palmer 500 (W--43501, W--481205). México: Hinton 4813 (Se--187251); Roe, Roe, Mori, & Rzedowski

1727 (Ld). Michoacán: Arsène 2545 (W--1003564), 2796 (E--844844, W--1003562), 5292 (E--844852, W--1003561), 8696 (E--840008, F--485027, W--1032260), s.n. [N. O. du Punqueto, Sept. 1910] (E--844842, W--1003570), s.n. [19/9/1909] (W--1003566); Hinton 12170 (Se--187250), 13154 (Se--187252), 15625 (Se--187248); King & Soderstrom 4762 (Au--207313). Morelos: Lyonnet 3326 (W--2636395). Nayarit: Gentry, Barclay, & Arguelles 19638 (Ld); Edw. Palmer 1999 (W--305277); Stevens & Fairhurst 2014 (Ln). San Luis Potosí: Parry & Palmer 713 in part (E--118782); J. Rzedowski 24694 (Ip). Sinaloa: Dehesa 1644 (W--1035802). Sonora: H. S. Gentry 1735 (E--1102316). Veracruz: Botteri 319 (W--771867); Bourgeau 2950 (Ca--322966); Purpus 1921 (Ca--139746, E--118808), 5727 (Ca--162550), 8054 (Ca--198450, E--825642, E--825643, W--891457), s.n. [Zacapan] (Ca--139744); Seaton 465 (W--57693). State undetermined: Hahn s.n. [1865--66] (W--43519). GUATEMALA: Alta Verapaz: Türckheim II.1628 (W--1323163, W--1323164); Williams, Molina R., & Williams 42212 (N, W--2707651). Amatitlan: Morales Ruano I.172 (F--601154). El Quiché: Molina R. & Molina 25965 (N). Guatemala: Rojas 64 (W--1166629); Tonduz 715 (W--1084743), Sololá: Degener & Degener 26649 (W--2298779). Department undetermined: Heyde 206 (W--248341). HONDURAS: El Paraíso: Molina R. 14622 (N). Ocotepeque: Molina R. 22516 (N). NICARAGUA: Madriz: Williams & Molina R. 20245 (N). COSTA RICA: Cartago: P. C. Standley 35873 (W--122728). LOCALITY OF COLLECTION UNDETERMINED: Ørsted 11183 (W--1269901). MOUNTED ILLUSTRATIONS: Kobuski drawing 14 (E--925406), 23 (E--925405).

PRIVA AURICOCCEA Meeuse, Bothalia 7: 424--425. 1960.

Additional bibliography: Friedrich-Holzhammer, Meeuse, & Meikle in Merxm., Prod. Fl. Stüd. Afr. 122: 9. 1967; Mold., Phytologia 14: 342--343. 1967; Mold., Résumé Suppl. 15: 8. 1967; Mold., Fifth Summ. 1: 254 (1971) and 2: 905. 1971.

Recent collectors describe this plant as an annual herb, 50--80 cm. tall, erect, and found it in flower in March. The corollas are said to have been "red" in color when fresh on Merxmüller & Giess 30596 and "hell-rosa bis leuchtend rosa" on their no. 30567. Friedrich-Holzhammer and his associates (1967) cite DeWinter & Leistner 5532 from Namibia.

Additional citations: NAMIBIA: Merxmüller & Giese 30567 (Mu, Z-photo), 30596 (Mu).

PRIVA BAHIENSIS P.DC. ex Schau. in A.DC., Prodr. 11: 533. 1847.

Additional & emended bibliography: Buek, Gen. Spec. Syn. Candoll. 3: 367. 1858; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 628. 1894; Peckolt, Bericht. Deutsch. Pharm. Gesell. 14: 465. 1904; Wangerin, Justs Bot. Jahresber. 54 (1): 1170. 1932; Mold., Geogr. Distrib. Avicenn. 26 & 28. 1939. [to be continued]

BOOK REVIEWS

Alma L. Moldenke

"OVER CAPE COD AND THE ISLANDS" by Stephen Proehl, xix & 139 pp., 110 color photos & plates & 2 b/w maps, Houghton-Mifflin Company, Boston, Mass. 02107. 1979. \$11.95 paperbound.

Norton H. Nickerson's Introduction offers the only text in the book save for the legends placed at the end and technical notes on the photography. He states what I would also write: "Mr. Proehl's mastery of aerial photography as well as his understanding of the significance of the Cape to his viewers are skillfully blended in page after page of contemporary scenes....A magnificent [helicopter] journey unfolds in these pictures.....down the north — and east — facing shores the full length of the Cape, and then along the bayshore beach, over the Monomoy Wildlife Preserve, along the south shore of the Cape, and over to the Elizabeth Islands, Martha's Vineyard, and then Nantucket, to end in the enigma of a recently grounded oil tanker." The plates are fascinatingly beautiful.

"GRASSES — An Identification Guide" text and illustrations both by Lauren Brown, x & 240 pp., 3 b/w maps & 170 line draw. fig. Houghton Mifflin Company, Boston, Mass. 02107. 1979. \$9.95.

This is one of the new field guides in the Peterson Nature Library. Since it is planned primarily for the amateur naturalist, especially in the northeastern part of the U. S. A., identification "is based on drawings and descriptive notes of the plant's distinctive features" with the grass and grass-like plants "organized by visual similarity, not always by taxonomic grouping". The author's sketches of plant form and inflorescences are really helpful. The text gives scientific and family names à la Gray's Manual, 8th edition, some common names, size, habitat, whether native or introduced, whether annual or perennial, blooming times and extra items of special interest. An excellent introductory chapter explaining the importance of the grasslands that "cover almost one third of the earth", of the cultivated forms that provide the grain crops for humans and fodder for cattle, of the extensive root systems that are often 90 percent of the plant's weight, of the grasslands of central North America that consist from west to east of short grass prairie or great plains adaptable to ranching, mixed grass prairie or wheat belt, and tall grass or true prairie (our corn belt).

"THE PRINCIPLES OF POLLINATION ECOLOGY" Third Revised Edition by Knut Faegri & Leendert van der Pijl, xi & 244 pp., 54 b/w fig. & 8 tab. Pergamon Press, Oxford OX3 0BW, England & Elmsford, New York 10523. 1979. \$15.00 paperbound.

The 1966 edition of this book was excellent, interesting and well worth the publishing, the 1971 edition was likewise and so is this new one which is also much enriched with new content, illustrations and bibliography, maintaining the authors' senior leadership in the field worldwide. The main topics treated in the 18 chapters are: history, techniques, pollination as spore dispersal, abiotic pollination by wind and water, biotic pollination by insects, mollusks, birds and bats, development of flowers in relation to the mode of pollination, primary and secondary attractants to pollinators, speciation, applied pollination ecology, and several case histories. "Pollination ecology provides examples of some of the most precise, most intricate, and most amazing adaptation in nature....., pollination has provided many 'sabretoothed tigers'.....and similar cases are on the point of occurring under our eyes today: Angraecum, Yucca, Ophrys."

"A FIELD GUIDE TO EDIBLE PLANTS of Eastern and Central North America" by Lee Peterson, xiv & 330 pp., 109 b/w pl. of line drawings, 78 color photo. Houghton Mifflin Company, Boston, Mass. 02107. 1978. \$8.95.

This is a welcome new member of the famous Peterson Field Guide Series. It certainly could prove to be a handy and reliable companion if one is lost in the woods, keeping you sustained until you ultimately got out or are rescued. It might help with food bills in a healthy way, but, most of all, it adds a new dimension to our looking at and for plants. The organization of this field guide is particularly helpful for interested folks not trained with Gray's Manual or such and interesting to those who have been so trained. First is the "Visual and Descriptive Text" grouped by plant type, color of bloom, etc. with excellent line drawings either by the author or by Roger Tory Peterson on the matching right-hand pages. Second is "Finding Edible Plants" with descriptions of the various habitats and listing the likely food species to be found there by seasons. There are 15 beautiful color photographic plates by the author showing 73 of these plants with notes on the left-hand pages. Third is "Food Uses" giving "general information on food preparation and lists by seasons". Careful cautions for conservation and against poisonous plants are given.

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NEW RECORDS OF BOLIVIAN MOSSES

William D. Reese

University of Southwestern Louisiana, Lafayette, LA 70504

The January-April 1978 Projeto Flora Amazônica expedition to the western Amazon Basin collected in the vicinity of Guayaramerín, Bolivia (Dpto. Beni), during the period 24 January-20 February. Preliminary study of the mosses collected reveals several new records for Bolivia, indicated by an asterisk (*) in the list below. A few other mosses are cited also to indicate the character of the bryoflora in the areas visited. All taxa cited here are new records for the state of Beni, according to the recently published review of Bolivian mosses (Hermann, 1976).

The collection numbers are my own; specimens cited are deposited at INPA and NY, with duplicates of most at LAF.

- *Brachymerium coarctatum Bosch & Lac. Underside of large, charred log in swidden, near Guayaramerín, 13000.
- *Bryum apiculatum Schwaegr. On soil in a flower bed, Hotel Sta. Ana, Guayaramerín, 12904.
- *Hydropogon fontinaloides (Hook.) Brid. Attached to shrubs in Rio Yata, ca 40 km SW of Guayaramerín; exposed at time of collection, 12888, 13038.
- Hyophila involuta (Hook.) Jaeg. & Sauerb. On shaded boulders along the Rio Beni at Cachuela Esperanza, ca. 47 km NW of Guayaramerín, 12827, 12834, 12839.
- *Jaegerina scariosa (Lor.) Arz. In thin colonies on tree trunks in the forest; various sites around Guayaramerín, 12860, 12891, 13027, 13101. This species is listed for Bolivia by Hermann (1976), but with a question mark.
- *Leucodontopsis geniculata (Mitt.) Crum & Steere. On tree trunks and fallen branches in the forest; scattered areas around Guayaramerín, 12797, 12902, 13018, 13029.
- Meteoriopsis patula (Hedw.) Broth. On tree trunk, 22 km NW of Guayaramerín, 12814.
- Neckeropsis disticha (Hedw.) Kindb. On shrubs and tree trunks; various sites around Guayaramerín, 12880, 12943, 13021.
- N. undulata (Hedw.) Reich. Rather common on tree trunks, shrubs,

and stumps; vicinity of Guayaramerín, 12811, 12856, 12943 pp., 12954, 12975, 13111, 13121.

Acknowledgements

I thank H. Ochi for determining the Brachymenium and the Bryum, and R. Zander for determining the Hyophila. The Projeto Flora Expedition was supported by the National Science Foundation, the Conselho Nacional de Desenvolvimento Científico e Tecnológico, the New York Botanical Garden, the University of Michigan, the Museu Goeldi, and the University of Southwestern Louisiana.

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Hermann, F. J. 1976. Recopilación de los musgos de Bolivia. The Bryologist 79:125-171.

CERTAMEN MELASTOMATACEIS XXX.

John J. Wurdack

U. S. National Herbarium, Smithsonian Institution

Optimistically, these notes are the final adjustments for the Flora of Ecuador. The text for about 3/4 of the Ecuadorian species of the family has already been sent to Sweden.

MERIANIA ALMEDAE Wurdack, sp. nov.

M. sanguineae Wurdack affinis, foliorum subtus pubescentia longiore calycis dentibus exterioribus eminentibus differt.

Ramuli primum rotundato-quadrangulati non alati demum teretes sicut foliorum subtus laminae petiolique dense pilis barbellatis 0.5-1 mm longis setulosi; ramulorum nodi collo stipuliformi crasso 3-5 mm alto inter petiolos armati. Petioli plerumque 2-4 cm longi ad apicem subtus tuberculis binis 0.5-1 mm longis armati; lamina (6-)8-14 X (3-)4-10 cm ovata apice hebeti-acuto basi rotundato-truncata vel paulo (usque ad 0.5 cm) cordata, subrigida et distanter serrata (serratulis crassis ca 1 mm altis), supra dense aspero-bullata bullis 0.5-1 mm altis, subtus reticulato-foveolata, 7-nervata nervis secundariis plerumque 2-3 mm inter se distantibus nervulis reticulatis. Panicula terminalis multiflora 21-31 cm longa angusta, floribus 5-meris in ramis 0.5-1 cm longis umbellatis; pedicelli 7-9 mm longi sicut hypanthia modice pinoideo-furfuracei (pilis 0.1-0.2 mm longis), bracteolis basalibus ca 0.3-0.5 X 0.1 mm caducis. Hypanthium (ad torum) 3 mm longum; calyx 1.5 mm longus truncatus, dentibus exterioribus crassis 1.2-2 mm eminentibus. Petala 9.2-10.2 X 8-9.2 mm suborbiculari-obovata glabra. Stamina isomorpha glabra; filamenta 5-5.2 mm longa; antherarum thecae 5 X 0.9 mm subulatae, poro dorsaliter inclinato 0.2 mm diam.; connectivum paullulo (0.1-0.2 mm) prolongatum ad basim dorsaliter dente hebeti 2.2 mm longo et appendice hebeti ascendenti 0.5 mm libera armatum. Stigma non expansum; stylus 12 X 0.8 mm glaber in ovarii apicem 0.3 mm immersus; ovarium 5-loculare glabrum apice hebeti-lobulato.

Type Collection: R. M. King & F. Almeda 7917 (holotype US 2850594; isotype CAS), collected on a wet windswept forested ridge 10 km east of Loja on road to Zamora, Prov. Loja, Ecuador, elev. 2480 m, 31 January 1979. "Shrub 2 m, infrequent. Petals crimson red. Filaments and anthers red; appendages yellow."

Meriania sanguinea has the leaf nerves and nervules beneath pubescent with hairs only 0.2-0.3 mm long, as well as obscure non-emergent external calyx teeth. The other two species in this complex also have obsolete external calyx teeth; M. radula (Benth.) Triana lacks interpetiolar cauline flaps and ascending stamen connective tooth and has larger petals, but approximates M. almedae in lower leaf surface pubescence; M. tetragona (Cogn.)

Wurdack has branchlets subulate-quadrate and leaf blades beneath nearly glabrous. All four species occur in Loja.

MERIANIA MACROPHYLLA (Benth.) Triana subsp. MERIDENSIS Wurdack

Because of a printer's error, M. macrophylla subsp. costanensis Wurdack appeared twice in the "Suplemento a las Melastomaceas de Venezuela" (Act. Bot. Venez. 13: 133-134. 1978). D. H. Nicolson believes that this lapsus does not need formal rectification; certainly the descriptions, specimen citation, and discussion of the subspecies should make the correct applications evident. The use of subsp. costanensis for the taxon with leaves glabrate beneath (page 134) is the correct one, the first-published new subspecies (page 133) being subsp. meridensis.

LEANDRA PASTAZANA Wurdack, sp. nov.

Sect. Secundiflorae. L. caquetanae Sprague affinis, foliorum laminis proportionaliter angustioribus supra pilis isomorphis ca 1-1.5 mm longis sparse strigosis subtus uniformiter pilis 1.5-2 mm longis sparsiuscule appresso-setosis differt.

Ramuli primum obtuse quadrangulati demum teretes sicut petioli laminarum subtus venae primariae inflorescentiaeque pilis laevibus incurvis eglandulosis ad basim subreflexis ca 1.5 mm longis induti. Petioli 1.5-2(-3) cm longi; lamina (5-)7-10 X (1.5-)3-4 cm lanceato-elliptica apice gradatim acuminato basi late acuta vel anguste obtusa, membranacea et crenulato-serrulata, supra sparse pilis subappressis ca 1(-1.5) mm longis induta, subtus modice pilis gracilibus 1-2 mm longis setosa, 5(-7)-nervata nervis secundariis 2-3 mm inter se distantibus nervulis subtus planis obscuris areolis ca 0.5-0.7 mm latis. Panicula 3-5 cm longa pauciflora; flores (4-)5-meri in ramulis secundi, pedicellis crassis 0.3-0.7 mm longis, bracteolis 1-1.5 X 0.2-0.3 mm setulosis persistentibus. Hypanthium (ad torum) 2.2-2.5 mm longum dense pilis (1-)1.5(-2) mm longis pro parte glanduliferis setosum; calycis tubus 0.1 mm longus, lobis interioribus 0.7-0.9 mm longis ovato-oblongis, dentibus exterioribus setulosis lobos interiores aequantibus vel paulo (0.1-0.2 mm) superantibus. Petala 2.8-3.1 X 0.5-0.8 mm glabra oblongo-lanceata acuta imperspicue (0.05-0.1 mm) apiculata. Stamina in dimensionibus paullulo dimorphica glabra; filamenta 2-3 mm longa; antherarum thecae 1.1-1.4 X 0.2-0.25 X 0.25-0.3 mm oblongae poro terminali ca 0.1 mm diam.; connectivum ad basim simplex. Stigma non expansum; stylus 4.5-6 X 0.2-0.3 mm glaber; ovarium (4-) 5-loculare et 0.8-0.9 inferum, cono 0.2-0.4 mm alto sparse vel modice pilis glanduliferis 0.2-0.4 mm longis coronato.

Type Collection: A. F. Skutch 4483 (holotype US 1775503; isotype K), collected near Puyo, Prov. Pastaza, Ecuador, elev. 750-1000 m, Sept. 1939. "Shrub 1.2 m. Fl. whitish."

Paratypes (all Pastaza, Ecuador): E. Asplund 19543 (S), from the shore of Río Alpayacu, Mera, elev. ca 1050 m, 2 March 1956 ("Very slender shrub ca 1 m, hairs of calyx reddish violet,

petals white, anthers yellowish white."); G. W. Prescott 399 (NY), from Puyo, 16 Feb. 1953; Ynes Mexia 6847 (US), from between Puyo and Canelos, elev. 325-375 m, 1-3 Feb. 1935 ("Spreading shrub 1.5 m; fls white.").

Leandra caquetana has leaf blades 7(-9)-nerved and with length/width ratio mostly 1.5-2 (rather than 2.3-2.9), the blade pubescence above distinctly dimorphic in size with the long hairs mostly ca 2 mm long and the short ones 0.3-0.5 mm and beneath shorter and mostly confined to the primary and secondary veins, as well as shorter anthers. As currently understood, L. caquetana is somewhat variable in trichome appression on the branchlets and primary leaf veins beneath; the species ranges from Colombia (Putumayo) and Ecuador (Napo, Pastaza) to Peru (Loreto: Killip & Smith 29478 and 29603, Mexia 6437, Schunke 70, Revilla 435, McDaniel & Rimachi 17317 and 17476). Some of the Peruvian material was distributed as L. francavillana Cogn. (which has denser leaf pubescence beneath and eglandular hypanthial hairs). Leandra retropila Cogn. differs from L. pastazana in the more strongly reflexed and finer cauline hairs, eglandular hypanthial hairs, and esetulose ovaries, while L. secunda (Don) Cogn. has petiolar hairs in part gland-tipped, a dense layer of minute glandular hairs along the primary leaf veins beneath, shorter hairs on the upper leaf surfaces, and slightly smaller flowers.

LEANDRA MACDANIELII Wurdack, sp. nov.

Sect. Secundiflorae. L. secundae (Don) Cogn. affinis, foliorum ramulorumque trichomatibus eglandulosis arcte appressis laminarum subtus venulis superficieque non setulosis differt.

Ramuli primum obtuse tetragoni demum teretes sicut petioli laminarum venae primariae supra et subtus inflorescentiaque pilis laevibus appressis eglandulosis ca 0.5-1 mm longis modice induti. Petioli 1-3 cm longi; lamina (4-)-5-9 X 2-4 cm elliptico-ovata apice gradatim acuminato basi late acuta vel obtusa, membranacea et paulo crenulato-serrulata ciliolata, supra in superficie primum sparsissime strigulosi pilis laevibus 0.3-0.5 mm longis eglandulosis demum glabrata, subtus in venis secundariis tertiariisque sparse strigulosa pilis 0.2-0.5 mm longis in venulis superficieque esetulosa, 5-nervata nervis secundariis ca 3-4 mm inter se distantibus nervulis subtus planis areolis 0.2-0.4 mm latis. Panicula 3-5 cm longa pauciflora; flores 5-meri in ramulis secundi, pedicellis obscuris 0.1-0.3 mm longis, bracteolis 0.3-0.7 X 0.1-0.2 mm persistentibus. Hypanthium (ad torum) 2.2-2.7 mm longum densiuscule strigulosum (pilis eglandulosis ca 1 mm longis) pilis glanduliferis subpatentibus debilibus ca 0.5 mm longis modice intermixtis; calycis tubus 0.1 mm longus, lobis interioribus 0.3-0.5 mm longis ovato-oblongis sparse ciliolatis, dentibus exterioribus 0.2-0.4 mm eminentibus setulosis. Petala 2-2.5 X 0.4-0.6 mm oblongo-lanceata glabra. Stamina in dimensionibus paulo dimorphica glabra; filamenta 2.1-2.9 mm longa; antherarum thecae 0.9-1.3 X 0.2-0.25 X 0.25 mm anguste oblongae, poro 0.1 mm diam. paullulo ventraliter

inclinato; connectivum ad basim non prolongatum dorsaliter obscure (0.05 mm) calcaratum. Stigma non expansum; stylus glaber 4-4.5 X 0.2-0.25 mm; ovarium 5-loculare et omnino inferum, apice pilis glanduliferis 0.2-0.3 mm longis sparsiuscule setuloso.

Type Collection: Sidney McDaniel & Manuel Rimachi 17151 (holotype US 2678417), collected in rainforest of Quebrada Yanayacu above Bomonaje, Trocha de Monte Carmelo, Dto. Indiana, Maynas, Depto. Loreto, Peru, 20 May 1973. "1 m tall, flowers white, fruit purple."

Paratypes (all deposited at US): Colombia, Putumayo: Cuatrecasas 10666, from Puerto Porvenir above Puerto Ospina, Río Putumayo, elev. 230-250 m ("Sufrutex de 40 cm; pétalos blancos; frutos rojos"); Koie 5015, from Tres Esquinas, Río Caquetá, elev. 200 m; King & Guevara 6167, from 15 km northwest of Puerto Asís, elev. 300 m ("Ca 0.5 m tall; flowers white"). Ecuador, Morona-Santiago: Cazalet & Pennington 7756, from Taisha, elev. 450 m ("2' shrublet sometimes rooting from nodes. Lvs purple below, fringed with white hairs. Petals white; stamens yellow"). Peru, Loreto: Asplund 14241 ("Flowers white") and Klug 1262 ("Shrub 50 cm; fls white"), both from Mishuyacu near Iquitos, elev. 100 m; Killip & Smith 27349, from Iquitos, elev. 100 m ("Subligneous herb 1.5-2 ft; petals and anthers white"); McDaniel & Marcos 11053, from Río Corrientes between Platanoyacu and mouth of Río Macusari ("Ca 0.3 m tall"); McDaniel & Rimachi 18418, from Río Tigre, Dto. Tigre ("0.5 m tall, corolla white, young fruit green, leaf beneath purple"); McDaniel & Rimachi 18932, from near Lago Chanchama, Río Nanay, Dto. Iquitos ("0.5 m tall, immature fruit green"); McDaniel & Rimachi 18318, from near Nauta road 2-4 km from Quisto Cocha, Maynas, elev. 150 m ("0.5 m tall, fls white"); McDaniel 15301, from Negro Urcu, Río Napo, Maynas, elev. 150 m ("Ca 0.5 m tall; mature fruit red"); Gentry & Revilla 16582, from near Base Araguana, upper Río Mazán north of Santa María de Nanay ("Subshrub 0.2 m, fruits turning red"); José Schunke 2456, from northwest of Santa María de Nanay, Alto Nanay, Maynas, elev. 130 m ("Arbusto 1 m, flores blancas, sepalos rojos violetas; hojas al envés violeta púrpura"); Velarde Nuñez 2459, from Pucallpa, Nishiuya.

Leandra secunda has short gland-tipped hairs intermixed with the longer eglandular ones on the petioles and primary leaf veins beneath, as well as leaf blades above sparsely strigulose with minute hairs and below setulose on the veins and venules. The two taxa are alike in the rather dense leaf venulation and floral features. Leandra secundiflora (DC.) Cogn. rather resembles L. macdanielii in the scanty strongly appressed vegetative pubescence, but differs in the laxer leaf venule areoles, eglandular hypanthial hairs, plumper anthers, and 3-celled ovaries. Despite the obscurely (0.1 mm) glandular-setulose ovary apices, I have referred two Loreto (Peru) collections (Schunke 252, Río Mazán; McDaniel & Marcos 11093, Río Corrientes) to L. secundiflora; the species is perhaps to be expected in Amazonian Ecuador. The interpretation of L. secunda to be used in the Flora of Ecuador is based on notes from the Madrid and

Florence material of Ruiz & Pavón as supplemented by many recent collections; an excellent modern match for the type collection is Killip & Smith 26557 (Junín, Peru) and a good match except for slightly less appressed cauline hairs is Mexia 7270 (Napo, Ecuador). Leandra rotundifolia Macbride is dubiously distinct from L. secunda, differing only in the more patent stem hairs.

BLAKEA JATIVAE Wurdack, sp. nov.

B. megaphyllae Wurdack in nodorum floriferorum membranibus bracteis floribusque affinis, foliorum nervis secundariis minus crebris et pagina subtus pinoideo-puberula differt.

Ramuli robusti paulo compressi sicut petioli foliorum venae primariae subtus pedicellique densiuscule et bracteae (praecipue basim versus) foliorum subtus paginae sparse pilis pinoideis ca 0.05(-0.1) mm longis deciduis induti; floralium nodi crassi processibus membranaceis acuminatis usque ad 5 X 1.5 cm mox lacertis et deciduis armati. Petioli 5-9 cm longi; lamina 20-28 X 14-20 cm paulo obovato-elliptica apice rotundato et abruptissime ca 1 cm acuminato basi acuta et in petiolum anguste decurrenti, tenuiter coriacea et obscure calloso-serrulata, supra glabra, 7-nervata (pari debili 0.5-1 mm inframarginali neglecto) nervis secundariis ca 2.5-3 mm inter se distantibus. Flores in quoque nodo 2(-4), pedicellis 2-3 cm longis; bracteae liberae concavae obscure multivenosae paullulo rigidae intus minutissime pinoideo-puberulae, apicibus hebeti-apiculatis; bracteae exteriores 19-22 X 22-23 mm suborbiculares; bracteae interiores 25 X 21 mm ovato-oblongae; processus tenuiter membranacei ca 11 X 7 mm ca 4 (inter bracteas exteriores et interiores) et 2 (inter bracteas interiores et hypanthium) evoluti. Hypanthium (ad torum) 7 mm longum glabrum; calycis tubus 1.5 mm longus, lobis ovatis ca 5 X 7 mm extus manifeste carinatis. Petala in pagina glabra 27 X 14-15 mm elliptica apice hebeti-obtusum. Filamenta 9 mm longa glabra; antherae 6.5 X 4.5 X 2 mm inter se cohaerentes minute biporosae; connectivum ad basim e filamentum dorsaliter ca 2 mm rotundato-elevato. Stigma non expansum; stylus 12 X 1.5-1 mm minute modice glandulosus; ovarium 6-loculare, cono 5.5 mm alto glabro costulato apice truncato (collo non evolutum).

Type Collection: Carlos Jatíva & Carl Epling 1128 (holotype US 2639753; isotypes NY, US), collected in tall forest at junction of Río San Juan and Río Camumbi near Tobar Donoso, Prov. Esmeraldas, Ecuador, elev. 150 m, 25 July 1966. "Shrub; flowers white."

Blakea megaphylla has glabrous 11-nerved leaf blades with secondary veins 0.5-1 mm apart, calyx lobes only 1.1-1.5 mm long and ovary cone only 3 mm long, but similar bracts, stamens, and style. Other Colombian species with very large leaf blades (B. allotricha Uribe, B. florifera Gleason, B. paleacea Gleason, B. pilosa Gleason, B. squamigera Uribe ex char., as well as several undescribed taxa from Chocó, Valle, and Nariño) all differ in foliar pubescence and/or floral features. I had not previously observed in the genus (but may have missed in dissection) hyaline scales between the usual two pairs of floral

bracts, although B. pilosa apparently does have ciliolate long setae similarly placed.

BLAKEA ERIOCALYX Wurdack, sp. nov.

B. repenti (R. & P.) D. Don affinis, processibus stipuliformibus longioribus stylo glabro ovarii cono paulo brevior differt.

Ramuli nodosi primum obtuse tetragoni demum teretes sicut folia primum villosuli pilis gracillimis ca 2 mm longis caducis; nodi caduce strigosi (pilis 3-5 mm longis) et inter petiolos processibus stipuliformibus demum deciduis 12-15 X 6-7 mm oblongo-lanceatis acuminatis extus glabris intus dense paleaceo-strigosis (pilis 2-3 mm longis) armati. Petioli 2.5-4 cm longi; lamina 15-23 X 8-13 cm elliptica apice abrupte 1-1.5 cm caudato-acuminato basi obtusa, firme chartacea et callosa-serrulata (dentibus ca 0.2 mm altis), ad maturitatem supra glabra et subtus in venis secundariis densiuscule in pagina sparsiuscule pilis 0.1-0.3 mm longis paulo asperis setulosa, 5-nervata (pari debili ca 2 mm inframarginali incluso) vel paulo (usque ad 0.5 cm) pseudoplinervata nervis secundariis ca 3 mm inter se distantibus tertiariis subtus paullulo evolutis. Flores in quoque nodo superiori 4-6, pedicellis 2-2.5 cm longis; bractee omnino liberae firme chartaceae multinervosae obovato-oblongae apice rotundato extus glabrae intus centraliter sparse strigosae (pilis 1-2 mm longis); bractee exteriores 18-20 X 14-18 mm; bractee interiores 20-24 X 15-17 mm. Hypanthium (ad torum) 8-9 mm longum extus modice setulosum pilis crispulis 0.5-1 mm longis intus glabrum; calycis tubus 1.5-2.5 mm longus, lobis 3.5-4 X 6-8 mm oblatis ad basim lateraliter paullulo imbricatis extus modice setulosis intus apicem versus modice strigulosis basim versus glabris. Petala 29-34 X 20-30 mm obovata apice rotundato-truncato sparse caduceque glanduloso-ciliolata alioqui glabra. Filamenta 9 mm longa glabra; antherae 5-6 X 3-3.2 mm inter se cohaerentes, poris binis minutis terminalibus; dens dorso-basalis 1.8-2 mm longus acuminatus. Stigma non expansum; stylus glaber 17 X 1-0.5 mm in ovarii collo 1-1.5 mm immersus; ovarium 6-loculare, cono 1.2-2 mm alto glabro.

Type Collection: E. Asplund 17244 (holotype S), collected at Los Puentes near Nanegal, Prov. Pichincha, Ecuador, elev. 1200 m, 11 August 1955. "Liana; flowers pink."

Paratypes (both Pichincha, Ecuador): A. Sodiro 524b (BR), from "silv. subtrop. v. Gualala, 9/903"; Harling & Andersson 11545 (GB), from mountain rain forest at Palmitopamba ca 10 km NNW of Nanegal, alt. 1300 m, 23 Jan. 1974 ("Shrub ca 1.5 m. Corolla pink").

Blakea repens has oblate stipuliform flaps 2-3 mm long at the young branchlet nodes, glandular-puberulous style, and ovary cone 3.5-5 mm long. For the Flora of Ecuador, the B. repens population complex has not been fragmented, the variability in pubescence of vegetative and reproductive organs and spacing of secondary veins probably intolerable under a simple binomial to a monographer; the salient features include the stipuliform

cauline appendages subtended by setae, the large rounded and free floral bracts, the more-or-less pubescent hypanthia, large calyx lobes, non-expanded stigma, glandular-puberulous style, large ovary cone (with a prominent stylar collar), and well-developed connective spur. Blakea villosa Cogn, from the description and type photograph, seems to be closely related to B. repens, but I have not studied Weberbauer 5032 for stylar and connective appendage features nor has any recent Peruvian material exactly comparable to the type been seen. One of two collections from eastern Ecuador (Acosta Solís 7482, Huamboya, Morona-Santiago; Asplund 19377, Cashurco-Río Zuñag, Pastaza) which are perhaps not conspecific may be referable to B. villosa; the Asplund material apparently differs from the photograph of B. villosa in the densely appressed-setose branchlets and obviously appressed-setose outer surfaces of the bracts and from the more pubescent phases of B. repens in the small anther spurs.

BLAKEA LANUGINOSA Wurdack, sp. nov.

B. eriocalyxi Wurdack affinis, foliorum subtus pubescentia lanata persistenti odororum processibus stipuliformibus oblati longe ciliatis floribus minoribus differt.

Ramuli primum sulcato-quadrangulati demum teretes dense pilis incurvo-erectis 3-5 mm longis demum deciduis induti; nodi dense appresso-setosi pilis robustis 10-16 mm longis et inter petiolos processibus stipuliformibus 4-5 mm longis oblati longe ciliatis demum deciduis armati. Petioli 3-4 cm longi robusti; lamina 16-25 X 9-13 cm elliptica vel oblongo-elliptica apice breviter (ca 5 mm) abrupteque hebeti-acuminato basi obtusa, sub-rigida et obscure distanterque calloso-serrulata, supra glabra, subtus dense persistenterque lanuginosa pilis gracillimis longis laxis et densiuscule pilis 0.1-0.3 mm longis ad basim stellulatis setulosa, 7-nervata (pari exteriori ca 1-1.5 mm inframarginali incluso) nervis secundariis 3-4 mm inter se distantibus. Flores in quoque nodo superiore 4-6, pedicellis 10-12 mm longis; bracteae omnino liberae firme membranaceae late suborbiculares (apice rotundato-truncato) extus glabrae intus centraliter modice strigosae; bracteae exteriores 14-15 X 18-20 mm; bracteae interiores 13 X 19 mm. Hypanthium (ad torum) 6 mm longum dense strigosum pilis gracilibus ca 2 mm longis; calycis tubus 2-3 mm longus, lobis 0.6-1.5 mm longis oblati. Petala glabra 15-20 X 16-18 mm obovata apice rotundato-truncato. Filamenta 4.2-4.4 mm longa glabra; antherae 4-4.5 X 2.3-3 mm, poris binis minutis terminalibus; dens dorso-basalis ca 2 mm longus acutus. Stigma non expansum; stylus glaber in ovarii collo ca 1 mm immersus; ovarium 6-loculare, cono ca 2 mm alto glabro.

Type Collection: Benkt Sparre 17395 (holotype S), collected in secondary rain forest at Km 72 of Chiriboga-Toachi road, Prov. Pichincha, Ecuador, elev. 1500 m, 5 July 1967.

Paratype: Padilla 128 (AAU), from Bancos, northeast slopes of Pichincha, Pichincha, January 1973.

Blakea eriocalyx (vide supra) has the villose cauline and foliar hairs promptly deciduous, the eciliate stipuliform nodal

processes oblong-lanceate and 12-15 mm long, and the larger flowers with more prominent calyx lobes.

BLAKEA PICHINCHENSIS Wurdack, sp. nov.

B. hispidae Markgraf affinis, foliis 7-nervatis bracteis brevioribus antherarum calcaribus dorsalibus acutis differt.

Ramuli teretes sicut petioli laminarum venae primariae subtus pedicellique dense incurvo-setosi pilis laevibus (ad basin expansam ipsam obscure asperis) plerumque (2-)3-4 mm longis; ramulorum nodi processibus stipuliformibus ca 4 mm longis semicircularibus dense ciliatis caducis armati et dense appresso-setosi setis 5-7 mm longis circum petiolorum bases ca 1 mm crasse manicati. Folia in quoque pari in dimensionibus paulo disparilia; petioli 1.5-3.5 cm longi; lamina (9-)12-20 cm longa (acumine excluso) et (4-)6-8.5 cm lata, oblongo-elliptica apice abrupte 2-2.5 cm caudato-acuminato basi late acuta, subcoriacea et obscure distanterque undulato-serrulata, supra primum sparse strigillosa pilis gracillimis mox deciduis subtus in superficie modice setulosa pilis gracilibus paulo crispulis ca 1-1.5 mm longis, 7-nervata (pari exteriori tenui inframarginali incluso) vel paulo (0.5-0.7 cm) plinervata nervis secundariis plerumque 3-4 mm inter se distantibus. Flores in quoque nodo superiore 6-8(-10), pedicellis 2-2.5 cm longis; bractee omnino liberae oblongo-ovatae extus modice appresso-setosae pilis 1-2(-3) mm longis intus ad apicem sparse strigosae alioque glabrae; bractee exteriores 12 X 8 mm, apice per 2-3 mm hebeti-acuminato; bractee interiores 10 X 8 mm, apice hebeti-acuto. Hypanthium (ad torum) ca 3 mm longum extus dense strigosum pilis 2(-3) mm longis; calycis tubus ca 0.8 mm altus, lobis ca 0.7 mm altis oblatis extus dense strigosus. Petala ca 18 X 10 mm obovato-oblonga apice rotundato sparse caduceque glanduloso-ciliolata (0.05 mm) alioqui glabra. Filamenta ca 6 mm longa glabra; antherae inter se cohaerentes ca 4 X 2 mm (connectivis inclusis) ad apicem minute biporosae; dens dorso-basalis ca 1.5 mm longus crassus hebeti-acutus. Stigma non expansum; stylus glaber in ovarii collo ca 1 mm immersus; ovarii conus ca 2 mm altus glaber, apice ca 0.2 mm denticulato.

Type Collection: E. Asplund 17462 (holotype S; isotype S), collected on a rivulet shore at Santa Ana on road from Chiriboga to Santo Domingo de los Colorados, Prov. Pichincha, Ecuador, elev. ca 1400 m, 25 Aug. 1955. "Shrub with few long branches (but hardly climbing); flowers somewhat reddish white."

Blakea hispida (vide infra) has only weakly 5-nerved (and usually smaller) leaf blades, bracts 15-20 mm long, an oblong terminally truncate dorsal appendage on the anthers, and a more-or-less glandular-puberulous style. The two species have qualitatively similar vegetative trichomes and stipular appendages at the branchlet nodes. The Colombian B. stipularis Wurdack seems somewhat more distantly related, having shorter and gradually short-acuminate leaf blades not setulose on the surface beneath, as well as obtuse floral bracts which are deciduously fine-strigulose externally.

BLAKEA HISPIDA Markgraf subsp. STENOPEOTALA Wurdack, subsp. nov.

Florum bracteis hypanthiisque dilute setosis petalis ca 15 X 5-7 mm differt.

Type Collection: Ynes Mexia 7098 (holotype US 1663038; isotype NY), collected in overgrown pastureland at Zatzayacu, Prov. Napo, Ecuador, elev. 400-500 m, 22-28 March 1935.

"Scandent shrub with spreading branches; fls white."

Paratype: Grubb, Lloyd, Pennington, & Whitmore 131 (US), from Talag 15 km SSW from Tena, Prov. Napo, Ecuador, elev. 600 m, 11/7/1960. "Shrub to 8 ft. Fls white."

The typical subspecies, known to me (ex descr.) from the topotypical Harling, Storm, & Ström 9833 as well as two other collections, has bracts externally moderately setose with hairs 2-3 mm long (rather than sparsely, with hairs 1-2 mm long), hypanthia moderately to densely setose with hairs 2-3 mm long (rather than rather sparsely, with hairs 1-1.5 mm long), and petals 20-25 X 9-12 mm. Both collections of subsp. stenopetala had been distributed as B. incompta Markgraf (and indeed the Talag specimen shows more extreme foliar dimorphism than the Zatzayacu material); that species, known from two recent excellent Pichincha collections (Asplund 7316 and 8684) lacks stipuliform flaps at the branchlet nodes, the petals are 15-20 mm wide, the anthers without a dorsal calcar, and the ovary cone without a stylar collar.

BLAKEA SUBVAGINATA Wurdack, sp. nov.

In aspectu superficiali B. subconnatae Triana affinis, antherarum connectivis dorsaliter ad basim cornu armatis differt.

Ramuli robusti primum hinc et inde quadrati demum teretes sicut folia primum indumento appresso amorpho-subsquamato induti mox glabrati; linea interpetiolaris crassa paulo (ca 0.5 mm) elevata evoluta. Petioli 3-6 cm longi basim versus paulo (ca 3 mm) vaginati; lamina 15-23 X 8-15 cm late elliptica apice abrupte per ca 0.5 cm hebeti-acuminato basi late acuta vel obtusa, firme chartacea et essentialiter integra, 5-nervata (pari debili 0.5-1 mm inframarginali neglecto) nervis primariis ad basim obscure a membrana coalitis nervis secundariis principalibus 2-3 mm inter se distantibus. Flores in quoque nodo superiore (2-)4(-6), pedicellis 2-3.5 cm longis apicem versus paulo expansis; bractee liberae membranaceae multinervosae glabrae; bractee exteriores 15-16(-25) X 14-16(-22) mm late obovatae vel suborbiculares apice rotundato et interdum hebeti-mucronulato; bractee interiores 12-15(-19) X 15-19(-22) mm suborbiculares apice rotundato-truncato. Hypanthium (ad torum) 9-10 mm longum glabrum; calycis tubus 1.5-2 mm longus, lobis 1-1.5 X 5-6 mm oblatis paulo emarginatis glabris. Petala glabra 20-24(-28) X (11-)15-20(-28) mm obovata apice rotundato-truncato. Filamenta 9-9.5 mm longa glabra; antherae inter se lateraliter cohaerentes 6-7 X 4-4.5 X 2.3-2.5 mm ad apicem minute biporosae; dens dorso-basalis 1-1.5 mm longus hebeti-acutus. Stigma capitellatum ca 0.4-0.5 mm altum et 1.7-1.8 mm diam.; stylus 15-20 X 1-1.3 mm glaber; ovarium 6-loculare, cono 1.5-2 mm alto

glabro apice truncato collo non evoluto.

Type Collection: E. Asplund 18393 (holotype US 2441366; isotypes NY, S), collected at Río Negro on shore of Río Pastaza, Prov. Tungurahua, Ecuador, elev. ca 1200 m, 12 Nov. 1955. "Epiphytic shrub, petals pink, anthers yellow."

Paratypes (all Ecuador): Harling, Storm, & Ström 9985 (GB, US), from Río Negro, Tungurahua ("Tree 8-10 m high. Corolla pale violet red"); Harling 3853 (NY, S), from Borja (Virgilio Davila, Río Quijos, Napo, elev. 650 m, 15-26 Jan. 1959 ("Large epiphyte; flower fragrant, corolla violet red"); Holger Lugo 89 (GB, US), from Colonia Játiva 15 km from Mera, Pastaza, 4 July 1968 ("Tree 12-15 m high. Corolla rose-coloured"); Dodson & Thien 2018 (US), from Topo on Baños-Puyo road, Pastaza, elev. 1300 m, 9 Jan. 1962 ("Tree 25 ft. high; sepals green; petals pink with some white; anthers yellow; filaments white"); Florman & Davis 4521 (US), from hills above Mera, Pastaza, elev. 1200 m, 24 Nov. 1974 ("Tree 10 m tall in swampy woods. Calyx pale green").

Blakea subconnata has somewhat closer spacing of the secondary leaf veins, ecalcarate anthers, an elongate-capitate stigma, and glandular-puberulous style, but similar bracts (in texture and venation) and leaves. In foliage and bracts, B. subvaginata also rather resembles B. repens (R. & P.) D. Don, which has setose young branchlet nodes with stipular flaps, bracts strigose within, longer calyx lobes, unexpanded stigma, glandular-puberulous style, and a well-developed ovary collar around the style base. The material of B. subvaginata had been previously distributed as B. subconnata.

BLAKEA ACOSTAE Wurdack, sp. nov.

B. incomptae Markgraf affinis, foliis paulo disparilibus subtus minus pubescentibus bracteais ad apicem rotundatis calycis lobis et ovarii cono longioribus differt.

Ramuli primum paulo quadrangulati demum teretes sicut petioli laminarum venae primariae subtus pedicellique modice pilis incurvis plerumque 1-2 mm longis basim versus expansis et paulo asperis induti. Folia in quoque pari in dimensionibus paulo (1:1.5-1.6) disparilia; petioli 1.5-2 cm longi graciles; lamina 6-11 (acumine excluso) X 3.5-7 cm elliptica vel oblongo-elliptica apice abrupte 1-1.5 cm caudato-acuminato basi late acuta vel obtusa, firme chartacea et integra, supra primum sparse strigulosa mox glabrata, subtus in venis secundariis sparse incurvo-setulosa (pilis ca 1 mm longis basim versus paulo expansis et asperis) in pagina glabra, 3-nervata (pari inframarginali debili neglecto) venis secundariis principalibus 1(-2) mm inter se distantibus. Flores in quoque nodo superiore bini, pedicellis (3-)4-4.5 cm longis; bracteae liberae chartaceae suborbiculares (apice rotundato) extus sparse et intus centraliter modice strigosae pilis 1-1.5 mm longis; bracteae exteriores 22 X 20-22 mm, interiores 23 X 17 mm. Hypanthium (ad torum) 8.5 mm longum extus basim versus sparse strigulosum; calycis tubus 2 mm longus, lobis 6 X 7-7.5 mm oblongis rotundatis ubique centraliter sparse

strigulosus. Petala 25 X 20-22 mm obovata (apice rotundato) marginibus glandulosis exceptis glabra. Filamenta 7.5-8 mm longa glabra; antherae 5.5 X 2.5 X 2 mm lateraliter cohaerentes apice minute biporosae (poris ca 0.1 mm diam. et ca 1 mm distantibus); connectivum dorsaliter paulo elevatum ecalcaratum. Stigma non expansum; stylus 13 X 1.5 mm modice et breviter (0.1-0.15 mm) glandulosus; ovarii conus ca 5 mm longus collo sparse glanduloso paullulo (0.1-0.2 mm) evoluto.

Type Collection: M. Acosta Solís 5271 (holotype F 1240479), collected between Bucay and Hacienda "Rosa Mercedes", Prov. Chimborazo, Ecuador, elev. 600 m, 12 August 1943. "Melastomácea arbórea de flores blancas y cáliz rojiso o algo rosado."

Paratype: J. A. Steyermark 52819 (F), from dense rich jungle between Río Blanco and Río Norcay on road between Chacanceo and Molleturo, Prov. Azuay, Ecuador, elev. 1520 m, 4 June 1943. "Shrub 15 feet tall; flowers white. Vern. name: Agua de Mono."

Blakea incompta has similar style and stamens, but leaves beneath more densely and persistently setose and strongly disparilous in each pair, narrowly ovate acuminate bracts only 0.6-1.2 cm wide, densely sericeo-strigose hypanthia, triangular calyx lobes only 2-3 mm long, and ovary cone only 0.5 mm high. The bracts of B. acostae in shape and texture are like those of B. subconnata Berg ex Triana and its relatives.

BLAKEA HIRSUTISSIMA (Macbride) Wurdack var. GLANDULIFERA Wurdack, var. nov.

A var. hirsutissima differt foliis plerumque minoribus ramulorum foliorumque setis plerumque glanduliferis.

Type Collection: G. Harling & L. Andersson 12868 (holotype GB; isotype US), collected along the Limón (General Plaza)-Macas road ca 20 km from Limón, Prov. Morona-Santiago, Ecuador, elev. 700-900 m, 26 March 1974. "Liana. Corolla pink."

The typical variety has leaf blades mostly 15-23 X 7-14 cm (rather than 9-14 X 4-6 cm), very dense and mostly eglandular cauline hairs, and only a very small proportion of the foliar hairs gland-tipped. The Ecuadorian variety chontalensis (Wurdack) Wurdack has much shorter and mostly eglandular cauline and foliar hairs. Harling & Andersson 13028 (7 km NW of General Proaño, Morona-Santiago, 1100 m) has pubescence as in var. glandulifera, but smaller leaf blades; this collection is perhaps abnormal since most flowers have the inner bract pair not evolved (1 dissected flower, however, with a single interior bract).

BLAKEA CILIATA Markgraf, Notizbl. 9: 1146. 1927.

Topobea ciliata Cogn., DC. Mon. Phan. 7: 1089. 1891.

Cogniaux' observations on the stamens from the holotype (P) were obviously based on a rather crumpled Cassia flower at the lower lefthand corner of the herbarium sheet, neither petals nor stamens being attached to the several melastome flowers associated with the leafy branchlets. From a description of this legume flower furnished to Rupert Barneby, an excellent

floral match was obtained under Chamaefistula gigantifolia Britton & Rose (to be treated by Irwin & Barneby as a variety of Cassia macrophylla Kunth). Barneby had already examined a Poortman collection (P) of this Cassia and probably the flower on the melastome sheet was an inadvertent stray in mounting. The Poortman collection of T. ciliata is without number or detailed locality. Fortunately Markgraf's binomial applies to the same species. Apart from the Poortman collection and Tessmann 4200 (NY), B. ciliata is known from Wurdack 1982 (Quebrada Tambillo, Río Marañón) and Ellenberg 3516 (Puerto Nazareth), both Prov. Bagua, Depto. Amazonas, Peru, elev. 425-540 m.

Hugo A.-C. Poortman collected under André's guidance and Mamé's and Drake del Castillo's subsidies in southernmost Ecuador and northernmost Peru (Huacabamba, Piura) from as early as 9 Nov. 1881 until at least 19 Jan. 1883 (Biblioth. Bot. 116: 50. 1937; Rev. Hort. 58: 60. 1886). He published an account of the ornamental plants seen during a trip from Loja to Zamora (Une excursion botanique dans les Andes. Bull. L'Assoc. Anc. Elèves de l'École d'horticul. Vilvorde 4: 20-30. 1890. See Bot. Centralbl. 45, 3: 94. 1891); a copy of this travelogue was kindly furnished by André Robyns (BR). Drake del Castillo described Poortmannia (Bull. Soc. Philom. Paris Sér. 8, 4[3]: 128-129. 1892), this solanaceous genus now synonymized under Trianaea. Poortman's collection numbers were not entirely chronological; the Paris sheets usually have fairly detailed habit and geographic data. The following list of his gatherings was assembled from perusal of several monographs and published parts of the Flora of Ecuador, file information from R. C. Barneby, L. B. Smith, and D. C. Wasshausen, and my own melastome notes.

<u>Number</u>	<u>Locality</u>	<u>Date</u>	<u>Species</u>
16	Route de Císne	19 Oct. 1881	<u>Miconia macrotis</u> Cogn. var. <u>canescens</u> Gleason
23	Zaruma		<u>Miconia ibaguensis</u> (Bonpl.) Triana
57	Chonta Cruz		<u>Passiflora cumbalensis</u> (Karst.) Harms and <u>P. mixta</u> L. f. var. <u>eriantha</u> (Benth.) Killip
78	Loja to Císne	3 Nov. 1881	<u>Tillandsia purpurea</u> R. & P.
90	Císne	22 Oct. 1881	<u>Miconia poortmannii</u> (Cogn.) Wurdack

<u>Number</u>	<u>Locality</u>	<u>Date</u>	<u>Species</u>
106	Chonta Cruz	7 Nov. 1881	<u>Miconia denticulata</u> Naudin
134	Saraguro	Jan. 1882	<u>Aechmea drakeana</u> André
149	prés de Loja	9 Nov. 1881	<u>Meriania drakei</u> (Cogn.) Wurdack
162	Santiago	20 Nov. 1881	<u>Miconia capitellata</u> Cogn.
175	Chuquiribamba	19 Nov. 1881	<u>Miconia</u> cf. <u>denticulata</u> Naudin
205	Huacapamba		<u>Fuchsia sessilifolia</u> Benth.
229	Gonzanama		<u>Saritaea magnifica</u> (Sprague ex v. Stenis) Dugand
247	Cerro de Santa Rosa	19 Jan. 1881	<u>Aphelandra grangeri</u> Leonard
263	Quilizarza		<u>Arrabidaea chica</u> (H. & B.) Verl.
269	Cordillera Zamora		<u>Fuchsia loxensis</u> H.B.K.
313	Rio de St. Fran- cisco	5 Jan. 1882	<u>Justicia</u> sp. nov.
346	Zamora (Zaraguro)	22 Jan. 1882	<u>Aphelandra jacobini-</u> <u>oides</u> Lindau
351	Zamora	23 Jan. 1882	<u>Chamaefistula gianti-</u> <u>folia</u> B. & K.
352	Zamora (Zaraguro)	25 Jan. 1882	<u>Mendoncia lindavii</u> Rusby
401	Zamora		<u>Huberia peruviana</u> Cogn.
416	Zamora		<u>Guzmania conifera</u> André ex Mez
442	Chuquiribamba, 2800 m.	May 1882	<u>Justicia</u> sp. nov.

<u>Number</u>	<u>Locality</u>	<u>Date</u>	<u>Species</u>
469	Císné-Ambocas	May 1882	<u>Tillandsia umbellata</u> André
476	Chinchanga		<u>Pitcairnia heterophylla</u> (Lindl.) Beer
478	Chinchanga		<u>Tillandsia conferti-</u> <u>flora</u> André
484	Huacapamba	19 Jan. 1883	<u>Centronia sessilifolia</u> Cogn.

BLAKEA OLDEMANII Wurdack, sp. nov.

B. campi Wurdack affinis, foliorum subtus primariis dense pinoideo-setulosus bracteas ad basim latioribus calycis lobis longioribus hypanthiis glabratis differt.

Ramuli plus minusve quadrati primum sicut petioli laminarum venae primariae subtus pedicellique pilis barbellatis intertextis ca 0.5-1 mm longis demum deciduis dense puberuli. Petioli 2-3 (-4) cm longi; lamina 11-18(-23) X 5.5-9(-14.5) cm, elliptica apice breviter (ca 0.5 cm) subabrupteque hebeti-acuminato basi late acuta vel obtusa, subrigida et essentialiter integra, supra glabra, subtus in pagina sparse pilis 0.5-1 mm longis apicem versus subclavatis et barbellatis subpersistentibus setulosa, 5-nervata (pari tenui ca 2-3 mm inframarginali incluso) nervis primariis interioribus ad basim paulo poculato-coalescentibus nervis secundariis obscuris 2-3(-4) mm inter se distantibus. Flores in quoque nodo superiore (2-)(4-)(8), pedicellis ca 2 cm longis; bracteae omnino liberae subrigidae demum subpatulae primum extus modice et intus sparse subamorpho-furfuraceae demum glabratae ad basim late (ca 4 mm) affixae; bracteae exteriores 9-11.5 X 7.5-9 mm oblongo-ellipticae apice hebeti-acuto; bracteae interiores 8-10 X 8-11 mm suborbiculares apice subrotundato. Hypanthium (ad torum) ca 4 mm longum glabrum vel sparse subamorpho-furfuraceum; calycis tubus ca 1 mm longus, lobis late triangularibus ca 1.5-2.5 mm longis extus densiuscule furfuraceis. Petala ca 14 X 9-10 mm elliptica apice hebeti-acuto vel obtuso in pagina glabra. Filamenta ca 4-4.5 mm longa; antherae ca 4 X 2 X 1.5 mm inter se cohaerentes, poris duobus minutis terminalibus, dente dorso-basali hebeti ca 1-1.4 mm elevato. Stigma non expansum; stylus ca 8 X 0.6-0.3 mm glaber; ovarium 6-loculare, cono ca 2-2.5 mm alto costulato glabro apice truncato (collo non evoluto).

Type Collection: Oldeman 3450 (holotype US 2789068), collected in 30-year old forest at Km 33 of San Juan-Chiriboga road, Prov. Pichincha, Ecuador, elev. 2700 m, 2 April 1976. "Arbol de 4 mts. de alto, epiphyta ?. Raíces adventicias. Peciolos a veces rojos. Brácteas con bordes rojizos al igual que el cáliz, corola blanca, estambres amarillos."

Paratypes (all Pichincha, Ecuador): B. Sparre 14925 (S),

from cloud forest at Dos Novias, Km 16 on Alog-Sto. Domingo road, elev. 2600 m; Sparre 17039 (S), from Km 43-45 of Nono-Nanegal road, Río Alambi, elev. 2200-2500 m; Sodiuro 522b (BR), from "silv. suband. m. Atacatzto"; Sodiuro 521 p. p. (BR, P), probably from Canzacoto ("Frutex v. arbuscula 3-5 metr."); Sodiuro 521c (P), from "silv. suband. vulc. Atacatzto" ("Arbor humilis patula").

Blakea campii has leaf blades beneath with only sparse and deciduous stellulate-pinoid hairs ca 0.1(-0.2) mm long, bracts at the base narrowed and only 1-1.5 mm wide (the hypanthium thus partly visible), calyx lobes 0.3-0.5 mm long, and hypanthia densely furfuraceous with stellulate-pinoid hairs 0.1-0.2 mm long. Blakea quadriflora Gleason, a glabrous species with barely lobed calyx limb, seems somewhat more distantly related. Sodiuro 521 (BR) is a mixed collection from "Conzacoto et val. Pallatanga"; the right-hand sprig (probably from Conzacoto) is B. oldemanii, while the left-hand sprig (inadequate for detailed study and not matched among more recent collections) is an undescribed (but related) taxon with smaller more acuminate leaf blades and smaller flowers.

BLAKEA MADISONII Wurdack, sp. nov.

B. campii Wurdack affinis, innovationibus tantum stellulato-pinoideo-puberulis bracteis latioribus antherarum connectivis ad basim appendice longiore acute acuminata armatis differt.

Ramuli primum obscure quadrangulati demum teretes sicut petioli laminarum subtus venae primariae pedicellis bracteaequae sparsiuscule caduceque pilis pinoideis ca 0.1 mm longis granulosis; ramulorum nodi paulo incrassati. Petioli 1-2 cm longi; lamina 4-7(-9) X 3-5(-6.5) cm obovato-elliptica apice obtuso et abrupte ca 1-2 mm apiculato basi obtusa, coriacea et integra, ubique primum sparse lepidibus minutis induta supra mox glabrata, 5-nervata (pari debili ca 2 mm inframarginali incluso) paribus exterioribus subtus ad basim poculis corneis 1-2(-3) mm longis ornatis nervis secundariis ca 1-1.5 mm inter se distantibus obscuris. Flores in quoque nodo superiore 2-4, pedicellis 1.3-1.8 cm longis; bractee omnino liberae firmae demum patententes ellipticae vel oblongo-ellipticae; bractee exteriores 9-10 X 6-6.5 mm apice hebeti-acuto basi ipsa 3 mm lata; bractee interiores 13.5 X 10.5-11 mm apice rotundato basi ipsa 2.5 mm lata. Hypanthium (ad torum) 5 mm longum extus modice stellulato-pinoideo-puberulum; calyx 2 mm longus et paullulo (0.1-0.2 mm) 6-undulatus. Petala glabra 13-13.5 X (8-)10.5 mm obovata apice rotundato-obtusio. Filamenta 4-4.3 mm longa; antherae 4 X 3 X 1.2 mm oblongae inter se cohaerentes minute biporosae; connectivum dorsaliter ad basim calcari 3 mm longo acuminato armatum. Stigma non expansum; stylus 11 X 0.8-0.5 mm glaber; ovarii conus 1-1.8 mm altus collo 0-0.3 mm longo hebeti-lobulato obscure (0.03 mm) glanduloso.

Type Collection: M. T. Madison, T. C. Plowman, H. A. Kennedy, & L. Besse 5243 (holotype US 2847799; isotype SEL), collected in wet submontane forest near Lita on Ibarra-San

Lorenzo RR, Prov. Esmeraldas, Ecuador, elev. 550-650 m, 11 June 1978. "Epiphytic shrub. Leaves pale yellow-green below. Petals pink; anthers white."

Blakea campii has the vegetative apices setulose with barbellate hairs to 0.5 mm long, outer bracts only 4-4.5 mm wide and inner bracts 3.5-3.7 mm wide, anthers only ca 1.5-1.7 mm wide, and dorso-basal connective appendage ca 1.6 mm long and truncate. Blakea quadriflora Gleason has glabrous hypanthia, smaller petals, and blunt connective tooth only ca 1 mm long. In foliage (except for the somewhat closer spacing of the secondary veins), B. madisonii resembles B. pyxidanthus Triana; in that species however, the leaf pocolle development is between the costa and interior primary veins and the bracts are shorter than the hypanthium and basally somewhat united. Sparre 17635 (Río Cayabe, Pastaza, Ecuador; S) probably represents an undescribed taxon related to B. pyxidanthus, the leaves however somewhat larger and with closer secondary vein intervals; more material of this population is needed for comparison with both B. pyxidanthus and B. portentosa Wurdack.

BLAKEA PUNCTULATA (Triana) Wurdack, comb. nov.

Topobea punctulata Triana, Trans. Linn. Soc. Bot. 28: 150. 1871.

Several recent collections (Cauca: La Costa near El Tambo, elev. 800-900 m, Sneidern 829 and 831, S; Nariño: Corregimiento Santander-Barbacoas, elev. 840-200 m, Garcia-Barriga 13132, US) have confirmed observations on the holotype (Triana 4089, BM); the anthers are thick (3.5-4 X 2 X 2 mm), not appendaged, with two separate (0.7 mm) minute pores ventrally, the style glabrous and barely immersed in a short ovarial collar, and the stigma capitate (ca 1.5 mm diam). The relations are apparently with B. subconnata Berg ex Triana and its relatives with exappendiculate anthers and capitate stigmas.

TOPOBEA MACBRYDEI Wurdack, sp. nov.

In systemate Cogniauxii T. parasiticae Aublet affinis, foliis ad basim acutis pedicellis longioribus calycis lobis lateraliter imbricatis differt.

Ramuli primum quadrangulati mox teretes sicut laminarum subtus venae primariae et secundariae petiolique indumento appresso arachnoideo caduco induti alioqui glabri. Petioli 3-4 cm longi; lamina oblongo-elliptica apice abrupte per 1-1.5 cm caudato-acuminato basi acuta, subcoriacea et essentialiter integra, 16-20 X 5.5-8 cm, 5-nervata nervis secundariis principalibus 1.5-2 mm inter se distantibus. Flores in quoque nodo superiore 4-6, pedicellis 3.5-4 cm longis sparse verruculosi; bracteae omnino liberae glabrae paulo firmiae calyces paulo superantes; bracteae exteriores 9.5-10 X 7.5-8.5 mm late ellipticae apice hebeti-apiculato; bracteae interiores 10 X 10 mm orbiculares apice truncato-rotundato. Hypanthium 5 mm longum glabrum; calycis tubus ca 1 mm altus, lobis 2 X 4.6 mm oblatis lateraliter ca 0.6 mm imbricatis. Petala glabra 13 X 10-11 mm

obovata apice rotundato-truncato. Filamenta 6.5 mm longa; thecae 6 X 1.4 X 1.2 mm subulatae poro ca 0.25 mm diam. dorsa-liter inclinato; dens dorso-basalis 0.4-0.5 mm longus hebes. Stigma non expansum; stylus 10.5 X 0.7-0.4 mm glaber in ovarii collo ca 1 mm immersus; ovarium ca 1/5 inferum glabrum.

Type Collection: Bruce MacBryde 963 (holotype US 2852134), collected in cloud forest about one hour by trail from base camp at headwaters of Río Piuntza overlooking Río Zamora, NW range of Cordillera del Cóndor, Prov. Morona-Santiago, Ecuador, elev. 1850 m, 5 January 1972. "Tree to 4 m, older leaves red; petals white; anthers yellow; fruit green."

Topobea parasitica has relatively wider leaf blades rounded to subcordate at the base, pedicels up to ca 1 cm long, calyx lobes broadly triangular and remote at the base, and longer (8.5-9 mm) more slender anthers. Other species in the complex around T. parasitica include those previously cited by me (Flora de Venezuela 8: 375), as well as T. floribunda Gleason (which has a non-expanded stigma, rather than capitate as originally described) and T. pubescens Gleason. The general aspect of T. macbrydei (but not the internal floral details) is rather like that of Blakea punctulata (Triana) Wurdack (vide supra).

NOTES ON NEW AND NOTEWORTHY PLANTS. CXXVI

Harold N. Moldenke

ERIOCAULON SEXANGULARE var. MICRONESICUM Mold., var. nov.

Haec varietas a forma typica speciei statura plerumque minori foliis angustioribus gracilioribus capitulis minoribus recedit.

The type of this variety was collected by D. O. Otobed (no. P. 10143) at Ngerpang, on Babeldaob island, Palau Islands, deposited in the United States National Herbarium at Washington.

PAEPALANTHUS BIFIDUS f. PARVICAPITULATUS Mold., f. nov.

Haec forma a forma typica speciei capitulis parvioribus 2-4 mm. latis bracteis non perspicue prolongatis recedit.

This form differs from the typical form of the species in having smaller heads, these being mostly only 2-4 mm. in diameter, with none of the involucre bracts prolonged beyond the flowers. The type was collected by G. T. Prance and E. Lleras (no. 23719) in a disturbed white sand area along the Rio Tarumazinho, Manaus, Brazil, on July 7, 1976, and is deposited in my personal herbarium.

PAEPALANTHUS MACROCAULON var. **CONTASENSIS** Mold., var. nov.

Haec varietas a forma typica speciei pedunculis elongatis 47—51 cm. longis multicostatis irregulariter longipilosis capitulis magnis 15 cm. latis recedit.

The type of this variety was collected by R. M. Harley, S. J. Mayo, R. M. Storr, T. S. Santos, & R. S. Pinheiro (Harley 19804) in a marsh in a region of closed cerrado and adjoining grassland and marsh, at 1300 m. altitude, 18 km. west-northwest along the road from Villa do Rio de Contas to the Pico das Almas, in the Serra do Rio de Contas, Bahia, Brazil, on March 21, 1977, and is deposited in the herbarium of the Jardim Botânico in Rio de Janeiro, Brazil. The collectors comment that this plant is an herb to about 50 cm. tall with rosettes of rigid mid-green leaves and white flower-heads.

SYNGONANTHUS AURIPES var. **BAHIENSIS** Mold., var. nov.

Haec varietas a forma typica speciei pedunculis brevioribus glabris et vaginis glabris recedit.

This variety differs from the typical form of the species in its peduncles being much shorter, only 8—11 cm. long, glabrous, and the sheaths also being glabrous.

The type of the variety was collected by R. M. Harley, S. J. Mayo, R. M. Storr, T. S. Santos, and R. S. Pinheiro (Harley 18528) on white sand in damp open areas in a region of mixed restinga vegetation on sand, with high forest, low trees and shrubs, and sedge meadows with open wet areas on white sand, at sealevel to 50 m. altitude, 5 km. southeast of Marau at the junction with the new road north to Ponta do Mutá, in the coastal zone of Bahia, Brazil, at 39°00' W., 14°08' S. latitude, on February 2, 1977, and is deposited in the herbarium of the Jardim Botânico at Rio de Janeiro.

SYNGONANTHUS CURRALENSIS var. **HARLEYI** Mold., var. nov.

Haec varietas a forma typica speciei foliis erectis vel patentibus pilis parvioribus laxioribusque et pilis pedunculorum laxioribus.

This variety differs from the typical form of the species in having its upper leaves plainly erect or ascending-spreading, not tightly reflexed, and with the pubescence less dense and more loose rather than densely and tightly appressed, and the pubescence of the peduncles similarly more loose and spreading. The type was collected by R. M. Harley, S. J. Mayo, R. N. Storr, T. S. Santos, & R. S. Pinheiro (Harley 19306) in open areas of sandstone rocks with open sand in the flatter areas, open scrub in exposed sites to scattered low woodland, at about 1000 m. altitude, on the summit of Morro do Chapeu, about 8 km. southwest of the town of Morro de Chapeu to the west of the road to Utinga, Morro de Chapeu, Bahia, Brazil, on March 3, 1977, and is deposited in the herbarium of the Jardim Botânico at Rio de Janeiro. The collectors describe the plant as a rosette herb with rigid gray leaves and scapes to 25 cm. tall, the scapes gray, and the involucre bracts palest brown.

HOST-PLANT COEVOLUTION AND THE DIVERSITY OF BEES
IN RELATION TO THE FLORA OF NORTH AMERICA

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That California supports an extremely high level of species diversity of bees (ca. 1500) was preliminarily documented in Moldenke & Neff (1974) and referred to subsequently in Moldenke (1976). This extraordinarily high number of resident bee species is however somewhat misleading, since the political boundaries of the state artificially encompass a wide spectrum of biotic realms and climatic patterns. This paper is an attempt to examine the levels of bee species richness throughout North America in order to demonstrate more appropriately respective levels of bee diversity in light of species/area relations, paleohistorical lineages and the role of specialized-feeding habits -- all so important in a basic understanding of the pollination ecology of any region.

The subject matter of this paper entails more directly an interest on my part, than the suitability/maturity of the data base for analysis. Judgments I make in this paper on the basis of the published literature and museum specimens are likely at times to be subsequently proven incorrect. In very general terms, two of the largest and most diverse bee genera in North America are only partially taxonomically revised at this time (e.g., Andrena, Osmia), and two other genera (e.g., Dialictus, Evylaeus) are awaiting revision. Dr. Eickwort however, has been revising Dialictus for the past several years and has been gracious enough to provide me at times with preliminary data. Though the host-plant associations of bees within the state of California are "relatively" well known, a large majority await the type of documentation and study necessary for absolute assurance; the bees of other regions (particularly the

Information included in this report is largely the result of several requests for information from students working on disparate questions in different parts of the U.S.A.; in providing them with this information in order to assist them to generalize their conclusions, I felt that much of this essentially raw data should be presented publicly so that other workers could have access to it, in the ultimate hope that additional data could be generated along this aspect of inquiry to supplement the information presently available to me. It is in this spirit, that this preliminary information is presented.

eastern U.S.) are much more poorly understood in terms of host-associations.

Nevertheless, judging from my own collections and those of my associates as well as a large published data base of floral collection records, and placing much weight upon the conservative nature of such host-association patterns (in lieu of specific evidence to the contrary, and oftentimes meager specifically relevant floral association data) -- I feel relatively confident that the major conclusions presented in this paper will, upon subsequent documentation, prove to be essentially correct. Many new species of bees are still awaiting collection in the United States, and many distributional patterns are very incompletely known, however, I expect that thanks in part to the compendia published by Meusebeck et al (1951) and Mitchell (1960, 1962) (which I have subsequently amended in light of more recent monographic treatments) faunistic species totals will not vary by more than 5-10%. This level of inaccuracy will not affect the major conclusions. Since this paper involves such a preliminary analysis of pollination systems, data is presented in a form which will facilitate adjustments in numerical analysis in light of yet to be published research. Likewise, this paper is being presented in a primarily botanical journal in order to acquaint botanists with much of the information that is accessible to entomologists, but much less accessible to botanists interested in pollination ecology.

Utilizing twelve of the biotic units of North America recognized by Kuchler (1975) and Shelford (1963) reveals that the level of bee species richness only varies roughly three-fold (Table 1), excluding the climatically extreme tundra and muskeg. The species totals for the Great Basin and the Southern Mixed Forest are low; reflecting both low actual total species diversity and relatively poorly collected/studied faunas. Though the bee faunas of these two regions will undoubtedly increase significantly upon subsequent study, I am confident they will still remain relatively the most impoverished.

The Chihuahuan and Sonoran deserts support nearly 900 known bee species. Species resident in the Mexican portions of this arid region have not been included since they remain largely uncollected, and those species which have been named remain poorly known. Therefore this total of 890 species is undoubtedly a very low estimate for the non-montane desert region as a whole.

	TOTAL BEE SPECIES	TOTAL SPECIALIST SPECIES	# PLANT GENERA WITH SPECIALIST BEES	# PLANT FAMILIES WITH SPECIALIST BEES
DESERT (D)	890	592	38	27
MEDITERRANEAN CALIF. (M.Cf)	830	466	53	23
FORESTED CALIFORNIA (F.Cf)	600	252	38	22
ROCKY MOUNTAINS (RM)	500	90	20	22
GREAT PLAINS (GP)	500	184	28	19
BOREAL FOREST (BF)	450	77	19	14
(OAK/HICKORY FOREST (OHF)	450	106	28	23
MIXED MESOPHYTIC FRST				
PACIFIC NORTHWEST (PNw)	425	104	25	-
OAK/HICKORY/PINE FOREST (OHFP)	425	84	21	19
DESERT MOUNTAINS (DM)	395	98	16	-
GREAT BASIN (GB)	333	165	27	20
SOUTHERN MIXED FOREST (SMF)	280	63	13	11
TUNDRA & MUSKEG (T)	84	13	6	5

TABLE 1. BEE SPECIES RICHNESS OF NORTH AMERICAN BIOTIC REALMS.

"Pacific Northwest" includes the mountain axis of southwestern Canada, Washington, Oregon and northernmost California; it does not include the Great Basin intermontane portions of this territory nor does it include the forested regions of the major mountain chains in California. "Desert Mountains" includes montane and subalpine regions of Arizona and New Mexico.

The well-studied mediterranean climatic region of California contains approximately 830 species; this is a relatively robust estimate and does not include species which are primarily forested montane within California, only infrequently occurring in the regions of upper chaparral in the Sierra Nevada. The Rocky Mountain region and the Great Plains are next in abundance with approximately 500 resident species, followed by significantly lower levels within the three forested eastern provinces as well as the montane forested Pacific Northwest (Table 1).

Within the different geographic regions of California, likewise, there is only approximately a 3-fold difference in bee species richness. The southern more xeric regions are characterized by the highest levels of species richness, while the Great Basin, alpine, northern and immediate coastal regions are characterized by lower levels (Table 2). The total number of forested California bee species is approximately 600, well below the respective mediterranean and desert totals.

There is no particular correlation between the total bee species richness and the extent of the area occupied (Illus. 1). Regions of high bee diversity have in common an arid/semi-arid climate and relatively low canopy. However, the same features characterize the Great Basin and Great Plains, regions of distinctly less bee species. The number of bee species per 1,000 mi² varies from 0.5-3.0 for all regions (excluding the tundra) except for California, where forested montane California is characterized by approximately 12.0 and mediterranean California by 14.0 bee species. When the bee fauna for the entire eastern half of the United States (ca. 700, Meusebeck et al in Mitchell (1960)) is totalled, only approximately 0.5 bees per 1,000 mi² are encountered. Why the diversity of both forested montane and mediterranean California should be nearly ten times that of other regions of comparable altitudinal and climatic diversity is not known with certainty. On first examination, the crucial determinant would appear to be the Mediterranean region, since a large percentage (theoretically difficult to estimate) of the forested bees in California are much more characteristic of the chaparral than the forest understory. The Mediterranean climate regime is paleohistorically very novel, dating from only the past million years (Axelrod, 1966). The flora of California is also exceptionally diverse, both in terms of endemic relict species and rapidly evolving contemporary lineages; the former group is basically forest-associated while the latter is a feature of the

	TOTAL BEE SPECIES	TOTAL SPECIALIST SPECIES	# PLANT GENERA WITH SPECIALIST BEES
NO. GREAT BASIN (NGB)	213	118	17
GREAT BASIN (GB)	179	98	14
OWENS VALLEY (OV)	394	253	33
MOJAVE DESERT (MD)	456	271	33
COLORADO DESERT (CD)	482	299	35
TRINITY/SISKIYOU MTS. (T/S)	220	86	11
ALPINE SIERRA NEVADA (AS)	183	89	13
NORTHERN SIERRA NEVADA (NS)	398	170	28
SOUTHERN SIERRA NEVADA (SS)	516	219	38
MONTANE SOUTHERN CALIF. (MSC)	422	186	30
COASTAL DUNES & SAGE (C)	172	52	12
NO. COAST RANGES (NCR)	377	152	33
SO. COAST RANGES (SCR)	520	262	44
CISMONTANE SO. CALIF. (CSC)	555	253	47
NO. CENTRAL VALLEY (NCV)	238	108	29
SO. CENTRAL VALLEY (SCV)	282	161	36

TABLE 2. BEE SPECIES RICHNESS OF CALIFORNIA GEOGRAPHIC REALMS.

Data slightly corrected from that presented in Moldenke (1976b) in light of recent monographs and personal observations.

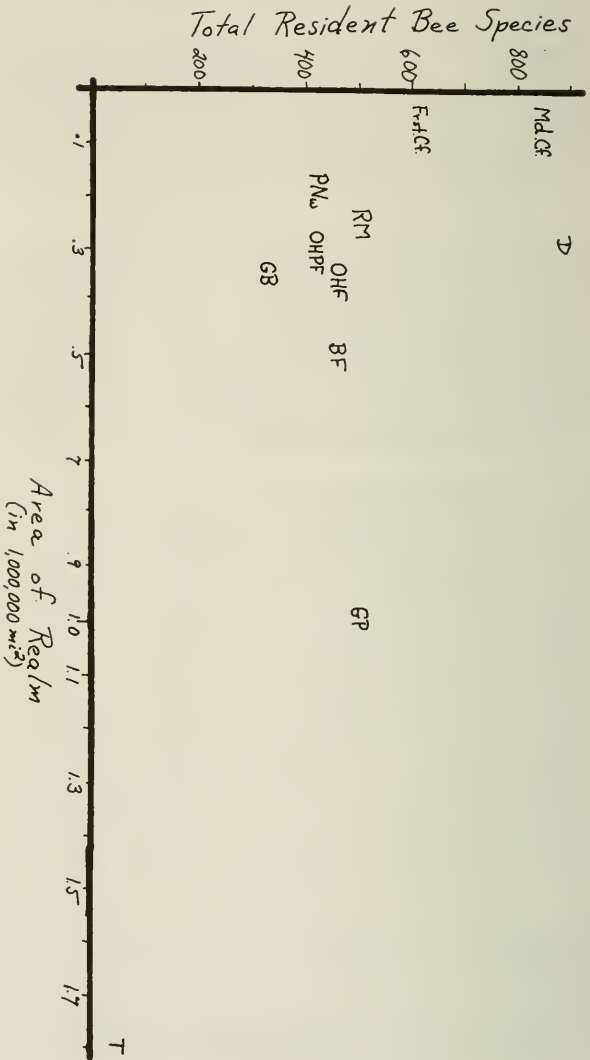


ILLUSTRATION 1

RELATIVE RICHNESS OF THE BIOTIC REGIONS OF NORTH AMERICA.
Abbreviations as in Table 1

arid ecosystems (Raven, 1977). The high proportion of forest floral endemics in California has been attributed to the relatively milder conditions during the Tertiary in California relative to more continental climates in North America. Perhaps a diverse assemblage of bee lineages also survived in the California forests under these conditions, and under the increasing aridity initiating in the Neogene have secondarily invaded the non-forested regions of the nascent mountain systems and rapidly speciated from this initially enriched stock.

Bee species with specialized feeding habits are frequent in all regions of the United States; so are species with established generalist feeding strategies. The vast majority of feeding strategies are not known with established certainty. Extrapolating from the habits of known close relatives (in the absence of conflicting data) does allow us to form general conclusions about the nature of food-choice preferences for the vast majority of species though. "Specialist-feeding" bee species should not be regarded as monoleges -- absolute specialization by a bee on only one species of plant host throughout its range is seldom, if ever, realized when the plant genus is not monotypic in the region concerned (e.g., Larrea) or the bee species very highly restricted in distribution. Specialist-feeding bees are usually restricted to the generic (or occasionally subgeneric) or closely-related generic group level (i.e., Potentilla, Ivesia, Chamaebatia & Horkelia). Some semi-specialists visit only a restricted subset of species of the families Compositae or Leguminosae. Specialists are usually faithful to the same "host-plant" throughout their range, though seldom have studies been undertaken to conclusively demonstrate this accepted working hypothesis.

For instance, Nomadopsis fracta visits the shrub Eriodictyon (Hydrophyllaceae) throughout its extensive range exclusively, except for regions of volcanic ash on Mount Shasta where it visits only the acaulescent Nama rothrockii (Hydrophyllaceae), Eriodictyon not being present (Moldenke, unpub. obs.) (one series bearing pollen and collected on Phacelia brachyloba (Hydrophyllaceae) in the San Bernardino Mountains exists in collections; and Rozen (1958) cites one possible instance on P. douglasii). Likewise, the very abundant Nomadopsis edwardsii is one of a sibling pair of species visiting Potentilla and closely related genera (Rosaceae) throughout extensive portions of the Pacific

Coast, however, at Mammoth Lakes, California, the population is morphologically dimorphic -- the larger individuals collecting the pollen and nectar of Calochortus (Liliaceae) apparently exclusively (Moldenke, unpub. obs.). I cite these examples from Nomadopsis, because the host-selections of most of these species have been clearly well-documented by Rozen (1958), and all the known species (except one) are clearly some of the most specialized bees known, but even in this group there are clearly some issues that need further study.

In the section that follows, I do not mean to imply that host-selection habits are fully known, or that when fully known there may not be many minor variations to the behavior noted, however, I confidently expect the general scheme I am presenting will not be grossly distorted. Poorly known groups clearly in need of subsequent study are indicated.

The series of phylogenies (Illustration 2) is presented in an oversimplified diagrammatic fashion to represent both the sequences of host shifts ("~~AAA~~") and the notable range extensions that have occurred in the evolution of North American bees. I recognize that the categories for range distribution are overgeneralized and perhaps overly simplistic in that they recognize basically only arid versus humid forest classes. At this stage of analysis, increasing the number of categories obscures the basic floristic relationships and patterns of plant associations. I have treated these categories somewhat liberally, for instance if a group is characterized by a basically arid western desert distribution, but does indeed inhabit a considerable portion of the southern prairies I have not noted that as a significant range expansion, but only have done so when such a distribution has clearly enlarged to include the eastern plains or the understory of the eastern forests. On the other hand, typical montane forested cool temperate species are noted in the xeric region only if they significantly inhabit xeric regions, rather than the isolated forested mountain tops throughout the western basins and deserts. Presumed paleogeographic lineages (based largely on the circular reasoning of present distributions) are basically unchanged from those presented in Moldenke (1976), and represent the published conclusions of taxonomic specialists or educated guesses on my part. Those of the Dufoureae represent unpublished studies of Bohart, Lincoln and myself; these studies will be published in more detail subsequently.

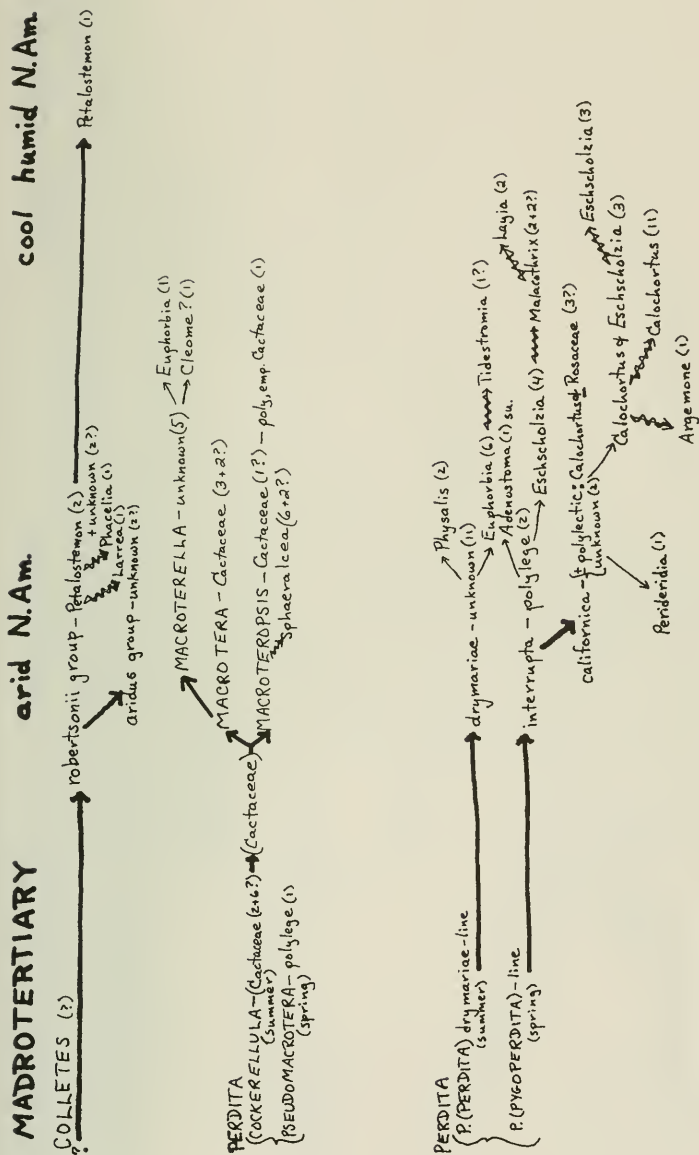
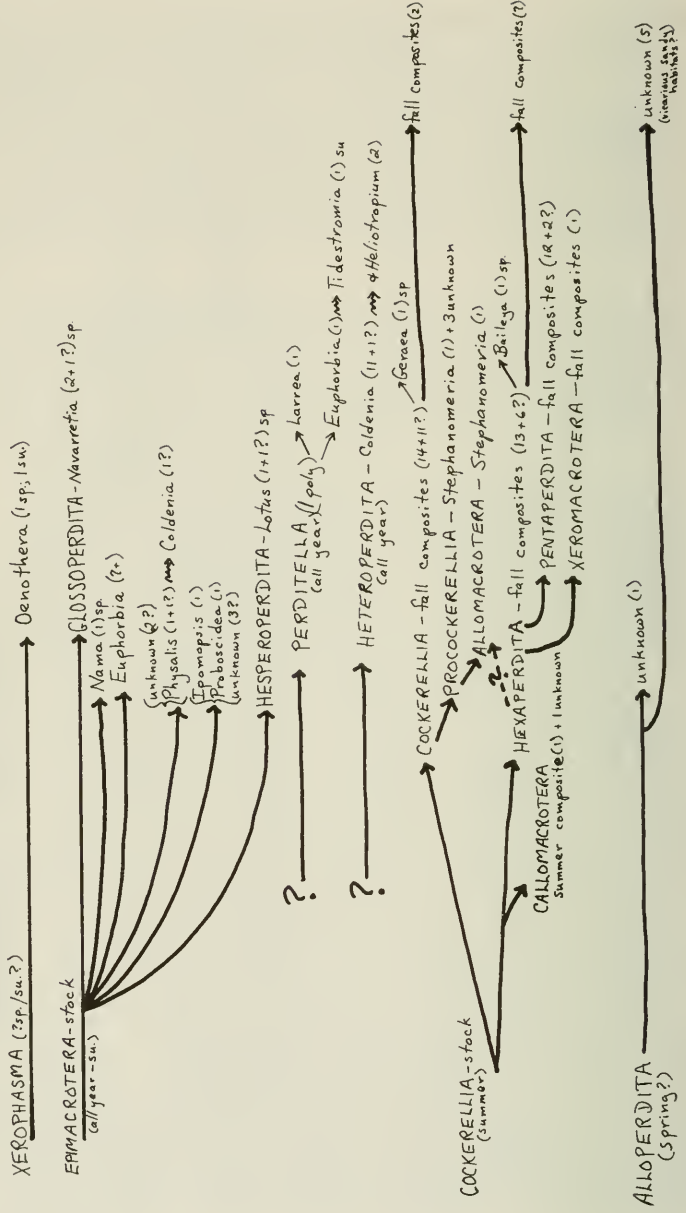
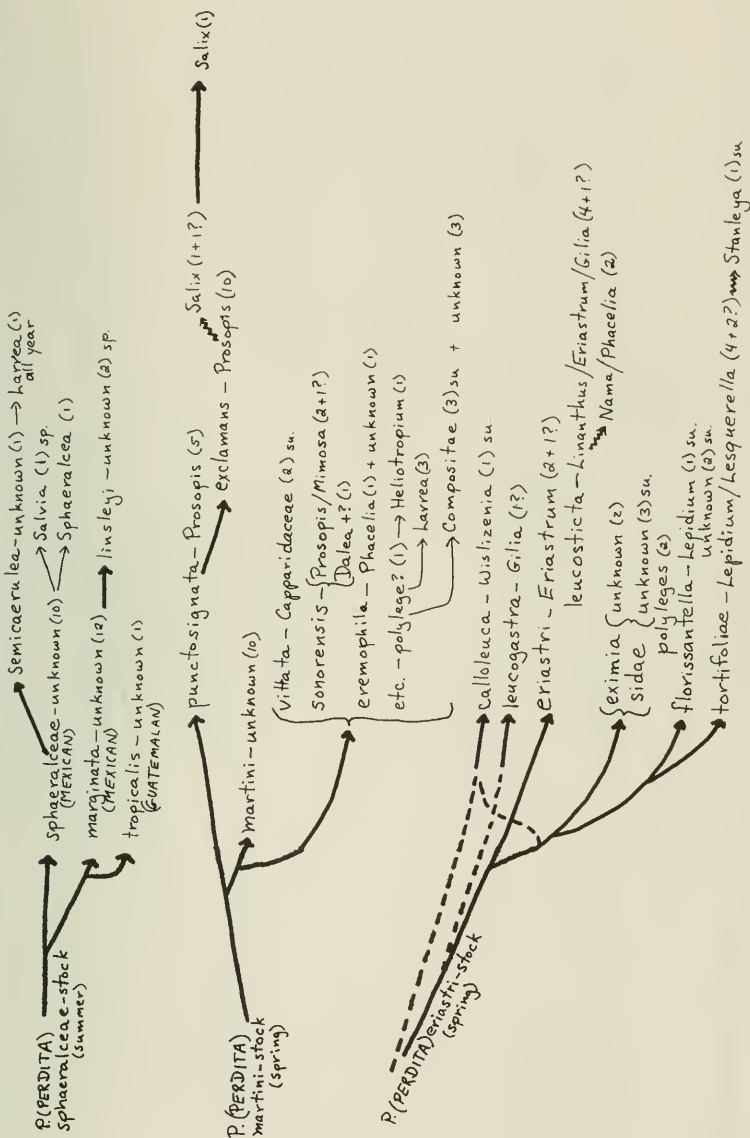


ILLUSTRATION 2 (and following)

↗↘ refers to host switches from one specialist to another.

MADROTERTIARY arid N. Am. cool humid N. Am.

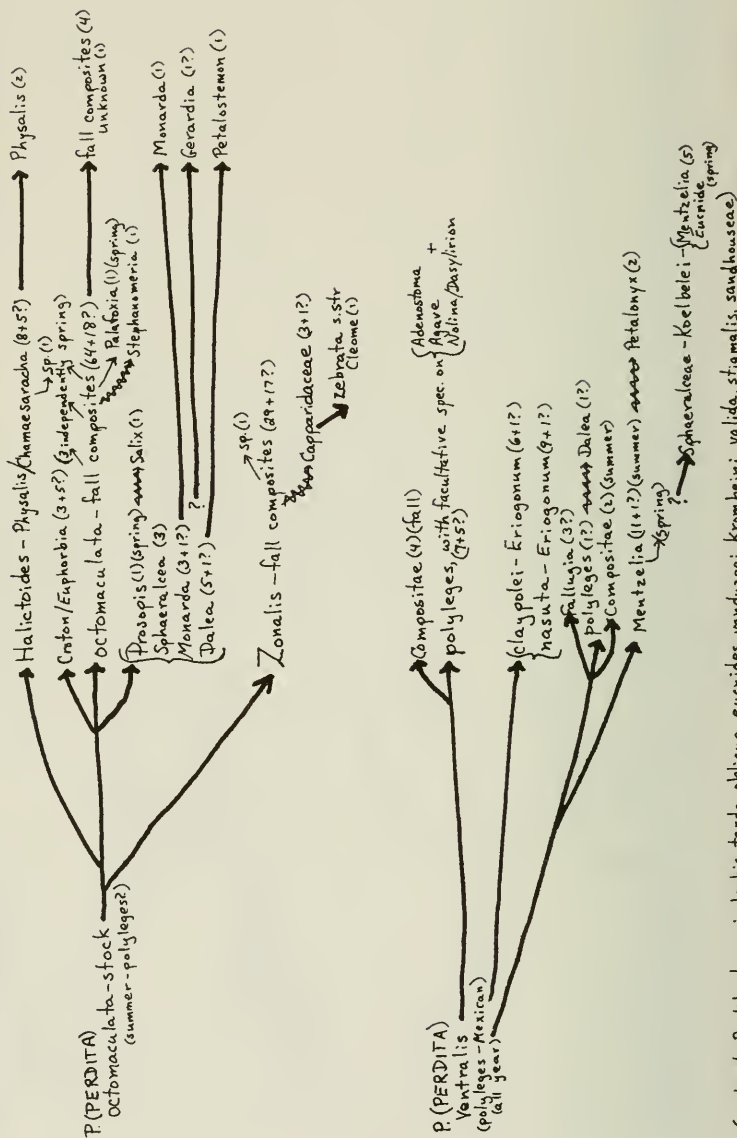




cool humid N. Am.

arid N. Am.

MADROTERTIARY

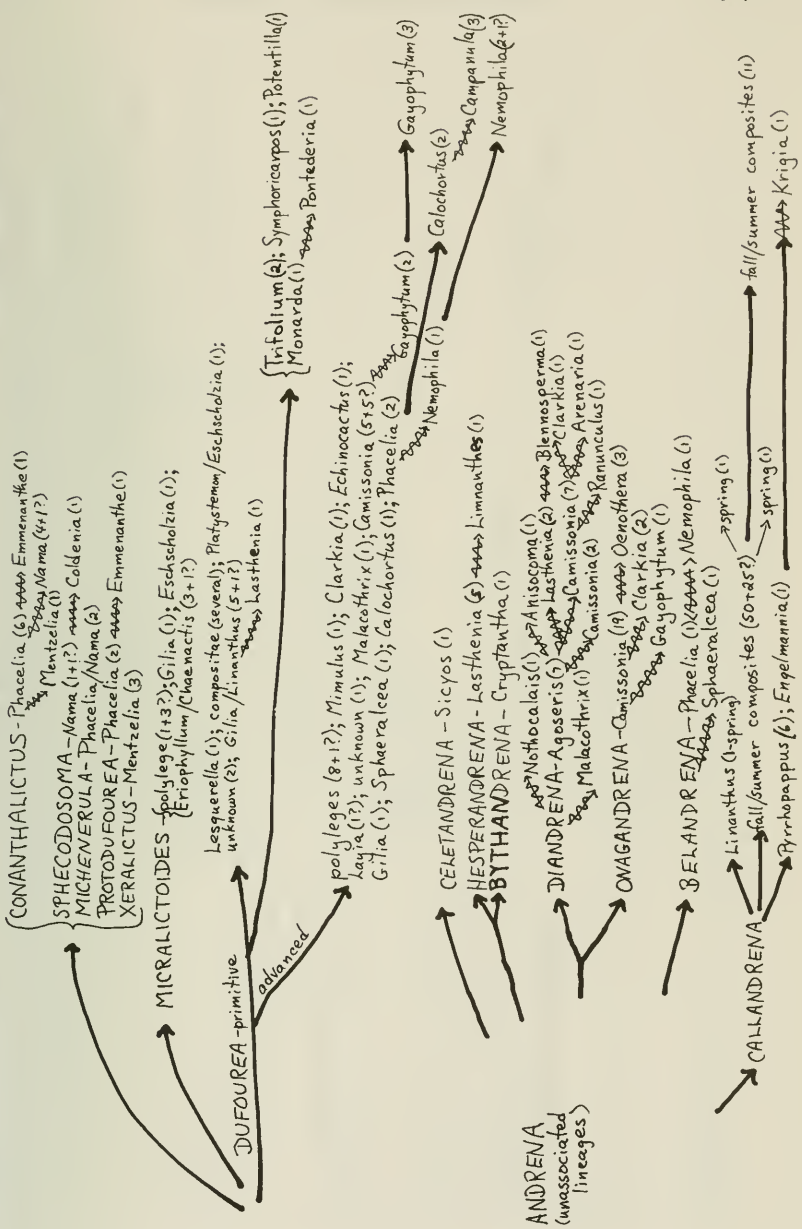


(unplaced Perdita taxa: imberbis, tarda, obliqua, eucnides, vanduzeei, krombeini, valida, stigmalis, sandhouseae)
 (unplaced specialist: dammersi (Malacothrix); lycii (Lycium))

MADROTERTIARY

arid N. Am.

cool humid N. Am.

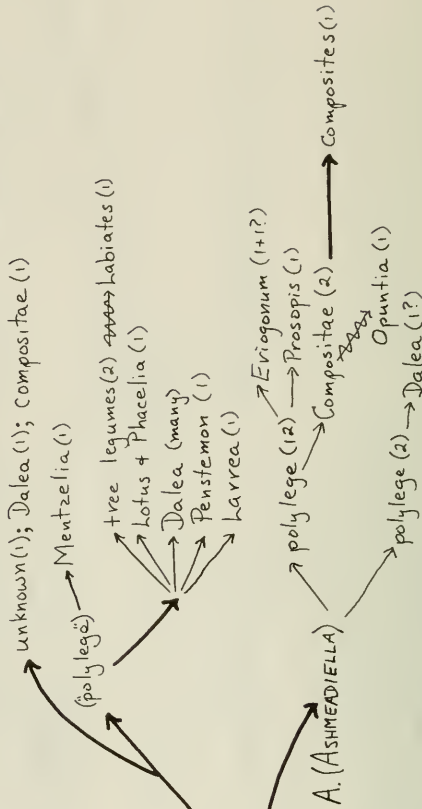


cool humid N. Am.

arid N. Am.

MADROTERTIARY

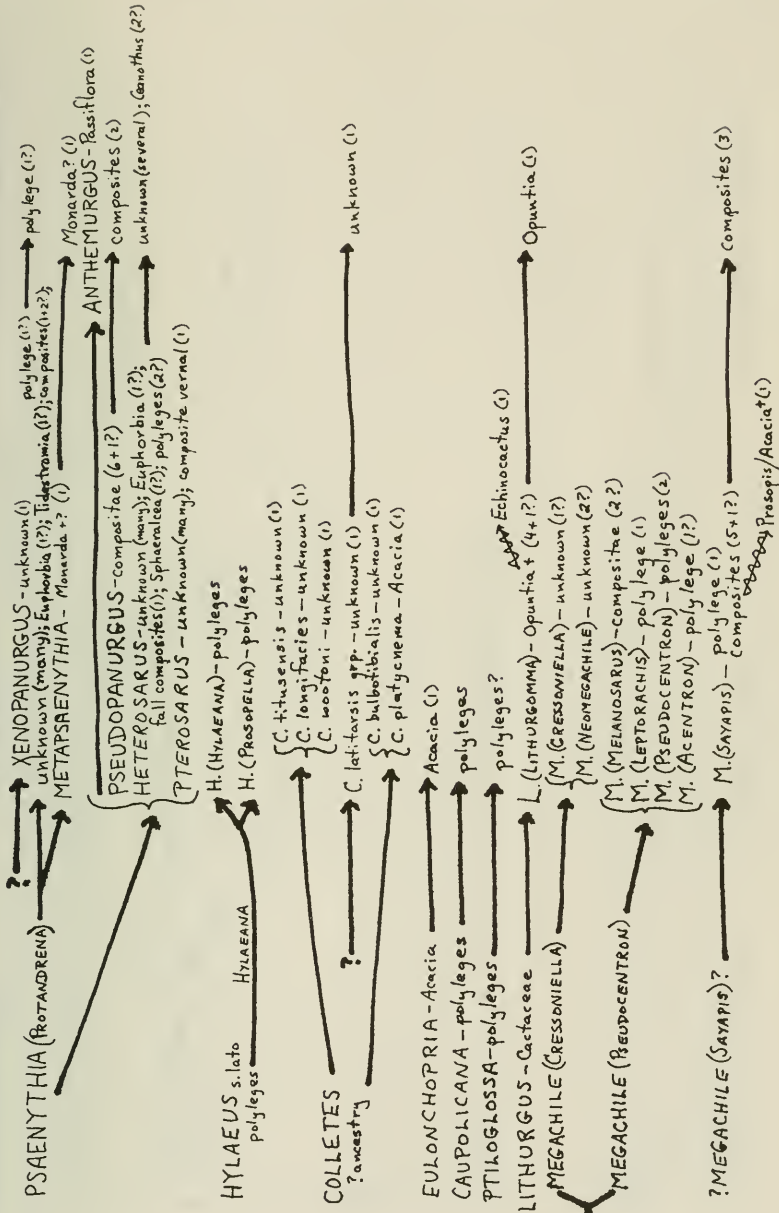
ASHMEADIELLA



NEOTROPICAL

arid N. Am.

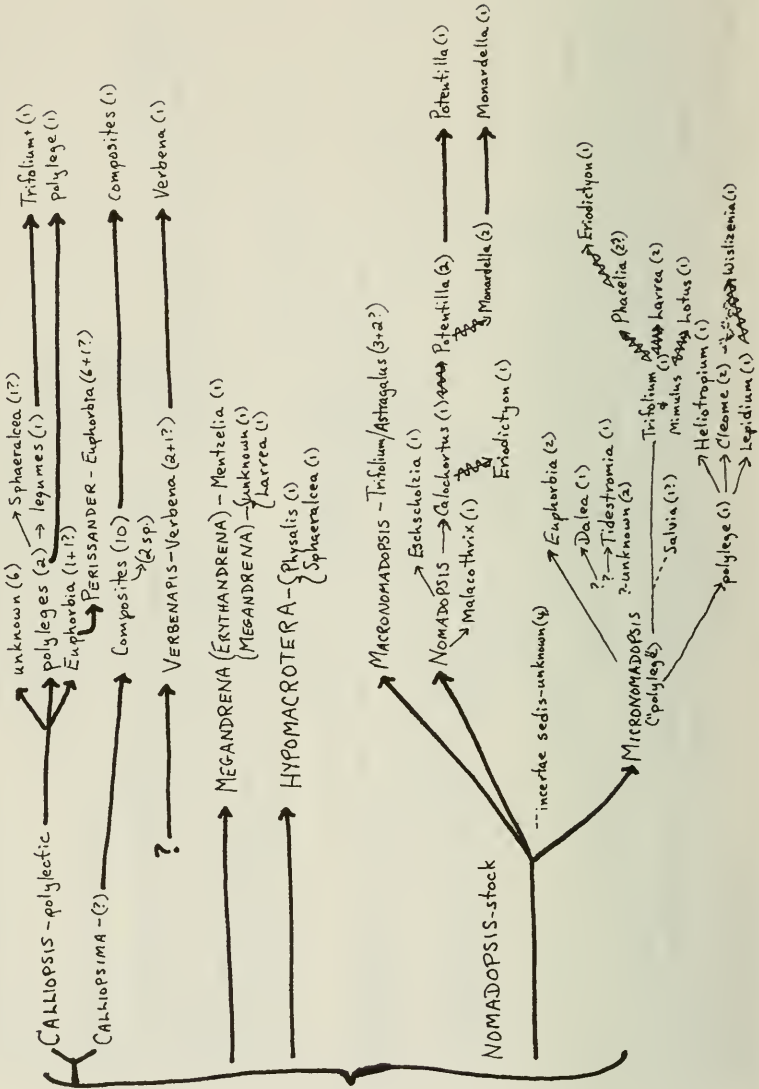
cool humid N. Am.



cool humid N. Am.

arid N. Am.

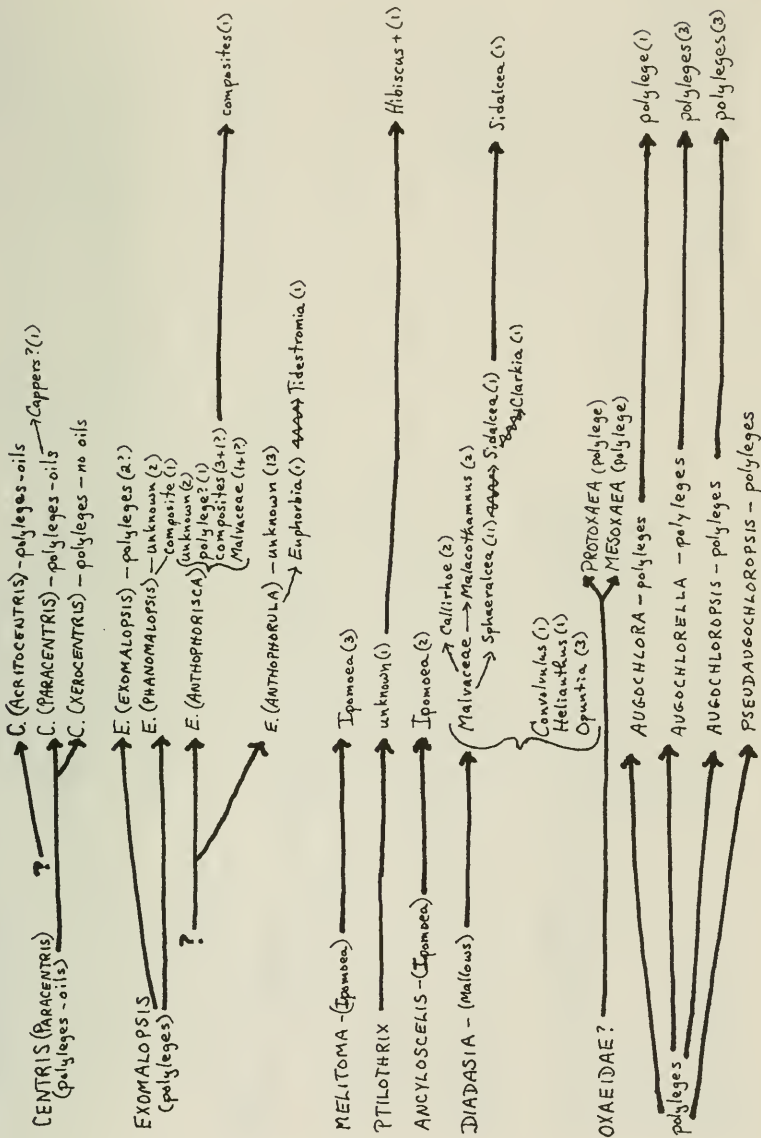
NEOTROPICAL



NEOTROPICAL

arid N.Am.

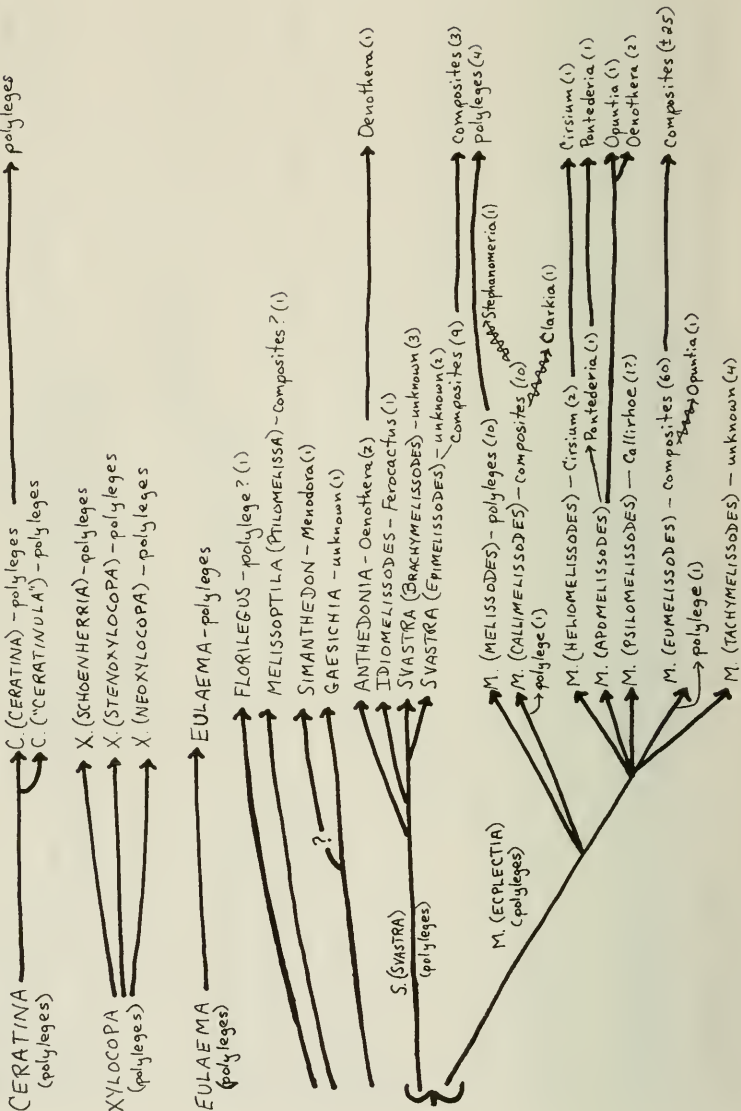
cool humid N.Am.



cool humid N. Am.

arid N. Am.

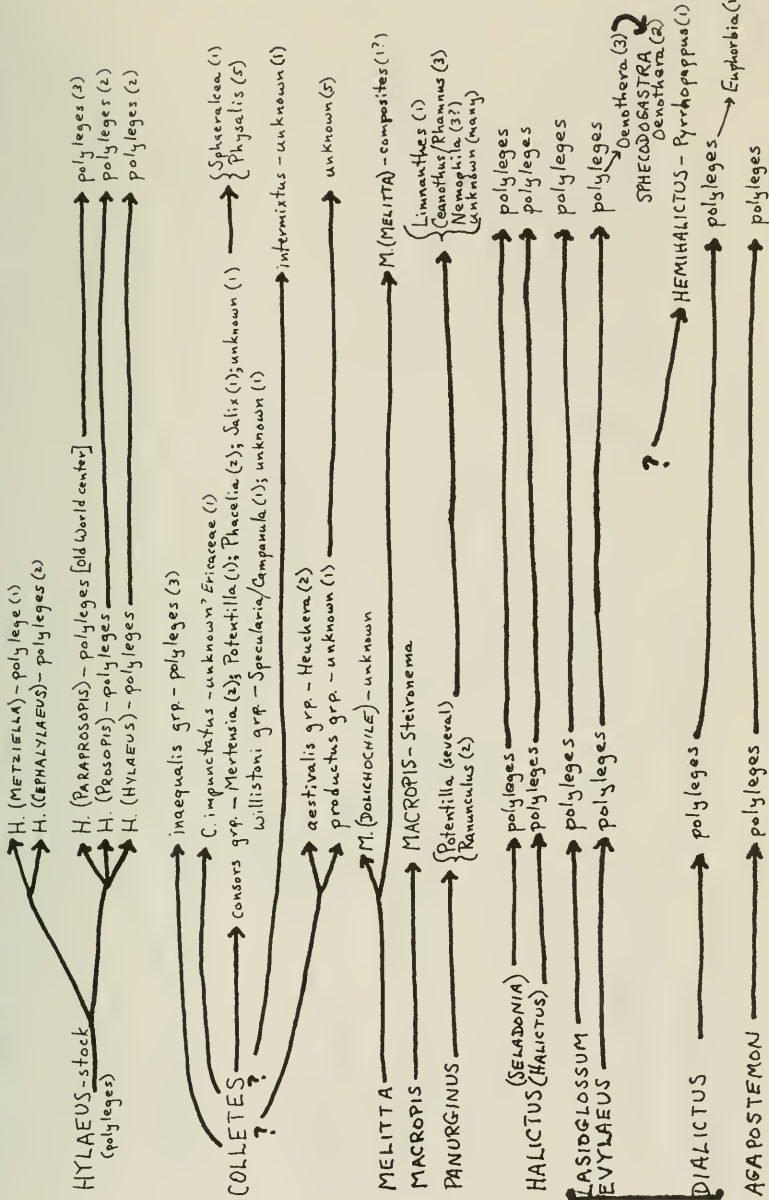
NEOTROPICAL



Laurasian Arctotertiary
(cool humid)

cool humid N.Am.

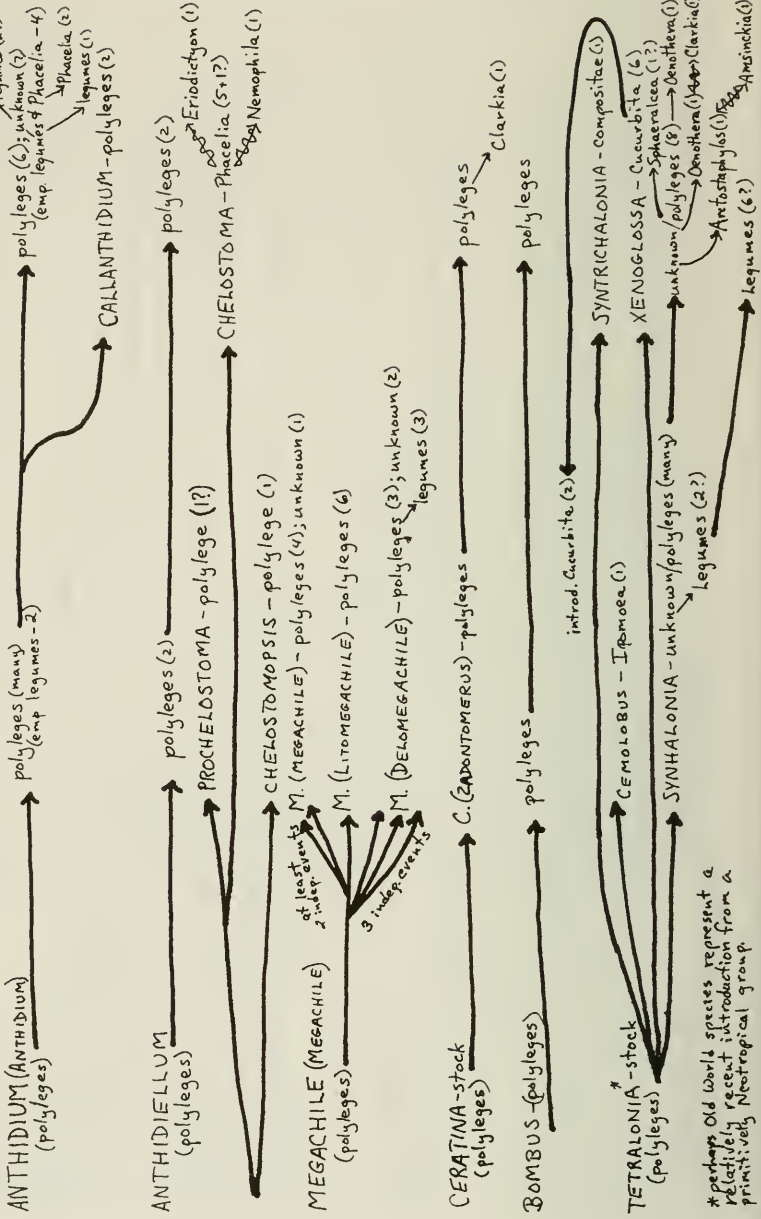
arid N.Am.



LAURASIAN ARCTOTERTIARY
(Cool humid)

cool humid N. Am.

arid N. Am.

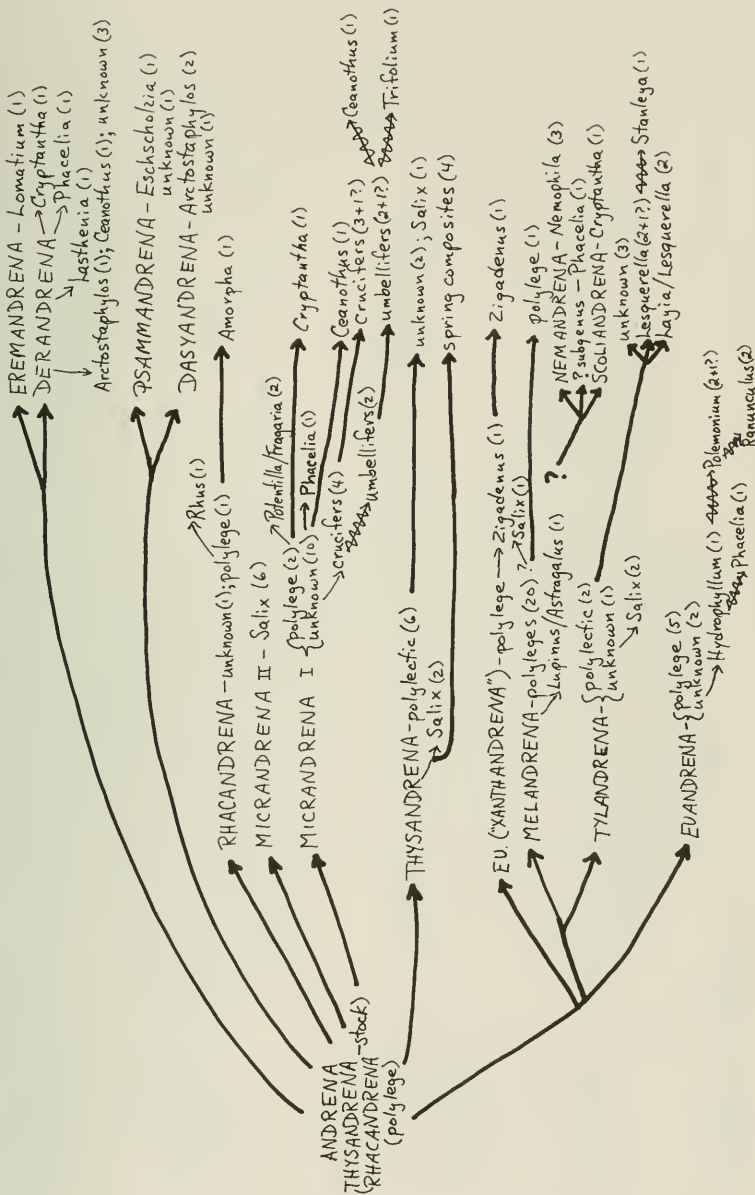


* perhaps Old world species represent a relatively recent introduction from a primitively Neotropical group.

LAURASIAN ARCTOTERTIARY
(cool humid)

cool humid N. Am.

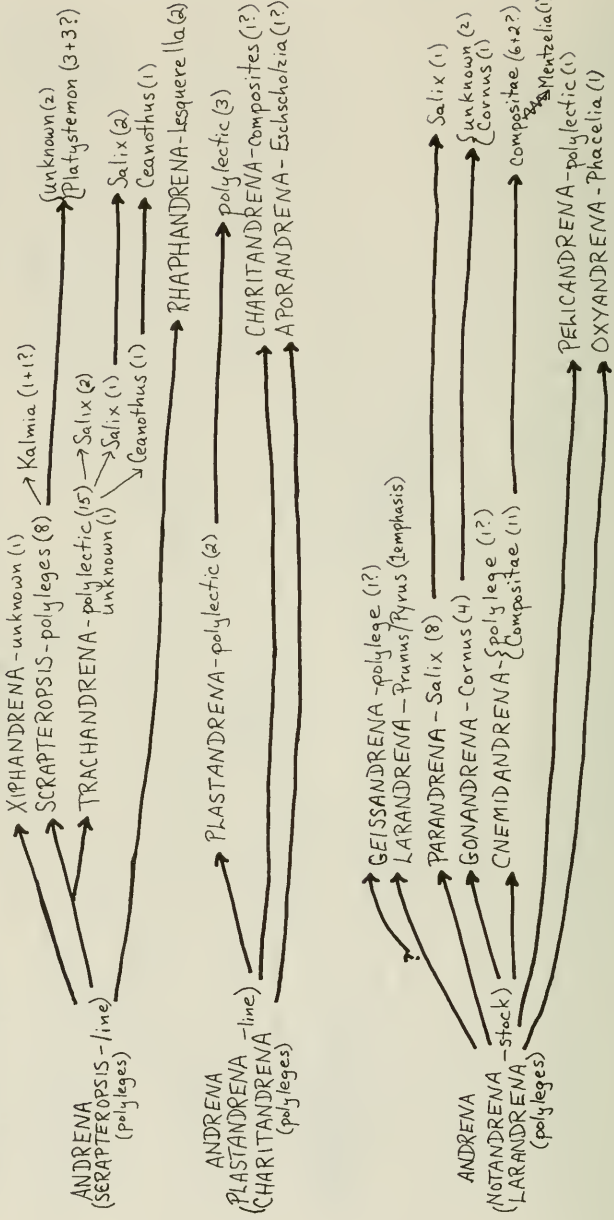
arid N. Am.



LARUSIAN ARCTOTERTIARY
(cool humid)

cool humid N. Am.

arid N. Am.

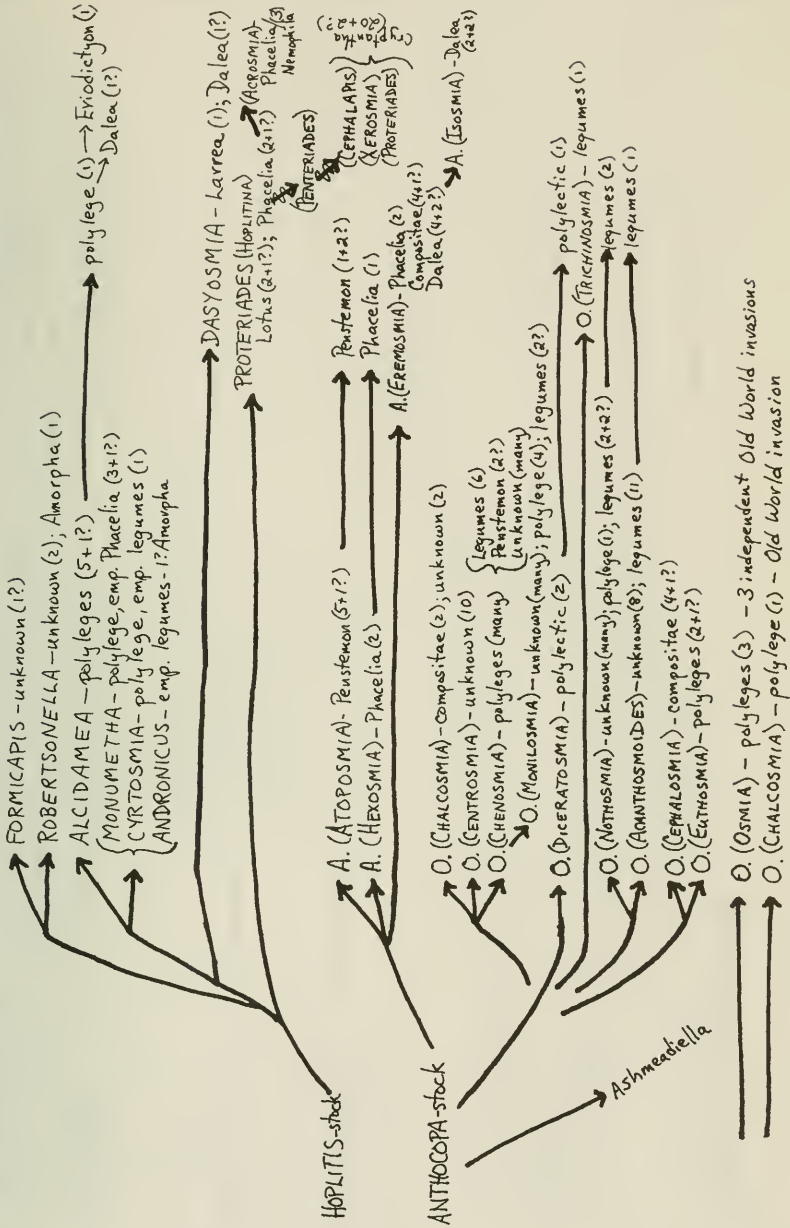


Not illustrated:
 Dactylandrena - Ribes (2+2?); Tomelissa - Viola (1); Ptilandrena [unknown (1); Claytonia (1)];
 n. subg. - Nothoscordum (1); n. subg. - Erythronium (2); Leucandrena [unknown (many); Erythronium (1)];
 Opandrens; Conandrens; Oligandrena; Simandrena (Platandrens, Stenandrens);
 Chauandrena; Taeniandrena.

LAURASIAN ARCTOTERTIARY (cool humid)

cool humid N. Am.

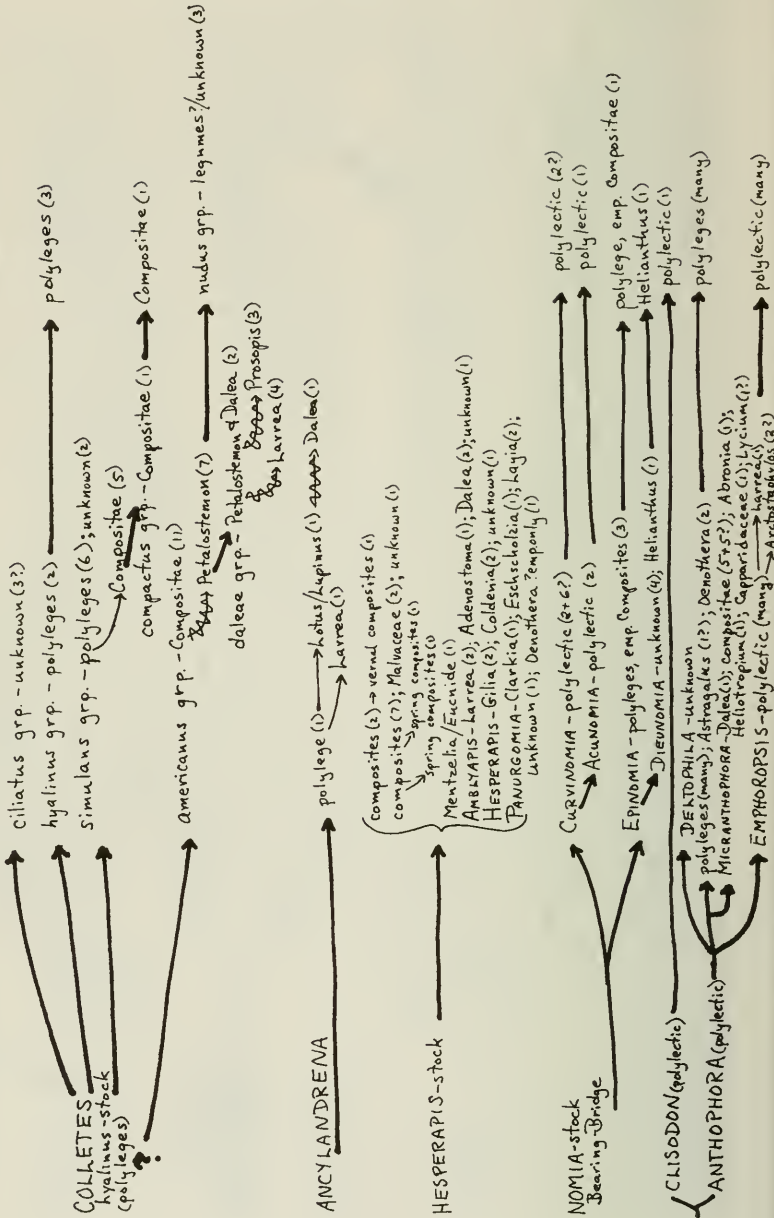
arid N. Am.



LURASIAN ARCTOTERTIARY
(warm arid)

arid N. Am.

cool humid N. Am.



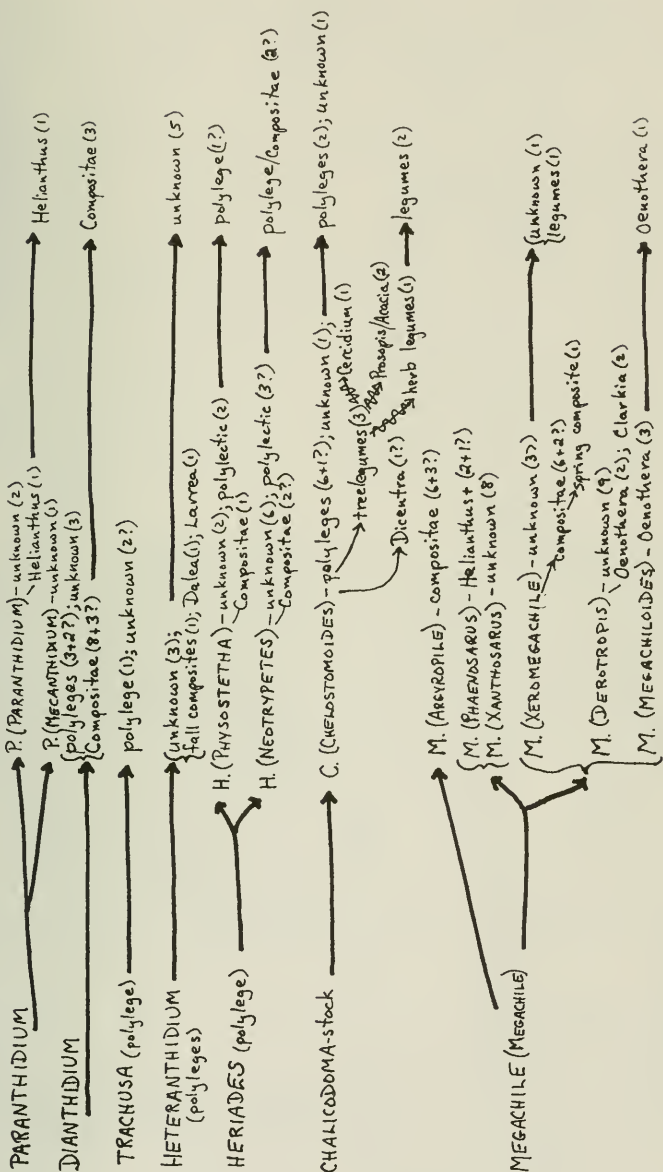
compactus grp. - Compositae (1) → Compositae (1)
 Americanus grp. - Compositae (11)
 Petalostemon (7) → nudus grp. - legumes?/unknown (3)
 Petalostemon of Dalea (2)
 Prosopis (3)
 Larrea (4)

LAVRASIAN ARCTOTERTIARY

(warm arid)

arid N. Am.

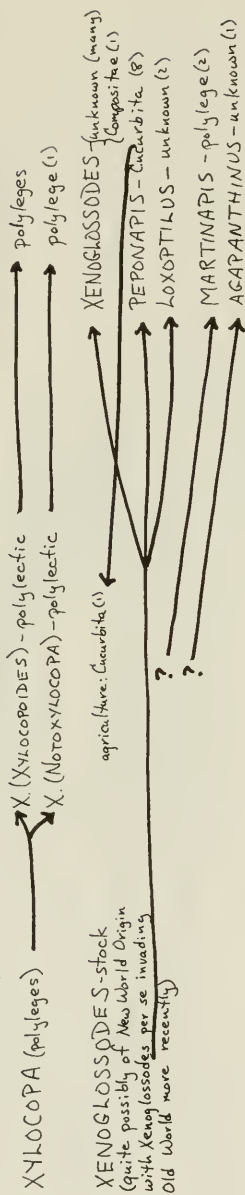
cool humid N. Am.



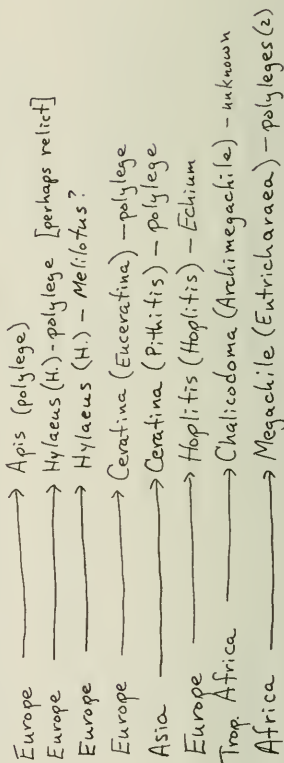
LAURASIAN DISTRIB. (humid warm)

humid warm N. Am.

xeric N. Am.



"RECENT" INTRODUCTIONS:



I have found approximately 250 instances of host changes of the nature polylectic \rightarrow specialist or specialist_a \rightarrow specialist_b (this excludes some unmonographed subgenera of Andrena and Osmia) in the evolution of North American bees. Depending on one's point of view, this can be taken as either a surprisingly large or a surprisingly small number since no comparable data exist. I personally fall into the latter camp for it should be emphasized that many such instances of specialization or "shifts" have not been particularly "successful" gauged in terms of adaptive radiation subsequent to such host changes nor have many of such changes markedly affected the pollination ecology of the North American flora. Many bee taxa which demonstrate host-specialization and host-shifts most frequently are not the most important pollinators of their respective hosts. There are also very many abundant melittophilous plant groups in North America which have not coevolved with any specialist-feeding bees at all, indeed the flora of North America (except for certain dominant tree genera) is overwhelmingly melittophilous.

Illustration 2 reveals that the presumed primitive character state in most groups is generalized feeding. This is not based solely on theoretical concerns, but in fact in many groups the structurally least specialized species are known to be generalized feeders. In some of the groups we do not know, even by inference, what the ancestors may have fed upon, since the least specialized species are characterized by divergent feeding patterns; my most reasonable guess of ancestral feeding patterns is sometimes indicated in the left-hand column. It is notable, and surprising I think, that there are no instances of host changes of the type from specialist \rightarrow polylege. Specialization appears to be an exclusively one way process. The only semblance of such a shift takes place in the evolution of our largely endemic Centris (Xerocentris) polyleges from ancestors within the genus Centris which while polylectic for pollen supplies still were obligately specialized to harvest oils instead of nectar (Neff unpub.).

In addition to the presumed and postulated ancient polylectic ancestors of our North American bee fauna, there have been at least 9 Neotropical, 2 Arctotertiary (with close present Old World ties) and two recent accidental introductions of formerly specialized lineages which have maintained their pattern of specialization here. Of the 250 instances of evolutionary host-plant specialization or switches, most have occurred in very few genera: more than 60 in Perdita.

24 in Dufourea, 18 in Nomadopsis, 15 in Colletes, 23 in the Eucerinae. Perdita and Andrena are the two most diverse genera in North America, hence their degree of specialization is not unexpected. The third largest genus, Dialictus, has speciated in the absence of host-plant specialization; all North American species are generalized feeders with the possible exception of one desert species implicated in association with Euphorbia (Eickwort, pers. comm.). Both Dialictus and Evyllaesus (considered by some workers congeneric) are apparently generally polylectic throughout their range, seldom specializing either in the Old World or the New World (Ebmer & Pauly, pers. comms.). I presume that this indicates that these and other halictine bees do not have the same type of genetic host-selection mechanisms possessed by most other bees.

Nearly all of the specialization events noted are those from polylege → specialist, only 53 are possibly switches between different non-confamilial individual plant hosts, again implying the unidirectional and apparently "dead end" nature of such switches. Interestingly, about half of the switches that apparently do occur take place in the Sonoran Desert and the other half in the Mediterranean regions of California, practically none in the other regions of North America. Though the arid regions do support greater diversities, this degree of difference cannot be accounted for on that basis alone. Climates are less predictable and smaller shifts in amplitudes in these regions produce greater effects on the flora and fauna perhaps by altering germination cues and the temporal synchronization of host plant and bee disproportionately.

Of these 53 non-confamilial host-shifts, only 10 occur between taxa which appear visually rather similar (at least to human eyes). Though relevant data on chemical cues are lacking for most taxa, it is reasonable to suppose that many such switches have indeed occurred between taxa which are in fact extremely dissimilar. In certain cases the recipient host is a dominant plant (e.g., Larrea, Prosopis) that the former species could reasonably be expected to have continual exposure to, or in some cases the novel host is one of the very few other plants to bloom during the particular time of year the original host was in bloom (e.g., Tidestromia, Limnanthes), but in many instances logical "explanations" for such shifts elude me. Examination of the lineage diagrams also reveals an additional ca. 30 confamilial host-shifts, occurring between visually rather dissimilar plants (Phacelia/Nemophila; Clarkia/Camissonia; Lesquerella/Stanleya; Mentzelia/Petalonyx);

it is reasonable to presume tentatively that such shifts were facilitated by the recognition of certain phylogenetically shared chemical characteristics, however such assumptions must be tested by subsequent chemical analysis.

In an analysis of evolutionary host-shift patterns, it is of course of utmost importance to determine as precisely as possible the cladistic relationships amongst the species themselves. I have accepted the published opinions of taxonomists wherever available. I have tried in all possible instances to examine their implied/stated cladograms with a skeptical eye, but seldom have I felt that an application of Occam's Razor (solely in light of known/postulated host associations) would change their point of view, except in instances of very rare incompletely known taxa which were unknown from the standpoint of host associations as well. Minor differences, either of conscious design on my part or misinterpretation, will be apparent since I have chosen to present diagrammatic cladograms to facilitate data examination in problem phylogenies. It is important to note that seldom (if ever) have bee taxonomists considered host-association or weighted it heavily in constructing their published phylogenetic speculations; such relationships are generally based on morphological structures, particularly the male genital apparatus. Indeed, recent monographers of Andrena have considerably revised the postulated relationships of this very large genus by not treating specific floral adaptations in their phylogenetic schemes.

I believe that the only conscious changes I have incorporated herein are: 1) the sinking and remixing of A. (Scaphandrena) into A. (Micrandrena) (a separation termed possibly artifactual by the latest monographer -- Ribble, 1974) which entails the lumping of the crucifer-feeding M. piperi-group, M. primulifrons-group and all crucifer-feeding Scaphandrena; uniting M. (I) chlorogaster with S. merriami; S. lomatii, mackiae, S. plana with M. (I) microchlora; M. (I) melanochroa perhaps united with Derandrena ziziaeformis; 2) the lumping of possible Polemonium A. (Euandrena) feeders (i.e. A. polemonii to A. segregans) by application of Occam's Razor; 3) the uniting (largely) on the basis of similarities of the 8th sternum from various tentative placements of a group of species related to the Perdita vittata/sonorensis groups (since many of these species, e.g., P. heliotropii, covilleae, punctulata, pluchaeae, perixantha, parvella, ambigua, tarda, have unknown hosts, at this preliminary level of analysis, the point is largely moot); 4) the uniting, by Occam's Razor only, of the P. koebeleii-group with other'

Mentzella-feeding Perdita; 5) uniting the Lesquerella-feeding A. (Tylandrena); 6) removing Colletes larreae & C. turgiventris from the C. robertsoni group on the basis of their distinct genital apparatus; 7) linking P. (Alloperdita) to P. (Procockerellia) by Occam's Razor alone; 8) removing the long-faced Perdita hurdi and P. gilliae from the long-tongued P. (Glossoperdita) and placing them in P. (Epimacrotera); 9) transferring Perdita erythropygga & P. fulvicauda from the ventralis-group to the octomaculata-group on the basis of the similarities of the eighth sternum; 10) linking by Occam's Razor the Dalea-oligoleges in Ashmeadiella (Rhamphorhyncha, Cubitognatha & Corythochila); 11) postulating monophyly in each of the composite-, Dalea- and Phacelia-feeding groups of Anthocopa (Eremosmia/Isosmia); 12) lumping as monophyletic the legume oligoleges in Osmia (Nothosmia & Acanthosmoides) on the basis of Occam's Razor alone in the absence of any conflicting information.

In groups which have not been recently monographed, cladistic sequences were not attempted, and are not indicated in Illustration 2, nor are the switches (whatever form they may really take) counted in textual analysis. Cladograms of Colletes and Perdita are original but attempt to agree with the taxonomic specialist's published anecdotal remarks.

Of the host-specialization relationships elucidated in this manner, most are represented in the western United States. Indeed, California is uniquely situated in which to study the precise forms that such adaptation can produce since all the trophic couplings between particular plant genera and specialist-feeding groups except 30 occur within the state; there are another six resident plant groups with specialist feeders in closely adjacent regions which subsequent field work will probably discover in California as well (i.e., Cornus, Nothocalais, Stanleya, Descurainia, Wislizenia, Polemonium).

Illustration 2 represents approximately 50 bee lineages that are suspected of ancient Arctotertiary Floral ties to closely related species in the Old World, 40 Neotropical, 25 endemic Madrotertiary Flora and 35 old North American Tropical. Since these lineage ancestries are by definition highly speculative, these results should be taken to indicate only relatively heavy phylogenetic inputs from the three external source paleohistorical realms to the present bee fauna of North

America. The terms Arctotertiary and Madrotertiary refer primarily to the floral associates of the bee lineages since the paleohistorical age of most bee groups is completely unknown in the absence of relevant fossils. Most bee taxonomists (unlike myself) believe that most bee lineages are of much more recent derivation than these basic floral assemblages. Both Arctotertiary and Neotropical (open savanna and humid forest not distinguished) stocks have contributed heavily to the semi-arid/arid regions of the southwestern United States; contributing by my count approximately 45 stocks each. Neotropical stocks have undoubtedly contributed even more heavily, since I am thoroughly unfamiliar with the bee fauna of semi-arid Mexico, and it is quite probable that no additional Arctotertiary elements (not already counted) have contributed. Twenty Neotropical stocks have also contributed heavily to the forested regions of the southeastern U.S.A., though many of these elements may have been archaically associated with North America rather than with temperate South America whose faunistic contribution may be limited to late Pliocene. Twenty-one separate lineages traceable to basically arid stock but not definitely associated with either Neotropical or Arctotertiary ancestries (termed "endemic Madrotertiary") have contributed to the present cool temperate North American fauna as well.

True range expansions of lineages into novel geofloras, usually involve polylectic species, or species which have followed a successful invasion by their host plant (i.e., Cucurbita, Opuntia, Oenothera?, Petalostemon) or species which were basically "family-oligoleges" and which were able to switch to alternate but closely related host plants. Range extensions associated with specialization upon a totally new plant host characteristic of the recipient floristic realm are not frequent; all such examples cited in Illustration 2 represent cool humid forest → semi-arid scrub shifts, except for two independent Prosopis → Salix shifts. (Too little data is available to cite any potential Neotropic → Madrotertiary extensions accompanied by major host jumps; such examples most certainly exist, however, I know too little about the pattern of host-selection in most truly Neotropical genera).

An interesting case in point involves Andrena (Callandrena), a group clearly associated with the Compositae (except one very distinct species, A. levipes) of the arid portions of Mexico and southwestern United States. LaBerge has carefully monographed (1967) the group and provided detailed postulates of

cladistic relationships. Of the twenty species which are not primarily distributed in the desert United States or Mexico, there are eleven distinct lineages (treating the genitally distinct A. haynesi as a monotypic group). Though host generic identity of the Mexican and southwestern United States species are not known, it is clear that nearly all of the basic lineages within the subgenus were able to expand into the adjacent portions of North America by specializing upon one particular genus (or several closely related ones) which then provided an access route to great geographic expansion (presumably through limited competition); though several species utilize apparently the same genus, the overlap was apparently circumstantial and not determined by the nature of their as yet unknown ancestral Mexican hosts (e.g., A. aliciae - Helianthus/Rudbeckia; A. melliventris - Gaillardia & A. rudbeckiae - Rudbeckia/Ratibida; A. accepta - Helianthus; A. crawfordi/sitiliae - Pyrrhopappus & A. krigiana - Krigia; A. simplex - Aster/Solidago & A. placata - Solidago & A. asteris/asteroides - Aster; A. fulvipennis - ?oligolectic?; A. haynesi - Helianthus; A. helianthi - Helianthus & bracata - Solidago & A. vulpicolor - autumnal Chrysothamnus & A. irrasus - Amphiachrys/Gutierrezia; A. helianthiformis - Echinacea; A. gardineri - vernal Senecio & A. ardis - Chrysothamnus/Gutierrezia). Thus the United States assemblage of species are not closely related as one might initially expect but seem to represent a diverse array of independent phylads, each of which owes its range expansion in some way to a separate instance of host specialization -- quite probably involving generic shifts from the ancestral host in many cases.

Table 3 summarizes the information in the phyletic charts as to plant genera within North America that are known to support specialist-feeding bees. In each case the probable number of independent evolutionary switches leading to that particular host association is indicated in parenthesis. Generic specialization within the Compositae, other than Cichoreae is omitted for brevity sake. The largest number of independent specialist groups are associated with the Compositae (38 summer & fall composites; 13 spring Lasthenia, Layia, Blennosperma; 5 spring cichoriacs Agoseris, Malacothrix, Anisocoma; 5 summer Stephanomeria, Pyrrhopappus); this group contains in excess of 525 species of which the host choices are relatively certain, well in excess of one third of all the specialized-feeding bee species in North America.

TABLE 3

Classes of Plants with specialist-pollinators:
 (# species; # independent lineages)

I Blooms at odd-time of the day:

Blooms early in the morning

- Calystegia (1;1)
 Camissonia (36;4)
 Cucurbita (14;2)
 Ipomoea (6;3)
 Agoseris/Malacothrix (14+2?;5)
 Pyrrhopappus/Krigia (8;2)
 Sicyos (1;1)

Blooms in the evening

- Camissonia (several)
 Oenothera (25;11)
 Mentzelia (several)

II Blooms at odd-times of the year:

Blooms in the early spring

- Amsinckia (1;1)
 Erythronium (3;2)
 Limnanthes (2;2)
 Lomatium/Sanicula (2;1)
 Ribes (2+?;1)
 Salix (29;11)
 Zigadenus (1;1)
 Ranunculus (3;2)
 Claytonia (1;1)
 Vaccinium (1?;1)
 spring dandelions (14+2?;5)
 spring composites (29+8?;14)

Blooms at the very end
of the season

- Aster
 Baccharis
 Chrysothamnus/Haplo-
pappus (many)
 Gutierrezia/Hetero-
theca
 Solidago
 Gayophytum (5;2)
 Perideridia (1;1)

III Dominant plant in community (or most abundant):

- Adenostoma (2;2)
 Arctostaphylos (4+2?;3+1)
 Ceanothus/Rhamnus (4+1?;5)
 Chrysothamnus/Haplopappus
(many)
 Larrea (22;12+3?)
 Lasthenia/Layia (26+7?;11)
 Lesquerella (7+3?;3)
 Prosopis (30+2?;9)
 Helianthus (many)
 Eschscholzia (15;7)
 Eriogonum (16+3?;2)
 Potentilla (alpine) (6;4)
 Cercidium (1;1)
 Acacia (2;2)

IV Unusual, hard-to-handle floral morphology;

unusually tiny pollen

- Cryptantha (24+2?;5)
 Mertensia (2;1)
 Nama (8+2?;3)
 Coldenia (15+2?;4)

unusually tiny flowers

- Croton (2;1)
 Euphorbia (28+10?;11)
 Eriogonum (16+3;2)
(not fasciculatum)
 Tidestromia (3+2?;2+2?)

pendant flowers

- Chamaedaphne (1?;1)
 Calochortus (albus+) (2;1)
 Campanula (rot.+) (1;1)
 Symphoricarpos (1;1)
 Erythronium (3;2)
 Mertensia (2;1)
 Dicentra (1?;1?)
 Emmenanthe (2;2)
 Viola (1;1)
 Vaccinium (1;1)
 Physalis/Chamaesaracha
(16+6?;4)

TABLE 3
Classes of Plants with specialist-pollinators:
 (# Species; # independent lineages)

IV (cont.) Unusual, hard-to-handle floral morphology:

<u>tubular flowers; with or without guard hairs</u>	<u>unusually large pollen</u>
Abronia (1;1)	Callirhoe (2;2)
Amsinckia (1;1)	Calystegia (1;1)
Coldenia (15+2?;4)	Ipomoea (6;3)
Cryptantha (24+2?;5)	Hibiscus (1;1)
Eriastrum/Navarretia (10+3?;3)	Camissonia (35;4)
Heliotropium (5;4)	Clarkia (11;9)
Linanthus (6;3)	Oenothera (25;11)
Nemophila (7;4)	Cirsium (4;2)
Verbena (3+1?;1)	Gayophytum (5;2)
Cirsium (4;2)	Malacothamnus (2;1)
Pontederia (3;2)	Sida/Sidalcea (1;1)
Passiflora (1;1)	Sphaeralcea (26+7?;10+1)
Petalonyx (2;1)	Cactaceae (17+10?;8)
Menodora (1;1)	
Ipomopsis (1;1)	<u>exclusion flowers</u>
Eriodictyon (4;4)	Dalea (23+8?;12+1?)
Penstemon (7+5?;3)	Lotus/Lupinus/Astragalus (36+14?;13+1?)
Nama (8+2?;3)	Trifolium (8;4)
Mimulus (1+1?;2)	Petalostemon+ (12+2?;3)
Lycium (??;2?)	Melilotus (1?;1?)
Monardella (2;1)	
Salvia (2+1?;3)	
Monarda (5+1?;3)	

V Flowers with oils but no nectar

Steironema (4;1)

UNCATEGORIZED EXAMPLES

total composites (416+74;38)	Polemonium (2+1?;1)
Phacelia (39+7?;20)	Cornus (4+1?;1)
total Mentzelia (24+1?;8)	Zizia/Taenidia/Thaspium (2+1?;1)
(bees not nocturnal)	Descurainia (3;1)
total Potentilla (6;4)	Fallugia (3?;1?)
Capparidaceae (13+3?;9)	Platystemon/Meconella (3+3?;1)
Calochortus (16+3?;3)	Kalmia+ (1+1?;1)
(not pendant)	Rhus (1;1)
Stephanomeria (4;3)	Hydrophyllum (1;1)
Lepidium (6+2?;2)	Thelypodium (1;1)
Gilia (6;5)	Arenaria (1;1)
Campanula/Specularia (4;2)	Barbarea (1;1)
(not pendant)	Argemone (1;1)
Heuchera (2;1)	
Nothoscordum (1;1)	

Lumping all papilionaceous specialist-feeders would yield about 40 separate specialist bee groups, but they are composed of only about 125 suspected specialist taxa. Many of the papilionaceous specialists are strongly genus-specific, and unlike the composite-feeders such a lumping on the familiar level may not be as meaningful a statistic.

All of the other groups of plants that have coevolved with specialist-feeding bees are of quantitatively a very different order of magnitude. Phacelia (Hydrophyllaceae) with at least 20 separate lineages comprising in excess of 40 species is exemplary. Camissonia (Onagraceae) and Sphaeralcea (Malvaceae) with about 35 specialist-feeders, Prosopis (Leguminosae), Cryptantha (Boraginaceae) and Salix (Salicaceae) with about 30, and Euphorbia (Euphorbiaceae), Oenothera (Onagraceae), Opuntia+ (Cactaceae) and Mentzelia (Loasaceae) with about 25 specialist-feeders each follow in that order. Of these groups however only Sphaeralcea (11), Salix (11), Oenothera (11), Prosopis (9), Euphorbia (8) and Mentzelia (8) are associated with more than 5 separate bee lineages each. Other specialist-feeding groups with 5-11 separate lineages but only 10-25 individual species are associated with Larrea (Zygophyllaceae), Ceanothus/Rhamnus (Rhamnaceae), Cleome/Cleomella/Wislizenia (Capparidaceae), Gilia (Polemoniaceae) and Eschscholzia (Papaveraceae). Plant groups with even fewer associated coevolved bee lineages but more than 10 individual species of obligate specialist-feeders are Penstemon (Scrophulariaceae), Physalis/Chamaesaracha (Solanaceae), Coldenia (Boraginaceae), Eriogonum (Polygonaceae), Cucurbita (Cucurbitaceae), Calochortus (Liliaceae) and Eriastrum/Navarretia (Polemoniaceae). All other plant genera with associated specialist feeders are associated with only 1-3 separate lineages and 10 or fewer bee species, so far as I am aware.

The plants utilized as resources by specialist-feeding bees are not a random sample of the North American flora, even though the wide range of bee sizes and energy requirements would not seem to preclude many possible non-anemophilous plants. Certain particular plant characteristics, however, seem most favorable to the coevolutionary relationships facilitating specialist-feeding habits (Table 3):

a) plants which bloom for a limited period very early in the morning or late at night generally represent the only available resource at that time and at the very least a facultative specialization by pollinators must result; continual competition from generalist-feeders on other resources during the

times when most floral resources are available might further restrict species pre-adapted to odd-time feeding and promote subsequent behavioral specialization. The majority of bees are associated with morning-blooming plants; the evening blooming plant-taxa are all primarily pollinated by moths and bee visits have probably not been major selective forces in evolving and maintaining the habit, though the bees associated with Camissonia are certainly locally important along the western edge of the Californian deserts and the southern Central Valley. On the other hand, the matinal Convolvulaceae, Cucurbitaceae, and Cichorieae are usually rather exclusively pollinated by these specialist bees. Though widespread throughout North America today, all such close co-associations are clearly arid southwest or Neotropical in origin.

b) plants which bloom at the very beginning or end of the blooming season within any community also force a restricted diet upon whatever pollinators are active contemporaneously. This temporally-induced restriction may be enhanced by selection for morphological specialization upon any short-lived bee species whose activity is completely restricted to these seasons. Such "odd-time blooming" specialists are present in all portions of North America, particularly so in the Eastern Deciduous Forests and Mediterranean California. Desert regions are not particularly susceptible to this type of selective pressure, since in the majority of instances the entire blooming season is extremely short and keyed to relatively temporally unpredictable rains.

c) Dominant plants might be expected to support specialist herbivores even under conditions of heavy exploitation by generalist feeders, since the resource base is both predictable and sufficient to permit "table scrapping" by specialists. With the exception of the coniferous and deciduous forested regions of North America (the dominant species of which are nearly entirely anemophilous), dominants do support specialized pollinators throughout the year. Interestingly, in the Eastern Deciduous Forest, Cornus (Benthamidia) has not coevolved with any specialist bees, even though the less abundant Cornus (Svida) has coevolved with the abundant Andrena (Gonandrena). Dominant floral resources in the California grasslands and the Great Plains are semantic problems necessitating quantitative analysis, however, Eschscholzia, Lasthenia, Layia and Helianthus must certainly be analogous to dominant perennials in other ecosystems.

d) Plants with unusual tubular floral morphologies or species which produce pollen with exceptional dimensions can be partially exploited by

numerous strategies; however, bee species with morphological preadaptations increasing efficiency at utilizing such a resource will be favored. Should such a morphological specialization simultaneously decrease efficiency at exploiting more generalized floral syndromes, progressive positive selective feedback would be expected to result in the accentuation of both morphological adaptation and specialized-feeding habits. Bees collecting large pollen usually have long thick sparse transporting scopal hairs; bees collecting the small spikey pollen of the Compositae usually possess dense fine highly plumose scopal hairs; bees exploiting tubular morphologies generally have special setae on the mouthparts or front legs enabling extraction of pollen. This classification of floral hosts has by far the most component examples, especially plant genera with narrow tubular morphologies; frequently such plant genera are pollinated by many pollinators other than bees and hence such an adaptation should not be assumed to be a specialized morphological adaptation on the part of the plant resulting from the activity of specialist-feeding bees, indeed I believe the relation is not causal in the majority of cases. Nearly all plant genera in category (d) are arid adapted (or originally so); the only clear forest/moist associated taxa are Erythronium, Mertensia, Campanula and perhaps some leguminaceous groups.

The data presented in Table 3 indicate that these special circumstances are indeed often correlated with specialized-feeding tendencies. However, many plant genera with specialist pollinators cannot be included in these four categories. In cases (a), (b) and (d) the plants which are associated with specialist-feeders are generally even more frequently associated with generalists as well. Some plants evidencing strategy (d) and most of those which bloom at odd times of the day are the only species which rely upon specialists exclusively for their pollination.

These data on host-specialization are of course very preliminary; many taxa remain unknown and some of the associations extrapolated from known close relatives are probably incorrect. Thanks primarily to Professor Timberlake and the many apidologists associated with the University of California, California and west Sonoran Desert bee species are relatively well-known. Robertson in Illinois, Michener in Kansas, Bohart in Utah and Rozen and Neff in southern Arizona have also provided great amounts of floral data, but much of the country, particularly the eastern United States remains poorly known. In addition, very rare species, no matter

what their distribution, are always problematic. Lists of specialist-feeding (known or suspected with relative certainty) bees are presented in the appendix for each of 10 major subdivisions of North America. Not all species listed inhabit the entire region under consideration, and hence citations in the same list do not necessarily imply sympatry or occurrence at a particular locality. These lists are presented in their entirety so that: 1) future discoveries on host-associations can be incorporated easily into the conclusions presented herein; and 2) observations on pollination ecology of plant species in different parts of the country might be facilitated. Listings for the different regions of California are too voluminous to incorporate; interested persons may obtain them from the author directly.

The proportion of specialist-feeding bees (of total resident non-parasitic bee species) in all biotic regions of North America is correlated to species richness (Illus. 3). This positive correlation is observed within the geographic regions of California as well (Illus. 4). The percentage of specialist-feeders varies from a low of 15-22% in the forested and boreal regions of North America to 35-45% in the Great Plains and Great Basin, to a high of ca. 50% in mediterranean California and the desert. As documented in Moldenke (1976b) the percentages within subregions of California run much higher, clustering between 40-55% in most regions, with a low of 30% in the immediate maritime province to a high of 60% in the Mojave Desert. Within California, as noted from an entirely different point site viewpoint in Moldenke (1971), the alpine Sierra Nevada is noteworthy in supporting very few total bee species, a remarkably large 50% of which are specialized feeders (nearly all the specialist-feeding species are extremely rare however).

The total number of plant genera specialized upon within a region is also directly correlated to species richness. The number of plant genera with specialized feeders is highest in mediterranean California (55) and lowest in the Southern Mixed Forest (10) and tundra (6). The bee fauna of the forests of upper Austria falls on the low end of the curve (18 genera with coevolved specialist-feeding bees; 27 (12%) total specialist bee species -- Hamann & Koller, 1956), considerably below levels observed in the boreal forests of the United States (still poorly studied -- and probably will yield more cases of specialization upon subsequent analysis. No comparable data from other parts of the world are available.

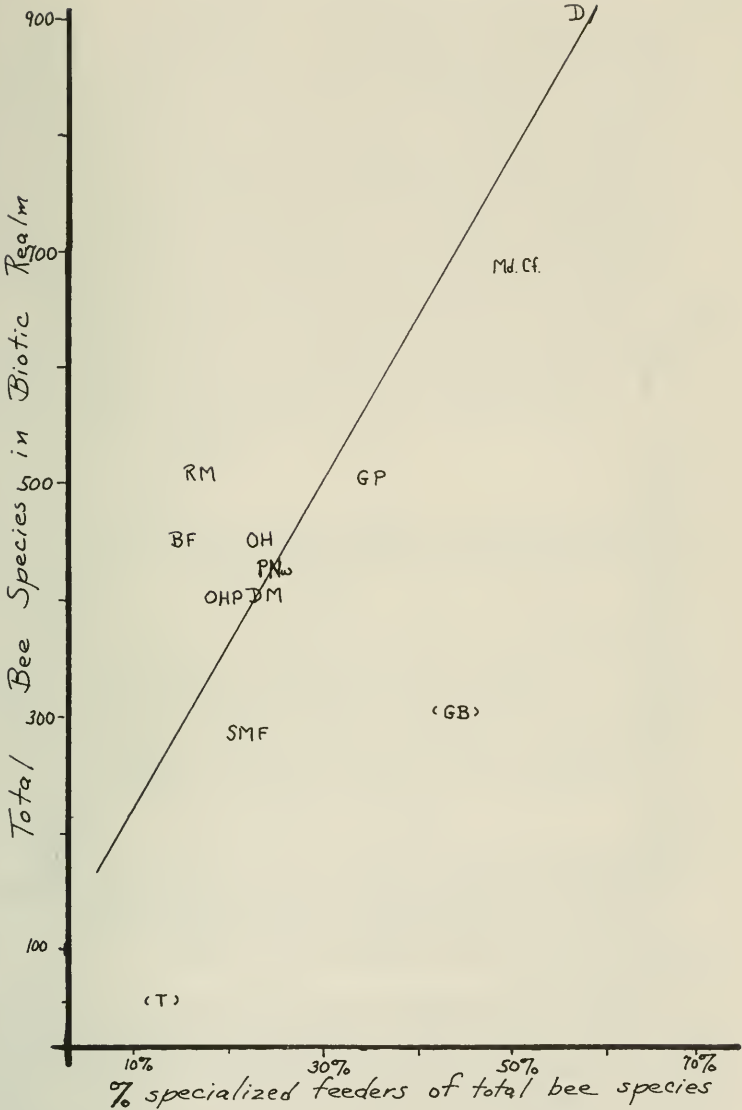


ILLUSTRATION 3

NORTH AMERICAN BEE DIVERSITY. Abbreviations as in Table 1. Faunal estimates of Great Basin and Tundra not considered robust enough to be considered in mathematical correlation. Slope significant at 99% certainty level.

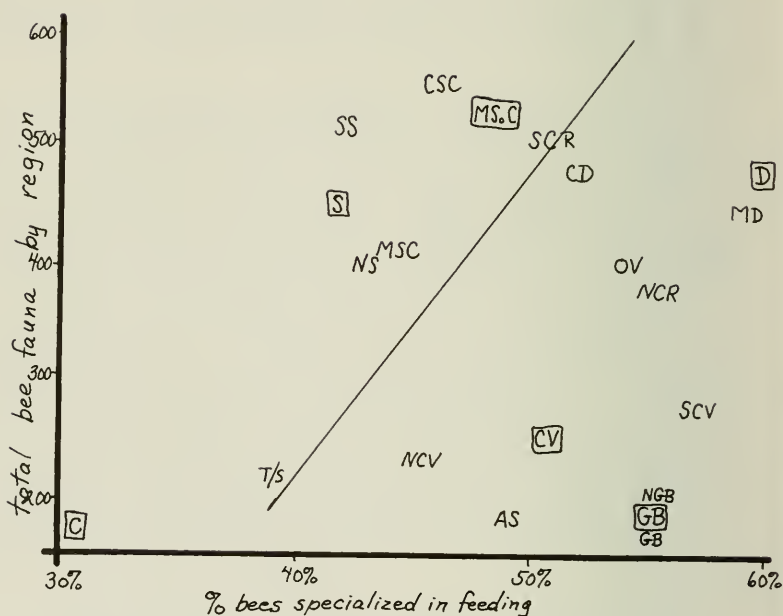


ILLUSTRATION 4

CALIFORNIA BEE DIVERSITY AND HOST-PLANT SPECIALIZATION. Abbreviations as in Table 2. Faunal estimates for AS, NGB & GB considered too tentative for mathematical analysis; slope significant at 90% certainty level. Average degree of specialization for compound regions indicated in squares: C=coastal; CV=central valley; GB; total Great Basin; D=desert; MSOC=montane southern California; S=Sierra/Cascade axis.

Within this group of specialist-feeding bees, the partial specialists "to the family level" (e.g., Compositae, Leguminosae) only increases as the total number of bee species and the percentage of total specialists decrease (Illus. 5). There is a semantic problem entailed in this analysis, however, since these type of "oligolectic" feeding patterns require extensive study, to determine whether such species in reality do utilize a number of unrelated confamilial plants throughout their range or whether there may be instances of true "generic specialists" included mistakenly within in the absence of more complete data. However, since this same trend is evident within the relatively better-studied subregions of California as well (Illus. 6), I presume it is not artifactual but reflects a reality of competition between specialists and generalists within constrained resource systems (ms. in prep.).

CONCLUSIONS

I. The host-association data base of North American bees is sufficient for tentative conclusions regarding many important aspects of host-plant specialization patterns.

II. There is only a 3-fold difference in bee species richness in the major phytogeographic realms of North America (excluding the depauperate tundra).

a) the high California bee diversity is in some ways an artifact of artificial political boundaries.

b) Great Basin and Southern Mixed Forest support fewest bee species; mediterranean California and desert support most bee species.

III. There is only a 3-fold difference in bee species richness between geographic regions of California.

a) cismontane southern California, southern Sierra Nevada and southern Coast Ranges are species rich; northern montane and coastal are species poor.

IV. There is not a clear species/area relationship underlying conclusion II. Bee species per area varies about 6-fold (excluding tundra), unrelated to possible simple causative correlations, but is an additional order of magnitude greater in mediterranean California.

V. True host specialization and host shifts have occurred about 250 times within the North American bee fauna.

a) nearly all ancestral stocks are primitively polylectic; nearly all diet changes are from polylectic → specialist. There are no known

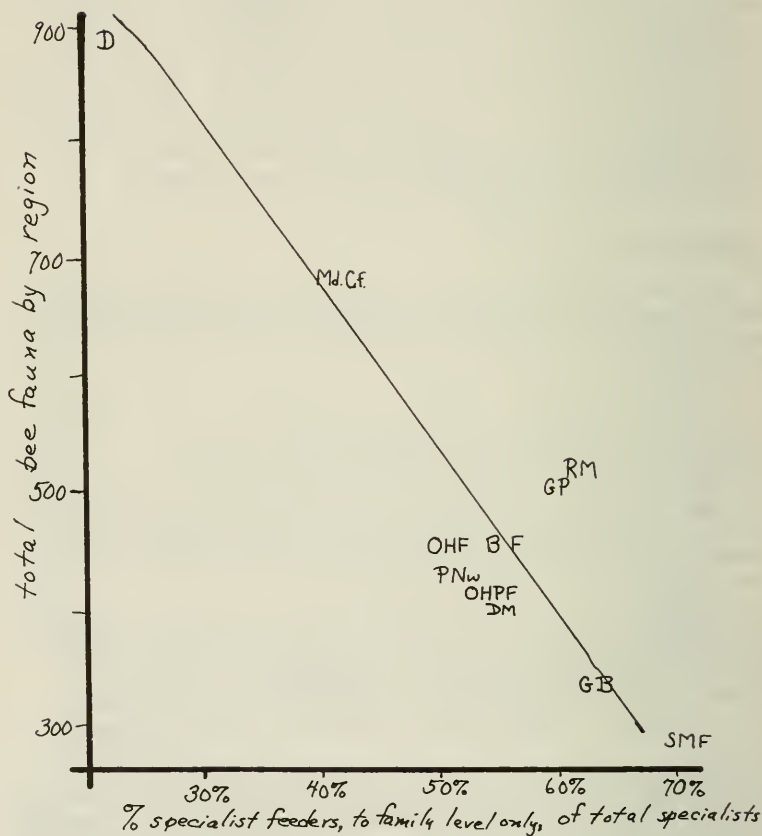


ILLUSTRATION 5

SPECIES RICHNESS OF "FAMILY-SPECIALIZED" BEES.
 Abbreviations as in Table 1. Correlation significant
 at 99% level.

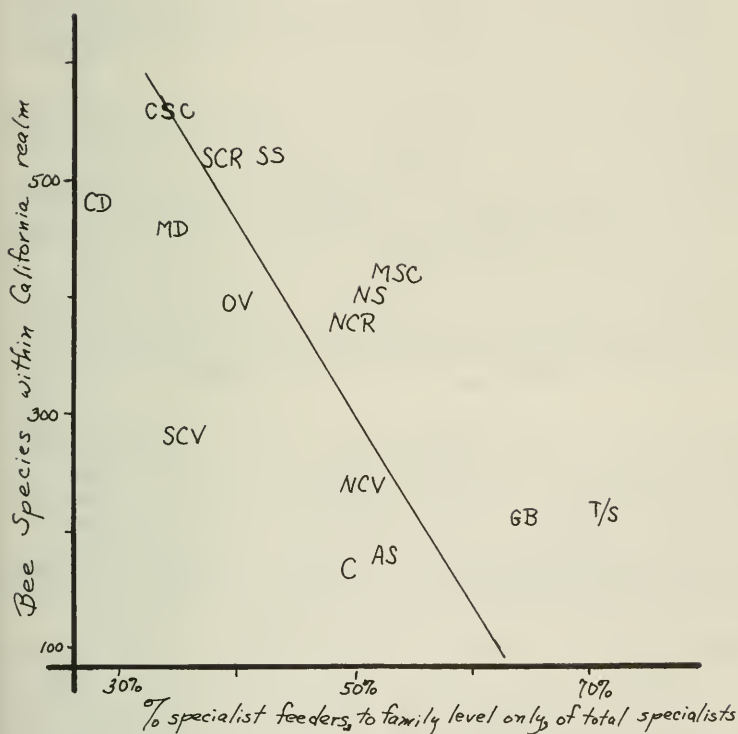


ILLUSTRATION 6

SPECIES RICHNESS OF "FAMILY-SPECIALIZED" BEES.
Abbreviations as in Table 2. Correlation significant
at 99% level.

specialist \rightarrow polylectic switches; such switches are apparently therefore one-way changes only.

b) considering the diversity of the North American flora and North American bees in general, this is a surprisingly small number of host changes, relative to the number of common North American melittophilous plant genera not supporting specialist pollinators.

d) most such shifts onto a novel plant are not particularly successful, measured in subsequent adaptive radiation;

e) some immigrant phyletic lineages have entered the United States as specialists and have remained so on the same plants;

f) the two largest genera of North American bees are characterized by the highest levels of host-specialization; the third largest by perhaps none at all;

g) only 53 switches are known from specialist_a \rightarrow specialist_b (a not confamilial with b). Nearly all true host switches take place in the southwestern deserts or mediterranean California (equally); this type of host switch is characteristic primarily of Nomadopsis and Perdita (Pygoperdita);

h) few host switches are between visually similar taxonomically unrelated plants; few (except poorly documented Compositae) between very dissimilar but confamilial plants; most between groups without distinct characters in common -- sometimes the switch is to a dominant community member, sometimes to the only synchronous bloomer, many unexplicated.

VI. Arctotertiary-and Neotropical-associated bee lineages have contributed about equally to pollination ecology relations in arid/semi-arid western plants. Range expansions into close association with a novel geoflora is usually by polyleges, or by specialists which are already associated with an invading plant genus, but occasionally by host shifts presumably onto a novel host in a region of parapatry. Nearly all such shifts have been from Arctotertiary to Madrotertiary floras; only two from Madrotertiary to Arctotertiary.

VII. Most specialist-feeding bees in North America are oligolectic on Compositae and legumes. More species are associated with Phacelia than any other genus. Most plant genera with obligate specialist pollinators have coevolved with only 1-3 lineages and less than 10 species.

VIII. Bees tend to coevolve specialist-feeding relationships with plants which:

- a) tend to bloom only early in the morning or late in the evening;
- b) those which bloom at the onset or close of the anthesis season for that particular community;
- c) are community dominants;
- d) plants with unusual floral morphologies (i.e., thin tubular corollas, extremely large or small pollen grains, pendant blossoms and unusually tiny flowers).

IX. The percentage of specialist-feeding bees on a faunistic basis varies from ca. 15-50%:

- a) percentage of specialist-feeders is positively correlated to total bee diversity;
- b) highest percentages occur in Mediterranean California and the desert, lowest in eastern deciduous forests;
- c) the total number of plant genera with coevolved specialists in biotic realms of North America is also positively correlated to total bee diversity (but disproportionately highest in med. California);
- d) oligolectic "specialists to the family level" are negatively correlated to total species diversity within the floristic provinces of North America and within geographic regions of California.

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(specific references not cited in the text but utilized in the construction of Illustration 2 are omitted for brevity sake; the author acknowledges that most of this information is not original)

APPENDIX:

The lists which follow represent an attempt to catalogue the specialist-feeding bees associated with particular host-plants throughout the major biotic provinces of North America. Following the entry of each bee species is a designation of the assurance I have in its host association: F = relatively certain fact based on considerable host collection data and perhaps pollen microscopic analysis in addition; IV = tentative assignment, relatively certain of validity but needs microscopic verification; ZO = uncertain host-association made in the absence of sufficient direct data, usually on the basis of the known behavior of close relatives.

Specialists in Mediterranean California

Compositae

- Colletes angelicus F; annae disseptus F; fulgidus fulgidus F; fulgidus longiplumosus F; lutzii monticola IV; ochraceus IV; simulans simulans F.
 Hesperapis semirudis IV; n. sp. IV.
 Andrena citrinihirta F; isocomae F; pallidifovea F; scutellinitens F.
 Heterosarus californicus; compactus F.
 Calliopsis oernardinus F; pugionis F.
 Perdita (octomaculata) ensenadensis F; hirticeps luteocincta F; scitula antiochensis F; (zonalis) colei F; ericameriae F; foleyi F; interserta interserta F; lepidosparti lepidosparti F; lepidosparti novella IV; lomdocensis ZO; melanderi ZO; obispoensis ZO; pallidiventris ZO; polita F; punctifrons F; repens ZO; rivalis F; scotti F; similis similis F; sweezyi F; zonalis bernardina F; zonalis monticola F; zonalis zonalis F; (ventralis) colei F; (zonalis) ciliata.
 Dufourea australis australis F; australis mexicana F.
 Dianthidium parvum schwarzi F; pudicum consimile F(?); singulare F; ulkei F.
 Ashmeadiella buconis denticulata F; cubiceps clypeata F.
 Hერიades cressoni IV.
 Anthocopa hemizoniae F.
 Osmia coloradensis F; texana F; californica F; grinnelli F; montana quadriceps F; subaustralis F.
 Megachile alata F; nevadensis F; subnigra angelica F; parallela facunda F; perihirta F; fidelis F; inimica jacumbensis F; inimica sayi F; pugnata pomonae F; pugnata pugnata F.
 Exomalopsis chionura IV.
 Diadasia enavata F.
 Anthophora exigua F.
 Xenoglossodes davidsoni F; pomonae F.
 Svastra obliqua expurgata F; sabinensis nubila F; texana eluta F.
 Melissodes rivalis F-Cirsium; lupina F; lustra F; glenwoodensis F; agilis F; semilupina F; bimatrix F; bicolorata F; expollita F; robustior F; hurdi F; pallidisignata F; tululenta F; vernalis F; velutina F; saponellus F; apressa F; microsticta F; paulula F; personatella F; melanura F; moorei F; confusa F; micheneri F.

Lasthenia

- Andrena baeriae F; duboisi F; lativentris ZO; dissimulans IV?; essigi ZO?; hermosa IV; orthocarpi IV?; pensilis ZO?; puthua F; submoesta F; vexabilis?
 Dufourea californica F.

Blennosperma

- Andrena blennospermatis F.

Stephanomeria

- Perdita hirticeps hirticeps F; Melissodes nigricauda F.

Chaenactis/Eriophyllum

- Micralictoides altadenae F.

Layia

- Andrena sublayiae F; layiae F; lativentris ZO?; duboisi F; escondida ?.
 Perdita aureovittata aureovittata F; layiae basalicola F; layiae excisa F; layiae layiae F.

Dandelions/Malacothrix

- Perdita vandykei IV; aureovittata aureovittata F; aureovittata stenozona F; aureovittata maderensis F.
 Andrena malacothricis F.
 Dufourea malacothricis F.

Dandelions/Agoseris

- Andrena (Diandrena) ablegata F; agoeeridis F; chlorosoma F; chalybioides F; evoluta F; gnaphalii F; olivacea F; subchalybaea F.

Legumes

- Anthidium atripes F; clypeodentatum F; emarginatum F; mormonum F; palliventre F; tenuiflorae F; utahense F (e. m. p. & t with Phacelia too)
 Osmia integra F; nigrifrons F; nigrobarbata F; obliqua F; physariae F; sedula ?; liogastra F; lupinicola F; latisulcata F; calla F; clarescens F; malina F; cyanopoda IV; kincaidii F; regulina IV; sanctae-rosae F; densa densa F; densa pogonifera F; gabrielis F; + many potential species ZO.
 Megachile concinna IV; melanophoea submelanophoea F.
 Synhalonia -- many potential species ZO.

Melilotus

- Hylaeus bisinuatus IV.

Trifolium

- Andrena plana F.
 Nomadopsis anthidius anthidius F; anthidius lutea F; trifolii IV.

Specialists in Mediterranean California (cont.)

Lotus

- Perdita* *pyrifera* ZO; *tresignata* F.
Nomadopsis *mellipes* IV.
Ancylandrena *atoposoma* F.
Anthidium *collectum* F; *pallidiclypeum* F.
Osmia *aglaia* IV+*Penstemon*?
Ashmeadiella *timberlakei* *solida* F + *Phacelia*; *timberlakei* *timberlakei* F + P.
Proterolades *bunocephala* F; *howardi* F.

Phacelia

- Colletes* *californicus* F; *turgiventris* F; *consors* *pascoensis* IV +?.
Andrena *negra* F; *viridissima* F; *nigroclypeata* ?.
Nomadopsis *barbata* IV; *phacelliae* IV.
Conanthalictus *bakeri* F; *macrops* F; *nigricans* F.
Protodufourea *parca* F
Dufourea *mulleri* F; *trochantera* F.
Anthidium *banningense* F; *tenuiflorae* F; *palmarum* F; *collectum* F; *emarginatum* F; *mormonum* F; *palliventre* F; (c. e. m. t. & pall. on *Lotus* too) F.
Chelostoma *californicum* F; *incisulum* F; *marginatum* *marginatum* F; *marginatum* *incisuloides* F; *minutum* F; *phacelliae* F.
Ashmeadiella *micheneri* ?; *timberlakei* *timberlakei* F + *Lotus*; *timberlakei* *solida* F + *Lotus* too.
Hoplitis *fulgida* *platyura* - emphasis only.
Proterolades *monavensis* ZO.
Anthocopa *phacellarum* IV +?; *copelandica* *albomarginata* - emphasis only?

Emmenanthe

- Conanthalictus* *seminiger* F.
Protodufourea *wasbaueri* F.

Penstemon

- Ashmeadiella* *australis* F.
Anthocopa *anthodyta* *anthodyta* F; *elongata* F; *hebitis* F; *pycnognatha* *pycnognatha* F; *pycnognatha* *solatus* F; *triodonta* *triodonta* F; *triodonta* *usingeri* F.
Osmia -- several species perhaps IV.

Cryptantha

- Andrena* *cryptanthae* F; *osmioides* *osmioides* F; *osmioides* *benitonis* F; *timberlakei* F
Proterolades *boharti* ZO; *jacintana* F; *caudex* F; *evansi* F; *incanescens* *tota* IV
nanula *sparsa* F; *nanula* *nanula* F; *seminigra* *seminigra* F; *seminigra* *yosemitensis* F; *semirubra* F; *tristis* F; *tricauda* F; *remotula* F.

Camissonia

- Hesperapis* *nitidula* - emphasis only.
Andrena (*Diandrena*) *anatolis* F; *apasta* F; *chalybaea* F; *cyanosoma* F; *eothina* *foxii* F; *macswaini* F; *parachalybaea* F; *sperryi* F; (*Onagandrena*) *blaisdell* F; *chylismiae* F; *convallaria* *convallaria* F; *convallaria* *subhyalina* F; *flandersi* F; *furva* F; *oenotherae* F; *oraria* *actidis* F; *oraria* *oraria* F; *rozeni* F; *vespertina* F.
Dufourea *boregoensis* F; *oenotherae* F; *saundersi* F; *scintilla* F +; *truncata* F; *timberlakei* F; *tularensis* F.

Oenothera

- Evyllaesus* *aberrans* F.

Clarkia

- Hesperapis* *regularis* F; *Andrena* *bernardina* F; *lewisorum* F; *omnigra* *clarkiae* F; *omnigra* *omnigra* F; *Dufourea* *macswaini* F; *Megachile* *gravita* F; *pascoensis* F; *Diadasia* *angusticeps* F; *Melissodes* *clarkiae* F; *Tetralonia* *venusta* *carinata* F; *Ceratina* *sequoiae* F.

Eriogonum

- Ashmeadiella* *rufitarsis* F; *altadenae* ZO; *Perdita* *claypolei* *australior* F; *claypolei* *claypolei* F; *claypolei* *limulata* F; *jucunda* F; *nevadensis* *nevadensis* IV; *nodoscornia* F; *rhois* *reducta* - emphasis only; *rhois* *rhois* - emphasis only; *timberlakei* F; *varleyi* *niveipennis* F; *yosemitensis* F.

Sida

- Diadasia* *consociata* F.

Malacothamnus

- Diadasia* *laeticauda* F; *nitidifrons* F.

Specialists in Mediterranean California (cont.)

Sidalcea

Diadasia nigrifrons F.

Eschscholzia

Hesperapis pellucida ZO; n. sp. F; *Andrena haroldi* ?; *Nomadopsis obscurella* F; *Perdita coalingensis* F; *interrupta vernalis* F; *nitens* IV; *quadri-signata* IV; *distropica* F; *monterreyensis* F; *obtusata* ? (d. m. & o on *Calochortus* too); *Micralictoides ruficaudis* F; *Dufourea leachi* F; *Andrena coactipostica* IV.

Platystemon/Meconeilla

Dufourea leachi F; *Andrena angusticrus* F; *aquila* IV; *biareola* ZO; *buccata* ZO; *stipator* F.

Ceanothus

Andrena ceanothifloris ?; *candidiformis* F +?; *cleodora melanodora* F; *cleodora cleodora* F +?; *lupini* IV +?; *scurra* IV; *Panurginus* - several species possible; *Perdita micheneri* IV (emphasis only).

Ranunculus

Andrena coerulea F; *suavis* F; *cuneilabris* F; *Panurginus melanocephalus* IV; *nigrihirtus* IV.

Neophila

Andrena crudeni F; *subnigriceps* F; *torulosa* F; *viridissima* F; *nemophilae* F; *macrocephala macrocephala* F; *macrocephala tetleyi* F; *Panurginus* spp. ZO.

Potentilla +

Andrena melanochroa F; *Nomadopsis comptula* F; *edwardsii* F.

Euphorbia

Nomadopsis helianthi F.

Calochortus

Perdita californica californica F; *calochorti* F; *distropica* F; *macrostoma* IV; *monterreyensis* F; *obtusata* ?; *tularensis* F (d & mon. on *Eschscholzia* too); *Nomadopsis cincta hurdi* F; *edwardsii* F (1 population only); *Dufourea dentipes* F-albus group.

Arctostaphylos

Andrena arctostaphyllae F; *Tetralonia acerba* F; *Emphoropsis cineraria* IV; *dammersii* IV.

Opuntia +

Ashmeadiella opuntiae F; *Diadasia australis californica* F; *opuntiae* F; *rinconis mimetica* F; *rinconis rinconis* F.

Lomatium/Sanicula

Andrena microchlora F; *pallidiscopa pallidiscopa* F; *pallidiscopa trifasciata* F.

Perideridia

Perdita nevadensis culbertsoni IV.

Ribes

Andrena caliginosa F; *submaura* F; n. spp. F.

Mimulus

Nomadopsis trifolii IV + (*Trifolium*); *Dufourea pectinipes* ZO; *versatilis versatilis* IV; *versatilis rubriventris* F.

Linanthus/Gilia

Andrena levipes F +?; *Perdita propinqua* IV; *Dufourea brevicornis* F; *callientensis* F; *gilia* F; *linanthi* F; *tuolumne* F; *vanduzei* F; *Hesperapis rufipes* F; *Micralictoides* n. sp. F; *Dufourea femorata* F; *pectinipes* ZO?; *versatilis versatilis* IV?;

Eriastrum/Navarretia

Perdita richardsi ZO; *blaisdelli* ZO; *leucosticta* F; *navarretiae powelli* IV; *navarretiae angusticeps* IV; *navarretiae navarretiae* F; *pelargoides* F; *davidsi* ZO; *eriastrum eriastrum* F; *eriastrum fusciventris* F.

Cucurbita

Peponapis pruinosa angelica F; *Xenoglossa strenua* F; *angustior* F.

Zigadenus

Andrena astragalii F.

Salix

Andrena albihirta ?; *perarmata* ?; *rhodotricha* ?; *thaspiiformis* ?; *annectens* F; *bucculenta* F; *concinnulla* F; *gibberis* IV; *nevadensis* F; *ressoni infasciata* ?; *huardi* ?; *opacella* ?; *ishii* F; *subaustralis* F; *sempunctata* F; *Perdita salicis occidentalis* F; *salicis personata* F; *salicis tristis* F; *Colletes xerophilus cismontanus* F.

Adenostoma

Hesperapis illicifoliae F; *Perdita fieldi* F; *rhois reducta* F - emphasis only; *rhois rhois* F - emphasis only.

Salvia/Lepechinia/Trichostema

Ashmeadiella salviae F.

Specialists in Mediterranean California (cont.)

Lepidium

Andrena lepidii IV.

Nomadella

Nomadopsis timberlakei F; *zonalis sierrae* F; *zonalis zonalis* F.

Amsinckia

Tetralonia amsinckiae F.

Calystegia

Diadasia bituberculata F.

Limnanthes

Andrena limnanthis F; *Panurginus occidentalis* F.

Heliotropium

Perdita heliotropii perducta F; *Nomadopsis hesperia equina* F; *hesperia hesperia* F; *Anthophora flavocincta* IV.

Arenaria ?

Andrena subapasta IV.

Eriodictyon

Chelostoma cockerelli F; *Nomadopsis linsleyi* F; *fracta* F; *Hoplitis coleii* F.

Gayophytum

Dufourea davidsoni F; *spilura* F; *subdavidsoni* F.

Specialists in southwestern Deserts

Compositae

Colletes compactus compactus F; *compactus hesperius* F; *annae annae* F; *annae disseptus* F; *rufocinctus* F; *laticinctus* F; *gypsicolens* F; *tectiventris* IV.

Hesperapis fulvipes F - *Geraea*; *arenicola* F - *Geraea*; 2 n. spp. F - *Geraea*; 2 n. spp. IV.

Andrena (*Callandrena*) *isocomae* F; *balsamorhizae* F; *monticola* F; *accepta* F; *aliciarium* F - *Pectis*; *perpuncta* F - *Heterotheca*; *heliianthi* F; *ofella* IV; *auripes* ZO; *vulpicolor* F - *Chrysothamnus*; *trimaculata* IV; *tegularis* IV; *peocosana* F; *ardis* F; *barberi* ZO; *calvata* F; *neomexicana* IV; *pectidis* F - *Pectis*; *simulata* IV; *sonorensis* F - *Gutierrezia* F.

Calliopsis deserticola F; *pectidis* F; *coloratipes* F; *tiberlakei* F; *crypta* F; *rozeni* F; *unca* F;

Protandrena pectidis F; *verbesinae* IV;

Pseudopanurgus fraterculus timberlakei F; *fraterculus fraterculus* F; *aethiops* F; *perpunctatus* F; *dicksoni* IV; *pectidellus* F; *cazieri* ZO; *verticalis* ZO;

Perdita (*ventralis*) *snellingi* F; *austini* F; *brevihirta* F; *semicrocea* F; (*martini*) *amicula* ZO?; (*sidae*) *ovaliceps* ZO; (*Cockerellia*) *albihirta* *albihirta* F - *Geraea*; *albihirta geresae* F - *Geraea*; *luculenta* ZO; *coreopsidis collaris* F - *Gaillardia*; *albipennis pasonis* IV; *beata beata* F; *incana* ZO; *lepachidis lepachidis* F; *perpulchra* F; *verbesinae verbesinae* F - sunflowers; *utahensis* F - *Pectis*; (*Xeromacrotera*) *cephalotes* IV; (*Pentaperdita*) *albovittata* F; *idahoensis* F; *mandibularis* F - *Geraea/Chaenactis*; *melanochlora* F; *ancena* ZO; *chrysophila* F; *megapyza* F; (*Hexaperdita*) *bebbiae* - *P* *Bebbia*; *callicerata* F - *Baileya*; *heterothecae heterothecae* F - *Heterotheca*; *asteris* F; *heterothecae trizonata* F; *compacta* IV; *ignota ignota* F; *xanthisma* F; *foveata persimilis* IV; *cambarella platyura* F; (*zonalis*) *ampla* F; *fraterna* F; *irregularis* F - *Chrysothamnus*; *baccharidis* F - *Baccharis*; *basinicola* ZO; *chrysothamni* F; *dicksoni* F; *ericameriae* F; *interserta* F; *isocomae* F; *lepidosparti lepidosparti* F; *nigrocincta* ZO; *pallescens* F; *zonalis zonalis* F; *taeniata* F; *townsendi* F; *placida* ZO; *primula* ZO; *proxima* F; *scocia* ZO; *scotti* F - *Chrysothamnus*; *similis similis* F; *sweezyi* F - *Erigeron*; (*octomaculata*) *abdominalis* F - *Pectis*; *elegans* F - *Palafoxia*; *apacheorum* F; *butleri* F - *Pectis*; *affinis* F; *flavifrons* F; *halli* ZO; *indicoensis* F - *Haplopappus*; *media* F; *mimula* F - *Haplopappus*; *melanostoma albocincta* F; *aplopappi* F; *croceipes* F - *Gutierrezia*; *fallax* F; *gutierreziae* F; *aperta* F - *Gutierrezia*; *biparticeps* F; *dalyi* F - *Haplopappus*; *lasiogastra* F - *Pectis*; *maculipes* F - *Haplopappus*; *mesillensis* F; *pluchae* F; *retusa* F; *scitula scitula* F; *trifida* F; *trimaculata* F; *xanthodes* F; *nuda* F; *pellucida* F - *Haplopappus*; *phymatae* F - *Gutierrezia*; *reperita* F - *Chrysothamnus*; *sedulosa* F - *Baccharis*; *sejuncta* F - *Gutierrezia*; *snowii* F; *translineata* F; (*subfasciata*) *subfasciata* F;

Micralictoides arizonensis F - *Chaenactis*;

Dufourea australis australis F; *dammersi* F; *oryx* F;

Specialists in southwestern Deserts (cont.)

Compositae (cont.)Heteranthidium autumnale ZO?;Paranthidium jugatorium jugatorium F - sunflowers; jugatorium butleri F - sunflowers;Dianthidium curvatum sayi F; desertorum ZO; heterulkei heterulkei F; heterulkei fraternum F?; implicatum IV?; parvum parvum F; platyurum mohavense F; platyurum platyurum F; ulkei ulkei F; ulkei perterritum F; curvatum xerophilum F;Heriades texana ZO +?; crucifera ZO +?;Anthocopa mirifica F; viguierae F;Ashmeadiella bucconis denticulata F; cubiceps clypeata F; difugita emarginata F;Megachile alata F; subnigra angelica F - Chaenactis; townsendiana ZO; inimica sayi F; mellitarsis F; pollicaris F; subfortis ZO?; frugalis frugalis - emphasis only; frugalis pseudofrugalis - emphasis only; soledadensis IV?; parallela facunda F; rossi F; sabinensis F; manifesta F; mohavensis IV?; subparallela F; fidelis F;Exomalopsis solidaginis IV; gutierreziae IV?; compactula IV?;Diadasia enavata F - Helianthus;Syntrichalonia exquisita F - Helianthus;Anthophora exigua F - Chrysothamnus; maculifrons F - Chrysothamnus; petrophila F; curta F - emphasis only;Svastra helianthelli F; obliqua expurgata F; pallidior F; texana texana F; texana eluta F; machaerantherae F; petulca suffusca F (all preceding species emphasize Helianthus); sabinensis nubila F;sabinensis laterufa IV; sabinensis sabinensis F; sila F;Melissodes relucens F - Haplopappus/Chrysothamnus; agilis F - Helianthus;Fasciatella F - Haplopappus; limbus F; montana F - Helianthus+subagilis F - Grindelia; coreopsis F - Helianthus/Aster/Solidago;exilis F; humilior F - Aster/Solidago/Haplopappus; pallidisignata F;ryialis F - Cirsium; submenuacha F - Helianthus+plumosa F - Helianthus; menuachus F - Solidago/Grindelia; ochraea F - Haplopappus/Chrysothamnus;cerussata F; expolita F; lutulenta F; utahensis F;brevipyga F - Haplopappus/Chrysothamnus; vernalis F - Erigeron+appressa - Helianthus/Grindelia+velutina F; personatella F;verbesinarum IV;StephanomeriaPerdita albonotata F; hirticeps apicata F; stephanomeriae F.PyrrophappusAndrena tonkaworum ZO? (+Engelmannia).EnceliaAnthocopa enceliae enceliae F; enceliae mortua F.MalacothrixAndrena agoseridis F+; olivacea F; malacothricidis F; Dufourea malacothricis F; Nomadopsis puellae F; Perdita dammersi F; malacothricis malacothricis F; malacothricis unica F.LegumesAnthidium atripes F; clypeodentatum IV; dammersi IV; palliventre F +Phacelia; emarginatum F + Phacelia; utahense IV - emphasis only;Ashmeadiella cazieri F; Anthocopa nitidivitta F; robustula F - Dalea;segregata ZO; timberlakei IV; Osmia titusi F; liogastra F;latisulcata F; clarescens F; Chelostomoides chilopsidis F; browni IV;lobatifrons F; occidentalis F (b, c, l & o emphasis tree legumes);subexilis F.LotusAnthidium pallidiclypeum IV; Ancylandrena atoposoma F; Ashmeadiella aridula aridula - emphasis only.Astragalus?Anthophora porterae IV?; Nomadopsis zebtrata IV?PetalostemonColletes gilensis ZO; Perdita perpallida IV.DaleaColletes petalostemonis IV; Hesperapis leucura F; n. sp. F; Nomadopsismeliloti IV?; Ancylandrena koelbelei F; Perdita amplipennis IV;hirsuta F; chloris F; eremica IV - emphasis only; erythrogyga F;paroselae F; Heteranthidium bequaerti F; Ashmeadiella inyoensis F;erema IV; euryrhynga IV; cazieri IV +?; rhodognatha F; xenomastax F;Hoplitis elongaticeps ZO; paroselae IV; Anthophora hololeuca F;Anthocopa daleae F; hypostomalis F; hurdiana F; rubrella rubrella ZO;rubrella rubrifer F; rubrella macswaini F.

Specialists in southwestern Deserts (cont.)

Phacelia

Colletes californicus F; turgiventris F; Andrena nigra F; palpalis F; Nomadopsis phacelliae IV; Perdita cuspidata F + Nama; dentata IV; eremophila IV; nigrella IV; Conanthalictus bakeri F; caerulescens F; cockerelli F; macrops F; minor F; wilmattae F; Michenerula beameri F; Protodufourea n. spp. F; Dufourea mulleri F; trochantera F; Anthidium palliventre F + Lotus; palmarum F; emarginatum F + Lotus; Chelostoma marginatum marginatum F; Proteriades bullifacies F; mohavensis IV + Nama; Anthocopa beameri F + Nama; rupestris F; copelandica arefacta F.

Mentzelia/Eucnide

Hesperapis laticeps F + Eucnide; Megandrena mentzeliae F; Perdita atrata F; adustiventris F + Eucnide; bicuspidariae F (involucrata only); koelbelei concinna F (involucrata only); koelbelei koelbelei F (involucrata only) (+ Eucnide); mentzeliae F; mentzeliarum F; viridinotata ZO?; perplexa F; nigridia F; punctifera F; falcata F; Conanthalictus mentzeliae F; Xeralictus timberlakei F; bicuspidariae F; n. sp. F (all 3 involucrata only); Ashmeadiella leachi F.

Petalonyx

Perdita exilis F; crandalli F.

Eriozonum

Perdita clypeata clypeata F; clypeata immaculata F; distans F; jucunda F; labrata F; lucens F; nasuta nasuta F; nasuta galacticoptera F; nasuta obscurascens F; pectoralis IV; semilutea F; thermophila thermophila F; thermophila trilobata F; timberlakei F; varleyi varleyi F; xerophila fuscicornis F; xerophila xerophila F;

Larrea

Colletes clypeonitens F; covilleae F; larreae F; salicola F; stepheni F; Megandrena encelliae F +?; Hesperapis arida F; larreae F; Nomadopsis foleyi F; larreae F; Ancylandrena larreae F; Perdita covilleae F; flavipes IV; larreae F; punctulata IV; semicaerulea F; lateralis lateralis F - emphasis only; marcialis F - emphasis only; Hoplitis biscutellae F; Heteranthidium larreae F; Emphoropsis pallida F.

Penstemon

Anthocopa abjecta abjecta IV; anthodyta anthodyta F; arizonensis ZO?; elongata F; panamintensis ZO; pycnognatha pycnognatha F; triodonta triodonta F.

Sida

Exomalopsis sidae IV; Diadasia consociata IV; afflictula ZO.

Sphaeralcea

Hesperapis n. sp. F; Protandrena sphaeralcea IV?; Andrena sphaeralcea F; Calliopsis rhodophila IV?; Colletes sphaeralcea F; Hypomacrotera subalpinus subalpinus F; subalpinus andradensis F; Dufourea vandykei F; Perdita arcuata dinognatha F; bridwelli F; latior F; portalis F; sphaeralcea sphaeralcea F; sphaeralcea alticola F; magniceps IV; haplura IV; Tetrалonia albescens ZO?; mohavensis ZO?; Diadasia lutzii F; diminuta F; martialis F; sphaeralcearum sphaeralcearum F; sphaeralcearum affinis F; tuberculifrons F; vallicola F; megamorpha F; olivacea F+; palmarum F+.

Argemone

Perdita argemonis F; Andrena argemonis - emphasis only.

Eschscholzia

Nomadopsis obscurella F; Perdita inflexa F; interrupta interrupta F; mohavensis F; mucronata F; robustella F; duplonotata F; mohavensis pimana ZO?

Abronia

Anthophora abroniae F.

Salvia

Ashmeadiella salviae F; Perdita salviae IV.

Cryptantha

Andrena cryptanthae F; Proteriades basingeri F; bidenticulata F; cryptanthae F; deserticola F; hamulicornis F; incanescens incanescens IV; incanescens nevadensis IV; nanula nanula F; nigrella attonita F; nigrella nigrella F; pygmaea F; reducta F; similis F; palmarum F; xerophila F.

Camissonia

Andrena (Diandrena) sperryi F; (Onagandrena) boronensis F; ohyllismiae F; convallaria convallaria F; convallaria subhyalina F; deserticola F; flandersi F; anograe F; mojavensis F; oenotherae F; rozeni F; rubro-tincta IV; vespertina F; Dufourea boregoensis F; nudicornis F + Oenothera; latifrons F; scintilla F+.

Specialists in southwestern Deserts (cont.)

Oenothera

Hesperapis wilmattae - emphasis only; *Andrena linsleyi* F; *Perdita pallida* F; *bequaertiana* F; *Evyalaus aberrans* F; *Sphecodogastra noctivaga* F; *Anthedonia nevadensis* F; *compta* F; *Tetralonia venusta venusta* F; *Anthophora affabilis* F; *aterrima* F.

Nama

Conanthalictus deserticola F; *minor* F + *Phacelia*; *namatophilus* F; *rufiventris* F; *conanthi* F; *cotullensis* F; *Sphecodosoma dicksoni* F; *pratti* F; *Protodufourea* n. sp. F + *Phacelia*; *Proteriades mojavensis* F + *Phacelia*; *Anthocopa rupestris* F; *beameri* F (both + *Phacelia*); *Perdita cuspidata* F + *Phacelia*; *namatophila* F.

Tidestromia

Protandrena tidestromiae ZO?; *Nomadopsis callosa* ZO; *Exomalopsis rufiventris* F; *Perdita cladotrichis* F; *drymariae* ZO?

Verbena

Calliopsis verbenae F; *hirsutifrons* F.

Acacia

Colletes platycnema IV; *Eulonchopria punctatissima* F.

Ipomopsis

Perdita giliae F.

Menodora

Simanthedon linsleyi F.

Euphorbia

Calliopsis squamifera F; *anomoptera* F; *rogeri* F; *limbus* F; *gilva* F; *fulgida* F; *Nomadopsis nigromaculata* F; *Protandrena euphorbiae* ZO?; *Pterosarus nanulus* IV; *Exomalopsis euphorbiae* F; *Perdita euphorbiae* F; *mellea* F; *minima* F; *polycarpae* F; *helianthi* F; *biguttata* F; *cochiseana* IV; *crassula* ZO; *crotonis crotonis* F + *Croton*; *nanula* F; *obscura* F;

Prosopis

Colletes algarobiae F; *deserticola* IV?; *perileucus* ZO?; *prosopidis* F; *Hylaenus sejunctus* IV?; *Perdita ashmeadi simulans* F; *ashmeadi vierecki* F; *difficilis* F; *discors* ZO; *exclamans* F; *genialis genialis* F + *Acacia*; *genialis panamintensis* F; *innotata* F; *luciae luciae* F; *luciae decora* F; *numerata numerata* F + *Salix*; *numerata hesperia* F; *nigricornis* F; *pallidipes* F; *prosopidis* F; *punctosignata punctosignata* F; *punctosignata flava* F; *punctosignata sulphurea* F; *mimosae* F + *Mimosa*; *sonorensis* F; *stathamae stathamae* F; *stathamae eluta* IV; *triangulifera* F; *Ashmeadiella prosopidis* IV?; *Megachile newberryae* F + *Acacia*; *Chelostomoides odontostoma* F + *Acacia*; *browni* IV + *Acacia*.

Coldenia

Perdita arenaria F + *Heliotropium*; *bellula* F; *coldeniae* F; *frontalis* F; *maculosa* F; *optiva* F; *rhodogastra* F + *Heliotropium*; *scutellaris* F; *serifasciata* F; *wasbaueri* F; *trifasciata* ZO?; *vesca* ZO?; *diversa* ?; *Conanthalictus* n. sp. F.

Calochortus

Nomadopsis cincta cincta F; *Perdita bilobata* F; *bispinata* F; *calochorti* F; *californica inopina* F; *leucozona* F; *arizonica* F; *digressa* IV?

Arctostaphylos

Andrena cristata F; *Emphoropsis cineraria* IV.

Cactaceae

Perdita carinata IV; *texana texana* F; *texana ablusa* F; *Lithurgus apicalis apicalis* F; *apicalis opuntiae* F; *arizonensis* ZO?; *socorroensis* ZO?; *Melissodes opuntiella* IV?; *paucipuncta* F; *Exomalopsis cerei* ZO?; *Diadasia australis australis* F; *australis californica* F; *opuntiae* F; *piercei* ZO?; *rinconis rinconis* F.

Echinocactus

Dufourea echinocacti F; *Lithurgus echinocacti* F; *Idiomelissodes duplocincta*

Cucurbita

Peponapis pruinosa F; *timberlakei* F; *crassidentata* F; *melchbacherorum* F; *utahensis* F; *Xenoglossa strenua* F; *kansensis* F; *angustior* F; *patricia* F; *gabbi* F.

Heliotropium

Perdita heliotropii heliotropii F.

Proboscidea

Perdita nardi F.

Specialists in southwestern Deserts (cont.)

Salix

Colletes xerophilus xerophilus F; *xerophilus sonoranus* F; *Andrena cressoni infasciata* IV; *papagorum* IV; *concinna* F; *Perdita salicis hirsutior* F; *salicis imperialis* F; *salicis laeta* F; *maculigera maculigera* F + *Prosopis*.

Croton

Perdita crotonis leucoptera F; *cucullata* F; *titusi* F; *crotonis* F; *undecimalis* F.

Capparidaceae

Anthophora cockerelli IV; *Centris californica* IV; *Perdita wilmattae stanleyae* F.

Cleome +

Perdita vittata tricolor F + *Wislizenia*; *zebrata flavens* F; *zebrata zebrata* F; *cleomellae* F; *thelypodii* F; *wislizeniae* F (*Wislizenia*); *Exomalopsis eriogoni* ZO?; *Nomadopsis scitula lawae* F; *macswaini* IV - *wislizenia*.

Descurainia

Andrena piperi F.

Lepidium

Andrena lepidii F; *Perdita tortifoliae tortifoliae* F; *tortifoliae fremontii* F; *confusa* F; *geminata* IV; *greggiae* F; *Nomadopsis australior* F.

Lesquerella

Andrena prima F; *mohavensis* ZO?; *capricornis* F; *jessicae* F; *mesillae* F; *primulifrons* F; *alamonis* F; *Dufourea pulchricornis* F; *Perdita trinotata*

Lycium

Anthophora phenax IV?; *perdita lycii* F; *Anthophora coptognatha* IV?.

Eriastrum

Hesperapis n. sp. F; *Perdita compta* IV; *eriastri fusciventris* F; *richardsi* ZO.

Physalis/Chamaesaracha

Hypomacrotera callops callops F; *callops persimilis* F; *Perdita binotata* ZO; *physalidis* F; *rozeni* ZO; *lenis* F; *munita* F; *chamaesarachae* F; *sexmaculata* IV +?; *Colletes scopiventer* F; *chamaesarachae* IV.

Ipomoea

Ancyloscellis sejunctus F.

Cercidium

Colletes cercidii ZO?; *Chelostomoides discorhina* F (+?); *Ashmeadiella clypeodentata clypeodentata* - emphasis only.

Dasyliiron/Nolina

Perdita dasyliirii - emphasis only; *rehni* - emphasis only.

Specialists in Great Basin

Compositae

Colletes compactus hesperius F; *gypsicolens* F; *laticinctus* F; *rufocinctus* F; *simulans simulans* F;

Andrena (*Callandrena*) *ardis* F; *pecosana* F; *helianthi* F - *Helianthus*;

simulata IV; *utahensis* IV; *vulpicolor* F - *Chrysothamnus*; (*Cnemid-andrena*) *nubecula* F; *colletina* F; *ramaleyi* F; *chromotricha* F;

xanthigera F; *costillensis* F; *canadensis* F; *sulcata* F; *bendensis* F;

Calliopsis chlorops F; *coloratipes* F; *timberlakei* F;

Perdita (*Cockerellia*) *albipennis* F-*Helianthus*; *hilaris* F; (*subfasciata*)

subfasciata F; (*Hexaperdita*) *ignota ignota* F; (*Xeromacrotera*)

cephalotes ZO; (*ventralis*) *brevihirta* F; *semicrocea* F; (*zonalis*)

aemula aemula F; *adjuncta* F-*Chrysothamnus*; *zonalis aequalis* F-

Chrysothamnus; *aemula quadrifasciata* F-*Chrysothamnus*; *oregonensis*

oregonensis F; *lepidosparti lepidosparti* F; *confinis* ZO; *affecta* ZO;

fraterna F; *townsendi* F; *albopicta* F; *dubia parillis* F; *festiva* ZO;

vestita F; *haigi* ZO; *munda* ZO; *similis similis* F; *similis pascoensis*

IV; *subvestita* F; *toschiae* ZO; *stottleri stottleri* F; (*octomaculata*)

affinis F; *aplopappi* F; *aridella* F; *electa* F; *hirticeps candidipennis*

F; *idonea* F; *knowltoni* F; *nuda* F; *percincta* F; *reperta* F; *phymatae* F;

rectangulata F; *rhodura* F; *sejuncta* F; *snowii* F; *gutierreziae* F;

imbellis ?; *luteola* F; *mesillensis* F.

Dufourea marginata halictella F; *oryx* F.

Ashmeadiella buconis denticulata F.

Osmia texana F; *coloradensis* F; *californica* F; *grinnelli* F; *montana*

montana F; *subaustralis* F.

(cont. over)

Specialists in Great Basin (cont.)

Compositae (cont.)

- Megachile *agustini* F-Helianthus; *manifesta* F; *nevadensis* IV?;
parallela facunda F; *asterae* ZO?; *nebraskana* IV?; *perihirta* F.
Dianthidium *curvatum* sayi F +?; *heterulkei* *heterulkei* +?; *parvum*
parvum F; *cresoni* ZO?; *singulare* F; *subparvum* F; *ulkei* *ulkei* F.
Anthophora *exigua* F; *maculifrons* F (both *Haplopappus/Chrysothamnus*).
Svastra *obliqua* expurgata F.
Melissodes *rivalis* F-Cirsium; *lupina* F; *plumosa* F-Helianthus; *metenua*
IV; *coreopsidis* F; *snowi* F; *coloradensis* F-Helianthus; *lustra* F-
Haplopappus/Chrysothamnus; *agilis* F-Helianthus; *bimatrix* F-Chryso-
thamnus; *menuachus* F-Solidago/Grindelia; *semilupina* F; *bicolorata*
F-Chrysothamnus; *perpolita* F; *confusa* F; *robustior* F-Helianthus;
pallidisignata F-Haplopappus/Chrysothamnus; *rustica* F; *grindeliae*
F; *hymenoxidis* F; *subagilis* F-Grindelia; *brevipya* F-Haplopappus/
Chrysothamnus; *lutulenta* F; *utahensis* F; *vernalis* F; *saponellus* F;
monoensis F-Chrysothamnus; *microsticta* F.

Nothocalais

- Andrena* *nothocalaidis* F.

Malacothrix

- Nomadopsis* *puellae* F.

Agoseris

- Andrena* *ablegata* F; *evoluta* F.

Stephanomeria

- Perdita* *albonotata* F.

Penstemon

- Anthocopa* *abjecta* *abjecta* IV; *abjecta* *alta* F; *anthodyta* *anthodyta* F;
elongata F; *pycnogatha* *pycnogatha* F; *triodonta* *triodonta* F; *Osmia*
penstemonis F; spp. IV; *Ashmeadiella* *australis* F.

Phacelia

- Chelostoma* *phacellae* F; *Dufourea* *trochantera* F.

Legumes

- Nomadopsis* *zebrata* *bobbae* IV?; *Tetralonia* *chrysophila* IV; spp. IV;
Osmia *integra* F; *physariae* IV?; *sedula* F; *clarescens* F; *gaudiosa* IV?;
kincaidii F; *densa* *densa* F; spp. IV; *Megachile* *rohweri* IV; *Anthophora*
porterae IV?; *Anthidium* *mormonum* F +*Phacelia*; *atripes* F; *clypeo-*
dentatum F.

Trifolium

- Nomadopsis* *filiorum* ZO?; *anthidius* *lutea* F.

Salix

- Perdita* *salicis* *monoensis* F; *subtristis* F; *salicis* *euxantha* IV; *salicis*
sublaeta IV; *Andrena* *erythrogaster* F; *subaustralis* F; *illinoensis* F;
labergei F; *salictaria* F; *ishii* F; *mariae* F; *sigmundi* F; *striatifrons*
IV; *wellesleyae* F; *gibberis* IV; *andrenoides* F.

Croton

- Perdita* *crotonis* *caerulea* F; *crotonis* *juabensis* F; *crotonis* *dilucida* F.

Gayophytum

- Dufourea* *scabricornis* F.

Sphaeralcea

- Perdita* *beatula* F; *latior* F; *xanthochroa* F; *Diadasia* *lutzi* F; *olivacea*
F +; *nitidifrons* F; *Calliopsis* *rhodophila* IV?; *Colletes* *sphaeralcea*
F; *Hesperapis* *sphaeralcea* IV; *Protandrena* *sphaeralcea* ?

Camissonia

- Dufourea* *orovata* F; *Andrena* *nevadae* F.

Oenothera

- Andrena* *anograe* *knowltoni* F; *thorpi* F; *raveni* F; *chylismae* F; *rozeni* F;
Tetralonia *speciosa* IV?; *Anthophora* *affabilis* F; *Megachile* *umatillensis*
F; *anograe* IV?; *Anthedonia* *nevadensis* F; *Sphecodogastra* *noctivaga* F;
Evyllaesus *aberrans* F.

Mentzelia

- Andrena* *mentzeliae* F; *Perdita* *holoxantha* IV; *lunulata* F; *albata* F;
Conanthalictus *mentzeliae* F.

Eriogonum

- Perdita* *xerophila* *discrepans* F; *pectoralis* ZO?; *gentilis* F; *jucunda* F.

Petalostemon/Amorpha

- Colletes* *gilensis* ZO; *petalostemonis* IV; *robertsoni* F; *albescens* IV.

Argemone

- Andrena* *argemonis* - emphasis only.

Wislizenia

- Perdita* *vittata* *confinis* F.

Cleome/Cleomella

- Perdita* *depressa* F; *zebrata* *zebrata* F; *Nomadopsis* *scitula* F; *personata* F.

Specialists in Great Basin (cont.)

Stanleya

Perdita wilmattae wilmattae F; *wilmattae miricornis* F; *Andrena hallii* IV.

Lepidium

Perdita florissantella F; *Nomadopsis australior* F.

Ceanothus

Andrena cleodora F; *candidiformis* F (+?).

Calochortus

Perdita sculleni sculleni ?; *sculleni segona* ?; *Nomadopsis cincta cincta* F.

Arctostaphylos

Andrena ooscuripostica F; *cristata* F.

Lomatium

Andrena microchlora F.

Cryptantha

Proteriades remotula F; *incanescens incanescens* F; *Andrena chapmanae* F.

Crucifers

Perdita cruciferarum F; *Andrena piperi* F; *scurra* F.

Cucurbita

Peponapis pruinosa F; *utahensis* F; *Xenoglossa strenua* F.

Thelypodium

Andrena winnemuccana IV?

Potentilla

Nomadopsis edwardsii F.

Specialists in Montane Western U.S.A.

Compositae

Colletes fulgidus F; *laticinctus* F; *compactus compactus* F; *rufocinctus* F; *simulans simulans* F; *lutzi monticola* F;

Hesperapis dispar F; *carinata rodecki* F;

Protandrena pectidis F;

Pseudopanurgis fraterculus timberlakei F;

Calliopsis chlorops F; *coloratipes* F;

Perdita ciliata IV; (*Hexaperdita*) *ignota ignota* F; (*zonalis*) *dubia dubia* F;

dubia parilis F; *stottleri stottleri* F; *oregonensis expleta* F;

rivalis F-*Erigeron*; *sweezyi* F-*Erigeron*; (*octomaculata*) *fallax* F;

snowii F; *solidaginis* F; *affinis* F; *aperta* F; *aplopappi* F; *luteola* F;

gutierreziae F; *melanostoma* F; *phymatae* F; *rhodura* F;

Andrena (*Callandrena*) *accepta* F; *calvata* F; *helianthi* F; *neomexicana* IV;

ofella F; *pecosana* F; *simulata* IV; *sonorensis* F; *vulpicolor* F;

(*Stenandrena*) *pallidifovea* IV; (*Cnemidandrena*) *columbiana* F; *surda* F;

scutellinitens F; *nubecula* F; *apacheorum* IV; *colletina* F; *sulcata* F;

hirticincta F; *costillensis* F; *canadensis* F; *bocensis* F; *robervalensis* IV (all *Cnemidandrena* emphasis *Aster/Solidago*).

Dufourea marginata marginata F; *marginata halictella* F (both *Helianthus*+);

Ashmeadiella buconis denticulata F;

Heriades cressoni IV;

Dianthidium curvatum sayi F; *ulkei ulkei* F;

Osmia texana F; *coloradensis* F; *californica* F; *marginipennis* F; *montana*

montana F; *montana quadriceps* F; *subaustralis* F;

Megachile agustini F; *wheeleri* F; *parallela facunda* F; *perihirta* F;

fidelis F; *frugalis frugalis* F; *inimica sayi* F; *mellitarsis* F;

pugnata pugnata F; *pugnata pomonae* F; *subnigra angelica* F; *frugalis*

pseudofrugalis F;

Anthophora curta F (+?);

Svastra obliqua expurgata F;

Melissodes rivalis F-*Cirsium*; *lupina* F; *composita* F; *glenwoodensis* F;

coloradensis F-*Helianthus*; *agilis* F-*Helianthus*; *perlusa* F-*Helianthus*;

montana F-*Helianthus*; *confusa* F; *pallidisignata* F-*Haplopappus*;

Chrysothamnus; *grindelliae* F; *subagilis* F-*Grindelia*; *lutulenta* F;

microsticta F; *lustra* F; *bimatrix* F-*Chrysothamnus*; *robustior* F-

Helianthus; *pullatella* F; *wheeleri* F; *rustica* F; *snowi* F;

Phacelia

Dufourea trochantera F; *Proteriades laevibullata* ZO?; *plagiostoma* ZO?;

rufina ZO?; *Chelostoma phacellae* F; *minutum* F; *Anthocopa copelandica*

albmarginata F; *copelandica copelandica* F.

Polemonium

Andrena ribblei ZO?; *segregans* F.

Zigadenus

Andrena astragalii F.

Specialists in Montane Western U.S.A.

- Fragaria
Andrena melanochroa F.
- Prunus/Pyrus
Andrena miserabilis F (+?).
- Cornus
Andrena persimulata IV; flocculosa ZO? Andrena hallii IV.
- Campanula
Dufourea campanulae F; maura F; dilatipes F.
- Symphoricarpos
Dufourea holocyanea F.
- Potentilla +
Colletes nigrifrons F; Andrena birtwellii F; Nomadopsis edwardsii F;
Dufourea fimbriata fimbriata F; fimbriata sierrae F; Panurginus bakeri F; cressoniellus F.
- Calochortus
Perdita sculleni segona ZO?; leucostoma IV?; pulliventris ZO?;
tularenensis F; Dufourea calochorti F; dentipes F.
- Mertensia
Colletes paniscus paniscus F; paniscus sculleni F; consors consors F(+?);
consors pascoensis F (+?).
- Petalostemon
Colletes gilensis ZO; petalostemonis IV; robertsonii IV.
- Steironema
Macropis nuda F; steironematis opaca IV.
- Arctostaphylos
Andrena cristata F; obscuripostica F; arctostaphyllae F; Emphoropsis cineraria IV; Tetralonia acerba F.
- Gayophytum
Dufourea scabricornis F; spilura F; subdavidsoni F.
- Legumes
Andrena lupinorum F; Tetralonia aragalli IV; spp. IV; Nomadopsis zebrata IV?; Megachile melanophoea calogaster F; melanophoea melanophoea F; melanophoea submelanophoea F; melanophoea wootoni/rohweri IV; Osmia integra F; longula F; nifoata F; nigrifrons F; physariae IV?; sedula F; trifoliata F; gaudiosa IV?; kincaidii F; malina F; densa F; calcarata F; nigrobarbata F; obliqua F; calla F; cyanopoda IV?; regulina IV?; gabrielis IV?; spp. IV.
- Salix
Andrena semipunctata F; striatifrons F; sigmundi F; salicifloris F; mariae F; subaustralis F; erythrogaster F; nevadensis F; wellasleyana F; andrenoides F; concinnula F; trizonata F; labergei F; nigrae F; salictaria F; illinoensis F; Perdita maculigera maculigera F; numerata numerata F; salicis coloradensis F; salicis subtristis F; wernerii ZO?
- Mimulus
Dufourea versatilis rubriventris F.
- Ceanothus
Andrena cleodora F; mackiae F; scurra F; candidiformis F.
- Ranunculus
Andrena suavis F; caerulea F; cunellabris F.
- Penstemon
Ashmeadiella australis F; Osmia penstemonis F; spp. IV; Anthocopa triodonta shastensis F; triodonta triodonta F; oregona ZO; hebitis F; abjecta abjecta IV; abjecta alta F; elongata F; anthodyta anthodyta F.
- Clarkia
Melissodes clarkiae F; Ceratina sequoiae F; Diadasia angusticeps F; Megachile gravita F; pascoensis F; Andrena lewisorum F.
- Trifolium
Andrena plana F; Dufourea afasciata F; spinifera F; Nomadopsis trifolii IV (+Mimulus); anthidius anthidius F; micheneri F.
- Lomatium/Sanicula
Andrena microchlora F.
- Agoseris
Andrena chalybioides F.
- Sidalcea
Diadasia nigrifrons F.
- Crucifers
Andrena scurra F.
- Hydrophyllum
Andrena geranii F.
- Heuchera
Colletes aestivalis F.
- Ribes
Andrena (Dactylandrena) spp. F.
- Stanleya

Specialists in Great Plains & Prairies

Compositae

- Colletes compactus* F; *simulans* F-Solidago/Aster/Bidens; *rufocinctus* F-Solidago/Aster/Heterotheca; *birkmanni* ZO?; *laticinctus* F-Pectis/Gutierrezia; *americanus* F-Aster/Solidago; *mandibularis* ZO?; *lutzi* IV?;
- Andrena* (*Callandrena*) *accepta* F-Helianthus; *aliciae* F-Helianthus; *melliventris* F-Gaillardia; *rudbeckiae* F-Rudbeckia/Ratibida; *helianthi* F-Helianthus; *helianthiformis* F-Echinacea; *irrasus* F-Amphiachrys; *beameri* IV; *simplex* F-Solidago; *asteris* F-Aster; *bullata* F-Heterotheca; *Haynesi* F-Helianthus; *gardineri* F-Senecio; *ardis* F; *berkeleyi* ZO?; *biscutellata* ZO; *tonkaworum* - *Engelmannia* F.
- Calliopsis coloradensis* F-Solidago/Bidens;
- Pseudopanurgus aethiops* F-Helianthus; *albitarsis* F-Helianthus; *rugosus* F-Helianthus;
- ?*Pterosarus labrosifrons distractus* F; *nebraskensis nebraskensis* F; *compositarum* ?; *innuptus* F-Helianthus;
- Perdita* (*Cockerellia*) *shinnersi* F; *purpurascens* F-Gaillardia; *perpulchra flavidor* F; *perpulchra punctatissima* F-Heterotheca; *lactepennis lactepennis* F; *lepachidis lepachidis* F-Gaillardia; *lepachidis pallidipennis* F; *lepachidis canadensis* F; *coreopsidis kansensis* F; (*Hexaperdita*) *pratti* F-Helianthus/Heterotheca; *cambarella cambarella* F-Heterotheca; *cambarella platyura* F-Heterotheca; *xanthismae* F; *fedorensis* ZO; *bishoppi planorum* F-Heterotheca; *ignota crawfordi* F-Heterotheca; *ignota ignota* F-Heterotheca; *foveata foveata* ZO; *foveata brachycephala* F; *alexi* F-Helianthus/Heterotheca; (*zonalis*) *stottleri* F; (*Pygoperdita*) *nebraskensis* ZO; (?) *albipennis* F-Helianthus; (*octomaculata*) *luteola* F; *rnodura* F-Haplopappus; *gutierreziae* F-Gutierrezia/Haplopappus; *laticincta* F-Haplopappus; *melanostoma* F-Gutierrezia; *lasiogastra* F-Pectis; *microsticta* ZO; *bruneri* F-Solidago/Grindelia; *swenki* F-Solidago/Grindelia; *prionopsidis* F; *tridentata* F-Helianthus; *fallax* F-Helianthus; *dolichocephala* F-Helianthus; *octomaculata terminata* F-Solidago/Aster; *atriventris* F-Heterotheca;
- Dufourea marginata* F; *oryx* F (both Helianthus);
- Nomia heteropoda kirbii* F-Helianthus;
- Paranthidium jugatorium jugatorium* F; *jugatorium perpictum* F (both Helianthus);
- Dianthidium curvatum sayi* F; *curvatum curvatum* F; *ulkei ulkei* F;
- Ashmeadiella bucconis bucconis* F;
- Osmia subaustralis* F; *texana* F;
- Megachile townsendiana* F; *fortis* F; *parallela* F; *pugnata pugnata* F; *fidelis* F; *pollicaris* F; *inimica sayi* F; *perihirta* F; *frugalis* F; *nebraskana* F; *manifesta* F; *nevadensis* F; *wheeleri* F;
- Diadasia enavata* F-Helianthus;
- Svastra obliqua obliqua* F; *petulca* F-Helianthus; *brevicornis* F-Helianthus; *comanche* IV?;
- Melissodes trinodis* F-Helianthus; *vernoniae* F-Vernonia; *wheeleri* F-Helianthus; *elegans* F; *snowi* F; *grindeliae* F; *subagilis* F-Grindelia; *agilis* F-Helianthus; *bidentis* F-Helianthus/Rudbeckia; *boltoniae* F; *coreopsidis* F; *denticulata* F-Vernonia; *fumosa* F-Solidago; *illata* F; *menuachus* F-Grindelia/Solidago; *rustica* F-Aster/Solidago; *desponsa* F-Cirsium; *coloradensis* F-Helianthus; *tuckeri* F-Aster/Heterotheca; *dentiventris* F; *perlusa* F; *nivea* F; *confusa* F; *pallidissignata* F-Haplopappus/Chrysothamnus; *gelida* F-Helianthus; *microsticta* F;

Legumes

- Chelostomoides suberilis* F; *Megachile melanophoea melanophoea* F; *Osmia dakotensis* IV?; spp. IV; *Anthidium maculifrons* IV (emphasis?); *psoraleae* IV (emphasis?); *atriventre astragali* IV (emphasis?); *Tetralonia belfragei* IV?; *illinoisensis* IV?; *chrysobothrys* IV?; spp. IV; *Calliopsis andreniformis* F.

Petalostemon /Amorpha

- Colletes robertsonii* IV (+Amorpha); *metzi* ZO?; *kansensis* ZO?; *aberrans* IV; *albescens* IV (+Amorpha); *saganae* IV; *wilmattae* F; *petalostemonis* IV; *Andrena cragini* (Amorpha) F; *Perdita perpallida* F; *Hoplitis micheneri* (Amorpha) IV; *Xenoglossodes albata* ZO?

Salix

- Perdita maculigera maculipennis* F; *maculigera bilineata* F; *Andrena illinoisensis* F; *salictaria* F; *nigrae*; *erythrogaster* F; *mariae* F; *trizonata* F; *bisalioidis* F; *arenicola* F; *wellesleyana* F; *andrenoides* F; *nida* IV.

Specialists in Great Plains & Prairies (cont.)

Monarda

Perdita gerhardi *gerhardi* F; *gerhardi dallasiana* F; *variegata pura* F;
variegata variegata F; *Metapsaerynthia abdominalis abdominalis* F;
Dufourea monardae F.

Pyrrhopygus

Hemihalictus lustrans F; *Andrena verecunda* F; *afimbriata* IV;
crawfordi F (+*Serinia*); *sittilliae* IV; *senticulosa* IV (+*Serinia*).

Croton

Perdita crotonis crotonis F; *crotonis dilucida* F; *crotonis subnitens* F.

Steironema

Macropis clypeata F; *nuda* F; *patellata* F; *steironematis* F.

Ipomoea

Melitoma taurea F; *grisella* F; *Cemolobus ipomoea* F; *Ancyloscelis sejunctus* F.

Opuntia

Lithurgus bruesi F; *apicalis apicalis* F; *Perdita opuntiae* F.

Euphorbia

Nomadopsis helianthi F; *Perdita labergi* F.

Lesquerella

Andrena trapezoidea F; *primulifrons* F.

Physalis/Chamaesaracha

Colletes wickhami ZO?; *swenki* ZO?; *Perdita maura* F; *halictoides* F.

Stanleya

Perdita wilmattae wilmattae F; *Andrena halli* IV.

Oenothera

Tetralonia speciosa IV?; *Melissodes fimbriata* F; *Anthophora aterrima* P?;
Sphecodogastra texana F; *oenotherae* F; *Megachile amica* ZO; *anograe* F;
oenotherae F;

Callirhoe

Diadasia afflicta perafflicta F; *Melissodes intorta* F.

Sphaeralcea +?

Diadasia diminuta F.

Phacelia

Andrena lamelliterga F.

Fragaria

Andrena melanochoera F.

Zizia

Andrena ziziae F.

Cleome

Perdita zebtrata zebtrata F.

Mentzelia

Perdita woottonae F.

Verbena

Calliopsis nebraskensis F.

Melilotus?

Hylaeus bisinuatus IV.

Heuchera

Colletes andrewsi F.

Specularia

Colletes brevicornis F.

Rhus

Andrena brevipalpis F.

Zigadenus

Andrena astragali IV.

Hydrophyllum

Andrena geranii F.

Prunus/Pyrus +

Andrena miserabilis F+.

Lepidium

Nomadopsis australior F.

Hibiscus

Ptilothrix bombiformis IV (+?).

Specialists in Northern Boreal Forests

Compositae

Colletes compactus F; *simulans* F-Solidago/Aster; *americanus* F-Solidago/
Aster; *mandibularis* ZO?; *solidaginis* ZO?;

Andrena (*Callandrena*) *helianthi* F-Helianthus; *aliciae* F-Helianthus;
simplex F-Solidago; *placata* F-Solidago; *asteris* F-Aster; *asteroides*
F-Aster; (*Cnemidandrena*) *canadensis* F-Aster/Solidago; *hirticincta* F-
Aster/Solidago; *nubecula* F-Solidago/Aster; *peckhami* ZO; *chromotricha*
F-Solidago/Aster; *robervalensis* IV;

Paranthidium jugatorium jugatorium F-Helianthus;

Dianthidium simile IV;

Osmia subaustralis F;

Megachile pugnata pugnata F;

Svastra obliqua obliqua F;

Melissodes desponsa F-Cirsium; *agilis* F-Helianthus; *denticulata* F-

Vernonia; *dentiventris* F-Aster; *illata* F; *rustica* F; *subillata* F;

trinodis F-Helianthus;

?*Pseudopanurgus albitarsis* F-Helianthus; *labrosus* F-Helianthus;

?*Pterosarus aestivalis* IV; *andrenoides* IV; *illinoisensis* IV;

nebraskensis nebraskensis IV; *solidaginis* IV;

Specialists in Northern Boreal Forests (cont.)

Salix

Andrena (*Andrena*) *frigida* IV; *clarkella* IV+; (*Micrandrena*) *salictaria* F; *nigrae* F; (*Thysandrena*) *bisalicis* F; (*Parandrena*) *andrenoides* F; *nida* IV; *wellesleyana* F; (*Trachandrena*) *sigmundi* F; *mariae* F; (*Tylandrena*) *erythrogaster* F.

Ericaceae

Colletes productus ZO?; *impunctatus* ZO?; *Andrena kalmiae* (*Kalmia*) F; *bradleyi* (*Chamaedaphne*) IV; *carolina* (*Ledum*) IV; *Osmia inermis* IV?

Legumes

Megachile melanophoea F; *Osmia integra* IV; spp. IV.

Cornus

Andrena persimulata IV; *nigrifrons* F; *integra* IV; *fragilis* F.

Pontederia

Melissodes apicata F; *Dufourea nova-angliae* F.

Steironema

Macropis longiligua F; *ciliata* F; *nuda* F; *patellata* F.

Penstemon

Osmia spp. IV.

Claytonia

Andrena erigeniae F.

Fragaria/waldsteinia

Andrena ziziaeformis F; *melanochroa* F.

Thaspium/Taenidia

Andrena ziziae F.

Heuchera

Colletes andrewsi F; *aestivalis* F.

Mertensia

Colletes consors IV?

Melilotus ?

Hylaeus bisinuatus IV.

Rhus

Andrena brevipalpis IV.

Hydrophyllum

Andrena geranii IV.

Prunus/Pyrus +

Andrena miserabilis F.

Cucurbita

Peponapis pruinosa F.

Oenothera

Sphacodogastra cenotherae F.

Echium

Hoplitis anthocopoides F.

Bees of Boreal America (Tundra & Muskeg)

Mertensia

Colletes consors mesoscopus ZO.

Potentilla

Colletes nigrifrons F; *Dufourea fimbriata* F.

Aster/Solidago +

Andrena (*Cnemidandrena*) *nubecula* F; *canadensis* F; *hirticincta* F; *columbiana* IV; *robervalensis* ZO.

Salix

Andrena frigida IV; *mariae* F; *salicifloris* F; *sigmundi* F.

Ericaceae

Andrena bradleyi (*Chamaedaphne*) IV.

Legumes

Anthidium psoralaeae zo?; *Osmia longula* ZO; (*Acanthosmoides*) spp. IV; *Megachile melanophaea melanophoea* F.

Specialists in Oak/Hickory & Mixed-Mesophytic Forests

Compositae

Colletes solidaginis F; *mandibularis* ZO?; *compactus* F; *simulans* F-Aster/Solidago; *americanus* F.

Andrena (*Callandrena*) *accepta* F-Helianthus; *aliciae* F-Helianthus; *rudbeckiae* F-Rudbeckia/Ratibida; *helianthi* F-Helianthus; *simplex* F-Solidago; *placata* F-Solidago; *asteris* F-Aster; *duplicata* F-Helianthus; *gardineri* F-Senecio; *fulvipennis* F; *asteroides* F-Aster; (*Cnemidandrena*) *hirticincta* F-Aster/Solidago; *nubecula* F-Aster/Solidago; *robervalensis* IV; *canadensis* F-Aster/Solidago.

Pseudopanurgus rudbeckiae IV; *pauper* ZO?; *solidaginis* IV; *rugosus* F-Helianthus; *labrosus* F-Helianthus?; *helianthi* F-Helianthus? *albitarsis* F-Helianthus?

Pseudopanurgus rugosus F-Helianthus.

?*Pterosarus albitarsis* IV-Helianthus?; *helianthi* IV-Helianthus?; *labrosus* IV-Helianthus?; *andrenoides* IV; *compositarum* IV; *rudbeckiae* IV; *solidaginis* IV; *labrosiformis* *labrosiformis* IV; *nebraskensis* *nebraskensis* IV.

Heterosarus illinoiensis F.

Perdita (*Cockerellia*) *bequaerti indianensis* F; (*Hexaperdita*) *boltoniae* *boltoniae* F-Chrysopsis; (*octomaculata*) *swenki* F-Solidago/Grindelia; *octomaculata octomaculata* F-Solidago/Aster.

Nomia heteropoda heteropoda F-Helianthus.

Osmia texana F.

Specialists in Oak/Hickory & Mixed Mesophytic Forests (cont.)

Compositae

- Megachile inimica sayi* F; *frugalis frugalis* F; *pugnata pugnata* F; *parallela* F.
Ashmeadiella buconis buconis - emphasis only?
Dianthidium simile IV.
Paranthidium jugatorium jugatorium F; *jugatorium lepidum* F (both *Helianthus*).
Svastra obliqua obliqua F; *petulca* F.
Melissodes desponsa F-Cirsium; *coloradensis* F; *agilis* F-Helianthus; *bidentis* F; *boltoniae* F; *denticulata* F-Vernonia; *dentiventris* F-Aster; *fumosa* F-Solidago; *illata* F; *nivea* F; *rustica* F-Solidago/Aster; *subillata* F; *tincta* F; *trinodis* F-Helianthus.

Monarda

- Perdita gerhardi gerhardi* F; *Metapsaenythia abdominalis tricolor* F; *Dufourea monardae* F.

Stelironema

- Macropsis ciliata* F; *nuda* F; *patellata* F; *stelironematis* F.

Cucurbita

- Peponapis pruinosa* F; *Xenoglossa kansensis* F.

Taenidia/Thaspium

- Andrena personata* F; *ziziae* F; *neonana* ZO?

Phacelia

- Andrena lamelliterga* F; *phacelliae* F.

Oenothera

- Sphecodogastra texana* F; *Anthedonia compta* F.

Cornus

- Andrena nigrifrons* F; *integra* IV; *fragilis* F.

Salix

- Andrena erythrogaster* F; *illinoensis* F; *salictaria* F; *nigrae* F; *mariae* F; *bisalicis* F; *andrenoides* F; *wellesleyana* F; *nida* IV.

Legumes

- Megachile ingenua* IV; *melanophoea melanophoea* F; *mucida* F; *Tetralonia atriventris* IV; spp. IV; *Anthidium maculifrons* IV; *Osmia* spp. IV.

Cruciferae

- Andrena arabis* F. *Rhus Calliopsis andreniformis* F

Ericaceae

- Colletes validus* IV?; *productus* ZO?

Fragaria/Waldsteinia

- Andrena ziziaeformis* F.

Pyrhopappus

- Hemihalictus lustrans* F.

Krigia

- Andrena krigiana* F.

Prunus/Pyrus +

- Andrena miserabilis* F+.

Specularia/Campanula

- Colletes brevicornis* F.

Heuchera

- Colletes aestivalis* F.

Hibiscus

- Ptilothrix bombiformis* IV?

Melilotus ?

- Nylaeus bisinuatus* IV.

Polemonium

- Andrena polemonii* F.

Hydrophyllum

- Andrena geranii* F.

Viola

- Andrena violae* F.

Penstemon

- Osmia* spp. IV.

Physalis

- Perdita halictoides* F.

Pontederia

- Dufourea nova-angliae* F.

Passiflora

- Anthemurgus passiflorae* F.

Ipomoea

- Melitoma taurea* F.

Ceanothus ?

- Heterosarus pauper* IV; *virginicus* IV

Specialists restricted to Pine Barrens & Coastal Sandy E. U.S.A.

Compositae

- Colletes mitchelli* F; *thysanellae* ZO?; *Andrena braccata* F; *placata* F; *fulvipennis* F; *Perdita (Hexaperdita) bishoppi bishoppi* F; *bishoppi isopappi* F; *boltoniae chrysopina* F; *nubila* F; (*octomaculata discreta* F; *consobrina consobrina* F; *consobrina lepida* F; *Megachile inimica inimica* F; *townsendiana* F; *Melissodes pilleata* F; *manipularis* F.

Physalis

- Perdita halictoides* F.

Monarda

- Perdita gerhardi monardae* F.

Euphorbiaceae

- Perdita picturata* ZO?

Opuntia

- Lithurgus gibbosus* F; *Melissodes mitchelli* IV.

Kunnistera

- Colletes howardi* IV.

Pontederia

- Melissodes apicata* F.

Hibiscus

- Ptilothrix bombiformis* IV (+?)

Specialists restricted to Pine Barrens & Coastal Sandy E. U.S.A.

Ipomoea

Melittoma taurea F; Cemolobus ipomoea F.

Ericaceae

Colletes validus IV?; Andrena daeckii IV.

Oenothera

Megachile oenotherae F; Melissodes fimbriata IV; Anthedonia compta F.

Specialists in Oak/Hickory/Pine Forests

Compositae

Andrena (Callandrena) accepta F-Helianthus; aliciae F-Helianthus; ignota ZO; (Cnemidandrena) hirticincta F-Aster/Solidago; nubecula F-Aster/Solidago;

Colletes compactus F; simulans F-Solidago/Aster; americanus F-Aster/Solidago; mandibularis ZO?; solidaginis ZO?;

Perdita (Cockerellia) bequaerti bequaerti F; (Hexaperdita) georgica F-Chrysopsis/Aster; boltoniae boltoniae F-Chrysopsis; boltoniae chrysopina F-Chrysopsis; (octomaculata) consobrina consobrina F-Chrysopsis; octomaculata octomaculata F-Solidago/Aster;

Paranthidium jugatorium jugatorium F; jugatorium lepidum F (both on Helianthus);

Dianthidium simile F; curvatum curvatum F;

Ashmeadiella buconis buconis F;

Megachile townsendiana F; parallela parallela F; pugnata pugnata F;

frugalis frugalis F; inimica sayi F; polycaris F;

Svastra aegis F; obliqua calliginosa F; petulca F;

Melissodes desponsa F-Cirsium; coloradensis F; agilis F-Helianthus;

boltoniae F; denticulata F-Vernonia; dentiventris F-Aster; fumosa

F-Solidago; illata F; nivea F; rustica F-Aster/Solidago; tinctoria

F-Aster/Chrysopsis; trinodis F-Helianthus;

Nomia heteropoda heteropoda F-Helianthus;

Pseudopanurgus rugosus F-Helianthus.

Heterosarus illinoisensis F.

?Pterosarus albitarsis F-Helianthus; compositarum IV; labrosiformis

labrosiformis IV; solidaginis IV; nebraskensis meusebeckii IV.

Legumes

Anthidium maculifrons IV (emphasis only?); Tetralonia atriventris IV;

spp. IV; Megachile mucida IV; ingenua IV?; Chelostomoides spp. IV;

Osmia spp. IV; Calliopsis andreniformis F.

Cucurbita

Peponapis pruinosa F; Xenoglossa strenua F; kansensis F.

Salix

Andrena mariae F; bisalicis F; andrenoides F; nida IV; nigrae F;

erythrogaster F.

Ceanothus ?

Faenidium/Thaspium

Andrena personata F; neonana ZO?; ziziae F.

Heterosarus pauper IV; virginicus IV

Opuntia

Melissodes mitchelli IV; Lithurgus gibbosus F.

Oenothera

Megachile oenotherae F; Anthedonia compta F; Sphecodogastra oenotherae F.

Ericaceae

Colletes productus ZO?; validus IV?

Krigia

Andrena krigiana F.

Ipomoea

Melittoma taurea F.

Fragaria/Waldsteinia

Andrena ziziaeformis F.

Prunus/Pyrus +

Andrena miserabilis F (+?)

Specularia

Colletes brevicornis F.

Cornus

Andrena fragilis F.

Gerardia

Perdita gerardiae IV.

Pontederia

Melissodes apicata F.

Melilotus ?

Hylaeus bisinuatus IV?

Steironema

Macropis ciliata F; steironematis F.

Potentilla

Panurginus potentillae IV.

Passiflora

Anthemurgus passiflorae F.

Monarda

Metapsaenythia abdominalis F.

Specialists in Southern Mixed Forests

Compositae

- Colletes simulans* F-Solidago/Aster/Bidens; *mandibularis* ZO?;
solidaginis ZO?;
Andrena (*Callandrena*) *aliciae* F-Helianthus; *asteroides* F-Aster;
fulvipennis F;
Perdita (*octomaculata*) *consobrina lepida* F-Chrysopsis; (*Cockerellia*)
bequaerti bequaerti F; *lepachidis levifrons* F; (*Hexaperdita*)
georgica F-Chrysopsis/Aster; *blatchleyi* F; *bishoppi bishoppi* F-
Heterotheca; *graenicheri* F-Chrysopsis; *boltoniae chrysopina* F-
Chrysopsis; *nubila* F-Erigeron;
Pseudopanurgus rugosus F-Helianthus;
Heterosarus illinoiensis F;
?Pterosarus nebraskensis meusebecki IV; *solidaginis* IV;
Dufourea marginata F-Helianthus;
Nomia heteropoda kirbii F-Helianthus;
Megachile parallela F; *townsendiana* F; *pugnata pugnata* F;
Svastra aegis F; *petulca* F;
Melissodes desponsa F; *agilis* F-Helianthus; *boltoniae* F; *denticulata*
 F-Vernonia; *dentiventris* F-Aster; *fumosa* F-Solidago; *nivea* F;
rustica F-Aster/Solidago; *tincta* F-Aster/Chrysopsis; *trinodis* F-
 Helianthus.

Lecumes

- Anthidium maculatum* IV (emphasis only?); *Osmia* spp. IV; *Tetralonia* spp.
 IV; *Chelostomoides* spp. IV; *Megachile ingenua* IV.

Salix

- Andrena nigrae* F; *bisalicis* F; *andrenoides* F.

Ipomoea

- Melitoma taurea* F; *Cemolobus ipomoea* F.

Cucurbita

- Peponapis pruinosa* F; *Xenoglossa kansensis* F; *strenua* F.

Oenothera

- Anthedonia compta* F; *Melissodes fimbriata* F; *Sphecodogastra oenotherae*
 F; *Megachila oenotherae* F.

Opuntia

- Lithurgus gibbosus* F.

Prunus/Pyrus +

- Larandrena miserabilis* F (+?)

Pyrrhopappus

- Hemihalictus lustrans* F.

Gerardia

- Perdita gerardiae* IV.

Specularia

- Colletes brevicornis* F.

Ericaceae

- Colletes productus* ZO?

Thaspium/Taenidia

- Andrena ziziae* F; *neonana* ZO?

ADDITIONAL NOTES ON THE GENUS PRIVA. VII

Harold N. Moldenke

PRIVA Adans.

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PRIVA ASPERA H.B.K.

Additional & emended synonymy: Priva aspera Humb. & Bonpl. ex Steud., Nom. Bot., ed. 1, 651 & 873. 1821. Priva aspera Kunth ex Spreng. in L., Syst. Veg., ed. 16, 2: 753. 1825.

Additional bibliography: Steud., Nom. Bot., ed. 1, 651 & 873. 1821; Spreng. in L., Syst. Veg., ed. 16, 2: 753. 1825; Steud., Nom. Bot., ed. 2, 2: 397. 1841; Kobuski, Ann. Mo. Bot. Gard. 13: 1, 3, 4, 7, 18--20, 23, & 32--[35], pl. 4, fig. 14, & pl. 5, fig. 23. 1926; Mold., Phytologia 43: 332--334. 1979.

Illustrations: Kobuski, Ann. Mo. Bot. Gard. 13: [33] & [35], pl. 4, fig. 14, & pl. 5, fig. 23. 1926.

PRIVA BAHIENSIS P. DC.

Additional bibliography: Kobuski, Ann. Mo. Bot. Gard. 13: 2, 4, 6, 10, 23, & 32--[35], pl. 4 & 5, fig. 9 & 18. 1926; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 38, 41, & 99. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 628. 1946; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 89, 99, & 195. 1949; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 628. 1960; D. de Andrade Lima, Anaix XV Cong. Soc. Bot. Bras. 348. 1964; Mold., Phytologia 14: 343--344. 1967; Mold., Fifth Summ. 1: 169 & 187 (1971) and 2: 612 & 905. 1971; Troncoso, Darwiniana 18: 360, 408, & 411. 1974; Mold., Phytologia 43: 334. 1978.

Illustrations: Kobuski, Ann. Mo. Bot. Gard. 13: [33] & [35], pl. 4 & 5, fig. 9 & 18. 1926.

Recent collectors describe this species as a lank, perennial, branched herb, 0.5--1 m. tall, or an "arbusto" [Pareira 9713, mixed label?], the leaves pale- or dark-green and rugose, the flowers very small, and the calyx [in fruit] inflated, pale-green. They have encountered it in disturbed ground by cutover woodland, in waste ground with scattered shrubs and marshy lake margins, in cacao plantations "in coastal rainforest with small rivers and clearings with disturbed ground", "in disturbed roadsides near

small artificial lakes and open grazed scrub", and "na descida da serra", at altitudes of sealevel to 800 m., flowering and fruiting from January to March.

The corollas are said to have been "violet" on Harley & al. 15016, "lilac" on Harley & al. 17260, "pale-lilac, lower 2 petals purple-streaked at the base" on Harley & al. 19403, and "lilac-rose" on Pereira 9713. Andrade de Lima (1964) refers to the species as "common" in Pernambuco, Brazil.

Peckolt (1904) uppercases the initial letter of the specific epithet and records the vernacular name, "giriti falso", which he translates as "falsche Giriti", describing the plant as perennial, with oval, almost cordate, "grob kerbig gesägten" leaves, light-violet corollas, and drupes that are enclosed by the mature calyx. He notes that "Die Blätter werden benutzt bei Waschung von Wunden. Das Dekokt der Wurzel, 100 g zu 1.1 Kolatur, dreimal täglich ein Helchglas voll bei Gonorrhöe."

Additional & emended citations: BRAZIL: Bahia: Blanchet 643 (F--520688), 1027 [Macbride photos 7857] (F--645633--photo of cotype); A. Castellanos 25133 [Herb. Cent. Pesq. Florest. 3902] (Fe); Harley, Mayo, Storr, Santos, & Pinheiro in Harley 19403 (N); Harley, Renvoize, Erskine, Brighton, & Pinheiro in Harley 15016 (Ld), 16260 (Ac), 17260 (Ld); Pereira 9713 [Pabst 8602; Herb. Brad. 35069] (Mu, Mu, N); Salzmann 438 (E--118802--cotype). Pernambuco: Pickel 2616 (F--753734, W--1518172). MOUNTED ILLUSTRATIONS: Kobuski drawing 9 (E--925406), 18 (E--925405); Schau. in Mart., Fl. Bras. 9: pl. 50. 1851 (N, Z).

PRIVA BOLIVIANA Mold., Phytologia 3: 172--173. 1949.

Additional & emended bibliography: R. C. Foster, Contrib. Gray Herb. 184: 170. 1958; Troncoso, Darwiniana 11: 591--597, fig. 1--3. 1959; Caro, Kurtziana 1: 271--282. 1961; Burkart, Excerpt. Bot. A.5: 467. 1962; Mold., Phytologia 14: 344--345. 1967; Mold., Fifth Summ. 1: 183, 187, & 199 (1971) and 2: 905. 1971; Troncoso, Darwiniana 18: 359, 360, 408, & 411, fig. 18. 1974.

Additional illustrations: Troncoso, Darwiniana 18: 359, fig. 18. 1974.

Troncoso (1974) cites Peredo 267 from Santa Cruz, Bolivia, T. Rojas 7249 from Paraguay, and Burkart 20184 from Formosa and Luna Ruiz s.n. [Herb. B. Aires 5338] from Salta, Argentina.

PRIVA CORDIFOLIA (L. f.) Druce, Bot. Exch. Club Brit. Isles 4: 641. 1917.

Additional synonymy: Steptium asperum Roxb. ex Boiss., Fl. Orient. 4: 533, in syn. 1879. Priva leptostachya Kobuski ex Chiov., Fl. Somalia 1: 274, in syn. 1929. Priva leptostachya Aitch. ex Boiss., Fl. Orient. 4: 533, in syn. 1879. Priva ledtostachya Aitch. apud Parsa, Fl. Iran 4 (1): 535, sphalm. 1949. Priva cordifolia Druce apud Watt & Breyer-Brandwijk, Med. Poison Pl. S. East. Afr., ed. 2, 1053. 1962. Priva cordifolia (L.) Druce apud

S. V. Ramaswami, Stud. Flow. Pl. Bangalore [thesis] xxx, xxi, 1020, & 1447, sphalm. 1966.

Additional & emended bibliography: Pers., Sp. Fl. 3: 349. 1819; Spreng. in L., Syst. Veg., ed. 16, 2: 754. 1825; Sweet, Hort. Brit., ed. 1, 324 (1826) and ed. 2, 418. 1830; G. Don in Loud., Hort. Brit., ed. 1, 246 (1830) and ed. 2, 246. 1832; Loud., Hort. Brit., ed. 2, 552. 1832; G. Don in Loud., Hort. Brit., ed. 3, 246. 1839; J. Grah., Pl. Bomb. 154. 1839; Sweet, Hort. Brit., ed. 3, 552. 1839; Voigt, Hort. Suburb. Calc. 471. 1845; Buek, Gen. Spec. Syn. Candoll. 3: 368. 1858; Aitchison, Cat. Fl. Punj. 119. 1869; Boiss., Fl. Orient., imp. 1, 4: 533. 1879; C. B. Clarke in Hook. f., Fl. Brit. India 4: 565. 1885; Trimen, Journ. Ceyl. Br. Roy. Asiat. Soc. 9: [Syst. Cat. Flow. Pl. Ceyl.] 68. 1885; Balf. f., Bot. Socotra 232--233. 1888; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 1: 350 (1893) and imp. 1, 2: 628. 1894; Nairne, Flow. Pl. West. India 247. 1894; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 1004 & 1090. 1895; Trimen, Handb. Fl. Ceyl. 3: 349. 1895; Cooke, Fl. Presid. Bombay, ed. 1, 3: 422. 1905; J. C. & M. Willis, Rev. Cat. Flow. Pl. Ceyl. [Perad. Man. Bot. 2:] 69. 1911; Chiov., Result. Scient. Miss. Stef. 1: 143. 1916; Gamble, Fl. Presid. Madras 6: 1091. 1924; Kobuski, Ann. Mo. Bot. Gard. 13: 1, 6, 9--10, 23, 24, & 33--[35], pl. 4 & 5, fig. 8 & 17. 1926; Alston in Trimen, Handb. Fl. Ceyl. 6: Suppl. 231. 1931; Wangerin, Justs Bot. Jahresber. 54 (1): 1170. 1932; Watt & Breyer-Brandwijk, Med. Poison. Pl. S. Afr., ed. 1, 154 & 238. 1932; Mold., Geogr. Distrib. Avicenn. 29--33 & 39. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 45, 49--56, 74, & 99. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 1: 350 (1946) and imp. 2, 2: 628, 1004, & 1090. 1946; Glover, Prov. Check List Brit. Ital. Somal. 268. 1947; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 124, 125, 128--130, 163, & 195. 1949; Parsa, Fl. Iran 4 (1): 535. 1949; V. Täckholm, Stud. Fl. Egypt 154. 1956; Cooke, Fl. Presid. Bombay, ed. 2, imp. 1, 2: 502. 1958; Abeywickrama, Ceyl. Journ. Sci. Biol. 2: 217. 1959; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 1: 350 (1960) and imp. 3, 2: 628, 1004, & 1090. 1960; Martin & Noel, Fl. Albany Bathurst 92. 1960; Hartl, Beitr. Biol. Pfl. 37: 294. 1962; Lind & Tallantire, Some Comm. Flow. Pl. Uganda, ed. 1, 147, 246, & 254. 1962; Watt & Breyer-Brandwijk, Med. Poison. P. S. Afr., ed. 2, 1053 & 1429. 1962; Bois., Fl. Orient., imp. 2, 4: 533. 1963; W. G. Wright, Wild Fls. South. Afr. 156 & 158. 1963; R. Good, Geogr. Flow. Pl. 185. 1964; S. V. Ramaswamy, Bull. Bot. Surv. India 6: 17. 1964; Jafri, Fl. Karachi 288 & 362, fig. 283. 1966; Naithani, Bull. Bot. Surv. India 8: 260. 1966; S. V. Ramaswami, Study Flow. Pl. Bangalore [thesis] xxv, xxvi, 1020--1021, & 1447. 1966; Rao & Aggarwal, Bull. Bot. Surv. India 8: 23. 1966; Sebastian & Ramamurthy, Bull. Bot. Surv. India 8: 180. 1966; Cooke, Fl. Presid. Bombay, ed. 2, imp. 2, 2: 502. 1967; Mold., Phytologia 14: 394 & 397. 1967; Mold., Résumé Suppl. 15: 9, 22, & 23. 1967; Patzak & Rech. in Rech., Fl. Iran 43: 4 & 8. 1967; Ramaswamy, Bull. Bot. Soc. Bengal 21: 96. 1967; Santapau, Bull. Bot. Surv. India 8: 39. 1967; Vajravelu & Rathakrishnan, Bull. Bot. Surv. India 9: 43.

1967; Amico & Bavazzano, Webbia 23: 280 & 301. 1968; Gunawardena, Gen. Sp. Pl. Zeyl. 147. 1968; A. Löve, Taxon 17: 100. 1968; Mold., Résumé Suppl. 16: 10, 25, & 27 (1968) and 17: 5. 1968; Bolkh., Grif, Matvej., & Zakhar., Chrom. Numb. Flow. Pl., imp. 1, 716. 1969; Vander Schijff, Check List Vasc. Pl. Kruger Natl. Park 81. 1969; Lind & Tallantire, Some Comm. Flow. Pl. Uganda, ed. 2, 147, 246, & 254. 1971; Mold., Fifth Summ. 1: 209, 211, 213, 214, 231, 234, 238, 241, 248, 250, 252, 257, 262, 265, 269, 270, 278, 281, 284, 285, 368, & 420 (1971) and 2: 612, 613, 633, 634, 641, 644, 652, 670, & 905. 1971; Bavazzano, Webbia 26[Erb. Trop. Firenz. Publ. 21]: 260 & 320. 1972; R. R. Stewart, Annot. Cat. in Nasir & Ali, Fl. W. Pakist. 607--608. 1972; V. Täckholm, Stud. Fl. Egypt, ed. 2, 452. 1974; Mold., Phytologia 25: 242. 1973; R. R. Rao, Stud. Flow. Pl. Mysore Dist. [thesis] 2: 753--754. 1973; Rao & Razi, Journ. Mysore Univ. B.26: 102. 1973; Bolkh., Grif, Matvej., & Zakhar., Chrom. Numb. Flow. Pl., imp. 2, 716. 1974; Mold., Phytologia 28: 442 & 444 (1974), 34: 261 & 262 (1976), and 43: 331. 1979.

Additional illustrations: Kobuski, Ann. Mo. Bot. Gard. 13: [33] & [35], pl. 4 & 5, fig. 8 & 17. 1926; Jafri, Fl. Karachi fig. 283. 1966.

Recent collectors describe this species as an erect, probably perennial, deciduous herb, to 40 cm. tall, few-branched from the base, the flowers borne in drawn-out racemes, and the pyrenes two. They have found it growing in disturbed ground in cleared areas of scrub forest, among bushes, and in sandy loam soil in back of beaches, at 2--3 m. altitude, flowering in April, July, November, and December, fruiting in July. Rao & Agarwal (1966) report it from hedges on Beyt Island, citing Rao 527. Ramaswamy (1964) found it also in hedges in Bangalore. Rao & Razi (1973) record it from Mysore, where, they say, it flowers and fruits throughout the "Major part of the year". Lind & Tallantire found it in grasslands in Uganda, while Martin & Noel refer to it as "occasional" along roadsides in South Africa. In Sri Lanka it is said to be "rare" by Fosberg, "not common" by Cooray, and "very rare" by Trimen. Chiovenda (1916) reports it from Italian Somaliland, while Amico & Bavazzano (1968) found it in Zambezia, Mozambique. Voight (1845) reports it cultivated in Calcutta.

Good (1964) tells us that P. cordifolia, with Myrsine africana "and doubtless some others" extends in its range from Socotra or Abyssinia to the Cape of Good Hope in Africa. It also extends eastward to India.

The corollas are quite uniformly described as "white" by Clarke (1885), Nairne (1894), Trimen (1895), Baker (1900), Martin & Noel (1960), Bavazzano (1972), and on Cooray 6944407R and Fosberg 50229. The Cooray collection serves as voucher for ecological observations.

Naithani (1966) refers to P. cordifolia as "common", citing his no. 21266; Sebastine & Ramamurthy (1966) note that they saw

only a "few" in Madras, citing their no. 14550. Santapau (1967) lists it for Saurashtra, India.

Shetty (1961) reports the chromosome number as 36; Löve (1968) reports it as $n = 12$ and $n = 18$ according to Baquar & Warsi on the basis of collections made by them in Pakistan. Sweet (1826), Don (1830), and Loudon (1832) all assert that it was introduced into cultivation in England in 1799 from "E. Indies". Common names listed for it are "enkami", "hinisso", and "rough streptium".

The plant figured by Wright (1963) as *P. leptostachya* actually is *P. meyeri* Jaub. & Spach and the medicinal uses which he enumerates probably apply to the latter species. Watt & Breyer-Brandwijk (1962) report that the Zulu apply a cold infusion of the leaves of *P. cordifolia* to inflammation of the eyeballs and a paste of the ground-up seeds to sores and wounds. The seed is thought to contain tannin.

Cooke (1905) cites Cooke s.n., Lush s.n., and Woodrow s.n. from Bombay, India, and Woodrow s.n. from Sind, Pakistan, speaking of the species as "rare". Baker (1900) cites Bent s.n. and Schweinfurth 54 & 433 from Nubia, Schweinfurth & Riva 490 and Stuedner s.n. from Eritrea, Schimper 1023 from Ethiopia, Révoil s.n. from Somaliland, Scott-Elliott 6217 from Kenya, Höhnel s.n. and Volgens 2154 from Tanzania, and Buchanan s.n. and Whyte s.n. from Malawi.

Ramaswamy (1967) cites his no. 843 from India; Vajravelu & Rathakrishnan (1967) cite their no. 20698 from Madras, noting that the species is "common" there. Patzak & Rechinger (1967) cite Lamond 775, Rechinger 28622, and Stocks 571 from Baluchistan. They designate as nomenclatural type of the species J. G. König s.n. from India. Bavazzano (1972) records the species from Afars & Issis, citing his nos. 85, 116, 122, & 611.

Jafri & Ghafoor, in a personal communication, cite from Pakistan the following collections: Hamid s.n., Hussain s.n., Jafri 2475 & 3715, and Tasnif s.n. From Baluchistan they cite Stocks 571. Stewart (1972) cites only Jafri s.n., Stocks 571, and Woodrow s.n.

Material of *P. cordifolia* has been misidentified and distributed in some herbaria as *Stachytarpheta* sp. and as *Rhus mysorensis* Heyne [the latter doubtless due to mixed labels in mounting]. On the other hand, the Rodin 4158, distributed as typical *P. cordifolia*, is, instead, var. *abyssinica* (Jaub. & Spach) Mold., Bos 1188 and Edwards 3013 are var. *australis* Mold., Bayliss BS.3226 is *P. meyeri* Jaub. & Spach, and Farooqi 2193 is not verbenaceous.

Additional citations: PAKISTAN: Baluchistan: K. H. Rechinger 28622 (Mu). Sind: Abedin s.n. [12-7-1967] (Kh); Hussain s.n. [18.8.67] (Kh, Kh, Kh). INDIA: East Punjab: J. Drummond 26708 (Ca--244646). Khasi States: T. Thomson s.n. (Pd). Mysore: G. Thomson s.n. (Pd). State undetermined: Wallich s.n. [Ind. orient.] (E--119874). SRI LANKA: Collector undetermined s.n. [Dec. 19,

1882] (Pd); Cooray 69111h07R (W--2656656, W--2764801); F. R. Fosberg 50229 (Id, Pd, W--2612116); Trimén s.n. [Dec. 1882] (Bm, K).
 CULTIVATED: India: Herb. Hort. Bot. Calcut. s.n. (Pd). LOCALITY OF COLLECTION UNDETERMINED: Collector undetermined XIV (Pd).

PRIVA CORDIFOLIA var. ABYSSINICA (Jaub. & Spach) Mold., Feddes Repert. Spec. Nov. 41: 45--47. 1936.

Additional synonymy: Priva dentata Rich. apud Almagia in Pirotta, Fl. Col. Erit. 133, in syn. 1903 [not P. dentata A. L. Juss., 1895, nor Pers., 1806]. Priva cordifolia var. abyssinica (Jaub. ex Spach) Mold. apud Van der Schijff, Check List Pl. Kruger Natl. Park 81, sphalm. 1969.

Additional & emended bibliography: Aitchison, Cat. Fl. Punjab 119. 1869; Boiss., Fl. Orient., imp. 1, 4: 533. 1879; Balf. f., Bot. Socotra 233 & 433. 1888; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 1, 2: 628. 1894; J. G. Baker in Thiseit.-Dyer, Fl. Trop. Afr. 5: 285. 1900; Almagia in Pirotta, Fl. Col. Erit. [Ann. Inst. Bot. Roma 8:] 133. 1903; Kobuski, Ann. Mo. Bot. Gard. 13: 9 & 23. 1926; Mold., Geog. Distrib. Avicenn. 29--32. 1939; Mold., Known Geogr. Distrib. Verbenac., ed. 1, 45, 49--53, & 99. 1942; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 2, 2: 628. 1946; Glover, Prov. Check List Brit. Ital. Somal. 268. 1947; Mold., Known Geogr. Distrib. Verbenac., ed. 2, 109, 110, 116--120, 122, 124, & 195. 1949; Parsa, Fl. Iran 4 (1): 535. 1949; V. Täckholm, Stud. Fl. Egypt, ed. 1, 154. 1956; Jacks. in Hook. f. & Jacks., Ind. Kew., imp. 3, 2: 628. 1960; Boiss., Fl. Orient., imp. 2, 4: 533. 1963; Mold., Phytologia 14: 346--348 & 397. 1967; Mold., Résumé Suppl. 16: 25. 1968; Greenway, Journ. East Afr. Nat. Hist. Soc. 27: 196. 1969; Van der Schijff, Check List Vasc. Pl. Kruger Natl. Park 81. 1969; Mold., Fifth Summ. 1: 209, 211, 213, 214, 234, 238, 241, 248, 250, 252, 257, 262, & 265 (1971) and 2: 612, 613, 652, & 905. 1971; R. R. Stewart in Nasir & Ali, Fl. West Pakist. 607--608. 1972; Mold., Phytologia 25: 242. 1973; V. Täckholm, Stud. Fl. Egypt, ed. 2, 452. 1974; Mold., Phytologia 43: 331. 1979.

Täckholm (1956) regards P. leptostachya A. L. Juss. as a synonym of this variety, but actually it belongs to the synonymy of typical P. cordifolia (L. f.) Druce. Priva leptostachya Aitch. is also sometimes placed here, but applies to the Punjab plant and therefore must also go into the synonymy of typical P. cordifolia.

The Boissier (1879) reference in the bibliography above is often cited as "1875", but the page here involved was not actually issued until 1879.

Recent collectors have encountered P. cordifolia var. abyssinica along roadsides, in the shade of trees near streams, and in the strand association with trees and shrubs on inner beaches, at altitudes of sealevel to 4350 feet, flowering and fruiting in January and March, flowering also in December. They describe it as a common herbaceous plant, 18 inches to 3 feet tall, the in-

flated [fruiting-] calyx covered with viscid glandular hairs. The corollas are said to have been "white" on Repton 715 and "light-blue" on Rodin 4158.

Greenway (1969) cites Hucks 773b & 793, Napier 931, and Verdcourt 3876 from Tsavo East National Park. Van der Schijff (1969) cites his no. 1603 from Kruger National Park. Almagia (1903) cites from Eritrea: Pirotta 11, 3083, 3347, 3588, 3603, 4110, & 4203, Ragazzi 111, and "T.P." 67. He also records it from Dahalak island.

Material of this variety has often been misidentified and distributed in herbaria as P. adhaerens (Forsk.) Chiov. and P. leptostachya A. L. Juss.

Additional & emended citations: EGYPT: Täckholm, Kassas, Faway, Shalaby, Samy, & Zahran 412 (Gz, Gz, Gz, Gz, Gz, Gz, Gz, Gz, Gz, Gz), 415 (Gz, Gz, Gz, Gz, Gz), 537 (Gz, Gz, Gz, Gz, Gz, Gz), 833 (Gz, Gz, Gz), 1003 (Gz), s.n. [24.1.1962] (Gz, Gz). SUDAN: Red Sea: Kassas, Mobarak, & Omar 773 (Gz). ETHIOPIA: C. C. Albers 63006 (Au--224073). UGANDA: Dümmer 30 (W--633415); Mearns 2402 (W--632375). KENYA: Dümmer 4611 (W--1029976). MOZAMBIQUE: Lourenço Marques: Howard 118 (W--554445); Rodin 4153 (Ba). MALAWI: J. Buchanan 887 (W--807175). SOUTH AFRICA: Transvaal: Repton 715 (Ba). MOUNTED ILLUSTRATIONS: Kobuski drawing 8 (E--925406), 17 (E--925405).

PRIVA CORDIFOLIA var. **AUSTRALIS** Mold., Feddes Repert. Spec. Nov. 41: 47. 1936.

Additional bibliography: Mold., Geogr. Distrib. Avicenn. 32. 1939; Mold., Phytologia 14: 347 (1967) and 34: 262. 1976.

Recent collectors describe this plant as a "brittle-stemmed shrub", 4 feet tall, a "3-foot weed", or a "labiatous-looking herb with brown almost woody bases, square light-green stems, the entire plant covered by minute rather sticky hairs, membranous dull bright-green [sic!] leaves, paler below, green calyx", and have found it growing in littoral grassland and in sandy Table Mountain Series soils in Acacia burkei woodland, at 500 feet altitude, flowering in February and November, in fruit in November. The corollas are said to have been "white" on Edwards 3013 and "white, the lobes spreading, the 3 abaxial lobes with purple stripes emerging from the throat" on Mogg 13522.

Additional citations: MOZAMBIQUE: Marica e Sofala: Torre & Paiva 9125 (Ld). SOUTH AFRICA: Natal: D. Edwards 3013 (Mu); Mogg 13522 (Mu); Strey 4869 (Mu). Transvaal: Bos 1188 (Mu).

PRIVA CORDIFOLIA var. **FLABELLIFORMIS** Mold., Feddes Repert. Spec. Nov. 41: 47--48. 1936.

Additional bibliography: Mold., Geogr. Distrib. Avicenn. 30. 1939; Mold., Phytologia 14: 347--348. 1967; Mold., Fifth Summ. 1: 231, 234, 238, 248, 250, & 252 (1971) and 2: 905. 1971.

[to be continued]

Contribution to the Lichen Flora of Venezuela I.

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VENEZUELA

After the Second Field Symposium, INTERNATIONAL ASSOCIATION for LICHENOLOGY, held in San José, Costa Rica, T. Anti, P.M. Jørgensen, V. Wirth, H. Sipman and other lichenologist visited Mérida, Venezuela, during the month of January. Later on Mason Hale visited us for three weeks.

These specialists made several trips to different zones in the Andes of Mérida collecting specimens. The herbarium of the Faculty of Pharmacy (MERF) benefited from their visit because they identified and revised some selected groups of lichens. As a consequence we are contributing with a list of new records that enrich the Lichenological Flora of Venezuela.

Some new records made by A. Henssen, Mason Hale, Mason Hale & M. López in recent papers are also included.

Acarospora Mass.

Arthrospora Mass.

Astrothelium (Eschw.) Tevis.

Dermatocarpon Eschw.

Graphina Müll. Arg.

Menegazzia Mass.

Parmentaria Müll. Arg.

Pyrenula Ach.

Zahlbrucknerella Henss.

- Astrothelium austomum* Müll. Arg.
Arthropyrenia cinchonae Müll. Arg.
Cladonia andesita Vain.
Cladonia chlorophaea (Florke ex Somn.) Spreng
Cladonia chlorophaeodes (Vain.) Dodge
Cladonia granulosa (Vain.) Anti
Cladonia pyxidata (L.) Hoffm.
Cladonia verruculosa (Vain.) Ahti
Cladonia vulcanica Zoll.
Everniastrum paramense Hale & López
Graphina confluens (Fée) Müll. Arg.
Hypotrachyna cendensis Hale & López
Hypotrachyna meridensis Hale & López
Hypotrachyna primitiva Hale & López
Hypotrachyna pustulifera (Hale) Hale
Leptogium andinum P.M. Jørg.
Leptogium digitatum (Mass.) Zahlb.
Leptogium hibernicum Mitch.
Leptogium mandonii P.M. Jørg.
Leptogium palmatum (Huds.) Mont.
Leptogium papillosum (B. de Lesd.) Dodge
Leptogium resupinans Nyl.
Menegazzia terebrata (Hoffm.) Mass.
Parmentaria chilensis Fée
Parmotrema cristatum (Hale) Hale
Parmotrema crocoides (Hale) Hale
Parmotrema flavomedullosum Hale
Porina nucula Ach.
Pyrenula dermatodes Dchaer.
Zahlbrucknerella maxima Henss.

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BOOK REVIEWS

Alma L. Moldenke

"GEOGRAPHICAL ECOLOGY — Patterns in the Distribution of Species" by Robert H. MacArthur, xviii & 269 pp., 103 b/w fig. & 4 tab. Harper & Row, Publishers, Inc., New York, N. Y. 10016. 1972. \$29.95.

"The theme running through this book is that the structure of the environment, the morphology of the species, the economics of species behavior, and the dynamics of population changes are the four essential ingredients of all interesting biogeographic patterns."

Doing "the science of geographical ecology is to search for patterns of plant and animal life that can be put on a map". Those naturalists keen on noting changes in any certain living organisms from place to place are the best candidates for such work.

This is an excellent text, carefully prepared, interesting in presentation, and logical in its mathematics which can be avoided by the general reader but should not be avoided by today's college students. The first two chapters provide the outstanding short surveys on "Climates on a Rotating Earth" and "Machinery of Competition and Predation".

"ÜBER DIE CHEMIE DER SINNPFLANZE Mimosa pudica L." by H. Schildknecht, 32 pp., 5 color plates, 17 b/w figs & 3 tab. Springer-Verlag, New York, N. Y., Heidelberg, D-1000 Berlin 33, West Germany. 1978. DM.48 or \$26.40 paperbound.

This scientifically valuable but small, carefully presented and illustrated paper is published as Abhandlung 6 of the Sitzungsberichte der Heidelberger Akademie der Wissenschaften, Mathematische-naturwissenschaftliche Klasse and is offered for the unbelievably high price listed above. The author is an organic chemist on the trail of the "endogener chemonastischer Wirkstoffe", "Bewegungsstoffe" or leaf-movement factors with their amino acids and "Der Mechanismus der schnellen Mimosenreaktion".

"DIMENSIONS OF ECOLOGY" by Jonathan L. Richardson, xiii & 412 pp., 85 b/w fig., 33 photo. & 54 tab. Oxford University Press, New York, N. Y. 10016. 1977. \$16.00.

Ever since the mid-1940s until the mid-1970s I have considered the Odum ecology texts so far superior that all others were "alternatives" for all kinds of basic ecology courses for majors and non-

majors, for quarter, semester and year, for the more meagerly prepared and motivated and the keen, near zealots, and for the rural, agriculturally oriented and the unseeing urbanite. Richardson's "Dimensions of Ecology" breaks this pall as a skillfully and enthusiastically planned very fine text for a semester course. Its main divisions are: (1) Dimensions of ecology, (2) Communities and species adaptations, (3) Ecosystem processes and (4) Ecology of populations. There are a few plates, like Fig. 12-1, that are drawn too sketchily to be worth the printing. There is an important epilogue on "The Human Avalanche".

"MUSEUMS OF NATURAL HISTORY and the People Who Work in Them" by Patricia M. Williams, vi & 120 pp., 14 b/w photo. St. Martin's Press, New York, N. Y. 10010. 1973. \$5.95.

Bless Ms. Pat Williams for writing this lovely little book! She knows just what to convey because of her publicity articles for the Chicago or Field Museum and her feelings about such places. She relates the beginnings of museums across our country, with the collectings of Peale and Agassiz, the funding of Smithsonian and of Field, the explorations and resultant realistic exhibits of Akeley and Andrews, the behind-the-scenes research work and preparations, etc. There is a state-by-state roster of Natural History Museums in America with notes on their special interests.

"A FIELD GUIDE TO THE ATLANTIC SEASHORE — Invertebrates and Seaweeds of the Atlantic Coast from the Bay of Fundy to Cape Hatteras" by Kenneth L. Gosner, xviii & 329 pp., 217 color & ca. 1000 b/w line draw. Houghton Mifflin Company, Boston, Mass. 02107. 1979. \$12.95.

This is the most recent in the well-known Peterson Field Guide Series and has all its art work done by the author. Those readers familiar with Gosner's "Guide to the Identification of Marine and Estuarine Invertebrates" will appreciate the careful background for much of this field guide. Users may suspect or be glad to know that because of the wide range northerly and/or southerly of many marine plant and invertebrate species involved this guide can serve from the Arctic to the West Indies for the shoreline, tidepools and intertidal flats. As a field guide should, this fine one stresses the appearance and activity of the living organism rather than of decolored pickled specimens.

"THE HANDBOOK OF VERMONT TREES" by G. P. Burns & C. H. Otis, ii & 244 pp., 500+ b/w line draw. fig. & 9 photo. pl. Charles E. Tuttle Company, Rutland, Vermont 05701. 1979. \$5.25 paper-bound.

I am so pleased that this Vermont-located book publishing and

importing company has just made this book available again in a handy flexible form and at a reasonable price. The first edition was published in 1916 by the "Ag" college of the University of Vermont which, in turn, was based on an 1899 Bulletin. It was originally "intended primarily for the use of pupils in our public schools and of persons not especially trained in botany". The language, drawings, summer keys, winter keys, descriptive text and glossary all make this text very helpful to any season visitors and residents. It would be wonderful educationally if it could be used now in rural, suburban and urban elementary schools as it was years ago not only in Vermont but in most of our country's northeast and Canada. But today's teachers have to be trained and motivated; yesterday's teachers were usually so taught in their own elementary school days and again in their professional training in their normal schools and/or colleges.

The inside cover has the word "species" misspelled.

"THE HANDBOOK OF VERMONT SHRUBS AND WOODY VINES" by L. R. Jones & F. V. Rand, vi & 147 pp., 125 b/w line draw. Charles E. Tuttle Company, Rutland, Vermont 05701. 1979. \$3.95 paper-bound.

This is a welcome companion volume to "The Handbook of Vermont Trees", also just "off the presses" as a reprint of the 1909 Vermont Agriculture Experiment Station Bulletin planned primarily for use in the schools. It is to be hoped that it will be used anew there and also by amateur naturalist adults, resident or visitor, not only in this state but in the entire northeastern area of the U. S. The line drawings of floricanes and fruticanes are very helpful as are the simple keys. The descriptions are accurate and amplified with brief items of economic and cultural interest.

"SOIL CARE" by K. R. W. Hammett, 64 pp., 14 b/w fig., 1 tab., 25 photo. & 6 color photo. A. H. & A. W. Reed, Wellington, Sydney & London, distributed in U.S. by Charles E. Tuttle Company, Inc., Rutland, Vermont 05701. 1978. \$7.50.

Directed primarily to the home gardener anywhere in the world, this book gives him or her "some insight into the nature of soil so that he [or she] has a better understanding of what the various practical operations involved in soil husbandry try to achieve.... and of the main components of the soil environment and the part that each of these plays in the overall effect a soil has on plant growth". This information is well explained and effectively illustrated, making this book very useful indeed.

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THE ROLE OF HOST-PLANT SELECTION
IN BEE SPECIATION PROCESSES

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Relatively large numbers of bee species are resident in the major floristic regions of North America (ca. 350-900; Moldenke, 1979). Many such broadly sympatric species are congeneric and directly compete for common resources or most probably are descended from ancestors which did compete before the presumed recent evolution of distinguishing non-competitive niche characteristics. Examination of sympatric congeneric species can suggest the axes along which such species have differentiated (if indeed they have), and comparative study can reveal which types of character displacement are likely to occur under similar conditions.

Analysis will be confined to relatively closely related congeneric bee species, because bees as a group are known to be highly variable in respect to such characteristics as nest location and substrate, predators and parasites, energetic requirements and periods of activity, and behavioral/morphological traits which permit the exploitation of particular resources. Since further physiological and nutritional characteristics quite probably also vary widely, confining analysis to closely related species can minimize differences and perhaps enable examination of the axes on which the speciation process(es) in bees operates.

Biological knowledge of the several thousand bees in North America is not extensive. Useful reviews, such as those of Linsley (1958) and Stephen et al (1969), as well as chapters associated with recent taxonomic treatments (e.g., Rozen (1958), Shinn (1967), Rust (1974), Thorp (1969) and Daly (1973)) serve to point out more of what is not known, than what in fact is established. The geographic distributions of most bee species are also known very imprecisely, information generally limited to imprecise broad geographic regions and perhaps an indication of the plant genus/genera with which it has been associated by collectors. Comprehensive faunal analyses of precise locations are largely limited to those of Robertson (1929), Pearson (1933), Moldenke (1971), Moldenke & Neff (1974) and Neff (unpub.). Quantification of the levels of

sympatry amongst sibling species in different regions and their degree of host-specialization/switching has not been attempted for the total pollen-collecting bee fauna of North America. This paper represents such an attempt, admittedly very preliminary in view of the data base, to isolate the relative emphasis placed upon host-specialization and host-switching in the speciation and competitive processes in bees.

A unique hypothesis of speciation in bees was presented by Linsley & MacSwain (1957), in an examination of the locally species-rich and highly sympatric genus Diadasia, which postulated the occurrence of sympatric speciation following intense local competition. Since the possibility of sympatric speciation in bees has been raised, there is the question of whether or not it occurs, and if so how often? If it were to occur, how would it be possible to recognize past instances thereof? First, one must recognize that any such sympatric speciation events that may have taken place in the past and have resulted during the course of time in allopatric species today, would probably be technically impossible to elucidate. Therefore, one must look for instances of species pairs or clusters which are largely or completely sympatric, from which one may infer that they are at least candidates for sympatric speciation events. This is not to say that any or all sympatric siblings necessarily result from a process of sympatric speciation, only that these species are the best candidates for future analysis to determine the mechanism(s) which function(s) as the usual isolating event.

In point of fact, it appears circumstantially that the majority of speciation in bees is in the traditional allopatric mode, since the overwhelming majority of closely related species clusters have primarily non-overlapping distributions. The occurrence of large numbers of congeneric bee species in a particular region (many of which have very distinctive behaviors or morphological features associated with resource gathering) primarily represents independent colonization events or relative antiquity, since most of the distinctive species belong to distinct lineages which must have diverged a relatively long time ago, when the species in question (or the ancestors thereof) were quite probably living in very different geographic locations and were faced with competitive regimes no longer extant. This is not to imply, of course, that there are not narrow zones of overlap in regions of contiguous ranges of sibling species; such overlaps are to be expected and in the future should yield a great deal of information pertinent to the competition process. Most groups of bees are not well enough known, however, to permit this type of

analysis. Significantly, recent monographic treatment of Ceratina (Daly, 1973) has noted strong character displacement of secondary sexual characters in regions of sympatry of closely-related primarily allopatric species.

Sympatric siblings occur in all regions of North America. However, in this present analysis only about 225 instances of sympatric closely related species were noted, in a total fauna of several thousand. The Halictinae, however, have not been included in this analysis since the genera remain unmonographed at this date; personal field work implies that many species are sympatric and pertinent in this context. Broad areas of sympatry between primarily Great Plains species and Eastern Deciduous Forest species in the area of the midwest were usually excluded from the citations below, because of the problem of geographic resolution of the data recorded on most distribution maps and the interdigitating nature of the major forest and grassland floristic elements in this region. My own personal observations of bees within the eastern United States convinces me that much of the present-day overlap in bee species there is due to the disturbance wrought by man and the concomitant wide and rapid spread of many species of plants and the pronounced opening up of the canopy between areas of rich melittophilous understory growth formerly quite isolated (relative to bee vagility).

In an extreme instance, Xenoglossa strenua and X. kansensis are now widely sympatric over much of North America following their presumably independent switches to the utilization of cultivated taxa of Cucurbita from possible pre-colonial distributions centered in Mexico and the southern prairies respectively. Though many species of lacustrine plants may have been originally distributed throughout the northeastern United States (i.e., Verbena hastata), their recent history is clearly characterized by immense population increases and distributional expansion following logging and the introduction of cattle, providing incidently more stable and extensive nesting sites for Great Plains bees which have only recently (apparently) expanded eastwards in great numbers (i.e., Calliopsis nebraskensis; V. hastata is heavily pollinated today by lepidopterans and many groups of polylectic bees and presumably did not necessitate the presence of this specialist-feeder prior to agricultural development of the Northeast and Midwest to successfully set outcrossed seed.)

METHODS:

Published phylogenetic trees of North American bee genera were utilized whenever available, without reinterpretation except in the instance of Andrena (Micrandrena & Scaphandrena) as detailed in Moldenke (1979). Phylogenetic trees were prepared for many other bee genera in coordination with the previously mentioned paper on host choice. Some unmonographed genera (e.g., Anthidium, Hesperapis, Pterosarus, Dianthidium, Xenoglossodes, Anthophora, Emphoropsis, Exomalopsis, Panurginus, Osmia (Chenosmia, Monilosmia & Nothosmia), Andrena (as of yet unmonographed subgenera) and the Halictinae) were not analyzed and are not treated in this paper. Distributional data from monographic treatments, Mitchell (1960, 1962), Meusebeck et al (1951), Moldenke & Neff (1974b) and Neff (unpub.) was incorporated at the level of broad floristic provinces inhabited and broad altitudinal ranges. Floristic regions are the same as those utilized in Moldenke (1979; e.g., Boreal Forest, Oak Hickory/Mixed Mesophytic Forest, Oak Hickory Pine Forest, Southern Mixed Forest, Great Plains, Great Basin, Rocky Mountains, Pacific Northwest Forests, Mediterranean California and southwestern Desert) with resolution of sympatry generally to the scale of state within the eastern United States or general elevational relief within the western United States; actual associated plant community data is available only in California (Moldenke & Neff, 1974b). Point site occurrence data was not included since it is: 1) generally unavailable for nearly all parts of the continent; 2) may be biased in overestimating the richness of sympatric taxa since it is temporally constrained and may include ecotonal elements; and 3) may be biased in underestimating co-occurring taxa due to sample error. Hence the information tabulated in this report does not attempt to make a complete accounting of sympatric closely related taxa, but rather tries to analyze the general nature of bee distributions and host-plant utilization for only those bee groups which have been monographed fairly recently.

The use of the terms "sibling" or "closely-related congeneric" species in this paper indicates only general overall morphological similarity (often based on the genital and associated structures in many bee groups) and does not imply anything about ease of distinguishing the species in terms of colorational or pubescence characteristics. Closely-related groupings of such "sibling species" usually contain from 1-6 (averaging 2-4) species, and are arbitrarily delimited on the basis of the general structure of published cladograms and the subjective similarity of character correlations and

genitalic illustrations of genera without published phylogenetic accounts. A conscious effort is always made to reduce the number of members of such groups to a minimum to emphasize the distribution patterns of presumably only the most closely related and biologically most similar taxa in the hope of discovering as many possible instances that might later be examined for the possibility of sympatric speciation. More distantly related congeneric or con-subgeneric taxa are treated separately when instances of sympatry are high within the genus/subgenus as a whole. Extremely rare taxa about which little is known pertaining to host-selection are usually excluded from analysis of possible modes of diversification since they possess no reliable data. Species or species-groups may (and often do) enter into several of the tabular analyses if they demonstrate divergence in more than one characteristic. Particular examples cited in the results must not be interpreted as proven instances of a particular character displacement; data even for the relatively ecologically well-studied bumblebees is not sufficiently robust, let alone for the universally poorly-studied solitary bees. Such citations are the most likely examples of particular trends based on the data available to me presently.

RESULTS:

a) HOST-SWITCHING:

Change of host-species pollen resource has always been the aspect of bee/flower inter-relationships that has intrigued me the most. An overall account of the patterns of host change and specialization was presented in Moldenke (1979). Many of the switches noted in the phylogenetic illustrations of that paper are not included below since such species which have split off ancestral hosts are often deemed morphologically only distantly related in many taxonomic treatments. They may, in fact, be ancient splits in many cases, the results of the types of gradual phenomena listed below. If, on the other hand, speciation occurs in bees in much the same manner as the rapid evolution seen in Drosophila (Carson) and tephritid flies (Bush), then many such morphologically specialized oligoleges may in fact be much more closely allied than usually treated in recent monographs. The three major types of host switching phenomena observed in sibling species involve the switch from polylege to specialist (or generalist with heavy emphasis on one genus only), switches between specialists upon confamilial genera and the switch between taxonomically unrelated host plants by specialist-feeding bees.

The switch in host-choice among sympatric siblings

HOST-SHIFT CATEGORY	NUMBER SIBLING EXAMPLES	NUMBER NON-SIB EXAMPLES
POLYLEGE to EMPHASIS or SPECIALIZATION	23	7
POLYLEGE _{emp 1} to POLYLEGE _{emp 2}	5	4
SPECIALIST → SPEC. + POLY.	4	1
GENUS ₁ to GENUS ₂ (confamiliar)	28	14
SPECIES ₁ to SPECIES ₂ (congeneric)	6	1
GENUS ₁ to GENUS ₂ (unrelated)	27	(many)

TABLE 1. CATEGORIES OF HOST SPECIALIZATION AMONGST SIBLING AND UNRELATED CONGENERIC/GENERIC SPECIES. Unrelated generic host-plant distinctions between non-sibs often meaningless to enumerate.

may involve a number of different forms. Most simply a polylege appears to give rise to a taxon which, though technically a polylege, is nearly always associated with one or two particular plant genera. Such is apparently the case with the species pair Hylaeus timberlakei (polylege) and H. calvus (emphasis Ceanothus/Eriodictyon) throughout the Sierra Nevada of California and Hoplitis producta producta (polylege) and H. productsa bernardina (emphasis Penstemon) in the chaparral and forest understory of southern California. The change from polylege to specialist-feeder may be complete as in Ashmeadiella bigeloviae (polylege) and A. prosopidis (Prosopis specialist) throughout the southwestern deserts and may be accompanied by morphological specialization of the presumed derived species as in A. cactorum, A. bigeloviae (polyleges) and the small A. rufitarsis (Eriogonum oligolege) throughout much of Mediterranean California. Alternately, the polylege may apparently adapt to a family-level specialist taxon or said family-level specialist may apparently become generically restricted; possible examples of the former are Melissodes thelypodii/M. gilensis (polyleges) and M. tepida (emphasis legumes) in the Sonoran Desert and Chelostomoides campanulae (polylege) with C. exilis et al. (emphasis legumes) throughout most of the eastern United States, the latter is abundantly represented by Chelostomoides chilopsidis (all tree legume genera) with C. discorhina (Cercidium +?) and C. odontostoma/C. browni? (Prosopis/

Acacia) throughout the southwestern deserts and Melissodes confusa/M. elegans (composites in general) with M. tincta (Aster/Chrysopsis) and M. coreopsidis ("sunflower genera") throughout the Great Plains which again might be supplemented by considerable host-related size divergence for example in M. agilis (Helianthus specialist) relative to M. dentiventris (Aster/Chrysopsis specialist) and the ancestors within M. (Eumelissodes) (general composite feeders).

Another type of possible host-switch may be seen best within the Perdita (Ventralis-subfasciata) group: i.e., polylege (emphasis a) → polylege (emphasis b) [a unrelated to b]. This group of more than 10 species (inter-relationships unclear) is abundant throughout the southwestern deserts; all the species are apparently not truly generic-specialists, but generalists with heavy facultative specialization. Species are strongly sympatric and often active synchronously. The genera facultatively specialized upon are as divergent as Acacia, Washingtonia, Agave, Dasylyrion and Nolina. Within the reportedly polylectic Andrena species, A. miranda (Rosaceae emphasis)/A. virginica (Ceanothus emphasis), A. amphibola (not Ceanothus)/A. quintiliformis (emphasis Ceanothus) and A. cyanopoda (Potentilla/Ranunculus)/A. fuscicauda (Ceanothus) are potential examples as well as Melissodes communis (emphasis legumes and mints)/M. comptioides (emphasis composites). Such host differentiation may entail an active host-choice on the part of the bee, or might be an artifact (as in case #3) of a change in habitat preference which would automatically shift the preferred host as well.

Intriguing in this same vein are sibling pairs with closely specialized feeding habits, one member of which is implicated in exhibiting some minor degree of polylecty: Andrena fragilis (Cornus +)/A. nigrifrons (Cornus); Perdita larreae (Larrea)/P. marcialis (Larrea +); P. maculosa et al. (Coldenia)/P. arenaria & P. rhodogastra (Coldenia + Heliotropium); Andrena piperi (crucifers)/A. scurra (crucifers + poly). Whether these are examples of monophagic pollen-collecting species which are merely poorly temporally synchronized with their host and hence collected nectaring in greater frequency, or they represent true polyphagous tendencies in the light of some competitive pressure would be fascinating to determine; the all too possible sample bias might also obtain of course. The best estimate of host-selection habits (short of scopal pollen analysis) that I have found in my own research is the number of separate collections of female bees with significantly filled scopae; this data is seldom if ever available

outside of my own museum cataloguing in California. Of the three cited instances of sibling pairs of Andrena with polylectic habits, but differing emphases, I strongly suspect either sample bias or true allopatry (inter-community or altitudinal) which is hidden by lack of comprehensive knowledge of the species in question. However, polylectic species of the Perdita (subfasciata group) are clearly facultatively associated with different plant genera locally though no individual species is a strict oligoledge; habitat preference may be the determining factor.

True generically unrelated host-switching among sympatric closely-related bee species does indeed occur rather frequently, occurring both between unrelated plant species which are morphologically similar (Sidalcea → Clarkia; Calochortus → Eschscholzia (i.e., Perdita) as well as between completely unrelated and morphologically very dissimilar (nectar and scent chemistry?) genera, e.g., Dalea → Larrea (Colletes); umbellifers → Trifolium and Ceanothus (Andrena); Arctostaphylos → Amsinckia (Synhalonia). In nearly all of such generic switches encountered, the original and recipient plants are synchronous bloomers. The switch in Andrena between Polemonium (A. segregans, A. ribblei?) and Ranunculus (A. caerulea, A. suavis) involves a distinct time shift as well.

Where the individual sibling species have been ecologically studied as well, a switch between different congeneric host-plant species is encountered. Andrena chalybaea (Camissonia ovata specialist)/A. parachalybaea (C. bistorta & C. cheiranthifolia) along the immediate coast of southern California and A. eothina (C. campestris A. anatolis (C. bistorta) throughout cismontane southern California are well-documented examples, the latter accompanied by a change in size and timing of daily activity patterns as well. The distinction between the closely related Anthocopa (Eremosmia) and A. (Isosmia) respectively specialized on tree and annual species of Dalea is also associated with a marked shift in blooming season as well in the southwestern deserts. In the Colorado Desert of California, Perdita clypeata (Eriogonum inflatum specialist), P. distans (E. reniflorum), P. nasuta (E. trichopes) and several other rare sympatric species on specifically undetermined Eriogonum spp. may possibly be shown at some later date to have a complex group of species-specific (±) obligate host-restrictions. Host-restriction by a bee species may be correlated to the plant breeding system as seen in the large Chelostoma phaceliae & C. incisulum which frequent many species of large-flowered outcrossing Phacelia in cismontane southern California, while C. minutum is restricted to the tiny-flowered inbreeding P. davidsoni.

Examples of clearly established switches between confamilial genera are especially numerous within the Compositae (17 examples within Andrena, Melissodes, Perdita and Calliopsis) although they occur as well within the Leguminosae (i.e., Chelostomopsis), Loasaceae (i.e., Perdita), Cactaceae (i.e., Lithurgus), Malvaceae (i.e., Diadasia) and Hydrophyllaceae (e.g., Chelostoma, Dufourea, Protodufourea, Conanthalictus and Nomadopsis). Such switches are often accompanied by overall size changes, as well as seasonal activity phase shifts (at times pronounced as in Lithurgus apicalis et al. (on spring blooming Opuntia) to L. echinocacti (summer-blooming barrel cacti)). This category of host-switching between different genera by sympatric siblings will undoubtedly increase greatly upon increased collection and research on the composite-feeders of the plains and deserts.

Distinctive coordinated temporal and host switches between somewhat related plant genera is often observed, i.e., the switch from Camissonia to Gayophytum (Dufourea and Andrena) and many of the intra-Compositae shifts. Though such examples involve plant genera which are presently characterized by distinctly non-synchronous blooming periods, paleohistorically such plants may have once bloomed synchronously (perhaps during the period of the bee host-switching). Since in fact, most temporal shifts are between confamilial genera and not between unrelated taxa, such a possibility seems highly likely. Not surprisingly a large percentage of these examples are from mediterranean California and desert Arizona, where the bee fauna has been studied in much more detail with respect to host-plant association and the distinct winter rainy period is paleohistorically very novel.

Differential host restriction also occurs between congeneric distantly-related sympatric bee species, but it is much more difficult to distinguish meaningful specific examples without more complete data on distribution and host choice. The distinction between polylege and either composite- or legume-specialist exists in Melissodes/Andrena and Ancylandrena respectively. Unrelated con-subgeneric/congeneric sympatric polyleges emphasizing different plants are undoubtedly more frequent than represented in Table 1, with the paucity of information available for the genera Andrena and Colletes in the eastern United States. However, several examples are available from the western United States: 1) A. (Tylandrena) subtilis (Ranunculus emphasis)/A. (T.) perplexa (Prunus+ emphasis) in montane western U.S.A.;

2) Dufourea rhamnii (emphasis Dendromecon)/D. scintilla (emphasis Camissonia)/D. sandhouseae (emphasis Eschscholzia) in most mediterranean California (P. Lincoln, ms.); 3) Melissodes tessellata (emphasis Compositae)/M. tepida timberlakei & M. communis alopex (emphasis non-compositae) through mediterranean California; 4) Andrena (Euandrena) nigrihirta (Dentaria emphasis); A. (E.) nigrocaerulea (emphasis Linanthus); A. (E.) auricoma (emphasis Potentilla & Scrophularia); A. (E.) chlorura (emphasis Ceanothus & Arctostaphylos) throughout montane western United States. The fourth example is particularly interesting, since the floral data (cited from my own site-specific results) indicates localized strong specialization tendencies, but more importantly a very strong habitat separation in California (respectively deep forest, grassland, woodland/savanna, chaparral); distinctions of closely-related broadly sympatric species along this type of distribution gradient is probably highly likely, but resolution not possible in general in light of the distributional data available for most bees (see analysis of Ceratina distribution by Daly (1973)).

The most abundantly documented form of displacement amongst unrelated congeneric species involves differential specialization upon confamilial plant genera. Examples abound in Andrena (Callandrena) (see Moldenke, 1979), Perdita and Melissodes within composite feeders, and are also represented by Perdita vittata tricolor (on Wislizenia/Cleome) versus P. cleomellae/P. thelypodii/P. basinicola (on Cleomella/Thelypodium) in the montane desert and Owens Valley of California; and A. (Micrandrena) melanochroa (Fragaria) versus A. (Derandrena?) ziziaeformis (Potentilla/Waldsteinia) throughout the Eastern Deciduous Forests. Differentiation on the species level occurs in A. (Diandrena) among Camissonia species, and Perdita among Dalea species; in both of these instances slight differences in habitat selection (altitude or community type) are suspected as well.

b) CHANGING ENERGETIC BUDGETS:

In this examination of sympatric sibling species, I have attempted to discover significant changes in body size that have occurred. This is not an original idea on my part (viz. Hutchinson, Schoener, Inouye, Brian, Dressler), but rather reflects my assumption that an analogous principle of limiting similarity must exist amongst pollen-gleaning bees as it does amongst guilds of vertebrate foragers. Whereas it is intuitively obvious how such a principle has validity where, i.e. the beaks of large birds can be correlated with efficiency in utilizing seeds of a particular size range, it is not so

obvious how such size differences could be correlated with the differential utilization of precisely the same floral resources. Though I do not know what the relevant size range differential would have to be to achieve significance, it certainly is exceeded frequently amongst species of different genera working the same plant resource.

The notion of limiting similarity has to be approached from the point of view of environmental grain. Rapidly depleting pollen and nectar sources in flowers represent vastly different states of "graininess" (sensu Levins) relative to bees' physiological costs of harvesting it (especially with changing diurnal thermal regimes). For instance, larger-bodied bees are often capable of considerable heterothermy enabling activity at ambient temperatures at which their smaller non-heterothermic competitors are at a disadvantage (Neff et al., 1977). However, this strategy, in order to be successful, must utilize only concentrated resources, since the strategy requires more resources to operate the endogenous heat production and to nourish larger baby bees. Hence there comes, of necessity, a point of diminishing return in the gradual daily depletion of resources (or the varying density of plant populations) at which the energetically less costly strategies usually employed by smaller sympatric species gain an insuperable advantage in gleaning partially-depleted pollen resources from flowers.

Such a difference in the energetics of foraging need not be automatically associated with body size; Rust (1974) in his recent treatment of Osmia (s. str.) has noted the strong difference in flight speeds and behavior exhibited by the more-or-less equal-sized synchronous sympatric polyleges, O. ribifloris and O. lignaria, which are frequently observed in competition at precisely the same locations on the same plant species. Since, however, little is known about the flight speeds of related bee species in general, I have made special note in Table 2 only of rather large differences in relative body size as revealed in monographic treatments. Such measurements are seldom geared to local populations but represent average sizes over vast numbers of populations, hence this list cannot be considered more than an abbreviated attempt to pinpoint some of the more noticeable differences.

Table 2 contrasts with Table 1 in the abundance of polyleges and oligolectic specialists upon the Compositae (>50%). The most reasonable assumption is that species which are normally exposed to a very wide range of

resource sizes and morphologies adapt most quickly by altering their overall body sizes (perhaps with undetected differences in host choice emphasis as well), whereas obligate specialist-feeding species have less exposure to such differing resource states and hence must differentiate most readily along other axes, because (with the exception of Chelostoma on Phacelia cited above) the plant genera cited in Table 2 do not differ radically in floral size of relevant species. In two clear cases, the change in size may also be correlated to a shift in altitude (i.e., Hylaeus basalis/H. nunnenmacheri; Dufourea spilura/D. subdavidsoni), however in this sample, size is not correlated with elevation. On the other hand, the larger Colletes stephensi, is active in the very early morning and early night, whereas its smaller siblings C. salicola, C. covilleae and C. clypeonitens are active at Larrea during the warm desert day (Hurd & Linsley, 1975).

Size differentiation is much more frequent even than shown in Table 2 amongst sympatric unrelated congeners, rather than amongst siblings. This is because only con-subgeneric species were considered in erecting the table and the Bombinae and Halictinae are not adequately represented; within most large bee genera with several subgenera, size differentiation amongst sympatric species utilizing the same resource is commonplace. Such size/energetic displacement is characteristic amongst the pollinators of most plant species when the total range of local pollinators are considered, i.e. the probable graded energetic requirements of Phacelia pollinators in southern California -- Anthophora/Synhalonia; Bombus; Pseudomasaris (specialist pollen-collecting wasps); Anthidium; Colletes/Andrena/Osmia; Evylaeus/Lasioglossum; Anthocopa/Ashmeadiella/Dufourea/Osmia; Panurginus/Nomadopsis; Dialictus; Conanthalictus; Perdita. Accurate quantification of limiting similarity has not been attempted as of yet on a localized basis.

c) CHANGING TEMPORAL ACTIVITY PATTERNS:

Many bee species are characterized by very short adult life spans, often less than one month for a particular species in a particular locality -- and probably often only half that period for individual pollen-collecting females. With short life spans typical of many bees it is to be expected that closely

TABLE 2. SIZE DIFFERENTIATION IN SYMPATRIC SIBLING SPECIES AND SYMPATRIC UNRELATED CON-SUBGENERIC SPECIES AS RELATED TO HOST SPECIALIZATION.

non-sibling species

NUMBER INSTANCES
SIZE DIFFERENTIATION

GENUS

2 -- polyleges

HYLAEUS

14 --

ANDRENA

Helianthus, Camissonia,
Aster/Solidago, Lepidium
Potentilla/Fragaria,
Ceanothus, polyleges

7 --

PERDITA

Opuntia, Malacothrix,
Eriogonum, Sphaeralcea,
Tidestromia, Larrea

2 -- polyleges, Compositae

MEGACHILE

3 -- Compositae

MELISSODES

1 -- Compositae

PSEUDOPANURGUS

2 -- Eriodictyon, Trifolium

NOMADOPSIS

2 -- Compositae

SVASTRA

2 -- polyleges

XYLOCOPA

2 -- polyleges

CERATINA

many-- polyleges

BOMBUS

sibling species

NUMBER INSTANCES
SIZE DIFFERENTIATION

GENUS

1 -- polyleges

HYLAEUS

2 -- Larrea, Mertensia

COLLETES

8 -- Solidago/Aster, polyleges,
Compositae, Cornus, Salix,
Camissonia

ANDRENA

9 -- Mentzelia, Eriogonum,
Compositae, Coldenia

PERDITA

1 -- Euphorbia

CALLIOPSIS

1 -- Penstemon

ANTHOCOPA

1 -- Phacelia

CHELOSTOMA

1 -- polyleges

HOPLITIS

1 -- Cryptantha

PROTERIADES

1 -- Compositae

OSMIA

1 -- Compositae

MEGACHILE

1 -- polyleges(emphasis
legumes?)

SYNHALONIA

3 -- polyleges, Compositae

MELISSODES

1 -- Gayophytum

DUFOUREA

TABLE 2.

I ENTIRE SEASON ACTIVITY versus DEFINED SUBSET

Sibling species - 3 Non-sibling species - 3

II DIFFERENT ACTIVITY PHASES DURING BLOOMING SEASON

Sibling species - 22 Non-sibling species - 6

1) Eriogonum in Colorado Desert

sibling Perdita species

P. semilutea - xerophila - clypeata - nasuta

distans

labrata

April

May

May-June

June-July

-----thermophila-----

May-October

2) Prosopis in southwestern deserts

sibling Perdita species *

g. genalis - s. stathamae - p. flava

nigronotata p. sulphurea p. punctosignata

discors

Early

Mid

Late

sibling Perdita species *

duplicata - a. ashmeadi - exclamans

a. vierecki difficilis

nigricornis

l. luciae

Early

Mid

Late

3) Sphaeralcea in southwestern deserts

Diadasia spp.

lutzi - diminuta - megamorpha

martialis tuberculifrons olivacea

palmarum sphaeralcearum sphaeralcearum

vallicola

Early

Mid

Late

III DIFFERENT PHASES WITHIN DIURNAL PERIOD

Sibling species - 3 Non-sibling species - 2

TABLE 3. DIFFERENTIATION IN TIME OF ACTIVITY

* Unpublished studies by Neff in Arizona may indicate that this apparent temporal disjunction is artifactual and based upon biased general collection data (Neff, pers. com.).

related sympatric species might be able to allocate resources allochronically. Theoretically such divergence could occur in two very different manners. Firstly, polyvoltine or long-lived species active for much of the year, could become univoltine for just a specific synchronous portion thereof. Secondly, two or more short-lived asynchronous species might be able to partition the blooming period of the appropriate resource.

Examples of polyvoltine species of the first type I have not encountered often in the literature, probably for the simple fact that in the temperate United States few bee species are indeed active for most of the possible flight season. Such species are usually the social polyleges and the most diverse group of the polyleges, the Halictinae, remains very incompletely known and largely unmonographed. Six examples are however cited in Table 3, two of which are polylectic, two of which are Compositae-feeders and two of which visit desert plant genera (i.e., Larrea, Physalis) which facultatively respond to minimal desert water availability and may be found (presently, at least, with agriculture, etc.) in bloom at nearly any time of year. Hylaeus calvus has a very short flight season for members of its genus, most species (i.e., its sympatric sibling H. timberlakei) are active nearly throughout the entire community blooming season. As with temporally-delimited H. sejunctus (emphasis Prosopis) and its relatively-unrelated congeners, some degree of host specialization is suspected. The Compositae-feeding species of Colletes, C. fulgidus (all year), C. simulans & C. angelicus (late summer/fall), are very abundant sympatric sibling species, and though there are occasional individuals of C. simulans and C. angelicus known from extremely early spring, the temporal disjunction may be regarded as firmly established. The examples of Perdita binotata (fall)/P. rozeni (spring) versus P. physalidis (all year) on Physalis and Calliopsis timberlakei/C. pectidis versus P. rozeni (all year) on Compositae are rare taxa which might subsequently prove to be due to sample bias in present collections. Perdita larreae (summer bloom) is abundant enough to assume true temporal differentiation on Larrea from P. covilleae (spring bloom) (Hurd & Linsley, 1975).

The second type of temporal phase shift (i.e., non-synchronous short-lived specialists) is much more frequent and I fully expect that future synecological studies will discover a great many more examples, perhaps on a localized population rather than a species-specific basis. It is a most apparent phenomenon where whole

groups of congeneric species utilizing the same specialized plant resource are sympatric (i.e., Perdita on Prosopis; Perdita on Eriogonum; Diadasia on Sphaeralcea). I am confident that the same temporal shifts will be encountered when dominant composite genera are examined in more detail (e.g., Haplopappus/Chrysothamnus and Helianthus).

A particular form of phase shift occurs in regions bordering upon mediterranean-type climates. As Compositae are major elements of both the spring and summer floras in these regions, shifts from autumnal/summer activity to vernal activity (and occasionally vice-versa) are possible. Such switches have not been infrequent, and were noted on the phyletic lineages presented in Moldenke (1979). Analogous shifts are possible in the Sonoran Desert on genera of families, other than the Compositae, which bloom during disjunct desert rainy seasons (e.g., Sphaeralcea, Larrea, and Cactaceae). Circumstantial evidence indicates that many species may be primarily spring-active in California deserts but summer-active in the vicinity of Tucson. Since collecting in southcentral Arizona is not as extensive as it is in desert California, such indications may yet be proven artifactual. Type II changes are especially frequent amongst bee groups associated with the Compositae, comprising 50% or more of the examples in both the sibling and non-sibling categories in Table 3. Since the Compositae as a group are generally quite diverse in most North American communities, individuals of some species are generally in bloom for the entire community anthesis period, thus facilitating the possibility of such shifts. Examples of this phenomenon are bound to increase as Compositae-feeders become better known in the Great Plains and the southwestern deserts.

A third type of temporal shift is probably the most common in practice, for theoretically it is probably the most easily accomplished (and most difficult to detect with the present data) -- namely, differing times of activity during the diurnal cycle. Though seldom looked for, and perhaps to be expected more frequently between species of different genera utilizing the same host resource, it has been documented by Thorp (1969) in his revision of Andrena (Diandrena) associated obligately with species of Camissonia, by Linsley et al. (1963, 1964) with Andrena (Onagandrena) associated with Camissonia and Hurd & Linsley (1975) with Larrea specialists (also observed in Dufourea specialists on Camissonia (Lincoln & Moldenke, ms)).

d) CHANGING UTILIZATION STRATEGIES:

The elegant paper of Hubbell & Johnson (1978) has demonstrated clearly that both closely-related congeners as well as unrelated congeners are able to coexist sympatrically by utilizing different types of exploitation strategies. Analogous differences in solitary- versus group-foraging, relative social aggressiveness and pheromonal food-territory marking are unlikely amongst most sympatric congeneric Canadian and United States bees; however, somewhat similar phenomena doubtless are operant to some degree amongst Bombus and halictine species. The wide range of social behavior exhibited amongst Dialictus from solitary to truly social bees may possibly be reflected in distinctive utilization strategies as well, but field confirmation is lacking as yet. Within Bombus, the ability of Bombus terricola to "rob" flowers with deep corolla tubes might be viewed as an adaptation permitting coexistence with similar-sized Bombus species which are able to utilize partially the same resources by means of longer tongues/faces, but in the more general view it is probably a competitive strategy against hummingbirds and sphinx moths and largely unrelated to sympatric bumblebee species.

e) EQUIVALENT(?) SIBLINGS and the NATURE OF POLYLECTY:

Table 4 indicates the richness of sympatric sibling and non-sibling species groups which a literature search has uncovered and which do not seem to differ conclusively in any set of noticeable as yet discovered characteristics. Species clusters oligolectic for the Compositae are especially prominent (21% siblings; 33% non-siblings respectively). The same genera of plants are associated with both siblings and non-siblings to a large extent, implying that groups mentioned in both portions of Table 4 have long demonstrated their particular host-selection strategies and that sibling sympatry has perhaps characterized these particular groups throughout their history.

Significantly, perhaps, the only host associations listed in Table 4 centered in the eastern half of the continent are polyleges, Compositae-feeders, Salix-feeders (i.e., Parandrena) and Cornus-feeders (i.e., Gonandrena). The pronounced altitudinal and rain shadow gradients in the western United States have clearly worked to produce more parallelly evolving anciently diverged clusters of species which remain conservative in their host-choices. That those bees should be associated with the arid regions which have

repeatedly been the most dramatically effected (i.e., restricted to isolated regions) by climatic changes during the Pleistocene is surely not merely coincidental.

The most striking feature about species cited in this Table is the preponderance of polylectic-feeding bees (39% siblings; 33% non-siblings). "Polylectic" is a term which can, and is, used to cover a wide variety of feeding choice phenomena. In the sense I am using it, it means that the species is suspected of using a wide variety of taxonomically unrelated plant species for pollen sources throughout its distribution, though this might also be true at any one particular population throughout the course of the year. This does not imply that pollen sources are treated equivalently and that distinct host preferences might indeed be found for any particular time in any one population. Heinrich's extensive theoretical and field research, as well as that of Brown (1978), on bumblebees has shown this to be the predicted result of optimized foraging by bees with short memories and comparison-shopping behaviors. It is possible, that many non-Bombus polyleges are behaviorally host-specialized to a large degree on different hosts in different parts of their distribution, however, the data available in the literature seldom permits this degree of accuracy except in certain specific instances.

For instance, studies on the agriculturally important Megachile rotundata by Stephen & Torchio (1961) have shown that distinct populations do tend to specialize on unrelated host-plants in different parts of their range; indeed, on the Stanford University campus during the course of my pollination studies (1968-1970) both sexes of this species were found in enormous abundance on the introduced Lotus corniculatus, with individuals observed only infrequently on any other plant species in this plant species-rich region (garden plants, weeds and native chaparral).

Another case in point, the presumed polylectic wide-ranging (nearly throughout the non-desert United States) species, Colletes kincaidii (and its ± allopatric sibling C. eulophi), is known to be closely associated with the fagaceous species Lithocarpus densiflorus throughout Santa Cruz County, California (several dozen populations -- personal obs.) for both pollen and "nectar", which is apparently mostly fog condensation but contains detectable amounts of dissolved sugars. Females will visit Adenostoma, Eriodictyon and Rhamnus for nectar only, prior to the trees' anthesis. It is unknown what pollinates this

tree in the other parts of its range or whether C. kincaidii is ever associated with it elsewhere, however the bee must normally go to different sources since its range in California alone greatly exceeds that of tan-oak.

It is not known whether the majority of polylectic feeding patterns resemble the rather facultative type exhibited by M. rotundata or the less locally plastic type observed in C. kincaidii, presumably the former. If "polylectic" species do indeed facultatively specialize in local populations, then the opportunity exists for a large number of sympatric sibling polylectic species to avoid competition for food sources. If such food choices become heritable or conditioned (i.e., adult bee searches primarily for food with chemical characteristics it experienced as a larva) then such local assemblages could presumably remain quite stable assuming that plant abundances did not change drastically.

Such notions of food choice determinants for polylectic bee species merge indistinguishably with the known oligolectic patterns of feeders on various species of Compositae. Table 4 reveals that 20% of the sympatric species pairs for which no clear behavioral differences are known are obligately associated with the Compositae as pollen sources. Furthermore, most groups of Compositae-feeding bee species are heavily sympatric when the bee genus as a whole (and not just sibling species) is considered (e.g., Melissodes (Eumelissodes), Perdita (Cockerellia, Hexaperdita, Pentaperdita), Andrena (Callandrena, Cnemidandrena), Megachile (Sayapis), Calliopsis (Calliopsima), Pseudo-panurgus (s.str.)). The literature frequently records component species in long series from different composite species in different locations (even though apparently only one is utilized at any one site). Collection data is horrendously biased in these instances, of course, but the distinct probability exists that such "oligolectic" composite-feeders are indeed: 1) behaviorally generically specialized (and perhaps to some extent temporally and morphologically) in any one population; and 2) that this degree of specialization may indeed yield opportunities for considerably expanded local species richness phenomena.

Speciation rates in bees, on the obverse argument, are apparently either fastest or most successful when component lineages have associated themselves with the multiple options open to specialists "on the family level" (such as composites; or legumes, e.g.,

Ashmeadiella, Colletes, Osmia -- an additional 10% on Table 4) rather than specialists on non-diverse plant groups (e.g., Proboscidea, Passiflora, Mentzelia, Menodora) even if widely distributed (e.g., Lysimachia, Oenothera s. str., Ipomoea, Heuchera, Gerardia, Larrea, Campanula, Verbena, Lesquerella). The largest number of bee species in each one of the genera cited above are associated with the Compositae, far in excess of any phyletic lineages associated with different plant groups; the two other species-rich North American bee genera with predominantly specialist-feeders, Colletes and Osmia, both show major emphases on Compositae and Leguminosae, and indeed the genus Megachile contains elements (e.g., subgenera Delomegachile, Litomegachile and Megachile s. str.) which exhibit facultative sternotribic specialization by individual species on both Compositae and Papilionoideae.

As pointed out by Linsley and MacSwain (1957) in their premiere article on sympatric speciation in bees, such facultative specialization by generalists can theoretically lead to allopatric and sympatric speciation both, as long as the mating site is primarily associated with flowers chosen for exploitation by the female. Even in groups of bees in which there have been a great deal of field studies completed, the site of mating is seldom known with great certainty, since the successful insemination event is of extremely short duration (several seconds at most in many groups) except in Nomadopsis, where the couple rides around in copula for extended periods of time (even flying in tandem between many flowers). In Dufourea, which I am personally most familiar with, mating attempts are frequently observed on flowers (perhaps hundreds in the course of a day's observation) but in none of the Dufourea species have I or my colleague Pat Lincoln ever observed an unequivocally successful copulation attempt. This fact coupled with the observation that the rejection of the male is apparently because the female is previously mated, and that in most species the males also less frequently patrol nest site aggregations and attempt to mate with returning females, means that it is extremely difficult to unequivocally state whether mating in one or another genus of bees fulfills the preadaptation requirement for sympatric speciation or not.

Facultative host-specialization by a polylege does not necessarily imply subsequent evolution of an obligately host-specialized bee taxon. In fact, such specialization events from presumed polylectic ancestors are rather infrequent (Moldenke, 1979). Additionally,

there is an entire spectrum of possible diet types from theoretical random feeding (never realized in nature) to complete restriction to one particular species/genus of plants. Certain bees, in fact, seem to be rather restricted to two completely unrelated plant genera; in most of these species, presumably individual bees go to both different plant genera and the population is not simply polymorphic in the expression of obligate host-specialization. Dufourea vernalis is an example I have personally studied (with P. Lincoln, ms.) which carries mixed loads of Gilia (capitata and related species) and Eschscholzia pollen in relatively equivalent amounts, regardless of the relative abundances and local distributions of the usual two host species; other genera are sometimes utilized in portions of its range where one or the other usual host plant is absent. Similar specialization upon two unrelated sympatric plant species is suspected or known in a small number of other cases (e.g., Panurginus - Hydrophyllaceae+; Anthidium - Phacelia & Lotus; Ashmeadiella timberlakei - Lotus & Phacelia; Andrena chlorogaster - Ceanothus & Lomatium/Sanicula) and in the case of A. chlorogaster, Anthidium spp. and probably some Panurginus closely-related obligate feeding taxa restricted to either (but not both) of the plant genera utilized by the di-lege are known or suspected.

This type of "di-lecty" is distinct from the behavior exhibited by Dufourea rhamnii or D. scintilla (Lincoln & Moldenke, ms.), which heavily emphasize and may actually require Dendromecon and Camissonia (respectively) but do in fact usually carry mixed pollen loads in their scopae; the identity of the additional pollen types varies widely from place to place. This foraging behavior pattern differs again from that of: a) generalist-feeding species which usually, but not invariably, utilize a particular dominant (perhaps) resource heavily in the presence of many other species of potential plant hosts; and b) generalists which utilize a particular plant host heavily only under circumstances where that particular host is disproportionately abundant; Hurd & Linsley (1975) have documented these patterns amongst the Larrea bees of the southwestern United States.

The transition from generalist feeder, facultatively emphasizing different plants in different sites and at different stages of its temporal activity cycle (with no choice information presumably heritable or conditioned), to widespread obligate genus-specific monolectic feeder does not theoretically require the intermediacy of any of the former intermediate feeding strategies. The mechanism(s) of the shift from polylege → specialist,

	SOUTHWEST DESERTS	GREAT BASIN	GREAT PLAINS	EASTERN DECIDUOUS FORESTS	MEDITERRANEAN CALIFORNIA	MONTANE WESTERN STATES
APPARENTLY EQUIVALENT						
siblings	38	15	14	21	23	32
non-siblings	31	14	11	12	12	13
TIME PHASE SHIFT						
siblings	16	0	1	0	4	2
non-siblings	3	1	1	1	2	0
CHANGE IN SIZE						
siblings	11	3	2	3	2	6
non-siblings	13	4	6	6	7	8
CHANGE IN HOST-CHOICE						
siblings	26	5	6	6	22	5
non-siblings	5	2	4	5	3	4
TOTALS						
siblings	91	23	24	31	52	46
non-siblings	53	21	21	23	25	25

TABLE 5. GENERAL DISTRIBUTION OF SYMPATRIC SPECIES CLUSTERS AND THEIR AXES OF DIFFERENTIATION.

which is the most frequent type of host choice shift observed (Moldenke, 1979), is completely unknown and is not explainable solely on the basis of the host-choice patterns observed in sympatric sibling species, though such analyses do implicate the existence of intermediate feeding strategies at least in certain cases.

f) REGIONAL TRENDS IN CHARACTER DIFFERENTIATION:

If one examines the data in Tables 1-4 from the point of view of the geographical region in which the different aspects of overlap occurs, the highest instances are in the desert, mediterranean California and the montane western United States respectively (Table 5). However, since these regions support the most diverse total bee faunas, this is not surprising. When dealing with this information on a relative basis, it must be noted that our knowledge of the bee fauna is greatest for mediterranean California, followed by the desert and clearly has the least resolution (in terms of potential character displacement) in the eastern United States. This means that fewer examples of possible sympatry without any sort of behavioral differentiation would be expected in the areas that are better known, more examples of possible character displacement having been noted. To the extent that Table 5 verifies this bias, it points out in part the unsuitability level of this type of data for the analysis at hand.

Approximately one-third of all the instances of sympatric sibling species (Table 5) are encountered in the arid southwestern deserts. In each of the categories of sibling sympatric and con-subgeneric sympatric species, the desert supports the highest levels. Since the entries in the tables are not strictly additive, it would be improper to compare directly the proportions of closely-related sympatric species in the different regions with the total number of bee species recorded from each region. However, by comparing these results in general to the total bee species richness of the different regions of North America, it is apparent that the desert southwest and the montane western United States seem to support somewhat more instances of sympatric congeneric species than one would expect on the basis of total bee species alone. This phenomenon is undoubtedly due to unresolved differences in altitudinal preferences amongst many of the species, which disqualifies a certain proportion of these faunas as sympatric in reality. The large proportion of montane western bees which are placed in the categories signifying no known differences

between sympatric species, requires that the rest of the column be under-represented and makes the disproportionate number of size shifts more emphatic. Such size shifts in montane bees are quite probably correlated with the aforementioned altitudinal or community (sunny/shady) distinctions.

One interesting consistency of Table 5 is the relative numbers of non-siblings and siblings demonstrating distinct sympatric size divergences. In all cases the number of non-siblings outnumbers those of siblings, implying perhaps that the short-term effects of changing emergence dates or host-choice are easier to effect than the complex physiological and developmental shifts that might be inherent in changing body size (for a determinate body growth plan). However, since the numbers are so small and our knowledge of the actual instances of size divergence on a population basis are so limited, I would personally interpret these figures as only a possible indication that such size changes are in fact difficult to attain evolutionarily.

It is perhaps significant that in the mediterranean California bee fauna the instances of host shifts are more frequent than other types of displacement changes. This trend is paralleled in all the other regions (which remain less well studied) and perhaps indicates that host switches are indeed the easiest form of displacement to occur; it may possibly indicate that my own interests lie along this subject, but the overwhelming difference in numbers probably renders this an unlikely possibility. As I have taken pains to point out repeatedly in this paper, our knowledge of all three of these axes of possible divergence is very lacking, and I doubt if it is any weaker in time and size than in host divergence. Any significant change in either the time or the host-choice axis preadapts the bee for a correlated change in the other axis; that the number of host switch instances so far outnumbers those of time phase shifts may indicate a certain inflexibility of change in the cues used for emergence or may more likely mean that the significant degree of time change is much smaller than is possible to analyse with the present data. (see Schoener, 1974, for comparison with other animals)

CONCLUSIONS:

Nearly all sibling bee species (broadly defined) are basically allopatric. There are instances of sympatric siblings in all regions of North America, most frequently in regions of high species diversity and vice-versa. Often when sympatric siblings do occur.

over broad geographic ranges that is, differentiation is encountered in certain major characteristics.

Change in host occurs frequently from polylectic to specialist; and infrequently between: 1) unrelated, similar-appearing, synchronous blooming plant genera; 2) unrelated, dissimilar, synchronous-blooming plant genera; and 3) between taxonomically related non-synchronous plant genera.

Significant change in body size or flight behavior probably alters energetic requirements permitting character displacement relative to varying resource availabilities. Such size changes occur most frequently amongst presumed polylectic or "family-specialized" species groups, which normally visit floral resources of widely differing sizes and packagings, and may in fact be associated with as yet undetermined differential emphases in the preferred sizes of host resource. Significant size differences amongst obligate specialist feeders are not associated with floral size per se, and most likely reflect energetic differences in temporal activity patterns or resource spacing. Significant size shifts are much more frequent between sympatric relatively-unrelated equivalently specialized congeners than between sympatric siblings.

Changes in resource utilization strategies by competing social species are known in bumblebees and presumed to occur within the social gradients evidenced in the Halictinae.

Changes in temporal activities also occur between sympatric siblings. Polyvoltine species apparently shift to temporally limited univoltine taxa, with or without the involvement of complete host specialization. Phase shift occurs within short-lived species specialized on long-blooming resources, particularly between bees specializing on the Compositae. Spring/summer desert bloom switches occur in the western part of the Sonoran Desert, especially on resource plants that respond by flowering to both rainy seasons. Infrequent examples of sibling species on the same resource plant are known which are active during different time periods of the day.

Many examples of sympatric sibling species are known within which no obvious form of differentiation is presently known. These are presumably due to incomplete data, but the prevalence of polylege and Compositae family-oligoleges within this category, raises questions about the accepted assumptions of

"polylecty". Presumably localized populations of a polylege often specialize differentially in the face of different competitors and different host abundances; if there is any possibility that larval food conditioning plays a role in subsequent host-choice of adults, such a mosaic of relatively stable feeding patterns in polyleges would represent greater stability in many pollination systems than currently realized. Experiments on the mechanisms of host-allocation are especially critical since oligolectic Compositae-feeding and papilionaceous-feeding bee genera have frequently what appears to be the most rapid speciation rates.

Sympatric speciation cannot be directly implicated on the basis of present evidence, however, the existence of sympatric sibling species (with or without differences in some ecologically relevant character(s)) leaves the process a distinct, but definitely infrequent, possibility.

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STUDIES ON NEOTROPICAL VIOLACEAE TRIBE RINOREAE I .
NEW TAXA AND SYNONYMY IN GLOEOSPERMUM AND RINOREA .

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New taxa of Gloeospermum Triana et Planchon and Rinorea Aublet are published here in anticipation of a revision in Flora Neotropica. Gloeospermum and Rinorea are related to each other and belong to the subfamily Violoideae, tribe Rinoreae, subtribe Rinoreinae (Melchior 1925). In Gloeospermum the phyllotaxy is distichous and the inflorescences are cymose, mono-, di- or pleiochasial. The ovaries contain 3 x (8-22) ovules. Their capsula is indehiscent. In Rinorea the leaves are alternate or secondary opposite. The inflorescences are paniculate, thyrsoid or (pseudo)racemose. The ovaries contain only 3 x (1-3(4)) ovules. Their capsula is dehiscent into 3 valves. The distribution of Gloeospermum is confined to the neotropics; Rinorea is also recorded in tropical Africa and Asia. Taxa in both genera are shrubs or small trees, usually occurring in the understory of humid tropical forests from sealevel up to submountainous regions. New taxa are described, one species is transferred from Rinorea to Gloeospermum and some species in Rinorea are united or reduced to synonymy. The descriptions and transfers are usually followed by differential notes and discussions.

Gloeospermum grandifolium Hekking sp. nov., pl. 1, f. 1.

Arbuscula. Folia disticha; laminis ellipticis vel obovatis; venis lateralibus 9-13 (apice excluso); marginibus subintegris, apice subcrenatis vel subserratis; basi rotundata abrupte breviter attenuata in petiolum. Inflorescentia cymosa vel dichotoma. Sepala subinaequalia. Petala aequalia carnosa, versus basin leviter ciliolata. Stamina filamentis fere liberis; squamis ellipticis translucidis, 1/2 x longioribus quam thecis. Pistillum + 2.5 x staminibus longius; ovario subgloboso, glabro, 3 x ... ovulis; stylo versus basin inflato. Capsula subglobosa, sublignosa, indehiscens; seminibus 12-30, subglobosis, viscosis, amylaceis.

Shrub or tree 15-20 m tall, stem 25 cm diameter. Branchlets glabrate with subligneous lenticels. Leaves distichous; stipules deciduous, narrowly deltoid, 7.0-12.0 mm long, 1.0-2.0 mm wide, herbaceous, glabrous, ciliolate near the base; petioles 3.0-9.0 mm long, minutely pilosellous; lamina chartaceous to subcoriaceous, elliptic to obovate, acuminate to cuspidate, glabrous, 8.5-21.0 cm long, 3.0-8.5 cm wide; costa above minutely pilosellous only near the base, underneath

completely glabrous; lateral veins 9-13 (apex excluded); veinlets + scalariform; apex 1.2-2.0 cm long, obtusish; margin subcrenate to subserrate especially near the apex; base rounded, abruptly short decurrent into the petiole. Inflorescence cymose or dichotomous, glabrate to minutely pilosellous, green; pedunculus 3.0 mm long, green; pedicels articulate near the base, + 10.0 mm long, green; bracts ovate or deltoid/, 1.0 mm long, + 0.7 mm wide, coriaceous, minutely pilosellous, ciliolate, mucronate. Buds ovoid, obtuse; sepals, petals, stamens and style whitish. Sepals slightly unequal, 2.5-3.0 mm long and wide, carnose, glabrous, ciliolate; outer ones ovate, obtuse; inner ones orbicular. Petals (un?) equal, in buds + 6.0 mm long, + 3.0 mm wide, ovate, obtuse, carnose, glabrous, ciliolate near the base; inner ones probably boat shaped and smaller. Stamens with filaments nearly completely free, equal or slightly shorter than the thecae; glands subulate, carnose, adnate on the dorsal side of the filament, apical part free; filamental tube minute, surmounted by small linear scales between some filaments; the larger ones ciliolate at the apex; thecae elliptic; connective scales subulate to narrowly deltoid or lineary, transparent, 0.5 x as long as the thecae. Pistillum + 2.5 x longer than the stamens; ovary subglobose, glabrous; style erect, inflate at the base, filiform near the apex; stigma truncate. Capsula subglobose, ligneous, 3.5-5.5 cm long, 2.3 cm wide, glabrous; seeds 12-30, subglobose, 6.0-7.0 mm long, 5.0-6.0 mm wide, glabrous, viscosa, amylaceous.

Type: Little Jr 6405, 30 April 1943, (alab.) (holotype US; isotype F), "2 km S. of the Playa de Oro, Prov. Esmeraldas, Ecuador." Paratype: Romero-Castañeda 5401, 17 October 1955, (fr.) (COL), Monte Alto, al Sur de Tumaco, prov. Nariño, Colombia!

Distribution: Colombia and Ecuador, submountainous.

Vernacular name: "Cortillo" (Ecuador).

Uses: Wood hard "as rock", used for oars.

Gl. grandifolium Hekking sp. nov. is closely related to Gl. andinum (Tulasne) Melchior and Gl. sclerophyllum Cuatrecasas. In these species the filaments are + free while in the other species of this genus the filaments are united to a distinct tube at least near the base. In Gl. sclerophyllum the pistillum is equaling the stamens, while in Gl. andinum it is 2.0 x and in Gl. grandifolium even 2.5 x as long as the stamens. The shape and the colour of the connective scales are characteristic for each species. In Gl. grandifolium they are transparent, narrowly deltoid, 1/2 x as long as the thecae; in Gl. andinum orange brown, elliptic, equaling the thecae or slightly longer and in Gl. sclerophyllum narrowly ovate, 2 x as long as the thecae, transparent, only tinged with brown at the apex. From Gl. andinum and Gl. grandifolium only flower buds could be observed, since flowers in Gloeospermum are soon deciduous and therefore scarce

or even wanting. In Gl. grandifolium and Gl. andinum the seeds are globose, in Gl. sclerophyllum however discoid. Differences are also seen in the leaves, which in Gl. grandifolium and Gl. andinum have respectively 9-13 and 11-14 lateral veins (exclusive apex), in Gl. sclerophyllum only 4-9.

All three species occur in Colombia or in adjacent Ecuador. Gl. grandifolium is only known from the type localities in the Pacific area in Colombia (Nariño) and Ecuador (Esmeraldas) + at sealevel. The only known specimen of Gl. andinum was collected in the eastern sub-andean region of the Central Cordillera in Colombia (Tolimá) at 400-500 m. altitude. Gl. sclerophyllum is known from two collections near the Pacific Coast in Colombia (Valle) at 0-50 m. altitude.

Gloeospermum eneidense Hekking sp. nov., pl. 1, f. 2.

Arbuscula. Folia disticha; laminis ellipticis vel (ob)ovatis, subtus dense albido- et porphyreostictis; venis lateralibus 10-14 (apice excluso); marginibus subintegris. Inflorescentia cymosa, 1-3 x furcata, subsessilis. Sepala subaequalia. Petala inaequalia carnosae; exteriora 3 ovato-obtusae; interiora 2 anguste ovata, obtusiuscula, carinata. Stamina filamentis in tubo connatis; squamis superpositis, fuscis, apice obtusis vel truncatis et dentatis vel fimbriatis. Ovarium subglobosum, glabrum, ovulis 3 x (10-12). Stylus versus basin inflatus. Capsula ignota.

Tree + 5 m tall. Branchlets sparsely pilosellous, whitish punctate and striate. Leaves distichous; stipules deciduous; narrowly deltoid to lineary, acuminate, 8.0 mm long, 1.5-3.0 mm wide, herbaceous, glabrous, ciliolate near the base; petioles 2.0-7.0 mm long, minutely pilosellous; lamina coriaceous, elliptic to (ob)ovate, acuminate, glabrous, 7.5-17.2 cm long, 3.7-6.8 cm wide, (in sicco) underneath mixed purplish-white punctate; costa and veins glabrous on both sides; lateral veins 10-14 (apex excluded), veinlets scalariform; apex 0.8-1.0 cm obtusish or acutish; margin subentire; base rounded to cuneate. Inflorescence subsessile, cymose, 1-3 x branched; peduncle 0.3 mm, glabrate; lateral branchlets 2.5-5.0 mm long; pedicels articulate; basal part 1.0-2.0 mm long, sparsely pilosellous; apical part 2.0-3.0 mm long, glabrate; bracts deltoid to ovate, obtusish, mucronate, 0.8-1.0 mm long, 1.0-1.2 mm wide, coriaceous, minutely pilosellous, ciliolate. Buds ovoid, obtusish; flowers probably whitish. Sepals subequal, ovate, obtuse, 2.2-2.5 mm long and wide, carnosae at the base, minutely ciliolate. Petals unequal; outer 3 ovate, obtuse, 5.0 mm long, 2.5 mm wide (in older buds), carnosae at the basal and median part; margin scarious, glabrous; inner 2 narrowly ovate, obtusish, + 4.5 mm long, 2.2 mm wide, boatshaped, keeled, carnosae, not ciliolate. Stamens (in older buds) 3.0-3.7 mm long; filaments connate to a tube, 0.2-0.8 mm high, glabrous, with suborbicular lobes behind the thecae; thecae 1.2-1.5 mm long, 0.8-1.1 mm wide; connective scales ovate, 1.5-1.7 mm long, 0.8-1.2 mm wide, fuscous; apex obtuse or truncate, dentate or fringed. Ovary widely subglobose, 0.8-1.0 mm long, 1.0-1.2 mm wide, glabrous, containing 3 x (10-12) ovules. Style erect, 3.0 mm, conical inflate, only at the very apex

filiform, completely glabrous, 0.3 mm exceeding the stamens. Stigma truncate. Fruit unknown.

Type: Dwyer 8225, 17 January 1968, (alab., fl.) (holotype F), "Cerro Jefe and Eneida, Province Panama, Panama. Altitude: 650-900 m."

The taxonomic relationship of Gl. eneidense is discussed under the next species.

Gloeospermum equatoriense Hekking sp. nov., pl. 1, f. 3.

Arbuscula. Folia disticha; laminis ellipticis subtus porphyreostictis; venis lateralibus 6-8 (apice excluso); marginibus (sub)integris. Inflorescentia mono- vel dichasialis. Sepala subaequalia. Petala inaequalia carnosae; exteriora 3 ovata acuminata; interiora 2 anguste ovata, carinata, acuminata vel obtusiuscula. Stamina filamentis in tubo connatis; squamis superpositis, anguste ovato-deltoides translucentis. Ovarium trapezioides-subglobosum, glabrum, ovulis 3 x (+ 12). Stylus versus basin inflatus. Capsula juvenilis subglobosa vel subpyriformis. Seminum numerus ignotus.

Shrub. Branchlets sparsely minutely pilosellous with subligneous lenticels. Leaves distichous; stipules deciduous; lineary, acuminate, acutish, 5.0-6.5 mm long, 1.0 mm wide, herbaceous, sparsely minutely pilosellous ciliolate; petioles 4.0-9.0 mm long, minutely pilosellous, later on glabrous; lamina papery, elliptic, acuminate to cuspidate, glabrous, 4.0-11.2 cm long, 2.5-5.0 cm wide; costa minutely pilosellous near the base on both sides, purple striate especially underneath; lateral veins 6-8 (apex excluded), veinlets + scalariform; apex 0.4-1.0 cm obtuse, mucronate; margin subentire; base rounded to cuneate, minutely decurrent into the petiole. Inflorescence mono- or dichasial; peduncle 2.0 mm, minutely pilosellous to glabrate; lateral branchlets 2.0-18.0 mm long, minutely pilosellous; pedicels articulate, minutely erect pilosellous, densely purple striate, basal part 0.3 mm, apical part 1.5-2.0 mm; bracts widely ovate or deltoid, 0.6-1.5 mm long and wide, coriaceous, sparsely pilosellous, ciliolate. Buds ovoid, conical, obtusish; flowers white. Sepals subequal, ovate to orbicular, 2.0-2.5 mm long and wide, herbaceous, carnosae near the base and in median part, densely purple punctate, glabrous; margin scariose, ciliolate. Petals unequal, carnosae, densely purple punctate, glabrous, ciliolate; outer ones ovate, acuminate, obtusish, 7.0 mm long, 2.5 mm wide (in older buds); inner ones narrowly ovate 7.0 mm long, 2.0 mm wide, boat shaped, keeled, acuminate, obtusish. Stamens 3.0 mm long (in older buds); filaments connate to a tube 0.6-0.8 mm high, ciliolate, with orbicular lobes behind the thecae; thecae 1.3 mm long, 0.7 mm wide; connective scales narrowly ovate to deltoid, acuminate, transparent, erose to dentate, + 1.2 mm long, 0.5 mm wide; apex acutish. Ovary trapezoid-globose, 1.0 mm long and wide, glabrous, containing 3 x (+ 12) ovules. Style erect, 3.0 mm long, inflate, only 1/3 apical part filiform, 1.2 mm exceeding the stamens. Stigma truncate. Capsula of juvenile fruit

subglobose to slightly pyriform, 1 cm diameter, glabrous, sparsely punctate, sepals subsistent.

Type: Manuel Lugo 39, 8 February 1940, (fl., fr.) (holotype S), "Mera, Prov. Pastaza, Ecuador." Altitude 1000-1100 m.

In Gl. diversipetalum L. Williams, Gl. eneidense Hekking sp. nov. and Gl. equatoriense Hekking sp. nov. the filaments are distinctly connate. The three species are related to each other and are characterized by their unequal petals; the three outer petals are more or less flat or slightly curved, the two inner ones arc boat-shaped and carinate near the apex. In Gl. eneidense and Gl. diversipetalum they are 2 x longer than wide and not punctate or only slightly so near the apex; their margin is glabrous. In Gl. equatoriense however they are 3 x longer than wide and densely purple punctate; their margin is densely ciliolate from the base to the apex. Moreover, the filamental tube of Gl. equatoriense is ciliolate and the connective scales are transparent, narrowly ovate to deltoid and shorter as well as narrower than the thecae. In the other two species the filamental tube is not ciliolate and the connective scales are brown, elliptic to (ob)ovate and about as long as wide as the thecae. Colour and shape of the connective scales are also different in Gl. eneidense and Gl. diversipetalum. In Gl. eneidense they are fuscous, although at the base less intensely coloured; their apex is truncate and strongly erose to fringed, but the margin is subentire. In Gl. diversipetalum they are orange brown and transparent at the base; their apex is acuminate to acutish and their margin tends to become erose especially near the apex. Fruits are still insufficiently known; in Gl. equatoriense only juvenile ones have been observed while in Gl. eneidense fruits remain entirely unknown. The leaves of Gl. eneidense contain 10-14 lateral veins, those of Gl. equatoriense only 6-8; in Gl. diversipetalum this number is 7-12. Only in Gl. diversipetalum the margin of the leaves is distinctly serrate or crenate, especially near the apex; in the other species the margin is (sub)entire. The underside of the lamina has a different punctuation in each species. It is purple to white in Gl. diversipetalum, mixed purplish-white in Gl. eneidense and purple only in Gl. equatoriense. Gl. diversipetalum and Gl. equatoriense have similar punctuation and striation on the pedicels (observations made in dried material).

Gl. eneidense and Gl. diversipetalum seem to be confined to Central America. The only known specimen of the former species originates from a submountainous area, while the latter is known from several localities in Costa Rica, at altitudes varying from sealevel to 800 m. Gl. equatoriense is only known from the type locality in Ecuador, where it was collected on the eastern side of the Eastern Cordillera at an altitude of 1000-1100 m. Gl. diversipetalum and also the other species occur in the understory of tropical forests.

Gloeospermum falcatum Hekking sp. nov., pl. 1, f. 4.

Arbuscula. Folia disticha; laminis anguste ellipticis; venis

lateralibus 8-11 (apice excluso); marginibus subcrenatis. Inflorescentia cincinnis (1-2) x dichotomis. Sepala aubaequalia. Petala aequalia incrassata. Stamina filamentis in tubo connatis; squamis superpositis, cinnamomeis, parte basali translucidis, praesertim apice dentatis. Ovarium subglobosum, glabrum, ovulis 3 x 12. Stylus versus basin inflatus. Capsula subglobosa, sublignosa, indehiscens, verrucosa; seminibus 12-20, subglobosis, viscosis, amylaceis.

Treelet 13 m tall, stem 3.3 cm diameter. Branchlets glabrous with subligneous lenticels. Leaves distichous; stipules deciduous, subulate or lineary, acuminate, 6.0-12.0 mm long, 1.0-2.0 mm wide, herbaceous to coriaceous, scarious near the margin, glabrous, ciliolate; petioles 3.0-5.0 mm long, glabrous; lamina papery, narrowly elliptic, acuminate 6.5-19.2 cm long, 1.3-5.6 cm wide, glabrous, costa also glabrous on both sides; lateral veins 6-8 (apex excluded), veinlets reticulate; apex 1.0-2.5 cm acutish; margin subcrenate, mucronulate; base rounded to cuneate. Inflorescence consisting of 1-2 x bifid cincinnati, minutely pilosellous; peduncles 1.0-2.5 mm long; branchlets 0.3-1.0 mm long; pedicels articulate; basal part 1.0-2.5 mm long, minutely pilosellous; apical part 8.5-10.0 mm glabrous; bracts ovate to deltoid, obtusish, 0.8-1.0 mm long, 0.6-0.8 mm wide, coriaceous, minutely pilosellous to glabrous; margin scarious, ciliolate. Buds ovoid to conical, obtusish; flowers whitish. Sepals subequal, widely ovate, obtusish to acutish, 1.5-2.2 mm long, 1.5-2.5 mm wide, herbaceous to coriaceous, glabrous; margin scarious, minutely ciliolate. Petals equal, ovate to deltoid, acuminate, obtusish, 4.5-5.5 mm long, 2.2 mm wide, incrassate, glabrous, not ciliolate. Stamens 3.0 mm long; apical parts of filaments free, 0.3 mm long, 0.3-0.4 mm wide; basal part connate to a tube, 0.2-0.5 mm high, glabrous, with deltoid lobes between the stamens; thecae + 1.2 mm long, 0.8 mm wide; connective scales elliptic to narrowly ovate, 1.5-2.0 mm long, 0.4-0.9 mm wide, orange brown, at the base transparent; margin erose to dentate especially near the apex. Ovary subglobose 1.2-1.5 mm long and wide, glabrous, containing 3 x 12 ovules. Style erect 4.0 mm, glabrous, inflates near the base, 0.4-1.0 mm exceeding the stamens. Stigma obtuse. Capsula indehiscens, (in vivo) green to yellow, ligneous, 3.0-3.5 mm diameter, glabrous, verrucose, style subpersistent; seeds + 12-20, pyriform, 12.0 mm long, 7.0 mm wide, glabrous, densely purple punctate (in sicco) amylaceous.

Type: Little Jr 6528, 18 May 1943, (fl., fr. juv.) (holotype US, isotype F), "common in undergrowth of wet tropical forest, collected in old cacao plantation at Phichilingue, prov. Los Ríos, Ecuador." Paratype: Acosta Solís 13643, 1 September 1941, (fr.) (F), Loc.: "Km 170-175, vía Sto Domingo-Guainindé, prov. de Los Ríos, Ecuador. Alt. 300 m."

Distribution: Ecuador.

Vernacular name: "Naranjilla de monte."

Additional material: ECUADOR, Los Ríos, Dodson & Gentry 6297 (alab.) (AAU); Little Jr 6438 (fr.) (F, K, US).

The taxonomic relationship of Gl. falcatum is discussed under the next species.

Gloeospermum longifolium Hekking sp. nov., pl. 1, f. 5.

Folia disticha; laminis anguste ellipticis; venis lateralibus 9-11 (apica excluso); marginibus (sub)integris. Inflorescentia cincinnis (1-2) x dichotomis. Sepala subequalia. Petala aequalia herbacea. Stamina filamentis in tubo connatis; squamis superpositis, cinnamomeis. Ovarium trapezoideo-subglobosum, glabrum, ovulis 3 x 8. Stylus versus basin inflatus. Capsula ignota.

Tree. Branchlets glabrous with subligneous lenticels. Leaves distichous; stipules soon deciduous; petioles 9.0-11.0 mm long, glabrous; lamina papery, narrow elliptic, acuminate, glabrous, 14.7-23.0 cm long, 5.7-7.5 cm wide; costa glabrous on both sides; lateral veins 9-11 (apex excluded); veinlets scalariform; apex 0.5-1.5 cm, acutish to obtusish, mucronate; margin subentire; base rounded to cuneate. Inflorescence consisting of 1-2 x bifid cincinni, minutely pilosellous; peduncles 2.0 mm; branchlets 0.5-3.0 mm; pedicels articulate, erect minutely pilosellous; basal part 1.0-1.5 mm, apical part + 4.0 mm long; bracts ovoid to deltoid, acutish, mucronate, 1.2 mm long and wide, herbaceous, erect minutely pilosellous; margin scarious, ciliolate. Buds conical, obtusish; flowers whitish. Sepals subequal, (widely) ovate to orbicular, 2.5-3.0 mm long, partly carnose, minutely pilosellous, ciliolate. Petals equal, elliptic, obtuse, 7.0 mm long, 3.0 mm wide, partly ciliolate. Stamens 4.0 mm long; apical parts of filaments free, 0.2 mm long, 0.4-0.8 mm wide; basal part connate to a tube, 0.8-1.0 mm high, glabrous, with large obtuse lobes behind the thecae and sometimes with smaller ones between them; thecae + 1.2 mm long, + 0.9 mm wide; connective scales 0.8-1.0 mm long, 0.4 mm wide, narrowly elliptic, orange brown also at the base; margin erose to dentate only at the apex. Ovary trapezoideo-conical to subglobose, 1.5 mm long, + 1.2 mm wide, glabrous, containing 3 x 8 ovules. Style erect, 3.0 mm, inflate near the base, apical parts filiform, glabrous, 1.5 mm exceeding the stamens. Stigma truncate. Fruit unknown.

Type: Cuatrecasas 11143, 11 December 1940, (fl.) (holotype COL, isotypes F, NY) "Selvo higrófilo del río San Miguel en el afluyente izquierda. Quebrada de la Hormiga, 290 m. Comisaría del Putumayo, Colombia."

The type specimen Cuatrecasas 11143 has been determined as Gl. gossypium by Smith & Fernández (1954), who noted the aberrant character of the leaves. Those of Gl. gossypium are much wider ovate to elliptic with 13-20 lateral veins.

Gl. dichotomum (Rusby) Melchior, Gl. falcatum Hekking sp. nov. and Gl. longifolium Hekking sp. nov. are related to each other. The petals in these species are equal. The filaments are connate to a tube. Floral characters mainly serve to distinguish the species. In Gl. falcatum and Gl. dichotomum the pedicels are 8.0-14.0 mm long, surpassing those of Gl. longifolium, which are only 5.0-5.5 mm long. On the other hand Gl. longifolium has longer sepals, which are 2.5-3.0 mm long in Gl. longifolium and only 1.5-2.2 mm in the other species. In Gl. dichotomum the petals are + carnose, + 8.5 mm long and 2.7 mm wide, in Gl. longifolium they are herbaceous, + 7.0 mm long, + 3.0 mm wide and in Gl. falcatum incrassate, + 5.0 mm long, + 2.2 mm wide. Inside the flowers the location of the apical deltoid lobes of the filamental tube is different in each species. In Gl. dichotomum they are placed behind the stamens, in Gl. falcatum between them and in Gl. longifolium the larger ones behind and the smaller ones usually between the stamens. The thecae of Gl. falcatum and Gl. longifolium are + 1.5 x longer than wide; those of Gl. dichotomum 2 x. The connective scales are brown, but in Gl. falcatum and Gl. dichotomum they become transparent at the very base. Connective scales of Gl. longifolium are 0.8-1.0 mm long, + 0.4 mm wide, subentire and only erose-dentate at the apex; those of Gl. dichotomum 1.2-1.5 mm long, + 0.8 mm wide, subentire, bi-acuminate and in Gl. falcatum 1.5-2.0 mm long, 0.6-0.9 mm wide, erose to dentate especially near the apex. In Gl. longifolium, Gl. falcatum and Gl. dichotomum the style is respectively + 3.0 mm, + 4.0 mm and + 4.5 mm long. Dried fruits of Gl. falcatum are verrucose, while in Gl. dichotomum they are smooth and with whitish spots. Fruits of Gl. longifolium are unknown till yet. A few distinguishing characters are also found in the vegetative parts. The petioles of the apical leaves are 9.0-11.0 mm long in Gl. longifolium and only 2.2-6.0 mm in the other species. Moreover, in Gl. longifolium the veinlets are distinctly scalariform, in Gl. dichotomum they are less distinctly scalariform and in Gl. falcatum they tend to become reticulate.

Gl. longifolium was recorded along a frontier river between Colombia and Ecuador, without any indication of altitude. Specimens of Gl. falcatum originate from warm tropical forests at 150-300 m on the eastern slope of the Eastern Cordillera in Ecuador. Some specimens of Gl. dichotomum were collected in mountainous forests of the Sierra Nevada de Santa Marta (Colombia) at an altitude of 1300-1800 m. Another specimen has recently been collected in lower submountainous forest at 300 m on the East side of the Eastern Cordillera in Ecuador.

Gloeospermum blakeanum (Standley) Hekking comb. nov., pl. 1, f. 6.

Rinorea blakeanum Standley, Publ. 392. Field Mus. Nat. Hist.

22(15): 349. 1940; Robijns Jr, Ann. Missouri Bot. Gard. 54:

71. 1967; type: Terry & Terry 1513, 12 March 1940, (fl.)

(holotype F, isotypes A, MO), Cana-Cuasi. Trails. Chepigana-District, Darien Province, Panama. Altitude: ca 1500 m.

Standley (1910) described this species in Rinorea, but Robijns (1967) stated that the systematic position of this species was uncertain. The alternate "probably" distichous leaves and the contracted "racemose" inflorescences (or cincinni) suggested relationship to Gloeospermum, but by lack of fruits Robijns hesitated to make the transfer. The phyllotaxy, the inflorescence, the incrassate petals, the characters of the androecium and the ovary bearing 3 x 8 ovules indicate indeed that this species belongs in Gloeospermum, where it is related to Gl. sphaerocarpum Triana & Planchon and Gl. pilosum Melchior. The petals in the three species are equal and the stamens are connate forming a tube. This tube is ciliolate and deeply rounded sinuate in Gl. blakeanum, while the rounded lobes are located behind the stamens. In Gl. sphaerocarpum and Gl. pilosum the tube is not ciliolate and less distinctly and more irregularly sinuate. In Gl. blakeanum the thecae are only 1.2-1.5 x longer than wide, while in the latter two they are 2.0 x. The connective scales of Gl. blakeanum are strongly fringed and tinged brown at the apex, but in both other species they are completely transparent and (sub)erose to fringed. The ovary in Gl. blakeanum has 3 x 8 ovules, in Gl. sphaerocarpum 3 x 12 and in Gl. pilosum probably 3 x 9. The leaves of Gl. blakeanum tend to be smaller and long tapering; the upperside of the costa is pilosellous. In Gl. sphaerocarpum and Gl. pilosum the leaves are acuminate-cuspidate with the costa glabrous above. Moreover in Gl. pilosum the underside of the lamina is distinctly pilose (name!).

Gl. blakeanum is only known from a mountainous area at 1500 m. in Panama (Darién) close to the border with Colombia. Gl. sphaerocarpum has the largest area of distribution in this genus and is widely dispersed over French Guiana, Venezuela, Colombia, Ecuador, northern Peru and upper Amazonian Brazil. Gl. pilosum is only recorded from northern Peru.

Rinorea crenata Blake, Contr. U.S. Nat. Herb. 20 (13): 500. 1924;

Standley, Field Mus. Nat. Hist. Bot. 18 (2): 715. 1937

Rinorea roureoides Woodson, Ann. Missouri Bot. Gard. 37: 403. 1950

R. roureoides from Central America appeared to be synonymous with R. crenata from Colombia.

Rinorea apiculatus Hekking sp. nov., pl. 2, f. 7.

Arbor parva. Folia alternantia; laminis elliptico-ovatis; costis glabris; venis lateralibus 7-11 (apice excluso); marginibus sub-integris vel subcrenatis. Inflorescentia thyrsis 1-3 fasciculatis, axillaribus vel terminalibus; cymulis 1-3 floribus. Sepala (sub)-aequalia. Petala aequalia herbacea et scariosa, ciliolata. Stamina filamentis basali parte in tubo carnosio connatis; squamis superpositis, cinnamomeis. Ovarium subglobosum glabrum, ovulis 3 x 1. Stylus 1.5 mm longus, curvatus, glaber. Fructus juvenilis glaber.

Tree 5 m tall. Branchlets minutely pilosellous or pruinose, later on glabrous. Leaves alternate; stipules deciduous, ovate, 3.0-5.5 mm long, 1.0-3.0 mm wide, herbaceous, glabrate, ciliolate; apex purple mucronate; petioles 7.0-13.0 mm long, minutely pilosellous, later on ligneous; lamina subcoriaceous, elliptic to ovate, acuminate to cuspidate, glabrous, 8.5-20.0 cm long, 4.0-7.7 cm wide. Costa and veins densely minutely pilosellous underneath; lateral veins 7-11 (apex excluded); veinlets + scalariform; apex 0.7-1.0 cm long, obtuse, purple mucronate; margin subentire to subcrenate, purple mucronulate; base rounded to obtuse. Inflorescence thyrsoid, 1-3 fasciculate, axillary or terminal, 4.5-9.0 cm long, + 1.5 mm wide, pilosellous; cymules with 1-3 flowers; peduncles 2.0-6.0 mm long, pilosellous; pedicels 1.0-2.5 mm long, articulate, pilosellous; bract(let)s ovate to deltoid, acuminate, acutish, purple mucronate, herbaceous; margin scarious, ciliolate; bracts 0.7-1.0 mm long, 0.4-0.8 mm wide; bractlets 0.3-0.8 mm long, 0.3-0.5 mm wide, subopposite or alternate. Buds orbicular; flowers greenish to whitish. Sepals subequal 1.0-1.5 mm long, 0.8-1.2 mm wide, ovate, obtuse, herbaceous, obscurely 1-3 venose; margin scarious, ciliolate. Petals 2.5 mm long, 1.5 mm wide, ovate, obtuse, herbaceous; margin scarious, ciliolate. Stamens + 2.0 mm long; apical parts of filaments free, 0.2-0.4 mm long, 0.1 mm wide; basal part connate to a tube, 0.4-0.5 mm high, carnose, glandular, 5- sinuate; thecae 0.8-1.0 mm long, 0.6-1.0 mm wide, obtuse, sometimes 2 - mucronate, barbate at the base; connective outside + 0.5 mm long, 0.1-0.2 mm wide, barbate; connective scales apical, ovate or elliptic, fringed or erose, orange brown, 0.7-1.0 mm long and wide, equaling the thecae. Ovary subglobose, 0.8-1.0 mm long and wide, glabrous, containing 3 x 1 ovules. Style 1.5 mm long, slightly curved, glabrous, 0.5-0.7 mm exceeding the stamens. Stigma truncate, pulvinate. Juvenile fruit glabrous.

Type: Woytkowski 7536, 18 September 1962 (alab., fl., fr. juv.) (holotype F, isotypes MO, K) "in forest, altitude 900 m., Pendencia, dept. Huánaco, Perú."

Paratypes: Gentry 10164, 24 February 1974, (alab.)(GB, U) "wet forest, half way between Quevado and Santo Domingo de los Colorados, Río Palenque Field Station, elevation ca 200 m., prov. Los Ríos, Ecuador"; Harling, Eliasson & Andersson 14781, 22 January 1977, (alab., fl.)(GB, U) "secondary vegetation and disturbed rain forest, road Coca (Puerto Francisco de Orellana) Armenia Vieja, ca 15 km. S. of Coca, altitude ca 250 m. s.m., prov. Napo, Ecuador".

Distribution: Ecuador and Perú.

R. apiculatus is named after its apical connective scales just as in the two related species R. crenata Blake and R. oraria Steyermark & Fernández. The inflorescences of these species are terminal or axillary with 1-3 fasciculated in the axils of the leaves. In R. apiculatus and in R. crenata however they are

thyrsoid with cymes of 1-3 flowers and in R. oraria they are corymbose with cymes of 1-7 flowers or even more. The pedicels in R. apiculatus are mostly shorter than in R. crenata and R. oraria (respectively 1.0-2.5 mm, 2.0-5.0 mm and 1.5-6.0 mm long). In R. oraria and R. apiculatus the stamens are 2.5 mm long or less, in R. crenata 2.5 mm or more. The connective scales on the thecae are respectively + 0.6 mm, + 0.9 mm, + 1.5 mm long and + 0.5 mm, + 0.8 mm, and + 0.9 mm wide; in R. oraria they tend to be shorter, in R. apiculatus equaling and in R. crenata longer than the thecae. The filaments are at the base united into a tube of glandular character. This tube is in R. apiculatus and R. crenata 5-sinuate, in R. oraria 10-sinuate. The styles in R. apiculatus and R. oraria are + 1.5 mm long, but in R. crenata 2.0 mm or more. Fruits of R. apiculatus and R. crenata are glabrous, those of R. oraria are still unknown. The leaves are alternate in all three species, but they are distinctly more crenate in R. crenata (name!) than in the other ones.

The areas of distribution are well separated from each other: R. apiculatus is recorded from the eastern as well as from the western side of the Cordilleras in Ecuador (altitude 200-250 m) and from the Peruvian Andes (altitude 900 m); R. crenata is known from Costa Rica and Panama (altitude 10-100 m), while R. oraria was collected on the northern slope of the Coastal Cordillera near Caracas, Venezuela (altitude 700-900 m).

Rinorea longistipulata Hekking sp. nov., pl. 2, f. 8.

Arbor parva. Folia alternantia; laminis elliptico-ovatis; costis glabris; venis lateralibus 11-15 (apice excluso); marginibus subrenatis; basi rotundo-cuneata abrupte in petiolum attenuata. Inflorescentia pseudoracemis 1-3 fasciculatis, axillaribus, terminalibus; cymulis 1-3 floribus. Sepala (sub)aequalia. Petala equalia, exteriora versus basin subcordata, carnosa, intus pilosella. Stamina subsessilia; filamentis brevibus + liberis; connectivo dorsaliter glabro, producto in squama ovata, acuminata cinnamomea. Ovarium subglobosum, leviter trilobatum, pilosum, ovulis 3 x 2. Stylus erectus sive leviter curvatus. Fructus juvenilis pilosus.

Tree 6-8 m tall. Branchlets glabrate, younger ones pilosellous. Leaves alternate; stipules deciduous, narrowly deltoid, acutish 6.0-9.0 mm long, 1.0-2.0 mm wide, herbaceous, multi-striate, near the base pilosellous, margin minutely ciliolate; petioles 5.0-12.0 mm glabrous; lamina subcoriaceous to papery, glabrous, 6.0-14.5 cm long, 3.2-7.0 cm wide, elliptic to ovate, acuminate; costa glabrous on both sides; lateral veins 11-15 (apex excluded); veinlets + scalariform; apex 0.5-2.0 cm, acutish to obtusish; margin subrenate, purple mucronulate; base rounded to cuneate, abruptly short decurrent into the petiole; inflorescence pseudoracemose, 1-3 fasciculate, axillary or terminal, 3.0-10.0 cm long, 1.0-2.5 cm wide, pilosellous; cymes with 1-3 flowers, sometimes 1-2 rudimentary buds also present;

peduncles if not wanting 3.0-4.0 mm long, pilosellous; pedicels 2.0-6.0 mm long, articulate near the middle, pilosellous; bract (let)s deltoid, ovate or elliptic, acutish to obtusish, herbaceous, pilosellous, ciliolate; bracts 1.2-1.8 mm long, 0.6-0.8 mm wide, 3-5 venose; bractlets 0.7-1.0 mm long, + 0.6 mm wide, 1-3 venose, subopposite or alternate. Buds ovoid, conical to the apex; flowers whitish. Sepals (sub)equal, 2.0-2.5 mm long, 1.2-1.7 mm wide, elliptic to ovate, obtuse, herbaceous, 3(5)-venose, glabrous, margin scarios, ciliolate. Petals 5.0-6.3 mm long, 2.0-2.5 mm wide, ovate, acuminate, obtusish, herbaceous; margin scarios, only slightly pilosellous at the apex; outer petals at the base subcordate, carnos, pilosellous only inside. Stamens 3.5-4.5 mm long, subsessile; filaments + free, 0.3-0.4 mm long, 0.3-0.5 mm wide, slightly pilose on the ventral side; dorsal glands on some filaments, free, conical, callose, erected outward; thecae 1.5-1.8 mm long, + 0.8 mm wide, glabrous; connective dorsally 1.2 mm long, 0.3-4.0 mm wide, narrowly deltoid, glabrous; connective scales 3.0-4.0 mm long, 0.8-1.3 mm wide, ovate, acuminate, acutish to obtusish, orange brown, erose to lacerate at the base. Ovary subglobose or slightly trilobed, 1.2-1.5 mm long, + 1.0 mm wide, (in sicco) goldish pilose, containing 3 x 2 ovules. Style 3.0-4.0 mm long, erect or slightly curved near the base, glabrous, 0.3-0.5 mm exceeding the stamens; stigma truncate. Young fruits, pilose, green.

Type: Prance, Ramos & Farias 7623, 14 September 1968, (alab. fl., fr. juv.) (holotype U, isotypes A, C, COL, F, G, K, INPA, MG, MICH, MO, NY, US, VEN) "forest on terra firme, vicinity of Tarauçá, State of Acre, Brazil."

Paratype: Prance, Ramos & Farias 7529, 21 September 1968, (alab., fl., fr. juv.) (A, C, COL, F, G, K, INPA, MG, MICH, MO, NY, US, VEN) "1-3 km. E. of Ríó Tarauçá, State of Acre, Brazil."

The taxonomic relationship is discussed under the next species.

Rinorea multivenosa Hekking sp. nov., pl. 2, f. 9.

Arbuscula. Folia alternantia; laminis elliptico-ovatis; costis glabris; venis lateralibus 15-19 (apice excluso); marginibus (sub)serratis; basi obtuso-rotundata. Inflorescentia pseudoracemis 1-3 fasciculatis, axillaribus vel terminalibus; cymulis 1-3 floribus. Sepala subaequalia. Petala aequalia, versus basin carnos, extus minute pilosella, intus dense villosa. Stamina subsessila; filamentis brevibus + liberis; connectivo dorsaliter piloso, producto in squama anguste ovata acuminata cinnamomea. Ovarium subglobosum, villosum, ovulis 3 x 1. Stylus ad basin sigmoideo-curvedus. Fructus capsula ovata, glabrata, dehiscens in 3 valvis subaequalibus. Semina globosa, glabra, 3 x 1.

Tree. Branchlets sparsely minutely pilosellous to glabrate. Leaves alternate; stipules deciduous, narrowly deltoid to ovate, acutish, 4.0-5.0 mm long, 0.2-1.8 mm wide, herbaceous, multivenose, sparsely pilosellous, ciliolate; petioles 5.0-9.0 mm long, glabrate

to sparsely pilosellous; lamina papery to herbaceous, glabrous, 8.0-20.5 cm long, 4.5-10.2 cm wide, elliptic to ovate, acuminate; costa glabrous on both sides; lateral veins 15-19 (apex excluded), veinlets + scalariform; apex 0.6-1.5 cm acutish; margin (sub)-serrate, purple mucronulate; obtuse at the very base. Inflorescences pseudoracemose, 1-2 fasciculate, axillary or terminal, 5.0-13.0 cm long, 1.0-2.0 cm wide, strigillose, laxiflorous near the base; cymules with 1-2(?) flowers; peduncles, 1.0-2.5 mm strigillose; pedicels 2.5-2.7 mm long, articulate near the middle, strigillose; bract(let)s ovate, acuminate, acutish, herbaceous, 1-venose, strigillose, ciliolate; bracts 0.8-1.0 mm long, 0.5-0.6 mm wide; bractlets 0.5-0.8 mm long, 0.3-0.6 mm, subopposite or alternate. Buds ovoid, conical near the apex; flowers whitish. Sepals subequal, 1.3-2.0 mm long, 0.6-1.0 mm wide, ovate to deltoid, herbaceous, 3-venose, strigillose, ciliolate. Petals 5.0-5.2 mm long, 1.3-1.5 mm wide, narrowly ovate, acuminate, herbaceous, at the base carnos, outside minutely pilosellous, inside densely villose; margin glabrous; apex obtusish, pilosellous. Stamens 2.0 mm long; filaments + free, 0.3-0.7 mm long, 0.2-0.4 mm wide, villose near the thecae, connate at the very base over 0.1 mm; dorsal glands 0.2-0.4 mm, free, conical, callose, pilosellous or glabrate, extending outward; thecae 1.3 mm long, 0.7-0.8 mm wide; connective inside erect pilosellous near the base, outside 1.0-1.2 mm long, 0.2-0.3 mm wide, whitish villose; connective scales 3.5 mm long, 1.0 mm wide, ovate, obtuse or acutish, orange brown, suberose near the base. Ovary subglobose + 1.2 mm long, 1.0-1.2 mm wide, containing 3 x 1 ovules, goldish villose in sicco, greenish white in vivo. Style 3.0 mm long, at the base sigmoid, glabrous, whitish, 0.6 mm exceeding the stamens. Capsula ovate, obtusate, coriaceous or subligneous, dehiscent into 3 subequal valves, 8.5-9.5 mm long, 3.0-4.0 mm wide, glabrate. Semina 3 x 1, globose, + 4.5 mm, glabrous.

Type: Traill 22, 30 September 1874, (alab., fl.)(holotype K, isotype P) "low tree in varzea at Sapatini, R o Purus, upper Amazon and tributaries, Amazonas, Brazil."

Paratype: Traill 23, 29 January 1875, (fr.)(K, P) "Inambu Kisawa, R o Jutahi (= Jutai), 5^o 12'S, upper Amazon and tributaries, Amazon, Brazil."

Distribution: Brazil (Amazonas, Rio de Janeiro)

Additional material: BRAZIL, Rio de Janeiro, Quinta de S. Christov o, 18 October 1874, (fl.), Herbier de Glaziou s.n. (P).

R. multivenosa and R. longistipulata are closely related because of the following common characters: (1) leaves alternately arranged, (2) inflorescences terminal or axillary with 1-3 pseudoracemes fasciculated in the axils of the leaves, (3) flowers solitary or arranged in cymules of 2-3 flowers and (4) connective scales covering the dorsal side of the thecae nearly completely. The two species can easily be distinguished from each other. R. longistipulata has

longer stipules (6.0-9.0 mm!), bracts, sepals and petals than R. multivenosa. The length of the stipules in R. longistipulata is in fact longer than in other neotropical species of Rinorea. On the other hand R. multivenosa is characterized by the high number (15-19) of lateral veins, which is the highest number in neotropical species of Rinorea (also occurring in R. ulmifolia (HBK) Kuntze). In R. longistipulata only 11-15 lateral veins are observed. The dorsal side of the connectives (not the scales!) is villose in R. multivenosa and glabrous in R. longistipulata. In the former species the style is sigmoid at the base, in the latter + erect. The ovary in R. multivenosa contains 3 x 1 ovules and in R. longistipulata 3 x 2 ovules. Fruits of R. multivenosa are dehiscent into 3 subequal valves; its capsula is glabrate. The capsula of juvenile fruits of R. longistipulata is pilose.

Distribution of the two species is only known from the type localities in Acre and adjacent Amazonia in Brazil. One additional specimen of R. multivenosa is recorded from Rio de Janeiro and probably cultivated (?).

Rinorea bicornuta Hekking sp. nov., pl. 2, f. 10.

Arbor seu arbuscula. Folia alternantia; laminis obovatis; costis pilosis; venis lateralibus 10-13 (apice excluso); marginibus subintegris vel subcrenatis, sparse ciliolatis. Inflorescentia thyrsis solitariis, axillaribus vel terminalibus; cymulis 1-5 floribus. Sepala aequalia. Petala aequalia, carnosa et pilosa in mediana et basali parte, sparsim ciliolata. Stamina filamentis connatis in tubo carnoso; thecis ventraliter appendiculatis squama bicornuta; connectivo dorsali glabro, producto in squama ovata acuminata pallide cinnamomea. Ovarium subnaticum, apice pilosum, ovulis 3 x 1. Stylus erectus apice leviter curvatus. Fructus ignotus.

Tree or shrub; branchlets densely strigillose. Leaves alternate; stipules deciduous, narrowly deltoid 4.0-5.0 mm long, 1.0-1.5 mm wide, herbaceous, striate, costa pilose, margin ciliate; petioles 3.0-11.0 mm long, pilose; lamina papery, 10.0-20.0 cm long, 4.0-8.2 cm wide, obovate, acuminate, glabrous; costa sparsely pilose (lous) on both sides; lateral veins 10-13 (apex excluded); apex 0.5-2.2 cm, acutish; margin subentire to subcrenate, sparsely ciliate; base rounded to cuneate. Thyrses solitary, terminal, axillary, strigillose, 9.0 cm long, 1.0-1.5 cm wide; cymules with 3-5(?) flowers; peduncles 1.2-2.5 cm, pilose; pedicels 1.0-1.3 cm long, articulate in + 1/3 basal part, pilose; bract(let)s ovate to deltoid, herbaceous, pilose in median part, ciliate; bracts + 1.2 mm long, + 0.8 mm wide; bractlets subopposite, 0.8-1.0 mm long, + 0.6 mm wide. Buds conical, acutish; flowers cernuous, whitish. Sepals + equal, 2.0-2.2 mm long, 1.5-1.8 mm wide, ovate to deltoid, obtusish, herbaceous, carnosae and pilose near the base and along the costa; margin ciliate. Petals 3.2 mm long, + 1.5 mm wide, ovate to

deltoid, obtuse, herbaceous, carnose and pilose near the base and along the costa; margin sparsely ciliolate. Stamens 2.5 mm long; filaments connate to a tube, 0.2 mm high, glandular, carnose, glabrous; thecae 0.8 mm long, 0.4 mm wide, appendiculate by a two horned mucro, 0.4-0.8 mm long, 0.3 mm wide; connective outside + 0.6 mm long, 0.2 mm wide, glabrous; connective scales 2.0-2.2 mm long, 0.7 mm wide, ovate, acuminate, acutish, subentire, brownish. Ovary subconical, 0.8 mm long, 0.4 mm wide, pilose near the apex, containing 3 x 1 ovules. Style + 2.0 mm long, erect or slightly curved near the apex, + 0.5 mm exceeding the stamens. Fruit unknown.

Type : Ducke s.n. RB 21.353, 9 November 1927 (alab., fl.) (holotype RB) "Mata de terra firme, Tocantins, Solimões, Amazonas, Brazil."

R. bicornuta is named after its two long and fringed cusps on the ventral side of the apical part of the thecae: these cusps are connate at the base. The new species is related to R. paniculata (Martius) Kuntze, R. guianensis Aublet and R. bahiensis (Moriciand) Kuntze. In all the species the leaves are alternate, the inflorescences are solitary and terminal or axillary, the connective scales cover the thecae nearly completely, the filaments are connate and the ovaries contain 3 x 1 ovules. Fruits of R. bicornuta are unknown. Differences are the following. The inflorescence of R. bicornuta is thyrsoid with cymes of only 1-5 flowers; in the other species they are panicleate with cymes of 3-11 flowers (up to 21 in R. paniculata!). The flower buds are conical in R. bicornuta, tolpoid in R. guianensis and R. bahiensis and ellipitoid in R. paniculata. Buds and flowers are strongly deflexed only in R. bicornuta. R. bicornuta and R. paniculata differ from the two other species by shorter petals (1.7-3.2 mm long), by shorter thecae (less than 1.0 mm) and by shorter connective scales (distinctly shorter than 2.5 mm). In R. guianensis and R. bahiensis these floral parts are distinctly larger (e.g. petals 3.5-5.5 mm long). R. bicornuta is subsequently to distinguish from R. paniculata by its floral parts as follows. Pedicels of R. bicornuta are only 1.0-3.0 mm long, those of R. paniculata 2.5-5.0 mm. The petals are respectively + 3.2 mm and 1.7-3.0 mm long. The connective scales in R. bicornuta are 2.0-2.2 mm long and (2.5-3.0) x longer than the thecae, but in R. paniculata only 1.2-1.5 mm long and only (1.5-2.0) x longer than thecae.

The areas of distribution of these four species comprise three tropical lowland regions of S. America, separated from each other by mountain ranges: (1) N. Venezuela and Guianas, (2) Amazonia and (3) coastal region of S.E. Brazil. Only R. guianensis is recorded from all the three regions. R. bahiensis has a similar somewhat disjunct dispersion covering a more restricted area. It is not yet recorded from N. Venezuela nor from Amazonia, but was only collected on one locality of French Guiana and in a restricted area in S.E. Brazil. R. paniculata and R. bicornuta are so far only known from Amazonia. All the species occur along rivers and creeks and in humid forests from sealevel to submountainous regions.

Rinorea amapensis Hekking sp. nov., pl. 3, f. 11.

Arbor seu arbuscula. Folia opposita; laminis ellipticis; costis glabratiss; venis lateralibus 7-13 (apice excluso); marginibus subintegris, subserratis vel subcrenatis, versus basin rotundis vel cuneatis. Inflorescentia racemis solitariis, axillaribus, terminalibus. Sepala subaequalia. Petala aequalia, dorsaliter pilos(ell)a in mediana parte, apice ciliolata. Stamina filamentis liberis; thecis ventraliter 0-7 set(ul)is appendiculatis, dorsaliter in squamis erosis cinnamomeis productis. Ovarium subglobosum pilos(ell)um ovulis 3 x (1)2. Stylus erectus, ad basin leviter pilosellus. Fructus capsula dehiscens in 3 valvis subaequalibus pilos(ell)is, leviter venosis. Semina subglobosa, pilosella, 3 x (1)2.

Tree or shrub, 2.0-10.0 m tall, 2.0-15.0 cm diameter, bark greyish-maroon, wood creamy to brightly maroon; branchlets erect pilosellous and less densely pilose; porphyreous (in sicco), later on to greyish. Leaves opposite; stipules deciduous, deltoid, 1.0-4.0 mm long, 1.0-2.0 mm wide, herbaceous, appressed pilosellous, ciliolate; petioles 2.0-7.0 mm long, erect pilosellous above, appressed pilose(ellous) underneath; lamina papery, (2.5)5.0-13.7 cm long, 1.8-5.0 cm wide, elliptic to obovate, glabrous; costa above glabrous, underneath glabrate, occasionally sparsely appressed pilose; lateral veins (7)9-11(13) (apex excluded); veinlets reticulate; apex 0.3-1.8 cm, acutish, mucronate; margin subentire, subserrate to subcrenate; base rounded to cuneate. Racemes solitary, axillary or terminal, 5.0-8.5 cm long, erect pilosellous; pedicels 4.0-4.5 mm, articulate in 1/5-2/5 basal part; bract(let)s ovate to deltoid, herbaceous, 1-3 venose, pilose(ellous) along the median part, ciliolate; bracts + 1.2 mm long, 1.0-1.2 mm wide; bractlets + 1.0 mm long and wide, subopposite, close to the bracts but still separated from them. Buds ovoid-tolpoid, flowers whitish. Sepals subequal, 1.5-2.3 mm long, 1.3-2.0 mm wide, ovate to orbicular, obtuse to rounded, herbaceous, whitish pilose(ellous), whitish ciliolate; petals 3.0-4.2 mm long, 1.3-1.8 mm wide, narrowly ovate, obtuse, herbaceous, carnose near the base, scarious near the margin, appressed brownish pilose(ellous) in median part; apex sometimes ciliolate. Stamens 2.5-3.0 mm long; filaments free, 0.5-0.8 mm long, 0.2-0.5 mm wide (occasionally two filaments connected by connate glands); glands elliptic 0.3-0.8 mm long, 0.2-0.4 mm wide, occasionally wanting, carnose, glabrous; thecae 1.2-1.4 mm long, (0.4)0.6-0.8 mm wide, sometimes 1-7 set(ul)ose; connective outside 0.8 mm long, 0.2 mm wide, glabrate or pilosellous; connective scales + 2.3 mm long, + 0.8 mm wide, (sub)erose, fringed at the very base, orange brown. Ovary subglobose, 0.8-1.3 mm long, 0.6-0.9 mm wide, pilose, containing 3 x 1 ovules; style 2.0-2.7 mm long, erect, slightly pilosellous at the base, 0.2-0.5 mm exceeding the stamens; stigma truncate. Capsula ovate, coriaceous or ligneous, in vivo green with a flush of pink on one side, venose, pilose(ellous), dehiscent into 3 subequal valves, 0.8-3.2 mm long, 0.3-1.0 mm wide, Seeds 3 x 2, subglobose, 5.0-7.0 mm long and wide, pilosellous, brownish.

Type: Cowan 38121, 4 November 1954, (alab., fl., fr.)(holotype NY, isotype A, MICH, MO, NY, S, U, UC, W) "frequent in forest on Fritz Akerman Ore Body on heavily forested hills, altitude 300 m, R o Amapari, Serro de Navio, Amap a, Brazil."

Paratype: Cowan 38254, 11 December 1954, (fl. fr.) (A, K, NY, P, RB) "frequent in forest on laterite in vicinity of camp, 275 m alt. Montagne in Kaw (= Caux), French Guiana."

Habitat: undergrowth in dense forest, on slopes of hills, along rivers and creeks, on "mata virgem de terra firme", preference for clayish, lateritic and granitic soil. Altitude: 0-550 m.

Distribution: Brazil (Amap a, Par a), basin of the lower Amazon; French Guiana: Surinam, S.W. Venezuela; S.E. Colombia.

Vernacular names: "l le-tiki" (Surinam); "wayau" (French Guiana, nom ayampi).

Additional material: BRAZIL, Amap a: Cowan 38276 (fl., fr. juv.) (COL, NY); 38337 (fl.) (LIL, M, NY); Amazonas: Chagas 1279 (fl.) (COL); Don sio s.n. (fl.) (INPA 4043); Mello 1998 (fl.) (COL, INPA, MG, U); Prance, Ramos, Steward & Pinheiro 11417 (fr.) (U); Rodrigues s.n. (= Pessoal de C.P.F. 1810 = Xyl. no X. 779) (fr.) (INPA, U); Rodrigues & Chagas 1825 (fl.) (INPA, U); Rodrigues, Co lho & Chagas 4810 (fr.) (INPA, U); Rodrigues, Osmarino 8206 (fl.) (INPA, U); Par a: herb. Schwacke 3489 (alab) (RB); COLOMBIA, Vaup s: Schultes, Baker & Cabrera 17933 (alab) (A, GH, US); FRENCH GUIANA: Cowan 38735 (fr.) (NY, P, U); Deward 149 (fr.) (CAY); de Granville 679 (alab., fr.) (CAY, P); Hall  1066 (fr.) (P); Leeuwenberg 11650 (fr.) (CAY, U, WAG); Oldeman 1100 (fr.) (CAY); 1580 (fl.) (CAY); 1727 (fl.) (CAY); 1807 (fr.) (CAY); 2129 (st.) (CAY); 2136 (st.) (CAY); B-2282 (fr.) (CAY); B-4040 (alab.) (CAY); T-854 (fl.) (CAY); Oldeman & Sastre 294 (fr.) (CAY); Sastre 294 (alab., fr.) (CAY); SURINAM: Cowan & Lindeman 39034 (fr.) (NY, U); Maas & Tawjoeran s.n. = LBB 10899 (alab.) (BBS, U); s.n. LBB 10969 (st.) (BBS, U).

R. amapensis is closely related to R. passoura (D.C.) Kuntze and to R. brevipes (Bentham) Blake. In these species the leaves are (secondary) opposite and the inflorescences are racemose, solitary, axillary or terminal. Dried branchlets of R. amapensis are porphyreous to greyish, those of R. passoura ferruginous; in R. brevipes they are reddish, shiny and covered by small white lenticels. In R. brevipes and R. passoura the costa of the leaves is puberulous above and appressed pilose underneath; domatia* are present. In R. amapensis the the costa is glabrous on both sides or nearly so and domatia are wanting. In this species the bractlets stand close together

* = erect tufted hairs in the axils of the costa and of some of the lateral veins on the underside of the lamina.

with the bracts; in R. passoura and R. brevipes bractlets are distinctly separated from the bracts. The indument, especially in the floral parts, tends to become white in R. amapensis and R. brevipes and ferruginous in R. passoura. Dried sepals in R. brevipes and particularly in R. passoura are ribbed, but those of R. amapensis remain smooth. The petals of R. amapensis are brownish pilose (lous) along the median parts, those of R. passoura are ferruginous strigose only along the costa. In R. brevipes they are glabrous. In R. passoura and R. brevipes stamens are 3.0-5.5 mm long, but in R. amapensis they are only 2.5-3.0 mm. In all the species the filaments and glands are free. The style of R. brevipes being 4.0-5.0 mm long, exceeds the surrounding stamens by 0.7-1.3 mm; those of R. passoura and R. amapensis are only 2.0-2.7 mm long, while 0.-0.5 mm exceeding the stamens. There are 3 x (1-2) ovules and seeds in R. amapensis and R. brevipes, but 3 x (2-4) in R. passoura. The seeds of R. amapensis and R. passoura are pilosellous, those of R. brevipes glabrous. R. amapensis is also related, though more remotely, to R. riana (D.C.) Kuntze as well as to the complex of R. camptoneura (Radlk.) Melchior, R. falcata (Martius) Kuntze and R. flavescens (Aublet) Kuntze. Dried branchlets of R. riana are mostly reddish shiny as in R. brevipes, but they are covered by larger whitish lenticels. The ovary of R. riana is erect strigose, which gives its characteristic "spiny" habit. Fruits of R. riana seem to be velvety since they are covered by dense short and loose long hairs; in R. amapensis they are only loosely pilose. In dried specimens of R. riana the indument is mostly chestnut brown, while the ovary is sometimes goldish. In R. amapensis the indument varies from whitish to dirty brownish. R. camptoneura, R. falcata and R. flavescens finally differ from R. amapensis by their glabrous petals and seeds.

All these mentioned species are dispersed over tropical South America, north of 15° S and occur as an undershrub in humid forests on slopes, along creeks and rivers from sealevel to submountainous areas. R. passoura has the largest area of distribution, reaching to the Panama Canal Zone. R. brevipes is dispersed over N. Brazil (Pará, Amazonas, Rio Branco), Guyana and Surinam, while R. amapensis has an almost similar distribution, occupying N. Brazil (Amapá, Pará), French Guiana, Surinam and S.W. Venezuela. These areas of distribution are rather small in comparison with other related species.

Most of the specimens in the Paris Herbarium (P) belonging to R. amapensis were erroneously determined as R. martini (Turcz.) Blake, which appears to be a synonym of R. passoura (D.C.) Kuntze (fide holotype of Alsodeja martini Turcz. in KW: Martin s.n., (fl.), Cayenne, French Guiana). The complete synonymy of R. passoura is now as follows:

Rinorea passoura (A.P. de Candolle mss. ex Gingins) Kuntze, Rev. Gen. Pl. 1: 42. 1891, cited as Rinorea passura Kuntze; Blake, Contr. U.S. Nat. Herb. 20(13): 507. 1924; Melchior, Nat. Pflanzenfam. ed. 2. 21: 452. 1925; Baehni & Weibel, Candollea 8: 195. Mai 1941;

Field Mus. Nat. Hist. Bot. 13(4(1)): 61. 30 June 1941.

Conohoria? passoura (A.P. de Candolle mss. ex Gingins in D.C. Prodr. 1: 312; 1824

Passoura guianensis (Aublet, Pl. Guian. 2 suppl. 21. t. 380. 1775.

type: Aublet s.n. s.d., alab.fl. fr. (lectotype, P Herbier Jussieu 12797+B), Habitat in sylvis Timoutou'French Guiana; non Rinorea guianensis Aublet!

Alsodeia guianensis (Aublet) Eichler in Martius Fl. Bras. 13(1): 387. t. 28. f. 2. 1871, pro parte, ex vars;

Alsodeia pubiflora Benthham in Journ. Bot. Hook 4: 106. 1842;

type: R.H. Schomburgk 573 (holotype, K Herbarium Benthamianum, cited as Alsodeia pubiflora)

Rinorea pubiflora (Benthham) Sprague & Sandwith in Sandwith, Kew Bull. 1931(4): 171. 1931; Lémée, Fl. Guian. Franç. 3: 60. 1953; Smith et Fernández, Caldasia 6(28): 107. 1954

Alsodeja martini Turczaninoff, Bull. Soc. Imp. Nat. Moscou 36(1): 557. 1863

type: Martin s.n. s.d., fl., (holotype & isotype KW), Cayenne, French Guiana; syn. nov.

Rinorea martini (Turczaninoff) Blake, Contr. U.S. Nat. Herb. 20(13): 506. 1924; Lémée, Fl. Guian. Franç. 3: 59. 1953; syn. nov.

Distribution: map 1.; Illustration: pl. 3, f. 12.

Rinorea passoura (D.C.) Kuntze var. andersonii Sandwith ex Hekking var. nov. forma andersonii, pl. 3, f. 13.

Rinorea pulleana Melchior nomen nudum, Nat. Pflanzenfam. ed. 2. 21: 352. 1925; Lémée, Fl. Guian. Franç. 3: 60. 1953.

Type: Fanshawe F 2463 = FDG 5199, 8 April 1945, (fl. fr.) (holotype K, isotypes NY, P, U, US) "Apparently a var. of pubiflora (= synonym of passoura). Leaves longer acuminate, more strongly + intricately reticulate underneath. Sepals + Petals more glabrescent (manuscript of Sandwith, in K)."

Habitat: In low bushes to dense humid forests; between rocks, on slopes of hills and along creeks; on clayish soils. Altitude: 0-500 m.

Distribution (map 1): Northern Brazil, Guianas, Venezuela, Colombia.

Vernacular names: "Mamusarê" (Guyana); "Pate grulla, Pate de paují" (Venezuela, Bolivar).

Additional material: BRAZIL, Amapá: Cowan 38525 (fl., fr.) (NY, P, S, W); Pará: Pires & Silva 4617 (fl., fr. juv.) (US); COLOMBIA,

Meta: Idrobo & Jaramillo 2059 (fl., fr.)(COL); Karsten s.n. (LE, W); Killip 34268 (alab., fr.)(COL, US); Triana s.n.(1851-1857) (alab., fl., fr.juv.)(G, K, NY, W); Vaupés: Fernández 1975 (fr.)(US); FRENCH GUIANA: Granville 22 (fr.)(P); GUYANA: Andersson 617 (fl., fr.)(K); de la Cruz 1437 (alab., fr.)(A, F); 2991 (fl., fr.)(A, F, MO, NY, PENN, UC, US); 3176 (fl., fr.)(A, F, MO, NY, PENN, UC, US); 3297 (fr.)(F, MO, NY, PENN, UC, US); Forest Department BG (= FDG) 2548 (fr.)(K); JB 2893 (fr.)(FHO, K); SURINAM: Maguire 22942 (fl., fr.)(F, MO, NY, P, U, US, VEN); 24122 p.p. (alab., fr.)(BR, K); VENEZUELA, Bolivar: Cardona 483 (fl., fr. juv.)(US, VEN 8730); Killip 37305 (fl., fr.)(VEN 8723); 37436 (fr.)(LIL, NY, US, VEN 8724); Williams, LI 11498 (fl., fr.)(MICH, US, VEN,8728).

A varietate passoura differt racemis magis laxifloris; staminibus reductis; thecis reductis sive absentibus; stylo pilosello sive strigilloso in basali parte; sepalis, petalis et staminibus subsistentibus in fructu.

Habit similar as in var. passoura, but indument less dense. Treelet or shrub, up to 7.5 m tall; bark bright greyish; wood white. Lamina usually longer and wider, (5.0)9.2-20.5 cm long, (1.8)4.0-8.5 cm wide; apex longer tapering, erect or falcate, (0.8)1.0-3.5 cm long. Racemes more laxiflorous, 1.0-20.5 cm long, (2.0)4.0-8.5 cm wide, tending to be longer than usual in var. passoura. Flowers and floral parts whitish or creamy with reddish brown indument, tending also to be longer than in var. passoura. Petals (4.0)4.5-6.5 mm long, 1.5-2.0 mm wide. Stamens 3.0-4.0 mm long; filaments reduced to filiform, 0.6-1.5 mm long, 0.1-0.4 mm wide; thecae reduced or even wanting, 0.0-1.5 mm long, 0.0-0.7 mm wide; glands reduced or wanting, 0.0-1.2 mm long, 0.0-0.3 mm wide; connective scales narrowed or if not than thecae reduced, 1.0-2.2 mm long, 0.2-1.3 mm wide. Style always strigillose near the base, 2.0-3.5 mm long. Capsula relatively less long and more elliptic ovate than usually in var. passoura; valves 2.0-2.8 mm long, 0.5-1.0 mm wide, green, sometimes deep red; seeds sometimes larger (3.0)4.0-7.0 mm long and wide, brownish pilosellous.

Rinorea passoura (D.C.) Kuntze var. andersonii Sandwith ex Hekking fo. leiosperma Hekking forma nova.

Alsodeia falcata Martius ex Eichler var. grandifolia Eichler in Martius Fl. Bras. 13(1): 386. 1871.

Type: Martius s.n. s.d. (alab., fr.)(lectotype Martius (123) M, isolectotypes Martius (124), (125), (126), (127) M)

"Habitat in sylvis ad Ega (= Teffe), Provincia Rio Negro, Brasilia."

Rinorea scandens Ule, Verh. Bot. Ver. Brandenburg 47: 157. 1905(1906); Blake, Contr. U.S. Nat. Herb. 20(13): 515. 1924.

Type: Ule 5018, October 1900, (alab., fl., fr.)(holotype B (burned), lectotype HBG, isolectotypes F (photograph + fragment), G, L) "Kletterstrauch, Blüten strohgelb, Itanga (Marary), Juruá, Estado de Amazonas, Brasilien."

A forma andersonii differt seminibus glabris.

This form differs by its glabrous seeds from forma andersonii. It is a small shrub or tree, up to 10 m. Flowers white to straw-yellow. Fruits green.

Type: Duque Jaramillo 2015, November 1945, (fragm.fl., fr.) (holotype COL) "Trapecio Amazónico entre ríos Loretoyacu y Hamacayacu, orilla del Loretoyacu, 250 m. alt. "Dep. Amazonas, Colombia.

Habitat: along rivers up to submountainous areas; altitude 50-250 m.

Distribution (map 1): N.W. Brazil, Colombia, Venezuela. Vernacular names: "Amé" (Venezuela, Apure); "Salao" (Venezuela, Bolívar).

Additional material: BRAZIL, Amazonas: Martius 123, (124), (125), (126), (127), (alab., fr.) (M); Ule 5018 (fl., fr.) (HBG, F, G, L); VENEZUELA, Apure: Veze 2337 (fl.) (VEN); 2438 (fr.) (VEN); 2448 (fl., fr.) (US, VEN); COLOMBIA, Amazonas: Duque Jaramillo 3202 (fl., fr.); Schultes 6918 (fr.) (COL); Caquetá: Romero Castañeda 4085 (alab., fr.) (COL); 4087 (fl.) (COL); Chocó: Duke 11286 (fr.) (U).

Additional material of var. andersonii s.l. (adult seeds wanting or not seen): BRAZIL, Rio Branco: Prance, Steward, Ramos, Farias & Monteiro 9519 (fruct.juv.) (U); COLOMBIA, Meta: Pinto & Sastre 945 (alab., fr. juv.) (COL); Triana s.n. (1856) (fl.) (COL); Vaupés: Allen 3324 (fl.) (MO, US); Cuatrecasas 7331 (fl., fr. juv.) (F, US); FRENCH GUIANA: Granville B-4494 (fr.) (P); GUYANA: Martijn 280 (fl., fr. juv.) (K); Schomburgk 774 p.p. (fl.) (CGE, G, K); SURINAM: BW (= Gonggrijp) 2088 (fr. juv.) (U); Irwin, Prance, Soderstrom, Holmgren 55497 (fl., fr. juv.) (COL, F, U); Tresling 463 (alab.) (MG, U); VENEZUELA, Bolívar: Blanco 679 (fr.) (VEN); Cardona 878 (fl.) (F, NY, US, VEN 8731); Killip 37271 (fl.) (A, F, K, NY, US, S, VEN 8722); 37305 (fl.) (US, VEN 8723); Williams, L1 11546 (alab., fr. juv.) (US, VEN).

Var. andersonii can be recognized by its slightly deviating habit. The leaves tend to be larger, stiffer, more shining and tapering with the margin more crenate or serrate. On the other hand the indument of all parts tends to be less dense. Stamens are gradually reduced to narrow ones with slenderized thecae or even to slender staminodes. This gradual reduction of the stamens is not yet understood, but a comparison can be made with the tropical Asiatic species R. virgata (Thw.) Kuntze which has reduction of the androecium as well as of the gynoecium. Gynoecium reduction is not observed in R. passoura var. andersonii.

R. scandens Ule is here reduced to synonymy under R. passoura var. andersonii fo. leiosperma, although in all the specimens seen of R. scandens seeds are wanting. However, in the original description the seeds were described as "glabris".

The distribution of the varieties and formae of R. passoura is given on map 1.

Rinorea lindeniana (Tulasne) Kuntze var. fernandeziana Hekking var. nov., pl. 3, f. 14.

Rinorea riana auct. (p.p.!), Smith & Fernández, *Caldasia* 6(28): 108. 1954.

Differt a varietate lindeniana basi foliorum symmetrica; inflorescentia solum racemosa, brevior et latior, 3.0-6.5 cm longa, 0.8 cm lata; sepalis longioribus 1.5-2.0 mm longis et latis.

It differs from var. lindeniana by its symmetric leaf bases; its inflorescences only racemose, relatively shorter and wider, 3.0-6.5 cm long, 0.8 cm wide. Flowers and floral parts tend to be larger e.g. the sepals in younger flowers are already larger, 1.5-2.0 mm long and wide; the petals are elliptic, already 3.0 mm long, 1.8 mm wide. The style is more or less clubshaped, slightly curved at the very base, completely glabrous, 1.2-1.5 mm long. Fruits are not seen. Shrub or small tree of + 3 m, flowers white.

Type: Fernández 365, 16 June 1950, (alab., fl.juv.)(holotype COL, isotype US) "Corédo, costa del Pácifico, Departamento del Chocó, Colombia."

Habitat: in rain forest; altitude 200-300 m. Distribution: Colombia (Chocó).

Additional material: COLOMBIA, Chocó. Rain forest on hill N. of Alto Curiche, Duke 11216(3), 19 May 1967, (fl.)(U); probably also: Hydro Camp no 14, R. Salaqui, 6 days upstream from R. Sucio, elev. ca 200 m, Duke 11374(3), 23 May 1967, inflorescence without flowers, (U).

The variety has often been determined as R. riana (D.C.) Kuntze. Although the habit at first glance is similar, most of the characters point at R. lindeniana, e.g. venation, absence of lenticels, bracts up to 1.0 mm (1.5 mm or more in R. riana), stamens up to 2.5 mm (longer in R. riana), ovary not erect strigose and style curved and glabrous at base (erect and pilosellous in R. riana). It is unfortunate that fruits of var. fernandeziana are unknown since those of R. lindeniana var. lindeniana and R. riana are quite different too.

Rinorea lindeniana (Tulasne) Kuntze var lindeniana is widely distributed over N. Bolivia, Peru, Colombia, Guyana, Surinam and Brazil (Acre, Rondonia, Río Branco and adjacent regions in Amazonas). Var. fernandeziana occurs only in Chocó, Colombia, and is separated from var. lindeniana by the Western Cordillera of the Andes. Var. lindeniana occurs as a small tree or shrub in rain- or submountainous forests, on slopes, between rocks and along creek- and river banks. The altitude varies from 100-1100 m. Var. fernandeziana is reported to tropical rain forest of 200-300 m high, presumably the same habitat as the preceding variety.

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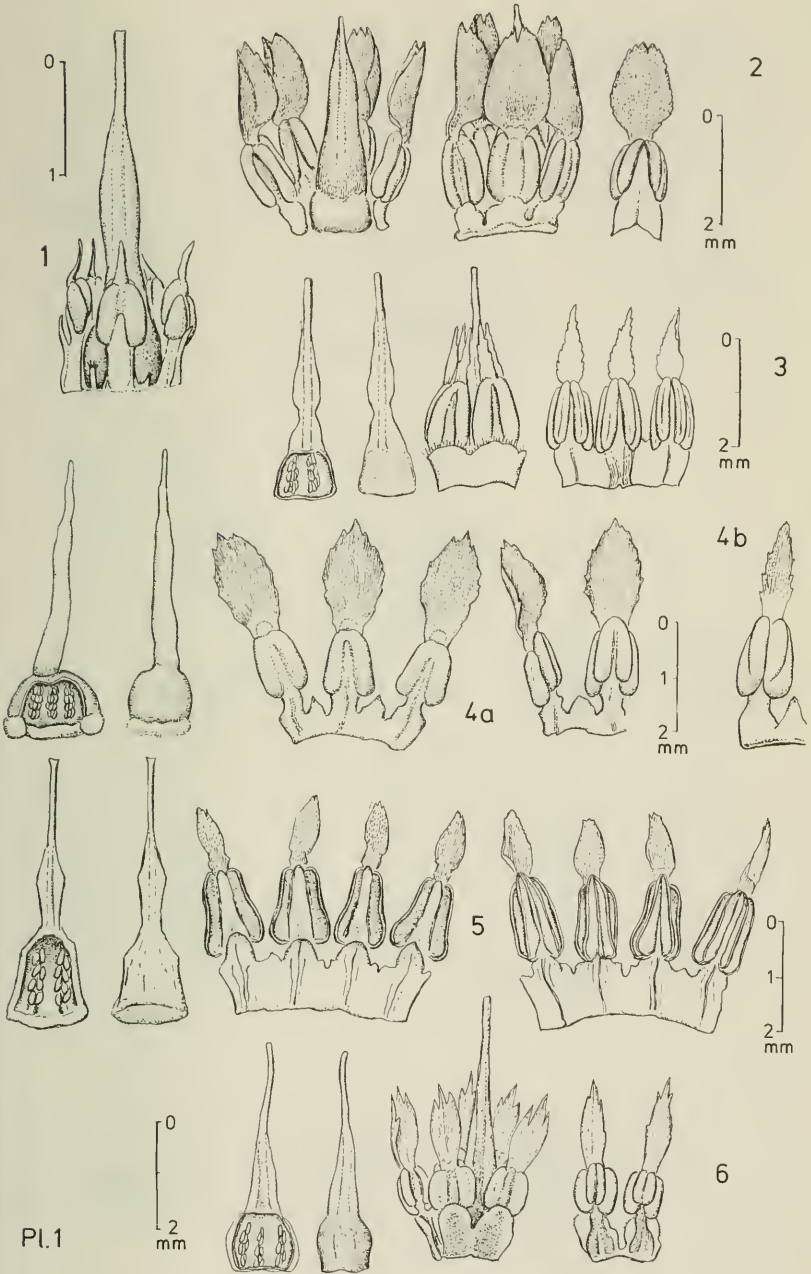
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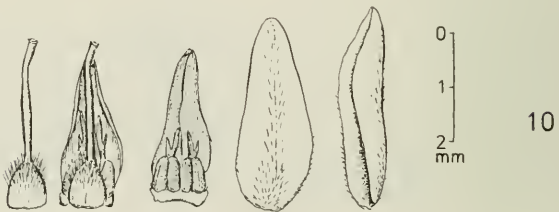
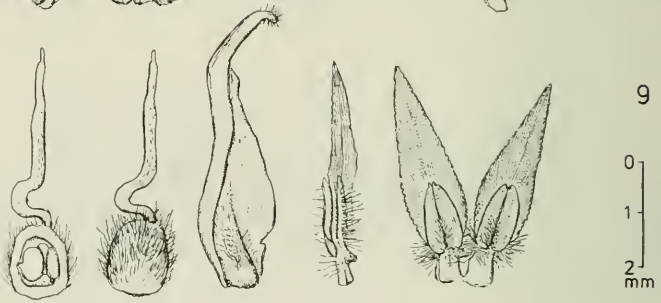
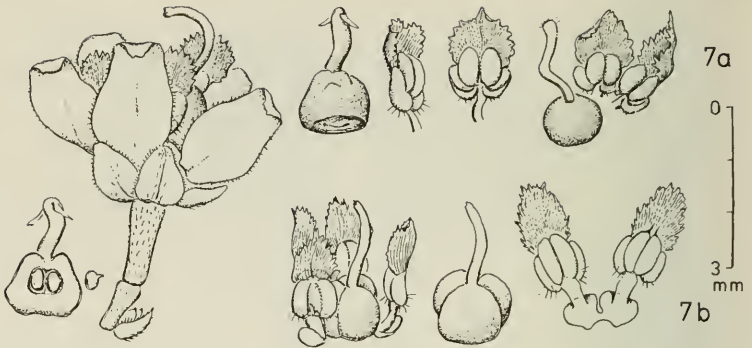
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ILLUSTRATIONS (by the author)

- Pl. 1., f.1. Gloeospermum grandifolium Hekking sp. nov.
(Little Jr 6405, type)
- f.2. Gloeospermum eneidense Hekking sp. nov.
(Dwyer 8225, type)
- f.3. Gloeospermum equatoriense Hekking sp. nov.
(Manuel Lugo 39, type)
- f.4. Gloeospermum falcatum Hekking sp. nov.
(4a: Little Jr 6528, type; 4b: Dodson & Gentry 6297)
- f.5. Gloeospermum longifolium Hekking sp. nov.
(Cuatrecasas 11143, type)
- f.6. Gloeospermum blakeanum (Robijns) Hekking comb. nov.
(Terry & Terry 1513, type)
- Pl. 2., f.7. Rinorea apiculatus Hekking sp. nov.
(7a: Woytkowsky 7536, type; 7b: Harling, Eliasson & Andersson 14781, paratype)
- f.8. Rinorea longistipulata Hekking sp. nov.
(Prance, Ramos & Farias 7623, type)
- f.9. Rinorea multivenosa Hekking sp. nov.
(Traill 22, type)
- f.10. Rinorea bicornuta Hekking sp. nov.
(Ducke s.n. RB 21.353, type)
- Pl. 3., f.11. Rinorea amapensis Hekking sp. nov.
(11a: Cowan 38121, type; 11b: Cowan 38254, paratype)
- Rinorea passoura (D.C.) Kuntze

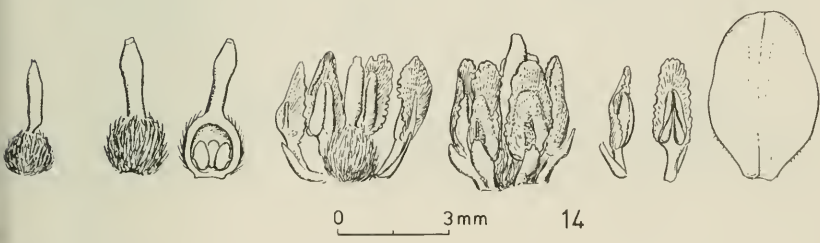
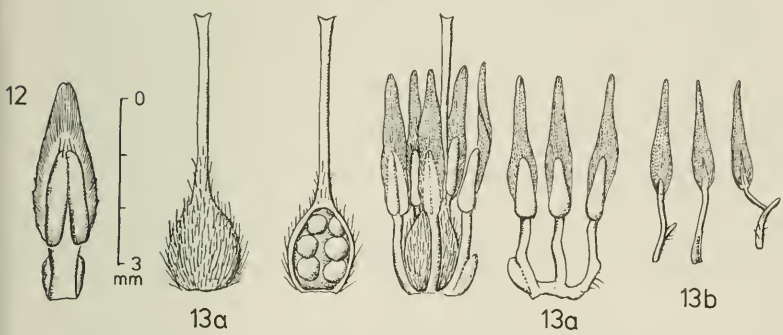
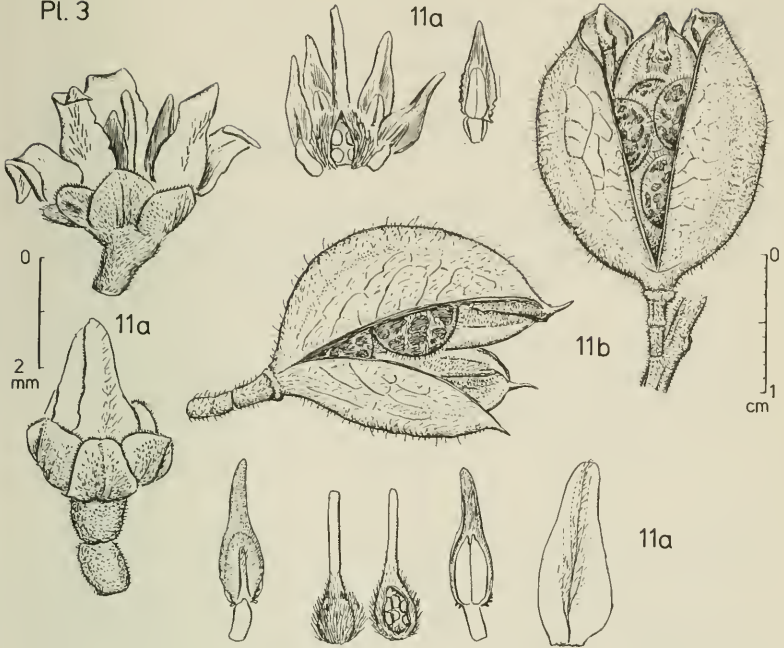
- f.12. var. passoura (A.C. Smith 2738)
- f.13. var. andersonii Sandwith ex Hekking var. nov.
fo. andersonii (13a: Fanshawe 2463 = FDG 5199,
type; 13b: de la Cruz 2911)
- f.14. Rinorea lindeniana (Tul.) Kuntze
var. fernandeziana Hekking var. nov.
(Fernández 365, type)

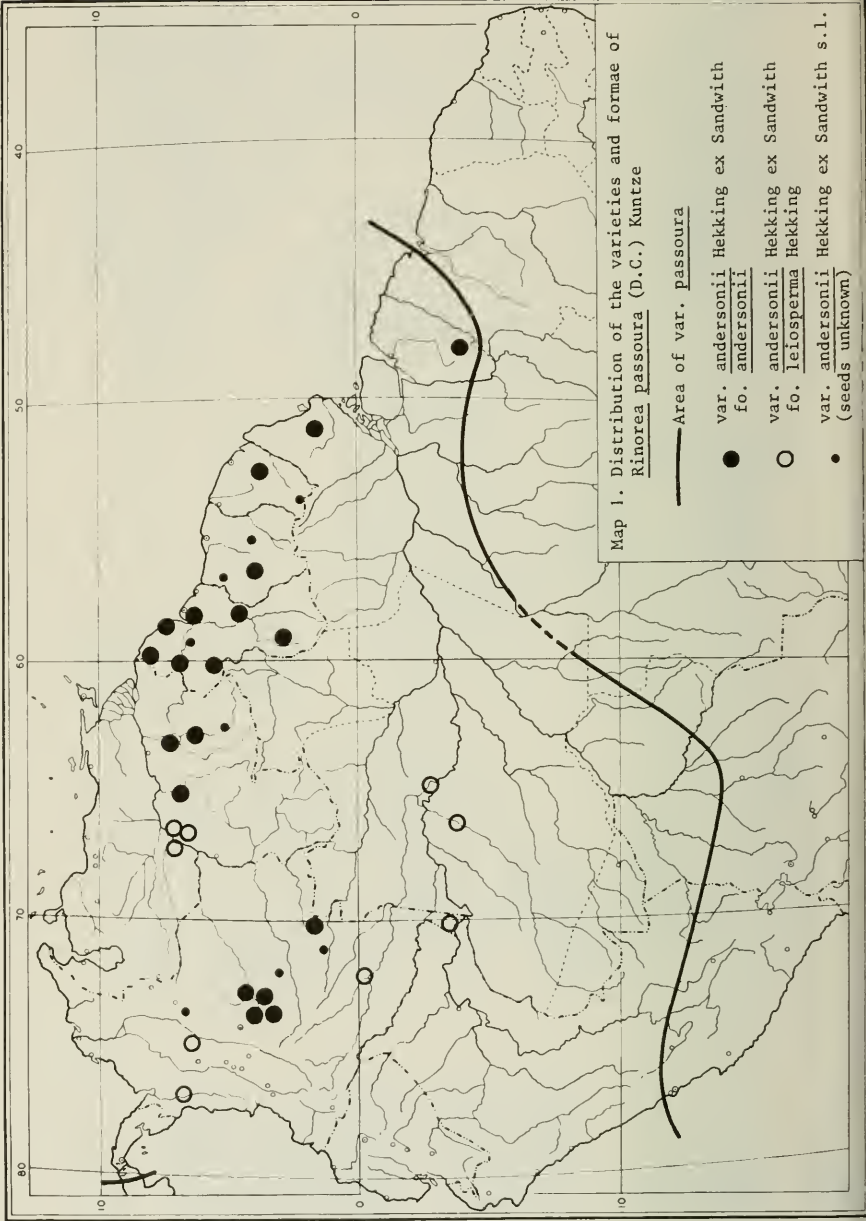




Pl. 2

Pl. 3





Map 1. Distribution of the varieties and formae of Rinorea passoura (D.C.) Kuntze

- Area of var. passoura
- var. andersonii Hekking ex Sandwith
- fo. andersonii
- var. andersonii Hekking ex Sandwith
- fo. leioperma Hekking
- var. andersonii Hekking ex Sandwith s.l. (seeds unknown)

BOOK REVIEWS

Alma L. Moldenke

"PRINCIPLES OF POLLINATION ECOLOGY" by K. Faegri & L. van der Pijl. Third revised edition. 1979.

This book was enthusiastically reviewed recently in *PHYTOLOGIA* 43 (3), but without the full information on prices provided by Pergamon Press. This paperback edition is listed as \$15.00 or £ 7.50 and the clothbound as \$25.00 or £12.50.

"ANATOMIE DES BLATTES. II. BLATTANATOMIE DER ANGIOSPERMEN. Entwicklungsgeschichtliche und topographische Anatomie des Angiospermenblattes" by Klaus Napp-Zinn, viii & 765-1424 pp., 650 b/w fig. & 280 tab. Gebrüder Borntraeger, Berlin & 7000 Stuttgart - 1, West Germany. 1974. Volume I. DM.250 & this volume II DM.213.

This is an excellently organized study of leaf and modified leaf anatomy and histology organized by the author who is known for his anatomical studies of Compositae leaves and involucre bracts. The explicative text describes the structure of all types of leaves and leaf parts in very many kinds of seed plants from all over the world. The detailed bibliography of almost 6,000 papers in divers languages covers the whole field worldwide through 1972. The illustrations are drawings usually given in exquisite detail. There is a separate taxonomic list by order, family and genus of the literature items of such scope. The author index has more than 3,000 names included. Therefore this work is obviously so thorough and encyclopedic that it is useful not only to plant anatomists but quite afield in phytopaleontology, pharmacognosy, fiber/food analyses, resistance breeding and forensic medicine.

It is a pity that the similar first volume on gymnosperms became "lost in the mails". It is a safe bet that it is equally well prepared.

"ANDERSON'S FLORA OF ALASKA and Adjacent Parts of Canada" by Stanley L. Welsh, xiii & 724 pp., 1 b/w map, 150 line draw. & 1 color plate. Brigham Young University Press, Provo, Utah 84602. 1974. \$29.95.

Jacob Peter Anderson (1874--1953) was well known for his botanical field work in Alaska and his wish to prepare a manual on which he made a considerable start, but Welsh's "volume is completely new as to text, keys, and illustrations....but designed to

retain the 'flavor' of Dr. Anderson's original." This fine work covers ferns, their allies, conifers and flowering plants; it is arranged taxonomically for these major groups and then alphabetically for families, genera and species. The keys indicate that they should work efficiently, the illustrations are precise, and the glossary helpful to those who need it. This is a worthwhile publication for field study courses at the colleges and universities in Alaska and western and arctic Canada and for naturalist-minded hobbyists living in these areas or visiting them, and, of course, for botanists in general.

"COMMON FOSSIL PLANTS OF WESTERN NORTH AMERICA" by William D. Tidwell, 197 pp., 91 color & 85 b/w photo., 6 tab., 1 map, & 561 line draw. Brigham Young University Press, Provo, Utah 84602. 1975. \$10.95 clothbound, \$7.95 paperbound.

"The [well fulfilled] purposes of this guide are to (1) discuss the various types of fossil plant preservation [as compressions, impressions, casts, molds and petrifications], (2) give an overview of the plant kingdom [which still uses the old-fashioned Thallophyta grouping], (3) explain how fossil plants are named [which should be a real help to amateurs and beginning college students], (4) discuss the development of western floras, (5) describe the more common elements of the fossil floras of this region, and (6) include some of the better known fossil-plant collecting sites." The many illustrations, glossary and carefully descriptive text make this study truly helpful.

"SUNSET NEW WESTERN GARDEN BOOK" 4th Edition by the Editors of Sunset Books & Sunset Magazine, 512 pp., 50 color photos, 16 maps, hundreds of color & b/w line draw., & 238 tab. Lane Publishing Co., Menlo Park, California 94025. 1978. \$9.95 paperbound.

It is amazing how much accurate horticultural information is crammed between the sturdy flexible covers of this book and how effectively and attractively it is all arranged. Geographically the area covered ranges from the Pacific Ocean coast east through Montana and south through New Mexico, all of which is varied enough to be divided into 24 climate zones. This new edition has all the well known advantages of the earlier editions to which are added (1) many lovely color photographs of layouts, etc., (2) the water requirements of plants, and (3) hundreds of line drawings in the encyclopedia section that now lists over 5,000 plants by common and scientific names with the latter checked by reference to "Hortus Third". Many of the small line drawings show diagnostic features or characteristic outlines that make the plants easily recognizable.

The appeal of this book because of both its content and format

makes it of interest to anyone interested in horticulture avocationally or professionally. The price is delightfully reasonable.

"AN INTRODUCTION TO POPULATION ECOLOGY" by G. Evelyn Hutchinson, xi & 260 pp., 142 b/w fig. & 14 tab. Yale University Press, London & New Haven, Ct. 06520. 1978. \$17.50.

This stimulating book is honed from the famous Hutchinson course on Ecological Principles for interested graduate and senior undergraduates at Yale. Going through this text with its copious and interesting footnotes almost gives the feeling of being there. Since "it is impossible to write about population ecology without using some mathematics....the amount employed here is pared down to a minimum" but including some linear algebra and integration and was distributed to the students at the first class session and appears in this book as an appendix entitled "Ratiocinator Infantium". The first chapter is an analysis of P. F. Verhulst's early mathematical model of a population not noticed for almost a century. And then Malthus' work is evaluated as are studies of mortality and longevity reduced to table form for man, insects, Dall sheep, other animals and plants, as well as fecundity patterns in plants and animals, predator-prey and symbiotic relationships, and the defining functionally of the niche. There is much more in this excellent study that is oriented toward patterns and principles that might be detected by sizing up the observations from the field or the laboratory.

P.S. In the preface the author makes a very, very important statement in tribute to the Peabody Museum: "At a time when such institutions do not take a very high place in the priorities of university administrators, I would emphasize the importance of a natural history museum with a really extensive collection in giving substance to names and ideas that might otherwise become meaningless abstractions."

"THE CARNIVOROUS PLANTS" by Francis Ernest Lloyd, xvi & 352 pp., 38 b/w plates, 9 fig. & 2 tab. Dover Publications, New York, N. Y. 10014. 1976. \$4.50 paperbound.

This book is an unabridged replication of the original 1942 excellent *Chronica Botanica* publication with the author's many detailed histological drawings of the various trap mechanisms (passive pitfalls, snares, fly-paper and active steel mousetraps) and his descriptive text of some 450 species on a worldwide basis, including some fungi. The higher plant families involved are the sarraceniacs, nepenthacs, droseracs, byblidacs, cephalotacs and lentibularacs. A lifetime of study is obviously involved. This book belongs on today's library shelf with the new works in the field with their gorgeous color plates.

"WILD FLOWERS OF THE PACIFIC COAST" by Leslie L. Haskins, viii & 407 pp., 182 b/w photo pl. Dover Publications, New York, N.Y. 10014. 1977. \$5.00 paperbound.

This is an unabridged copy of the 1949 edition which, in turn, had its origin in the 1934 edition to which was added a page of nomenclatural changes. It is a pleasant, popular, culturally annotated treatment of 332 native flowering herbs and shrubs characteristic of the humid coastal region of the North Pacific to the summit of the Cascades and from southern Alaska through northern California. The arrangement is by family, without keys, but with a good glossary, scientific and common name indexes, and many good photographs to help hunting.

"GROUND COVERS FOR EASIER GARDENING" by Daniel J. Foley, 224 pp., 104 b/w photo & line draw. Dover Publications, New York, N. Y. 10014. 1972. \$4.75 in Canada or \$4.00 in U.S.A. paperbound.

This unabridged (except for four color plates) reprint of the popular 1961 edition should also prove popular because of the author's continuing fine reputation as a horticulturist, landscapist and teacher through lecture and written word. Helping to choose "the right plant for the right place" there are 100 species (and more including their varieties) listed alphabetically by common name with their scientific names, their growing zone range, description, propagation and growing needs. The book is planned for the amateur gardener, but I know many professionals and trainees who use their copies often.

"NORTH AMERICAN BIRD EGGS" by Chester A. Reed revised by Paul A. Buckley, xii & 372 pp., 52 b/w photo pl. of nests with eggs & 566 photo of eggs, ca. 200 line draw. Dover Publications, Inc., New York, N. Y. 10014. 1965. \$5.00 paperbound.

Except for some needed modernization and clarification taxonomically explained in the new preface and a plea not to renew the egg collecting hobby of a couple of generations ago, this new edition is an "unabridged republication" of the original 1904 work. Dean Amadon's note consoles us with "Nowadays we are more interested in watching birds and studying their habits. It is a definite asset to the field man to be able to identify nests and eggs even when the parents are not in evidence". Eggs are photographed in proportionate sizes, described as well as the nests. There are marginal tiny sketches of hundreds of these egg-layers. This book is a classic made even more valuable by the revisions.

"1001 QUESTIONS ANSWERED ABOUT EARTHQUAKES, AVALANCHES, FLOODS AND OTHER NATURAL DISASTERS" by Barbara Tufty, xvi & 350 pp., 18 b/w photo pl. & 23 line draw. Dover Publications, Inc., New York, N. Y. 10014. 1978. \$4.00 paperbound.

This is an informative, but simple languaged, unabridged replication of the 1969 work which was then entitled "1001 Questions Answered About Natural Land Disasters". The queries are so logically ordered that, if omitted, the answers would read like helpful explicative text, carefully and simply developed, on the topics listed in the title as well as on volcanoes, tsunamis, landslides, droughts, fires and animal plagues. "Question 1001. What disasters has man caused unto himself? Possibly one of the greatest potential disasters to man is man himself.....increasing in tempo as man's ever-growing population assiduously pollutes the air, the water, the soil. Man's supreme folly is war."

"MEDICINAL PLANTS AND THEIR HISTORY" by Edith Grey Wheelwright, 288 pp., 9 b/w photo & 9 line draw. Dover publications, Inc., New York, N. Y. 10014. 1974. \$3.50 paperbound.

This popular interesting account "is an unabridged and unaltered republication" (except for half of the title) of the work entitled "The Physick Garden: Medicinal Plants and their History", originally published in 1935. Unfortunately, it perpetuates about a dozen misspellings, as of *Kola acuminata* on p. 30. The text is composed of chapters in reference to pre-historical times: early Asian, Mediterranean, Anglo-Saxon, the British Pharmacopoeia, English and European herbals, medicinal plant cultivation in England and elsewhere and just the beginnings of cytology and biochemistry of plant cells.

"ANNUAL REVIEW OF PHYTOPATHOLOGY" Volume 16 edited by Raymond G. Grogan, vii & 528 pp., 2 b/w photo, 5 fig. & 8 tab. Annual Reviews, Inc., Palo Alto, California 94306. 1978. \$17.00 U.S.A. & \$17.50 elsewhere.

This is one of the Annual Reviews that is regularly introduced by an interesting, informative and justly laudatory prefatory chapter which, in this case, is an autobiographical account of the training and professional life of A. A. Bitancourt and his role in phytopathology in the developing country of Brazil. There are 21 other papers including those on such topics as: intra- and inter-specific root graft transmission of tree pathogens, applications of plant virus serology, inter-continental epidemiology of Dutch elm disease (we have not heard the last of it yet), allelopathy in agro-ecosystems, genetics of horizontal resistance. According to the author, R. R. Nelson et al., "Vertical resistance and horizontal resistance.....are not indications of the action of

different genes, but rather are expressions of different actions of the same genes in different genetic backgrounds. There are, in fact, no major genes or minor genes. There are only genes for disease resistance....This concept implies that genes function vertically when they are separate and horizontally when they are together. Horizontal resistance appears to be controlled by several genes in most instances." As in the whole series reprints of individual papers may be ordered for \$1.00 each.

"ANNUAL REVIEW OF ECOLOGY AND SYSTEMATICS" Volume 9 edited by Richard F. Johnston, v & 618 pp., 47 b/w fig. & 20 tab. Annual Reviews, Inc., Palo Alto, California 94306. 1978. \$17.00 U.S.A. & \$17.50 elsewhere.

This is as usual a fine collection of 24 worthwhile papers with some of them about: Optimization of enzyme function "reached in which a biologically optimal balance is attained between catalytic efficiency.....and regulatory sensitivity; Optimization theory in evolution attempting to understand the diversity of life; Foraging strategies of insects for maximizing the net nutrient gain while minimizing the risks to survival; Lotka-Volterra population model with the reminder that extending the original models beyond their sensible limits produces results that may still be mathematically sound yet biologically irrelevant; Birds following army ants for the other insects that the latter flush; Convergence versus non-convergence in mediterranean climate ecosystems; Savanna vertebrate history; Origin of angiosperms as "monophyletic near the Jurassic-Cretaceous boundary by progenetic modification of caytoniaceous, corystospermaceous, or related seed ferns"; Speciation patterns in Amazonia which have origins that date, for the most part, from the Cretaceous onward and "intercontinental connections between Africa and South America".

"ANNUAL REVIEW OF PLANT PHYSIOLOGY" Volume 29 edited by Winslow R. Briggs, vii & 620 pp., 1 b/w photo, 48 fig., 15 tab. Annual Reviews, Inc., Palo Alto, California 94306. 1978. \$17.00 U.S.A. & \$17.50 elsewhere.

This book is composed of an interesting prefatory chapter "On the Interface of Horticulture and Plant Physiology" by J. B. Biale and 19 other well prepared papers on such divergent topics as: Delayed fluorescence in photosynthesis, Obligate photoautotrophy, Biological nitrogen fixation, Heterocysts, Sexual pheromones in algae and fungi widespread in their sex systems, Development of cell polarity, Plant productivity in the arid and semiarid zones, and Crassulacean acid metabolism with the prospect that "most rapid progress will emerge from studies of the inducible CAM described in Mesembryanthemum and others", and Energy coupling for membrane transport of the intensively studied major ions, with K⁺

and Cl^- still in doubt. In all volumes of these series carefully compiled bibliographies for each paper are of great value to readers of more than just passing concern.

"ANNUAL REVIEW OF PLANT PHYSIOLOGY" Volume 30 edited by Winslow R. Briggs, 671 pp., 9 b/w photo, 61 fig., & 12 tab. after p. 54. Annual Reviews, Inc., Palo Alto, California 94306. 1979. \$17.00 U.S.A. & \$17.50 elsewhere.

I did not have the chance to read the first couple of papers because this volume was defectively missing them, but the rest measured up to the expected high calibre of the Annual Reviews. Some of the papers in this volume consider (1) Polysaccharide conformation and cell wall function, (2) Central role of phosphoenol-pyruvate, a high energy compound, in plant metabolism which concludes "As befits an expanding research area, there are no clear conclusions, no broad generalizations; instead there are problems galore, loose ends to be taken up, and central problems to be attacked. What more could a research scientist ask for?", (3) Microbodies enzymatic in higher plants include glyoxysomes in fatty seedling tissues, peroxisomes in leaves and non-specialized microbodies in other plant tissues, (4) Fusicoccin's pattern for toxic effect and a concomitant useful application, (5) DNA plant viruses that are of two different groups biologically and biochemically, and (6) Cell biology of plant-animal symbiosis illustrated with a series of excellent transmission electron micrographs.

As in all numbers of the volumes of the different Annual Reviews there are full author and subject indexes.

"AUDUBON'S BIRDS OF AMERICA" by Roger Tory Peterson, 200 pp., 72 fullpage color plates & 30 small color plates. Crown Publishers, Inc., New York, N. Y. 10016. 1979. \$17.95.

The idea for this book is excellent because Roger Tory Peterson writes the introduction giving brief biographical details about Audubon's family life, his art training, his travels for bird painting and for publication, and for his "contribution for awareness which he more than anyone else seems to symbolize. That in itself is enough; awareness is inevitably followed by concern." Peterson, selecting his favorite plates, also provides descriptive and/or anecdotal text on facing pages with the common and scientific names of the birds on the plates reproduced from Audubon's paintings. For the screech owl plate Audubon stated that the gray bird was an adult and the two reddish ones were young, but Peterson says that actually they are "color phases" which may "often be paired, or they may be the products of the same brood". A few of the very bright colors are printed so strongly that feather texture seems to suffer. What a lovely gift to give or to receive!

"BOTANICAL ILLUSTRATION" by Ronald King, 104 pp. & 40 full-color plates, 15 b/w fig. & 8 photo. Clarkson N. Potter, Inc., distributed by Crown Publishers, Inc., New York, N. Y. 10016. 1979. \$14.95 clothbound & \$6.95 paperbound.

This book is a source of delight for those interested in the topic as well as for those who enjoy either botany or art or just beautiful renditions of things. Ronald King, who chose the plates, provided their legends and wrote the introduction, has spent his professional lifetime among such sources since he was formerly Secretary of the Royal Botanic Gardens at Kew. The printing of the plates is of particularly superior quality for such reasonably priced books. On p. 5 there is a too small reproduction of a frame with a mandrake being painted possibly by Kratueas while Dioscorides consults a book. The details are virtually lost on this part of the "Codex Vindobonensis". Here is a sampling of the diversity and the fame of these beautifully reproduced plates: Pl. 2, Dürer's "Das Rasenstück", 1503, the first ecological study or turf plant association, Pl. 20 Francis Bauer's unusual *Erica sebana*, 1796: He is regarded by the author and many others "as the finest botanical artist of all time", and Pl. 39 Anne Ophelia Dowden's tree peony or moutan published here for the first time.

"THE LIFE AND LORE OF THE BIRD In Nature, Art, Myth, and Literature" by Edward A. Armstrong, 272 pp., 217 b/w & 32 color plates. Chanticleer Press Edition for Crown Publishers, New York, N. Y. 10016. 1975. \$15.95.

This is an effectively organized, copiously and very well illustrated compendium as is typically expected of Chanticleer Press work. It makes a fine addition to public, school and ornithophile libraries. "By reason of the opening up of previously inaccessible parts of the world and the knowledge already amassed, we are in a better position than any of our predecessors to review the role that birds, and other animals, have played in religion, magic, mythology, ritual, art and in influencing man's response to his total environment, seen and unseen. There is an endless fascination in exploring these relationships." There are also chapters on the evolution of birds, their flight, song and dance, their use in sport, their feather finery, and endangerment. Then, as frosting perhaps on this avian cake, an appendix gives selections of great and familiar writings about birds by Paul A. Zahl, Aldo Leopold, Gustav Eckstein, Marjorie Rawlings, Sigmund Olson and Konrad Lorenz.

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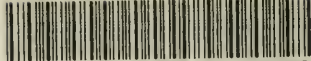
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