

Ramalina Ach. in Luyken
(LECANORACEAE: RAMALINACEAE)

After Numerous Authors, Who Often Contradict Each Other

Rev. 5/94

Thallus fruticose, erect or pendulous, heteromerous; tissues radially arranged; branches single to numerous, generally markedly compressed (bilaterally flattened) and strap-shaped, sometimes dorsiventrally differentiated but usually not, rarely \pm rounded or angular in section; bilaterally symmetrical in cross-section, or sometimes channelled; occasionally fenestrate (netlike in one species of Ramalina s. str.; \pm inflated and perforated in "Fistulariella"), simple to much branched, the branching dichotomous to irregular, rarely palmate; surface sometimes with pseudocyphellae or pale striae; all surfaces corticate. Cortex with thin, indistinctly plectenchymatous layer of anticlinal hyphae, usually overlying a \pm well developed, cylindrical, continuous zone or net of prosoplectenchymatous "mechanical tissue", strengthened by chondroid fibers of thick-walled periclinal hyphae which may form a continuous ring (chondroid tissue absent in R. lacera and some others, which may belong in segregate genera), invaded by the photobiont zone on its inner side; medulla white, usually sparse and laxly arachnoid, sometimes completely absent when the branches are \pm hollow ("Fistulariella"), rarely dense and opaque; attached to substrate by a restricted or spreading basal disk or holdfast, rarely unattached and straggling. Soralia frequent.

Apothecia apical or subapical, marginal or laminal, sessile or shortly stipitate, often on angled branches, peltate or cup-shaped; disc concave, pale green, brownish or pinkish yellow, sometimes whitish or pinkish pruinose; thalloid exciple persistent to almost excluded; hypothecium pale; paraphyses unbranched; asci clavate to elongate-clavate, Bacidia-type, unitunicate, 1+ blue; spores 8, ellipsoid to broadly ellipsoid or fusiform, sometimes curved (\pm reniform), 1(-3)-septate, hyaline, thin walled.

Pycnidia wholly or partly immersed, laminal or subterminal; wall and ostiole pale or (Niebla only?) blackened; conidiogenous cells subcylindrical, enteroblastic, acrogenous (exobasidial); pycnospores colorless, bacilliform, straight, 3-5 x 1-2 μ m. Cortex with usnic acid (often only in traces); medulla often with diverse phenolic acids (depsides or depsidones) or aliphatic compounds (mainly? fatty acids). Photobiont Trebouxia. On bark or rocks, in \pm humid areas, mostly tropical to temperate (to arctic in some "Fistulariella" species).

Separated from Pseudevernia and Evernia (E. prunastri) by the thallus being generally uniformly green on all surfaces (sometimes paler on one side, but not white). The thallus is usually harder and stiffer than that of Evernia.

Ramalina in the strict sense is characterized as follows: Cortex two layered: thin gelatinous matrix above periclinal array. Supportive chondroid strands usually attached to cortex. Pseudocyphellae often present. Apothecial margin concolorous with thallus. Pycnidia usually pale; exobasidial. Orcinol meta-depsides, para-depsides, 3-orcinol depsidones, rarely atranorin. High in O-methylation.

I. Thallus inflated and \pm hollow (Fistulariella)

(after Rundel & Bowler, unpubl., and Thomson, 1984)

1. Sorediate 2

1. Not sorediate. [Note: R. fastigiata may also key out here; R. almquistii may possibly have occasional soredia on the lobe tips]

2. Soralia helmet-shaped. [Species not treated as Fistulariella by Bowler & Rundel] 3

2. Soralia not helmet-shaped. 4

3. Containing evernic and obtusatic acids. Soralia mostly terminal, cupuliform (helmet-shaped) or occasionally labriform; soredia farinose. Thallus tufted, to 3 cm tall, partly hollow with a few fenestrations; branches 1.5-4 mm broad; cortex shiny smooth or obscurely spotted, pale green to straw-colored, pellucid when wet. Medulla KC-, containing evernic and obtusatic acids. Apothecia unknown. On twigs of coniferous and deciduous trees in the boreal forest, rarely on rocks. Temperate or boreal (to Arctic). Great Lakes area; California. (Ramalina obtusata)

3. Containing divaricatic acid. Thallus forming pulvinate to ragged tufts, scattered or forming swards; branches pale gray-green or dull green, \pm matt, broadening from base, sometimes tapered toward apices, compressed, internally solid or partly hollow with a lax, arachnoid medulla. Soralia mostly towards apices, lateral or subterminal, in rupturing helmet-shaped vesicles, or released from irregular lacerations of cortex; soredia 20-40 μ m diam., farinose. Apothecia very rare, marginal or on surface. Spores 15-21 x 6 μ m, broadly ellipsoid or \pm kidney-shaped. Medulla and soralia P-, K-, KC-, C-, UV \pm blue-white (divaricatic acid). On twigs and branches of shrubs and hardwood trees in well-lit situations; in British Isles also reported on rocks in dry underhangs. Baja California; Channel Islands of S. California. (R. canariensis)

4. Usually on bark. Thallus loosely tufted, erect to slightly pendent, attached by a holdfast, 1-4(-6) cm long, finely branched; main branches 1-2 mm broad; secondary branches often at right angles to the primary, toward the tips attenuated, finely dissected, multifid-dendroid, terete, often hooked, with soralia terminal or subterminal,

punctiform, with granular to isidioid soredia. Surface smooth, shining, \pm abundantly fenestrate, pale green. Apothecia very rare, small, subterminal; spores straight, 11-16 x 5-6.5 μ m. Thallus K-, C-, P-, containing either divaricatic acid or sekikaic acid agg. On branches of conifers in open forests, not abundant. Arctic-Boreal, eastern and western, southward along Pacific coast into Washington. R. roesleri

4. On rock. Branches dichotomous, coarse and flattened to tubular, with maculiform soredia towards the ends. Thallus tufted, 15-25 mm tall. Apices acute; surface smooth, shining, without pseudocyphellae. Apothecia unknown; black pycnidia common. Containing sekikaic acid and possibly also ramalinolic acid. (If divaricatic acid present, see R. almquistii). Near the sea, northern Pacific coast of Alaska. R. scoparia

5. On soil or rock, Arctic. Containing divaricatic acid or unknown. Thallus tufted, 6-24(-65) mm tall; branches terete or partly flattened, inflated, with few fenestrations (mainly towards base), pale to dark yellow. 6

5. On bark. Boreal and Pacific coast. Apothecia terminal, 3-5 mm wide; disk yellowish tan. Thallus pale yellow-green, fragile, tufted; branches round to flattened, somewhat inflated, ca. 1 mm diam., \pm regularly perforated with elongate holes. Thallus K-, C-, P-, containing divaricatic acid. On broadleaf trees (especially apple trees at least in California) in open forests or woodlands. 7

6. Lateral to subterminal apothecia and pale pycnidia present; thallus coarse; cortex glossy, opaque. On rock, North Pacific coast, Alaska, east to north-central Northwest Territories. Apothecia to 4 mm broad; margin concolorous with thallus, the underside smooth; disk pale brownish, epruinose; spores oblong with rounded apices, straight, 11-13 x 4-5 μ m. R. almquistii morphotype 1

6. Apothecia and pycnidia absent; thallus smaller, cladinaform; cortex translucent. On soil, inland areas. R. almquistii morphotype 2

7. Branches relatively compressed, abundantly branched. 8

7. Branches strongly inflated and robust, sparsely branched; apothecia very broad. Pacific coast and northern Rocky Mountains. R. sp. (undescribed)

8. Thallus usually under 15(-20) mm tall; branching compact. Thallus usually forming neat rounded tufts 2 cm across, arising from an expanded holdfast, yellowish green to greenish gray, branching freely,

and finely, often somewhat spiky in appearance, slightly inflated, with few or many round or elliptical holes, otherwise smooth, flattened at base but less so towards tips, under 3 mm across. Apothecia common, near tips of the branches so that often the branch tip forms a little spur below, to 2 mm across; discs at first concave, later convex, dull pink, pruinose; margin a slightly deeper color, becoming excluded. Thallus K+ transient yellow, P+ yellow to gray, C- (divaricatic acid). On tree trunks and small twigs. Northeast U.S. and Canada and Great Lakes Region according to Bowler & Rundel; also coastal forests in California (500-2000 ft elev.) and the northern Rockies according to Hale, but his concept was broad and probably included other species. R. dilacerata

8. Thallus commonly over 20 mm tall; branching open. Pacific coast (including California and Oregon) and northern Rocky Mountains. Also reported from the West Indies by Landrón, who lumps the two species below under R. inflata. The distinctions between them given below are based mainly on Galloway's descriptions of material from New Zealand. Stevens accepts the two species as distinct, though with some doubt expressed. 9

9. Branches to 1.5 mm broad at base, narrowing to 0.3 mm at tips, slightly flattened or rarely subterete. Apothecia numerous, subterminal or marginal, with a well-defined spur (geniculate), 1-3 mm diam., rounded, sub-pedicellate; thalline margin smooth, concolorous with thallus, becoming excluded when old; disc plane or convex, pale yellow-pink with a thick glaucous-yellow pruina; spores 6-8/ascus, biseriate, straight or curved, (10-)12-14 x 5-6 μ m. Thallus C-, P- K-, or P+ faintly yellow, K- or faintly yellowish or reddish (divaricatic in the type according to Landrón and to Stevens; sekikaic acid, with ramalinolic or trace of salazinic have also been reported). Thallus loosely tufted, to 30 cm tall, of dichotomously branched laciniae. Branches smooth or in places obscurely faveolate but not canaliculate, \pm fistulose, here and there with rounded holes to 0.5 mm diam., exposing hollow cavity of interior; surface pale greenish yellow or glaucous, shining. On shrubs or in canopy twigs on small trees, mainly coastal and lowland. Pacific Coast and northern Rocky Mountains. Bowler (1987) refers to this as "auct." R. geniculata (= R. inflata according to Landrón)

9. Branches to 3 mm broad, subterete, inflated, rarely compressed. Apothecia rather rare, terminal, 3-6 mm diam., subpedicellate; disc pale yellowish-glaucous, plane or convex, rarely concave; spores 10-11 x 5-6 μ m. Thallus P-, K-, C- (divaricatic acid in the type according to Landrón and according to Stevens; can also have accessory nordivaricatic acid and sekikaic acid). Thallus to 50 mm tall, sparsely dichotomously branching; branches fistulose; tips obtuse; surface shining, pale greenish yellow; cartilaginous strands obvious, discontinuous, with large

perforations or many small punctures. On shrubs, coastal and lowland. Pacific Coast and northern Rocky Mountains. Bowler (1987) refers to N. American material as "R. inflata auct.", implying that it may not be the same as the typical material from the southern hemisphere. R. inflata (J. D. Hook. et Taylor) J. D. Hook. et Taylor ssp. inflata

**Ila. Solid; Sorediate;
branches terete, to 1 mm diam.;
thallus often becoming pendulous.**

1. Branches often hooked fiddlehead-like around a few coarse soredia. Cortex poorly developed, with a thin layer of fibrous periclinial hyphae longitudinally oriented over the chondroid inner layer. Thallus threadlike, pendent or prostrate; branches terete, interwoven, divergent or closely angled; tips thin, filamentous; surface smooth, glossy, rarely with a few oval pseudocyphellae. Thallus K-, Pd- (usnic only, or occasionally an unknown). On conifers (especially on spruce twigs) and broad-leaved trees, in moist, sheltered woodlands, occasionally on rock, boreal ((SE to SW Canada, north to southern Alaska, south to NW Montana). R. thrausta

1. Branch tips without hooks. Cortex ? 2

2. Thallus pendent. Surface tuberculate (according to ?; not tuberculate but with pale warty areas especially at the tips, according to Moore). Thallus filamentous, fragile, to 6 cm long, much branched; filaments to 1 mm diam.; tips filiform and nodulose; surface nitid; cortex rigid. "Soredia" warty. Medulla K+ red, P+ orange (salazinic major, norstictic trace), or K-, P- (divaricatic). Apothecia infrequent, 1-3 mm across, marginal, concave; disk pale brown, pruinose; spores ellipsoid, substraight, 10-15 x 3-4.5 μ m. On trees and rocks, suboceanic, acidophilous, hygrophilous, thermophilous and photophilous. Tropical. Florida everglades, rare.
(see R. dasypoga)

2. Thallus decumbent, forming a dense tuft up to 1.5 cm thick. Branches solid, 0.1-0.3 mm wide, terete to subterete, contiguous; surface smooth, nitid; apices tapering, often ending in granular (30-50 μ m diam.) soredia; soralia terminal or laminal on main branches; pseudocyphellae indistinct, small, flat, orbicular, often becoming sorediate; cortex distinct, ca. 20 μ m thick; chondroid tissue cracked. Usnic and salazinic acids. On rock. Mexico; also United States. R. rigida Pers. ex Ach.

**II-b-1. Solid; Sorediate;
branches flattened to compressed or canaliculate.
Growing in tropical or subtropical areas.**

1. Medulla K+ red, Pd+ red (salazinic), C-, KC-. On bark. Soralia among cluster of terminal branches; thallus 2(-6) cm tall, not pendulous; branches linear, compressed, canaliculate, ending in dichotomous tips; surface pale stramineous, scrobiculate, often minutely punctiform. Soralia globose, to 4 mm across, marginal and terminal. Apothecia to 5 mm diam., both lateral and dorsal to the channels; disc concave or convex, almost red, pruinose. Spores subfusiform, straight or bent, 12-16 x 3-4.5 μ m. On bark, \pm tropical.R. sorediantha

1. Medulla K- or K+ faint pink, P-. 2

2. Branches up to 3 mm wide; soralia terminal or subterminal. 3

2. Branches less than 1.5 mm wide; soredia mainly marginal. Medulla K-, C-, P-, or K+, C+, and KC+ faint pink (sekikaic, homosekikaic, ramalinolic, and related substances). Thallus delicate and fragile; branches 0.1-0.9(-1.5) mm wide, flattened, becoming terete or subterete towards apices, densely branched. Soralia mainly marginal, rarely laminal, often \pm knobby-protuberant, eroded, 0.05-0.6(-1.2) mm wide, punctiform or ellipsoid, often giving rise to minute branchlets which are deformed or granular; soredia farinose, white or greenish. Thallus erect, shrubby, 2-4(-8) cm tall, densely and intricately dichotomously branched; branches greenish-gray or sordid gray, solid, linear, weakly striate or ridged or subfenestrate in basal parts, pseudocyphellate, granulose; margins undulate; apices multifid; cortex with cartilaginous strands seen through the thin outer layer. Apothecia rare, 1-2 mm across; disc concave, brown; spores subfusiform or ellipsoid, \pm straight, 10-17.6 x 3-4.5 μ m. On trees (e.g., royal palms) and shrubs. Florida (the Everglades) according to Landrón; not listed for N. America by Stevens; California. Compare with R. dendriscoides.R. peruviana

3. Soredia farinose. 4

3. Soredia granular, often with short secondary branches. 5

4. Soralia helmet-shaped, developing on lower surface of branches. Sekikaic or boninic acid major. Thallus shrubby, growing from a narrow holdfast. Soralia terminal. Pseudocyphellae sparse, punctiform. Chondroid tissue non-cracked. Branches to 3 mm wide; soralia terminal or subterminal. Branches dorsiventral to canaliculate. Thallus shrubby or caespitose, < 7 cm long. Branches solid. On bark. Also see Marcano & Morales Mendez, 1994, Tropical Bryology 9: 187-

199. R. cochlearis Zahlbr.

4. *Soralia capitate*, developing on the upper surface of branches. Soredia farinose. Branches to 3 mm wide; soralia terminal or subterminal. Branches dorsiventral to canaliculate. Thallus shrubby or caespitose, < 7 cm long. Branches solid. Race 1: sekikaic. Race 2: salazinic, often with small amounts of atranorin. See Kashiwadani, 1987. Peruvian species of Ramalina. R. subpollinaria Nyl.

5. *Soralia* on tips of secondary branches; boninic acid absent. Thallus shrubby; surface smooth. Thallus to 5 cm high, densely and intricately branched; branching irregularly dichotomous; branches flattened (but terete or subterete at the axils), dendroid, to 2 mm broad at the base. Thallus K+ red, P+ orange, with salazinic (in the type, according to Landrón), or K-, Pd-, with sekikaic (according to ?). Soredia granular, in small, semi-globose heads at tips of terminal or short lateral branchlets. Cortex thick, cartilaginous. Apothecia rare, lateral, 0.4-4.0 mm across; disk pale; spores ellipsoid or slightly bent, 6-16 x 3-3.5 μ m. On palms or other trees, fenceposts, or in dry scrub (rarely on calcareous rock), at low to moderate elevations. West Indies and Costa Rica; report from Florida is based on R. peruviana according to Landrón. R. dendriscoides

5. *Soralia* on main branches; boninic acid present. Boninic, 2'O-methylsekikaic and 4'O-methylpaludosic acids. Thallus corticolous, 3-5 cm long, dichotomously or irregularly branched, growing from a narrow holdfast; branches greenish yellow, solid, dorsiventral, main branches strongly canaliculate to irregularly unfurrowed, 0.5-1.5(-2.5) mm wide, distal branches attenuate, often ending in cylindrical branchlets, sorediate; soralia marginal or laminal on main branches; pseudocyphellae sparse, orbicular, often turning into soralia; thallus 200-350 μ m thick; cortex indistinct; chondroid tissue continuous, not cracked. Apothecia very rare, laminal, to 3 mm diam.; disc concave or flat; thalline exciple pseudocyphellate, spurred; ascospores short-fusiform, straight to weakly curved, 10-12 x 4 μ m. Usnic, boninic, 2'O-methylsekikaic and 4'O-methylpaludosic acids, possibly also 4'O-methylcryptochlorophaeic acid. On Quercus, Mexico: Chiapas. R. asahinae W. Culb. & C. Culb.

ADD?

R. farinacea

R. pollinaria

**II-b-2. Solid; Sorediate;
branches flattened to compressed or canaliculate.
Growing in temperate, boreal, or arctic areas,
or in the Sonoran Desert region.**

1. Cortex single-layered; branches broad, often decorticate on one side. *R. lacera* s. lato ("Dievernina"; will be placed in a new genus). 2

1. Cortex not single-layered. 3

2. Thallus flaccid when dry (medulla arachnoid, cortex under 30 μ m thick); with orange cephalodia. Soralia rather diffuse over the surface, in large laminal and marginal soralia. Branches to 5 mm wide. Medulla and soralia K-, Pd-, C-, KC-, UV- (bourgeanic acid). Thallus ranging from a single, often \pm convoluted lobe to \pm densely tufted, forming ragged clusters, erect or \pm pendent to partly decumbent; branches strap-like, flattened, concolorous or lower side paler, often with indented margins, with or without twisted and deformed marginal prolongations; surface matt, often \pm peeling, smooth or with a coarse reticulum of anastomosing ridges. Medulla dense, without prosoplectenchymatous tissue, without chondroid tissue. Soredia 20-40 μ m diam., farinose, derived from medulla, forming \pm ulcerose patches. Apothecia rare. Polymorphic. Mainly on wayside trees or scrub near the coast, usually in well-lit sites, also on rock in dry, sheltered situations, southern California; rare, may be nearing extinction because of development. *R. lacera* s. str. (synonym: *R. duriaei*)

2. Thallus rigid, at least when dry; without cephalodia. Branches to 4 cm wide. Mechanical tissue (inner cortex) lacking; surface reticulately wrinkled. Containing bourgeanic acid, plus either norstictic or salazinic acids. Laciniae developing from a broad holdfast, to 6 cm long, palmate, cuneate, or sublinear, sparingly divided, 0.5-6 cm broad, yellow-gray to pale yellow-green, smooth or scabrose, \pm reticulately ridged or cracked, with delimited, ulcerate areas on both sides producing granular soredia or corticate granules. Cortex one-layered (most other *Ramalina* spp. have two-layered cortex). Apothecia and pycnidia unknown. On rock in dry, sunny, exposed habitats, California. Somewhat similar to *R. pollinaria* but larger. *R. evernioides* (= *R. maciformis* according to Krog & Osthagen, 1980; = a European name erroneously applied to *R. lacera* according to Riefner & Bowler, 1994, but not a synonym of *R. lacera* as stated by Esslinger & Egan, 1995; N. American reports are misidentifications of *R. canariensis*)

3. Soralia bursting open; soredia farinose. Thallus tufted, mostly 1-2 cm tall. K-, P-. On bark or rock. 4

3. Soralia not bursting open. 6

4. Divaricatic acid. Soredia parietal, often blue-green. Lobe apices acute to attenuate; distinct chondroid tissue present. Thallus forming pulvinate to ragged tufts, erect to subpendulous, scattered or forming swards; branches pale gray-green or dull green, \pm matt, smooth, broadening from base, sometimes tapered toward apices, compressed, internally solid or partly hollow with a lax, arachnoid medulla. Soralia mostly towards apices, lateral or subterminal, in rupturing helmet-shaped vesicles, or released from irregular lacerations of cortex; soredia 20-40 μ m diam., farinose. Apothecia very rare, marginal or on surface. Spores 15-21 x 6 μ m, broadly ellipsoid or \pm kidney-shaped. Medulla and soralia P-, K-, KC-, C-, UV \pm blue-white (divaricatic acid, faint traces of nordivaricatic, \pm faint traces of unidentified possible triterpenes). On twigs and branches of shrubs and hardwood trees in well-lit situations; in British Isles also reported on rocks in dry underhangs. Baja California Norte & Sur; Channel Islands and other coastal areas of S. California. R. canariensis Steiner

4. Evernic and obtusatic acids. 5

5. Soralia laminal to terminal (or occasionally marginal), maculiform, often seemingly labriform at the tips, irregularly formed and spreading, not well defined; soredia somewhat granular.

Branches usually relatively broad (1-2 mm). Thallus K-, C-, P-, containing evernic acid agg. and (sometimes?) obtusatic acids. Thallus separate or in swards, 1-2(-6) cm tall, usually much branched, the lobes flat to terete, especially towards the apices, with numerous nodulose proliferations, sometimes deeply notched or incised; surface smooth, shiny, appearing cartilaginous; large lobes slightly foveolate. Medulla with prosoplectenchymatous tissue. Apothecia rare. On bark and twigs of conifers and broadleaf trees, dead wood, and rocks (usually steep or overhanging surfaces in sheltered areas). Boreal-temperate, in Pacific NW west of Cascades, California; mountains of AZ, NM and CO; Great Lakes to New England; and Arctic; rather rare. R. pollinaria

5. Soralia mostly terminal, cupuliform (helmet-shaped) or occasionally labriform; soredia farinose. Thallus tufted, to 3 cm tall, partly hollow with a few fenestrations; branches 1.5-4 mm broad; cortex shiny smooth or obscurely spotted, pale green to straw-colored, pellucid when wet. Medulla KC-, containing evernic and obtusatic acids. Apothecia unknown. On twigs of coniferous and deciduous trees in the boreal forest, rarely on rocks. Temperate or boreal (to Arctic). Great Lakes area; California. R. obtusata

6. Soralia mostly terminal or subterminal, or partly marginal, but not laminal. Soredia granular. 7

6. Soralia mostly marginal or laminal. Soredia farinose.

7. Surface irregularly lacunose and longitudinally wrinkled and pitted. On rock. Thallus K-, Pd- (no medullary substances). Soralia ellipsoid or round, irregularly formed, scattered over thallus; soredia granular. Branches flattened, little or not branched, usually over 1 mm wide, dark green, strap-shaped or variously longitudinally dissected, often \pm tapering towards the ends, often lacerate, contorted-twisted; surface uneven, \pm scabrid, \pm longitudinally ridged, striate, commonly with scattered or confluent, concolorous or paler pseudocyphellae which may open into numerous fenestrations. Granules present, 60-180 μ m diam., singly or mainly clustered around the pseudocyphellae, concolorous with thallus, \pm smooth, corticate. Apothecia rare, terminal or subterminal in small thalli, lateral and marginal in larger morphs, \pm persistently cup-like, rarely becoming convex; thalline exciple scabrid-verrucose; spores 12-16 x 4-6 μ m, broadly ellipsoid. Cortex rough. Thallus 3-6 cm long, erect or \pm decumbent, in dispersed tufts or often forming extensive swards. On nutrient-enriched rocks, particularly below bird-roosting or -nesting sites on cliffs. R. polymorpha

7. Surface smooth. 8

8. Medulla K- or + slowly dingy pink, C-, KC- Pd- (chemical race 1: sekikaic and homosekikaic acids, no ramalinolic), K+ yellow then red, P+ yellow orange (chemical race 2: norstictic), or K- or + dingy brown, P+ orange-red (chemical race 3: protocetraric acid). Soralia conspicuous, maculiform, not capitate, terminal or subterminal (to marginal), small, oval; soredia granular, whitish, occasionally bearing isidioid spinules; thallus short (1-5 mm), much branched, more or less rigid, the branches generally less than 1.5 mm across, flattened to subcylindrical, the apices tapering to isidioid tips; basal attachment plate-like; cortex greenish yellow, smooth and shiny. Medulla lax. Branches under 1 mm wide. Apothecia rare. Usually on moist cliffs and rocks (under overhangs) in shaded conditions, rarely on bark, boreal-temperate, to arctic. Great Lakes area; Appalachians; southern Rocky Mountains. R. intermedia

8. Medulla K-, Pd+ red (protocetraric acid). Morphologically like R. intermedia (but soralia mostly laminal or marginal?). On rock. R. petrina

9. Thallus small; branches mostly to 2 mm wide. No zeorin. 10

9. Thallus larger (3-6 cm long); branches wider (1-3 mm wide).

Zeorin. Base of thallus not blackening; thallus rather stiff. Thallus K-, P-, C- (medulla with zeorin, bourgeanic acid or acid deficient). Soralia linear or orbicular, mostly along margins. Thallus tufted to subpendulous. Apothecia

rare. Branches flattened, shiny, slightly pitted. Typically with shallow marginal splitting of confluent soralia. Branching pattern basal. On oaks and other broadleaf trees and fenceposts in north coastal forest and valley and foothill woodland in California, 1000-2500 ft., rather common. R. subleptocarpha

10. Thallus delicate and fragile; branches 0.1-0.9(-1.5) mm wide, flattened, becoming terete or subterete towards apices, densely branched. Soralia mainly marginal, rarely laminal, often \pm knobby-protuberant, eroded, 0.05-0.6(-1.2) mm wide, punctiform or ellipsoid, often giving rise to minute branchlets which are deformed or granular; soredia farinose, white or greenish. Thallus K-, C-, P-, or K+, C+, and KC+ faint pink (sekikaic, homosekikaic, ramalinolic, and related substances). Thallus erect, shrubby, 2-4(-8) cm tall, densely and intricately dichotomously branched; branches greenish-gray or sordid gray, solid, linear, weakly striate or ridged or subfenestrate in basal parts, pseudocyphellate, granulose; margins undulate; apices multifid; cortex with cartilaginous strands seen through the thin outer layer. Apothecia rare, 1-2 mm across; disc concave, brown; spores subfusiform or ellipsoid, \pm straight, 10-17.6 x 3-4.5 μ m. On trees (e.g., royal palms) and shrubs. Florida (the Everglades) according to Landrón; not listed for N. America by Stevens; California. Compare with R. dendriscoides. R. peruviana

10. Thallus coarser, rather firm, tough, rigid; branches 1-2(-3) mm wide, flattened or occasionally slightly channelled, sparsely (to sometimes richly) divided except toward tips. Soralia marginal or laminal, discrete, orbicular to elliptical, excavate to \pm flat, numerous; soredia 20-30 μ m diam., pale, farinose. Thallus tufted to \pm pendulous (but always arising from a delimited holdfast), 2-8(-10) cm long, surface pale yellowish green to dark gray-green, matt or \pm shiny, smooth to foveolate or longitudinally striated or pitted. Cortex thick, cartilaginous, rigid. Base darkening at point of attachment. Apothecia very rare, lateral, to 1.5 mm across; disc pale, concave; spores 8-15 x 5-7 μ m, subfusiform or broadly ellipsoid. Medulla K- or K+ pink to red, P- or P+ yellow to red, UV- or UV+ blue-white. Protocetraric acid, or salazinic acid, \pm norstictic ("R. reagens"), cryptochlorophaeic acid, hypoprotocetraric acid ("R. hypoprotocetrarica"), or no medullary substances). Usually on oaks, maples, alders, and other broadleaf trees, or wood, occasionally on rocks, in diverse habitats, ranging from shaded woodland to sunny, wind-exposed, isolated trees, coastal and montane forests and valley woodland, 500-3000 ft in California, north to British Columbia (to Alaska according to Landrón) and east to Montana, mostly from sea level to lower elevations; Great Lakes to NE U.S. and S.E. Canada; south to Puebla, Mexico. Specimens in polluted habitats are often dark

green, tufted, with short, decumbent, sometimes rather broad, contorted or recurved branches; conversely, in deep shade in woodland, material is often elongated, pale and rather sparingly branched with narrow branches. R. farinacea s. lato

ADD:

R. baltica Lettau

Thallus small, tufted, ragged; soralia lateral and subterminal to terminal, vesicular; parietal soredia present. Containing either divaricatic acid or evernic acid. On bark. Temperate, suboceanic. Coast of south-central California.

R. pacifica Asah. (= R. farinacea s. lato)

Mexico: Veracruz

**III-a. Solid; Non-sorediate,
pendulous, often to 10 cm or more in length.
On bark.**

1. Thallus netlike; branches flattened; surface not striate. Thallus K-, Pd-, C- (usnic only). Thallus yellow-green, pendulous, relatively soft, and often covering entire trees, 9-40 cm or more (to several m) long; branches 1-10 cm wide, twisted, variable, simple to expanded and perforate and becoming delicately netlike (the number and size of perforations quite variable); surface with white striations. Apothecia rare or common, 1-3 mm diam., scattered on surface of wider lobes; disk pale yellow-brown. On oaks and other broadleaf trees, shrubs, and conifers, in valley and foothill woodland and coastal forests, usually in relatively moist areas, from near sea level to 3500 ft elev. in California; on boojum trees in southern Baja California; on various trees in forests west of the Cascades in the Pacific NW. Two main ecotypes, one in coastal areas and one in somewhat more inland areas (see papers by Nash, et al.). A form in fog zones becomes brownish and has narrow branches with few obvious reticulate perforations; it may not be recognized at first as a Ramalina. [also see R. hoehneliana].R. menziesii

1. Thallus not netlike. 2

2. Branches terete. Medulla K+ red, Pd+ red (salazinic or norstictic) or K-, P- (divaricatic). [If lobe tips hooked and thallus containing unknowns or no medullary substances, see R. thrausta, above] 3

2. Branches compressed. Medulla K-, Pd-. 4

3. Medulla K+ red, P+ orange (salazinic major, norstictic trace), or K-, P- (divaricatic). Thallus pendent, filamentous, fragile, to 6 cm long, much branched; filaments to 1 mm diam.; tips filiform and nodulose; surface nitid, tuberculate (according to ?; not tuberculate but with pale warty areas especially towards the tips, according to Moore); cortex rigid. Apothecia infrequent, 1-3 mm across, marginal, concave; disk pale brown, pruinose; spores ellipsoid, substraight, 10-15 x 3-4.5 μ m. On trees and rocks, suboceanic, acidophilous, hygrophilous, thermophilous and photophilous. Tropical. Reported from Florida (Everglades, rare). R. dasypoga (= R. furcellata (Mont.) Zahlbr. according to Landrón, but type of R. furcellata not seen)

3. Medulla always K+ red, P+ orange. Norstictic major, salazinic trace. Thallus pendulous, stramineous, to 45 cm long; branching irregularly dichotomous; branches subcompressed, angular and two edged; terminal branches thin and terete; surface smooth, striate (var. peranceps) or not (typical variety). Apothecia rare, to 1.5 mm broad, lateral and adnate; disk tan, convave. Spores short-fusiform, 13-16 x 4-5 μ m (according to Kashiwadani & Krog), or ellipsoid, 12-22 x 6-8 μ m (according to Landrón), \pm

straight. On bark. West Indies; not in Florida according to Landrón. (R. anceps)

4. Spores kidney-shaped. Thallus to 20(-30) cm long, \pm pendent, coarsely tufted, rarely monophyllous. Apothecia marginal or laminal, usually frequent; stipitate, disc cup-like becoming flat or \pm convex; spores 10-17 x 4-7 μ m, kidney-shaped. Surface gray-green or olive to green-black, matt, rather soft in texture; lobes to 3 mm wide, flattened, sparingly branched, \pm twisted, tapering towards base and apices, flat or commonly \pm channelled, often with an uneven, finely, longitudinally and irregularly reticulately wrinkled or ridged surface, sometimes fenestrate or longitudinally lacerate; lateral branches usually arising near the distinct holdfast; pseudocyphellae frequent, inconspicuous, pale, rounded or oval. Medulla K-, KC-, C-, P-, UV- (no medullary substances). Varies considerably in size, width and numbers of branches. On nutrient-rich bark in windy, well-lit sites, in woodlands. North American reports may be misidentifications. R. fraxinea

4. Spores mostly straight, or if curved then ? (this character doesn't seem to work very well anywhere in these keys). 5

5. Spores fusiform, 16-22 x 3-5 μ m. 6

5. Spores ellipsoid, shorter. 7

6. Medulla K-, P-, C-, KC- (divaricatic--R. usnea s. str., or substance H--"R. pallida Magn. ined.", or no medullary substances--"R. usneoides auct."), or K+, C+ and KC+ pink (sekikaic and ramalinolic--"R. subanceps Nyl."). Thallus green or stramineous, pendulous, to 35 cm long; lobes linear, strap-shaped, pendulous, leathery, dichotomously much branched. Branches to 1 mm wide (according to ?), or varying from very thin (0.5 mm, in moist areas) to broad (5 mm in drier areas, according to Landrón), compressed, flattened and frequently contorted; thin branches with attenuate, often tin apices; wide branches frequently laterally digitate; cortex thick, with cartilaginous strands visibly separated by longitudinal striae (chondroid tissue cracked). Apothecia lateral, pedicellate, 0.2-0.6 mm wide; disk convex, pale brown. On bark, in a variety of habitats (wet to dry, cool to warm, low to high elevation, continental to maritime). Southern Florida, Texas, California, Mexico. Variable, with a number of infraspecific taxa described. Material from the southern U.S. contains divaricatic or sekikaic and ramalinolic. R. usnea

6. Medulla K+ red, P+ orange; medulla with norstictic acid (\pm salazinic acid). Similar to R. usnea; thallus pendulous, to 100 cm long; branches strongly flattened, 2-30 mm wide, with prominent wite

striations; virescent; apothecia marginal, uncommon; Mexico: Nuevo Leon, Coahuila, and Hidalgo. R. sharpii Rundel

7. Thallus pale yellow-green, \pm pendulous, 3-10 cm long; branches flattened, rugose pitted with some longitudinal striations. Apices attenuate-acute. Surface greenish. Branches (0.3-)1-5(-8) mm wide. Apothecia very common, mostly lateral or marginal to subterminal, 1-6(-8) mm diam., mostly stipitate; disk tan. Spores (10-)12-17(-19) \times (4-)5-7 μ m, mostly slightly curved, ellipsoid. No medullary substances; or bourgeanic; or bourgeanic and unidentified triterpene; or zeorin. On branches of oaks and other broadleaf trees or shrubs, rarely conifers, in valley and foothill woodland and north coastal forest, from sea level to over 1000 ft in California, extending north to Oregon and south to Baja California, common. R. leptocarpha

7. Not as above. 8

8. Medulla containing unknown substances. Apothecia very large, plane. Thallus tufted to pendulous, to 17 cm long, though often much smaller; blades straplike, to 2.0 cm wide, compressed and flat; surfaces rather bright green, coriaceous, sometimes wrinkled and ridged; branching variable but usually sparse. Apothecia often abundant, occurring the length of the blade marginally or \pm subterminally, and laminally on both sides of the blade; disc sometimes extremely large (to 2.8 cm diam.), often abraded when large; disc pale, often cupped to plane, becoming flattened when large. Spores 1-septate, straight to curved, (10-)12-14(-17) \times 4-6 μ m. Pycnidia not seen. On bark (usually Quercus lobata or Q. douglasii in interior savannas), southern California. [R. thomsonii Riefner & Bowler ined.]

8. Medulla without substances. Apothecia smaller.9

9. Thallus pale green to gray-green, erect, subpendulous to pendulous, membranous, to 12 cm (exceptionally to 30 cm) long; branching initially trichotomous, either remaining as a three-lobed thallus or thereafter dividing subdichotomously or irregularly, often producing densely branched thalli, rarely producing small branchlets at right angles to the primary branches; branches (1-)2-5 mm (exceptionally to 20 mm) wide, compressed, ranging from narrow and canaliculate with apices attenuate to broad and flat with apices acute or blunt; surface smooth to rugose, membranous or coarse and ridged with strands of chondroid tissue; cracks or holes may appear between these strands; pseudocyphellae usually present; holdfast delimited. Apothecia numerous, marginal on narrow branches, laminal and marginal on broader branches, occasionally on both upper and lower surfaces of the branch; disc 0.5-2.0 mm diam., plane to convex; margin narrow, entire, smooth or crenate, almost disappearing at maturity; spores oval, ellipsoid to slightly fusiform, mainly straight to slightly curved, (10-)12-16 \times 4-6 μ m. No

medullary substances. On bark, rarely on rock. Woodland and scrub. Subtropical to temperate, SE-SW U.S. (and S. California?), and Mexico. R. celastri v. celastri

ADD:

Thallus pendulous; with laminal linear pseudocyphellae on subparallel branches bearing short divergent side branches. Branches flattened. Chondroid tissue non-cracked. Apothecia marginal and laminal. Spores straight to curved, 13-15(-17) x 5-6 μ m. Medulla without substances. On bark. Fog zone forests. Coastal central California. See Swinscow & Krog's African treatment for full description. R. hoehneliana Müll. Arg.

Similar in spore characters and chemistry to R. celastri but with a larger, more rigid thallus, large mostly marginal concave apothecia and a Mediterranean climate distribution. Spores 12-16 x 4-6 μ m, straight to gently curved, fusiform, ovate or ellipsoid. Apothecia marginal, \pm laminal, to 12 mm diam., plane to concave, crenulate, stipitate. Thallus leathery rigid; branches flattened to canaliculate. No substances. Central California to Baja California, mostly coastal. R. sp. (Kashiwadani, mentioned by Riefner & Bowler, unpublished)

**III-b-1. Solid; Non-sorediate,
± tufted, mostly under 10 cm long; branches ± terete.
On bark.**

1. Thallus dark brown. see R. willeyi

1. Thallus not dark brown. 2

2. Spores fusiform. Branches torulose. 3

2. Spores ellipsoid. Branches not torulose.
(see R. dasypoga, above)

3. Spores to 16 µm long. 4

3. Spores mostly over 16 µm long. Branches attenuate. 5

4. On bark. Growing in SE U.S. Spores 9-16 µm long. Branches thin, attenuated. Southeast coastal plain. R. tenuis
[See Jones for more info.]

4. On rock. Growing in Mexico. Branches terete. Thallus subpendulous, decumbent, growing from a common holdfast, dichotomously branched; branches terete, often ending with nodules; pseudocyphellae longitudinally arranged, continuous; chondroid layer non-cracked; spores longly fusiform, 9.6-13.6 x 3.2-3.5 µm. Ch.: boninic (Race 1) or homosekikaic (Race 2) acids major; 2'O-methylsekikaic and 4'O-methylpaludosic acids minor. On rocks around the summits of small hills. Mexico (Baja California, Sinaloa). [Need full description from Bowler & Rundel]. [R. wigginsii Bowler & Rundel]

5. Branches terete or subterete but apices always terete; surface white papillate, or coarsely verrucose to tuberculate (not according to Moore). Apothecia marginal. Thallus 3-5(-10) cm tall. Spores (11-)16-22(-24) x 3-5 µm. Thallus straw-yellow, rarely green, usually caespitose, but sometimes pendulous, much branched, subdichotomous; branches 1-2 mm broad. Apothecia numerous, marginal, to 3 mm broad; disk tan, convex or flat. Medulla P-, either K+, KC+, and C+ turning pink (sekikaic and ramalinolic acids), or K-, KC-, C- (divaricatic acid). On bark of various trees, including royal palms, red maples, and oaks, or shrubs. Dry to moist areas, southeast coastal plain. Everglades and hammocks of Florida; Louisiana, Texas. R. montagnei

5. Branches compressed, with tips subterete; surface without papillae, verrucae, or tubercles. Apothecia terminal, or subterminal and then geniculate, but appearing terminal if the branch tips are broken. Thallus 1-3 cm high. Thallus pale stramineous, shrubby; lobes sometimes subcanaliculate; surface longitudinally striate; cortex thin. Apothecia 3-4 mm broad, numerous. Spores fusiform, ± straight, 18-22 x 3-5 µm. Containing divaricatic acid. On bark. Frequent in the Everglades of

Florida (reported by Landrón). R. subpellucida

**III-b-2. Solid; Non-soresiate,
+ tufted, mostly under 10 cm long;
Branches flattened to compressed, at least below, not torulose.
With tubercles or papillae.**

1. Surface tuberculate. 2

1. Surface papillate (i.e., bumps smaller?--this may not be a good choice). Note: rare papillate forms of *R. bajacalifornica*, which contain salazinic acid, may also key out here. 4

**2. Growing in the SE U.S. Thallus usually less than 3 cm long.
..... 3**

2. Growing in Sonora, Mexico. Thallus to 8 cm long, shrubby, growing from a narrow holdfast, moderately branched. Branches solid, greenish yellow to greenish gray, matt, dorsiventral, weakly canaliculate, 4-7 mm wide; surface rugose towards tips, longitudinal ridges of chondroid layer of longitudinal white striations common. Pseudocyphellae subrotund or elliptic, slightly depressed, abundant on lower side. Thallus 200-600(-900) μ m thick; cortex distinct, 15-20 μ m; chondroid layer continuous or discontinuous especially in edged branches, smooth to weakly cracked, 100-250 μ m thick. Apothecia subterminal or rarely laminal, often with short spurs, to 7(-10) mm diam.; margin entire or radially split; disc concave to flat in young stages, convex in maturity; thalline exciple entire, reticulately ridged, often pseudocyphellate; hymenium 45-55 μ m thick; hypothecium 20-25 μ m thick; proper exciple 15-20 μ m; spores shortly fusiform, straight or slightly curved, 2-celled, usually with additional septa, 11-14 x 3.5-4 μ m. Pycnidia very common, laminal, with pale ostioles, mixed with tubercles; pycnosporos rod-shaped, 3-4 x 0.5 μ m. Ch.: divaricatic and 4'-O-demethyldivaricatic acid. On shrubs and cacti, Baja California, very common. [*R. sonorensis* Kashiw. & Nash]

3. Medulla C+ wine red, KC+, P-; cryptochlorophaeic and paludosic acids present. Externally very similar to *R. americana*. Thallus caespitose, usually less than 3 cm long, much branched usually dichotomously; branches 0.5-1 mm broad, compressed in part but terete at tips; surface greenish, tuberculate. Apothecia common, terminal or subterminal, 1-5 mm broad; disc tan, convex or flat; spores 8-12 x 3-5(-6) μ m, ellipsoid. Common on *Taxodium* (cypress) in swamps, occasionally on hardwood twigs and fenceposts, Florida. *R. paludosa*

3. Medulla C-, P+ orange or red; cryptochlorophaeic acid absent; salazinic, protocetraric, or norstictic acids). Thallus fruticulose (tufted), branches tapering terminally. Thallus dark brown (greenish yellow according to Hale, and greenish according to Moore); main branches with small lateral branchlets. Medulla usually K+ red, P+ red (salazinic acid, or rarely norstictic acid), or sometimes K-, P+ red, orange (protocetraric acid; plus

KC+ orange substance?). Thallus characteristically forming spherical, rosette-like tufts. Branches 0.5-2 mm broad, slightly flattened, becoming terete towards tips, finely divided, the surface longitudinally striate, tuberculate. Apothecia common, mostly terminal or subterminal, sometimes lateral; usually with a single spur but occasionally radially spurred, 1-10 mm broad; disc tan, concave or convex; spores ellipsoid, straight or curved, 9-14 x 3-5 μ m. Protocetraric, norstictic, and salazinic. Common on trees (often on oaks, usually not cypress), shrubs, and fenceposts, Florida (SE coastal plain in general according to Hale), usually near the coast. Specimens with protocetraric acid are generally lighter green and less tuberculate, and are most common in the sand hills.R. willeyi

4. Branches (above base) ca. 2 mm wide. Branches not rugose, margins even. Thallus bushlike, to 8 cm long, dichotomously branching from a basal plate. Branches rigid, compressed, and flattened, basally to 5 mm wide, but usually ca. 2 mm wide. Cortices uniform, smooth for the most part, rigid, frequently displaying minute papillate structures. Branches usually two-edged, stramineous in old specimens. Medulla white. Apothecia common, subterminal, arising from the margins, often occurring the length of the branches. Discs pale, to 6 mm diam. Spores straight or slightly curved, 1-septate, "8.8-5.4" x 3.3-4.4 μ m. Medulla K+ yellow then red, P+ orange, containing salazinic acid. Mexico: Baja California Sur. The authors compare this species to members of the R. usnea group, but because of its size and growth form, it seems to fit here better. R. moranii Bowler & Rundel

4. Branches (above base) mostly over 2 mm wide
(?). 5

5. Papillae very abundant. Branches to 5 mm wide. Apothecia to 4 mm wide, laminal to subterminal. Thallus sparsely and diffusely branched, tufted, rigid and bushlike. Branches to 4 cm long, to 5 mm wide, strongly flattened, compressed, solid, arising from a thalloid attachment plate; upper and lower surfaces indistinguishable; tips tapering; surface somewhat wrinkled, with abundant characteristic white papillae along the length of the branches; cortex greenish; medulla white. Apothecia common and numerous, laminal, subterminal, to 4 mm diam., margins thalline; disk pale, concave; spores straight to slightly curved, 1-septate, 13.2-15.4 x 4.4 μ m. Medulla K-, C-, KC-, P-; sekikaic (?) and unknown acid. On leguminous trees in thorn forest, Mexico: Sinaloa. R. sinaloensis Bowler & Rundel

5. Papillae usually less abundant. Branches broader. Apothecia larger, more terminal. 6

6. Medulla K-, without salazinic acid. Surface strongly papillate or papillate-striate. Thallus pale greenish yellow, tufted, leathery, 2-3(-7) cm long; branching dichotomous; branches compressed, canaliculate,

to 2.5 mm wide; channels shallow, disappearing towards the tips; surface strongly papillate or papillate-striate (papillae sometimes appearing double lobulated or punctiform), nitid, stramineous, occasionally green. Cortex at first thin, then thick, cartilaginous to soft. Pseudocyphellae raised, punctiform or tuberculate. Chondroid tissue cracked. Apothecia numerous, terminal or marginal, rarely laminal, adnate, variable in size in accordance with the size of the thallus; disc concave, rarely convex, tan, pruinose; margin rugose; spores ellipsoid or ellipsoid-elongate, curved or bent, variable, 9-16 x 4-9 μ m. At least 7-8 chemotypes, with somewhat different distributions (see Landrón for discussion). Medulla K-, P- (divaricatic--R. complanata s. str. according to Landrón, or ramalinolic, or sekikaic), or K+ wine red, P- (cryptochlorophaeic), or K-, P+ red (protocetraric); strains with obtusatic, substance H, or substance A have also been reported. Common on tree trunks and branches in open areas along coast of Gulf of Mexico, and on palm trees along roadsides in southern Florida. Also reported from calcareous rocks and in salt sprayed habitats. Also reported from Ohio. R. complanata s. lato.

6. Medulla K+ yellow then red, with salazinic acid. Branches longitudinally rugose, margins uneven-denticulate. Thallus 3-5 cm long. Thallus \pm pale, greenish-olivaceous. Surface strongly papillate. Branches 1-5 mm wide. Lobes linear-elongate, subdichotomous; apothecia subterminal; discs concave, red, carneous-pruinose. Medulla K+ yellow then red, P+ orange. Salazinic acid major, norstictic trace. Reported from Mexico and the U.S. Originally described from Brazil. R. denticulata (= R. complanata according to Landrón, but type of R. denticulata not seen; according to Howe morphological distinctions can be seen when both occur together, but are not consistent)

**III-b-3. Solid; Non-sorediate,
± tufted, mostly under 10 cm long;
Branches flattened to compressed, at least below, not torulose.
Without papillae or tubercles**

1. Thallus composed of a single, fan-shaped lobe, from tiny when very young to as much as 12 cm broad, attached by a single holdfast, flat, dark green, with abundant longitudinal ridges (nerves) between which (at least on the lower side) are sparse pseudocyphellae. Apothecia common, to 12 mm broad, pedicellate, occurring on edges and surfaces; disc pruinose; spores 8/ascus, curved, 1-septate, 12-18 x 5-6 µm. Thallus K-, C-, P-; cortex KC+ yellow (usnic only). On twigs and branches of deciduous trees, Minnesota, Wisconsin, North Dakota, Texas. R. unifolia Thomson

2. Thallus usually branched, with more than one lobe, narrower. 2

2. Branches 1-5 cm wide. Spores often bent. K-, P-. 3

2. Branches under 1(-2) cm wide, often much less. 4

3. Thallus to 20(-30) cm long, ± pendent, coarsely tufted, rarely monophyllous. Apothecia marginal or laminal, usually frequent; disc cup-like, becoming flat or ± convex; spores 10-17 x 4-7 µm, kidney-shaped. Surface gray-green or olive to green-black, matt, rather soft in texture; lobes to 3 mm wide, flattened, sparingly branched, ± twisted, tapering towards base and apices, flat or commonly ± channelled, often with an uneven, finely, longitudinally and irregularly reticulately wrinkled or ridged surface, sometimes fenestrate or longitudinally lacerate; lateral branches usually arising near the distinct holdfast; pseudocyphellae frequent, inconspicuous, pale, rounded or oval. Medulla K-, KC-, C-, P-, UV- (no medullary substances). Varies considerably in size, width and numbers of branches. On nutrient-rich bark in windy, well-lit sites, in woodlands. North American reports may be misidentifications. (R. fraxinea)

3. Thallus 2-3.5(-6) cm long, erect or pendulous, loosely tufted or with ± scattered or overlapping palmate lobes, flaccid when wet. Apothecia lateral, terminal or subterminal, rarely laminal on extensions of the lobes, 3-9 mm diam.; margin ridged-reticulate; spores 12-15(-17) x 6-7 µm, curved. Evernic acid complex () or no substances (Swinscow & Krog). Lobes often with lanceolate processes along the edges and at the tips, with abundant nerves on the surface. Upper surface stramineous or gray-green; lower surface paler than upper. Lobes palmate, cleft almost to the base, forming several elongate, tapering extensions, or remaining almost entire with short to ± extended digital extensions from the margins, occasionally also with numerous small multiseptate marginal outgrowths. Upper surface with irregular or ± longitudinally oriented wrinkles, often fenestrate; lower surface with ± longitudinally oriented anastomosing low ridges. Lobes rather thin, conspicuously flattened. Lower

surface with partly decorticate white interspaces (pseudocyphellae), especially towards the holdfast but sometimes throughout the entire underside.R. sinensis

5. Thallus surface finely hairy. Thallus to 7.5 cm high with straplike or irregular branches arising from the base, varying from a single shallow lobed lamina or few-branched broad-lobed forms to densely branched cespitose morphotypes with very narrow blades; laciniae flattened, minutely puberulent (finely hairy), often sulcate; apices blunt with rounded rather than pointed tips in mature thalli; cortex coriaceous, extremely variable, smooth to irregularly corrugated or veined, lacunose, or ridged. Apothecia subterminal along lobe apices and often laminal on the distal half (on one side of the blade); disks cuplike to flat, to 14 mm diam., pale to pink-flesh colored; spores 1-septate, mostly gently curved to occasionally straight, (11-)12-16(-18) x (3-)4-7 μ m. Chem.: usnic acid, pigment SV-1, atranorin; chemical races include: no additional substances; bourgeanic acid and zeorin; bourgeanic acid; zeorin. On bark, especially oak, mostly away from the immediate coast, southern to central California. R. puberulenta Riefner & Bowler

5. Thallus surface not hairy. 6

6. Apothecia mostly terminal. 7

6. Apothecia mostly marginal or laminal (to partly subterminal in some species). 10

7. Spores sigmoid (flattened "s" shaped). Thallus pale straw, compressed, sublinear-laciniate, subcanaliculate, somewhat nervose-unequal to almost smooth, ca. 2 cm tall, branches ca. 2 mm diam.; branches attenuate-ramulose (lacinioles spreading attenuate-acute). Apothecia terminal or subterminal, 1-4 mm diam.; disc carneous-tastaceous, subpruinose, becoming convex; margin base plicate, constricted; folds towards the margins obliterated; spores fusiform-oblong, sigmoid, "bistortae" ("scilicet utroque apice sensu contrario nonnihil tortae septoque saepius obliquo), 12-16 x 6 μ m. California. R. bistorta Nyl.

7. Spores straight, or curved in only one direction. 8

8. Spores mainly straight. 9

8. Spores mainly kidney-shaped, rarely broadly ellipsoid. Branches not canaliculate, or only so at their bases, coarse. Containing evernic acid agg. Thallus 2-5 cm long, usually erect, densely tufted and richly branched, pulvinate, occasionally becoming lax and \pm pendent, pale green to dull gray-green; branches terete or \pm angular, \pm flattened, \pm hollow with a lax, arachnoid medulla; surface \pm longitudinally striate, the fenestrations few to

numerous. Apothecia terminal, often numerous, sometimes obscuring thallus; disc concave, becoming \pm convex when mature; spores 12-15(-18) x 5-6(-7) μ m, Polymorphic; thallus normally \pm globose, with the top-shaped apothecial branches forming a rounded cluster all at \pm the same level, but various modifications occur, especially in moist sites. North American reports are mostly (or entirely) based on misidentifications, often of R. americana, or perhaps sometimes of R. sinensis. On trunks or twigs on nutrient-enriched trees or shrubs, in exposed, well-lit areas, rarely on rocks, usually oceanic.R. fastigiata

9a. Eastern North America. With no medullary substances, or (in the southern Appalachians) either (Race 2) hypostictic and hyposalazinic acids, (Race 3) sekikaic and homosekikaic acids, (Race 4) divaricatic acid and unknown, or (Race 5) 4-O-demethylbarbatic acid and unknowns. Apothecia terminal (to subterminal or marginal), common, large; disks yellow. Thallus greenish yellow, tufted, 1-4 cm long; branches flattened throughout, quite variable in width, 2-3(-10) mm wide [broad-lobed specimens = R. sinensis Jatta]; surface smooth to striate with elongated pseudocyphellae, rarely perforate. Spores 12-13 x 5-6 μ m. Thallus usually K-, P-, C- (usnic only, or, in SE U.S., with sekikaic acid or any one of 5 or 6 unknown compounds). Common on tree trunks in open areas and on canopy branches in closed forests. Great Lakes area and southern Appalachians. R. americana

9a. California or Southern Mexico. 9b

9b. Southern Mexico. With 2-O-methylperlatolic acid, 2-O-methylstenosporic acid (major), 2-O-methyldivaricatic acid, and traces of other substances. Thallus pale yellow, erect and tufted, to 4.5 cm high, moderately branched throughout but more so towards the tips; branches 1-2(-3) mm broad, to 5 mm in the oldest parts, with punctiform or striate pseudocyphellae on the surfaces and (more commonly) the margins. Cortex irregular, 25-65 μ m thick; medulla (50-)65-100(-130) μ m thick. Apothecia abundant, lateral to subterminal, to 1-2 mm broad, flesh=colored like the thallus, the margins with a few V-shaped indentations; hymenium 50-80 μ m thick; subhymenium 40-60(-80) μ m; spores 8, ellipsoid, mostly straight, 1-septate, 13-16 x (4-)5-8 μ m. Pycnidia absent. Medulla K-, C-, KC-, P-. On trunk of Abies, Mexico: State of Mexico. R. sayreana Culb. & C. Culb.

9b. Southern California. With bourgeanic acid and unknowns. Thallus to 8 cm long; straplike branches arising from the point of attachment, with little branching; blades to 8 mm wide, compressed, longitudinally wrinkled/ridged, with infrequent pseudocyphellae, occasionally fenestrate, rigid, coriaceous; both sides corticate. Apothecia primarily terminal and/or clustered subapical, occasionally marginal or laminal, occurring to around half of the distance to the base; disc to 15 mm diam., usually cupped, pale.

Spores 1-septate, ovate to ellipsoid, straight or gently curved, (10-)12-13(-20) x 5-8(-9) μ m. Pycnidia not seen. Medulla with unidentified aliphatic substance, bourgeanic acid and unknown. On bark (primarily conifers, but also on Quercus agrifolia on the immediate coast). [R. chicitaculbersonii Riefner & Bowler ined.]

10. Medulla K-, P+ yellow (psoromic acid). On rock. Branches plane to weakly canaliculate towards the apices. Thallus erect. Thallus to 2.5 cm long, erect, sparingly branched, growing from a narrow holdfast. Branches greenish yellow, solid, 0.5-2(-3) mm wide, plane to weakly canaliculate towards the apices, semiangular to cylindrical near the base, surface longitudinally grooved, often with slit-like perforations. Pseudocyphellae common, laminal, short linear, \pm depressed. Thallus 150-250 μ m thick; cortex indisitnct, 5-10 μ m thick; chondroid layer continuous, not cracked, 50-180 μ m thick; medulla dense. Apothecia laminal or subterminal, to 2 mm diam.; margin entire; disc flat to convex; thalline exciple entire; hymenium 45-50 μ m thick; hypothecium 10-15 μ m thick; proper exciple 10-15 μ m thick; spores narrowly fusiform, straight or slightly curved, 2-celled, usually with additional septa, 10-13 x 3.2-3.5 μ m. Pycnidia not seen. On rock, in rather shaded coniditons. Texas; Mexico (Chihuahua). Ramalina ahtii Kashiw. & Nash

10. Medulla K-, P-, or K+, P+. Usually on bark or wood. 11

11. Medulla K+ red, P+ orange (norstictic or salazinic acids).

..... 12

11. Medulla K-, Pd-, C-, KC-, UV-. 13

12. Salazinic acid major. Growing in Mexico. Thallus tufted, to 4 cm long, simply branching, the linear branches compressed and flattened; branches to 4 mm wide, arising digitally from a broad (to 1.5 cm across) base. Surface rarely with papillae. Cortices uniform, rigid, smooth and shiny, with longitudinal cracks appearing as obvious white striae. Attachment to substrate by a basal plate. Branches stramineous; medulla white. Apothecia common, subterminal, laminal but primarily marginally oriented, extending the length of the branches. Disk pale, marginate, to 3 mm diam., concave. Spores straight or slightly curved, 13-17 x 3.5 μ m. Medulla K+ yellow then red, P+ orange. Salazinic acid and \pm unknown. On bark, Mexico: Baja California Norte & Sur. R. bajacalifornica Bowler & Rundel

12. Norstictic acid major; salazinic acid in traces. Growing in Florida. Thallus stramineous, caespitose, rigid, to 6 cm high; branching dichotomous; branches 2-3 mm broad, linear, canaliculate; tips usually bifid and compressed; surface denesly scrobiculate; cortex cartilaginous. Apothecia frequent, to 4 mm acorss, marginal and closely adpressed against the thallus; disk reddish to dark, concave, pruinose; spores ellipsoid, straight or curved, 9-13 x 3-4 μ m. On bark, southernmost tip of the Everglades

swamps, Florida (reported by Landrón; not mentioned by Egan). R. leptosperma Nyl. (synonym: R. scrobiculata Müll. Arg., according to Landrón)

13. Spores fusiform. Growing in SE U.S. or NE Mexico, and usually containing medullary substances (if growing in southern California and lacking medullary substances, see R. ottolangei). 14

13. Spores ellipsoid (to oblong-ellipsoid, or to slightly fusiform in R. celastri) or curved. 15

14. Containing stenosporic, or perlatoric and unknown (or no medullary substances, in rare specimens from Florida and North Carolina, which may be a distinct taxon). Branches strongly flattened including the tips (or sometimes partly terete?). Papillate or not, usually white striate, not tuberculate (according to Moore). Thallus to 15 cm long, usually caespitose but occasionally pendulous, much branched usually dichotomously; branches 0.5-2 mm broad; surface greenish. Apothecia common, marginal, 1-3 mm broad; disc tan, convex at maturity. Spores straight or curved, 13-15 x 2-5 µm. On trees and fenceposts. Southeast coastal plain. Florida; also reported from Baja California (probably a misidentification of R. bajacalifornica). R. stenospora [See Jones for more info.]

14. Ch.: boninic, 2'O-methylsekikaic, and 4'O-methylpaludolic acids. Thallus corticolous, greenish yellow, rosette-forming, erect, sparingly branched from a narrow holdfast, 1-2 cm high. Branches solid, greenish yellow, palmate, plane, thin, to 1.5 cm broad; surface flat to weakly reticulately ridged, rarely fenestrate; lower surface occasionally lacunose or decorticate exposing white medulla; pseudocyphellae laminal, scattered, \pm depressed. Thallus irregularly thickened, 160-640 µm thick; cortex indistinct, ca. 10 µm; chondroid layer continuous, not cracked, irregularly thickened, 20-240 µm thick. Apothecia common, laminal or subterminal, to 7(-10) mm diam.; disc plane, becoming convex; thallid exciple entire, rarely pseudocyphellate; hymenium 40-45 µm thick; hypothecium 10-15 µm; proper exciple 12-15 µm; spores short fusiform, straight or slightly curved, 10-13 x 3-4 µm. Pycnidia common; pycnosporos 3-4 x 0.5 µm. On bark. Mexico (Nuevo Leon). R. palmiformis Kashiw. & Nash

15. Spores curved. No medullary substances. Apothecia marginal. Lobes narrow to broad, linear, compressed; surface striate, not papillate. On bark. Southern California, Baja California, Caribbean. Described from New Zealand. R. linearis

15. Spores \pm straight. Apothecia marginal (or partly subterminal or laminal). 16

16. Branches not canaliculate. Thallus tufted, commonly grow in swards, to 6.5 cm long; branches to 5 mm wide, rather thin and friable; surface somewhat wrinkled, nearly shiny; primary branches straplike, radiating like

fingers from a broad basal area up to 2 cm wide, dichotomously branched from a primary stem. Apothecia marginal, subterminal; disc to 5(-8) mm diam., cupped, bowl-shaped, sessile or partly immersed, pale. Spores 1-septate, ellipsoid, fusiform, or ovate, straight to gently curved, 12-14(-16) x 4-6 μ m. No medullary substances. On shaded bark of Quercus agrifolia, in mountain woodlands, southern California. [R. ottolangei Riefner & Bowler ined.]

16. Branches at least partly canaliculate? 17

17. Surface shiny, especially towards base. Texture calcareous, horn-like. Branches \pm canaliculate throughout. Apothecia \pm marginal, subterminal, on angled branches. Containing sekikaic acid complex or no medullary substances. Thallus 5-8(-15) cm long, tufted, becoming pendent, gray-green, stiff and spiky when dry; branches 2-3(10) mm wide, smooth; pseudocyphellae frequent, punctiform, indistinct. Apothecia frequent; spores 10-16 x 5-7 μ m, broadly ellipsoid, straight. On branches and twigs, especially of shrubs with a \pm nutrient-rich bark, rarer on tree trunks, often near the coast in well-lit situations. Reports from N. America are probably dubious. R. calicaris

17. Surface matt. 18

18. Branching at least initially trichotomous. Thallus pale green to gray-green, erect, subpendulous to pendulous, to 12 cm (exceptionally to 30 cm) long; branching initially trichotomous, either remaining as a three-lobed thallus or thereafter dividing subdichotomously or irregularly, often producing densely branched thalli, rarely producing small branchlets at right angles to the primary branches; branches (1-)2-5 mm (exceptionally to 20 mm) wide, compressed, ranging from narrow and canaliculate with apices attenuate to broad and flat with apices acute or blunt; surface smooth to rugose, membranous or coarse and ridged with strands of chondroid tissue; cracks or holes may appear between these strands; pseudocyphellae usually present; holdfast delimited. Apothecia numerous, marginal on narrow branches, laminal and marginal on broader branches, occasionally on both upper and lower surfaces of the branch; disc 0.5-2.0 mm diam., plane to convex; margin narrow, entire, smooth or crenate, almost disappearing at maturity; spores oval, ellipsoid to slightly fusiform, mainly straight to slightly curved, (10-)12-16 x 4-6 μ m. No medullary substances. On bark, rarely on rock. Subtropical to temperate. R. celastri v. celastri

18. Branching dichotomous. Medulla K-, Pd-, C- (no medullary substances). Surface not papillate. Branches to 2-4(-1) cm wide. Thallus greenish yellow, thin, membranous and rather soft, 4-8(-20) cm long, caespitose to pendent; branches dichotomous, canaliculate, becoming flattened in large specimens; surface deeply striate longitudinally. Apothecia numerous, minute, marginal and laminal; disc concave, flat or convex, tan, pruinose; spores ellipsoid, 11-18 x 4.5-8.5 μ m. Common on tree trunks and in scrub forests of central and southern Texas, southward in Mexico; also rarely

on rocks. (R. ecklonii Sprengel; = R. cumanensis Fée according to Landrón, but types of neither species were seen; N. American reports of R. ecklonii auct. non Sprengel and R. yemensis (Ach.) Nyl. = R. celastri (Sprengel) Krog & Swinscow v. celastri)

ADD:

Thallus tufted to pendulous, to 17 cm long, though often much smaller; blades straplike, to 2.0 cm wide, compressed and flat; surfaces coriaceous, sometimes wrinkled and ridged; branching variable but usually sparse. Apothecia often abundant, occurring the length of the blade marginally or \pm subterminally, and laminally on both sides of the blade; disc sometimes extremely large (to 2.8 cm diam.), often abraded when large; disc pale, often cupped to plane, becoming flattened when large. Spores 1-septate, straight to curved, (10-)12-14(-17) x 4-6 μ m. Pycnidia not seen. Medulla containing unknown substances. On bark (usually Quercus lobata or Q. douglasii in interior savannas), southern California. [R. thomsonii Riefner & Bowler ined.]

ADD?

..... (R. leptocarpha)

Isidial branchlets common on distal branches. Chondroid tissue not cracked. Homosekikaic and sekikaic acid present. (R. peruviana)

Thallus K-, Pd-, C- (usnic only). Surface not papillate. Branches to 2-4(-1) cm wide. Thallus greenish yellow, thin, membranous and rather soft, 4-8(-20) cm long, caespitose to pendent; branches dichotomous, canaliculate, becoming flattened in large specimens; surface deeply striate longitudinally. Apothecia numerous, minute, marginal and laminal; disc concave, flat or convex, tan, pruinose; spores ellipsoid, 11-18 x 4.5-8.5 μ m. Common on tree trunks and in scrub forests of central and southern Texas, southward in Mexico; also rarely on rocks. (R. ecklonii Sprengel; = R. cumanensis Fée according to Landrón, but types of neither species were seen; N. American reports of R. ecklonii auct. non Sprengel and R. yemensis (Ach.) Nyl. = R. celastri (Sprengel) Krog & Swinscow v. celastri)

ADD:

R. dendriscoidella Vainio
Mexico: Veracruz

R. denticulata var. canalicularis Nyl.
Mexico

R. denticulata var. elongata Vainio
Mexico: Veracruz

R. fastigiata var. lacerata Müll. Arg.
Mexico

R. laevigata Fr.
Mexico: Baja California

R. mexicana Vainio
Mexico

R. subcalicaris Nyl.
Mexico

R. subfraxinea Nyl.
Mexico

R. usneoides (Ach.) Fr.
Mexico

R. wigginsii Bowler & Rundel

Thallus tufted, to 8.5 cm long. Branches fine, usually ca. 0.5 mm wide, abundantly branching in a perpendicular manner from the central axis, becoming dense and intertangled. Branches ellipsoidal in cross-section, becoming flattened, especially basally; solid. Finer branches and terminal segments displaying a lumpy, extruded appearance, with the branch tips recurvent and nodular. Cortex smooth and shiny, frequently thinning to form extensive longitudinal striations exposing the white medulla and producing a base for the formation of conspicuous corticate granules (ca. 100 µm), leaving pits in the striae upon evacuation. Thallus stramineous. Apothecia usually present, subterminal, concave, to 2 mm diam.; underside of thalline margin crinkled; disk buff and dull; spores straight, 1-septate, 8.8 x 4.4 µm. Medulla K-, P-, C-, KC-, containing two unidentified acids.. Mexico: Baja California Sur; Sinaloa.

Descriptions of the Species

Ramalina ahtii Kashiw. & Nash

Thallus to 2.5 cm long, erect, sparingly branched, growing from a narrow holdfast. Branches greenish yellow, solid, 0.5-2(-3) mm wide, plane to weakly canaliculate towards the apices, semiangular to cylindrical near the base, surface longitudinally grooved, often with slit-like perforations. Pseudocyphellae common, laminal, short linear, \pm depressed. Thallus 150-250 μ m thick; cortex indistinct, 5-10 μ m thick; chondroid layer continuous, not cracked, 50-180 μ m thick; medulla dense. Apothecia laminal or subterminal, to 2 mm diam.; margin entire; disc flat to convex; thalline exciple entire; hymenium 45-50 μ m thick; hypothecium 10-15 μ m thick; proper exciple 10-15 μ m thick; spores narrowly fusiform, straight or slightly curved, 2-celled, usually with additional septa, 10-13 x 3.2-3.5 μ m. Pycnidia not seen. Medulla K-, P+ yellow (psoromic acid). On rock, in rather shaded conditions. Chihuahua.

R. americana Hale (R. fastigiata auct.)

With no medullary substances. Apothecia terminal (to subterminal or marginal), common, large; disks yellow. Thallus greenish yellow, tufted, 1-4 cm long; branches flattened throughout, quite variable in width, 2-3(-10) mm wide [broad-lobed specimens = R. sinensis Jatta]; surface smooth to striate with elongated pseudocyphellae, rarely perforate. Spores 12-13 x 5-6 μ m. Thallus usually K-, P-, C-. Common on tree trunks in open areas and on canopy branches in closed forests. Great Lakes area and southern Appalachians. Not definitely reported from the Sonoran region, but included here because some reports of R. fastigiata from the region may be misidentifications of this.

R. bajacalifornica Bowler & Rundel

Thallus tufted, to 4 cm long, simply branching, the linear branches compressed and flattened; branches to 4 mm wide, arising digitally from a broad (to 1.5 cm across) base. Surface rarely with papillae. Cortices uniform, rigid, smooth and shiny, with longitudinal cracks appearing as obvious white striae. Attachment to substrate by a basal plate. Branches stramineous; medulla white. Apothecia common, subterminal, laminal but primarily marginally oriented, extending the length of the branches. Disk pale, marginate, to 3 mm diam., concave. Spores straight or slightly curved, 13-17 x 3.5 μ m. Medulla K+ yellow then red, P+ orange. Salazinic acid and \pm unknown. On bark, Mexico: Baja California Norte & Sur.

R. baltica Lettau (= R. obtusata according to Clauzade & Roux)

Thallus small, forming pulvinate to lax, often ragged tufts, sometimes coalescing into \pm continuous swards; surface gray-green to dull green, \pm shining, opaque when wet; lobes broadened from the base, flattened, internally solid or in part secondarily fistulose; medulla loosely arachnoid;

number and form of the lobes variable, ranging from forms with a single palmate lobe to those with numerous lacerate-dissected, twisted lobes. Pulvinate forms may have lobes with extensively abraded apices such that the broken gaping ends of the pustules reveal the white medulla and the glaucous, parietal soredia. Soralia mostly developed towards the apices, lateral and subterminal to terminal, vesicular (hood-shaped according to Clauzade & Roux), soredial development parietal, soredia released at the surface by means of lacerations or by the rupture of irregular, vesicular swellings. Apothecia extremely rare, marginal or laminal. Spores 15-21 x 6 um, straight or slightly curved. Medulla containing either divaricatic acid or evernic acid. On bark. Temperate, suboceanic. Coast of south-central California.

R. bistorta Nyl.

Spores sigmoid (flattened "s" shaped). Thallus pale straw, compressed, sublinear-lacinate, subcanaliculate, somewhat nervose-unequal to almost smooth, ca. 2 cm tall, branches ca. 2 mm diam.; branches attenuate-ramulose (laciniolae spreading attenuate-acute). Apothecia terminal or subterminal, 1-4 mm diam.; disc carneous-tastaceous, subpruinose, becoming convex; margin base plicate, constricted; folds towards the margins obliterated; spores fusiform-oblong, sigmoid, "bistortae" (towards both apices somewhat twisted, with septum often oblique), 12-16 x 6 um. California. I have seen no recent treatment of this species.

R. calicaris (L.) Fr.

Surface shiny, especially towards base. Texture calcareous, horn-like. Branches \pm canaliculate throughout. Apothecia \pm marginal, subterminal, on angled branches. Containing sekikaic acid complex or no medullary substances. Thallus 5-8(-15) cm long, tufted, becoming pendent, gray-green, stiff and spiky when dry; branches 2-3(10) mm wide, smooth; pseudocyphellae frequent, punctiform, indistinct. Apothecia frequent; spores 10-16 x 5-7 um, broadly ellipsoid, straight. On branches and twigs, especially of shrubs with a \pm nutrient-rich bark, rarer on tree trunks, often near the coast in well-lit situations. I suspect that reports from N. America are probably dubious.

R. canariensis J. Steiner

Thallus forming pulvinate to ragged tufts, scattered or forming swards; branches pale gray-green or dull green, \pm matt, broadening from base, sometimes tapered toward apices, compressed, internally solid or partly hollow with a lax, arachnoid medulla. Soralia mostly towards apices, lateral or subterminal [mostly marginal according to Clauzade & Roux], in rupturing helmet-shaped vesicles, or released from irregular lacerations of cortex; soredia 20-40 um diam., farinose. Apothecia very rare, marginal or on surface [terminal or subterminal according to Clauzade & Roux]. Spores 15-21 x 6 um, broadly ellipsoid or \pm kidney-shaped. Medulla and soralia P-, K-,

KC-, C-, UV± blue-white (divaricatic acid). On twigs and branches of shrubs and hardwood trees in well-lit situations; in British Isles also reported on rocks in dry underhangs. Baja California; Channel Islands of S. California.

R. celastri (Sprengel) Krog & Swinscow

Thallus (1-)5-10(-12) cm (exceptionally to 30 cm) long; pale green to gray-green, pale stramineous or fawn-gray rigid, erect, to subpendulous or pendulous; branching initially trichotomous, either remaining as a three-lobed thallus or thereafter dividing subdichotomously or irregularly, often producing densely branched thalli, rarely producing small branchlets at right angles to the primary branches; branches (1-)2-5(-10) mm (exceptionally to 20 mm) wide, compressed, ranging from narrow and canaliculate with apices attenuate to broad and flat with apices acute or blunt; young branches thin and membranous, ± smooth and even, older branches rugose to longitudinally ribbed-striate or reticulately ridged with subcortical strands of chondroid tissue; cracks or holes may appear between these strands; pseudocyphellae usually present, usually common and often prominent, white, shortly linear to irregular; cortex sometimes eroding to reveal ± clathrate arrangement of subcortical cartilaginous strands, margins sinuous, entire, slightly thickened; apices narrow, entire to broad and ± ragged, with well-developed thalli small lobules or adventitious thalli growing from the blades; holdfast delimited, prominent. Apothecia numerous, occasionally on both upper and lower surfaces of the branch, 0.2-0.5(-2.0) mm diam., marginal in young thalli and on narrower branches, laminal and marginal on broader branches, pedicellate, deeply cupuliform when young; discs plane to convex, sometimes papillate, white- or pinkish-pruinose; margin narrow, entire, smooth or crenate, becoming coarsely wrinkled scabrid, glossy, almost disappearing at maturity; spores oval, ellipsoid to slightly fusiform, mainly straight to slightly curved, (10-)12-16 x 4-6(-7) µm. No medullary substances. On bark, rarely on rock. Woodland and scrub. Subtropical to temperate, S. California?, and Mexico.

[R. chicitaculbersonii Riefner & Bowler ined.]

Thallus to 8 cm long; straplike branches arising from the point of attachment, with little branching; blades to 8 mm wide, compressed, longitudinally wrinkled/ridged, with infrequent pseudocyphellae, occasionally fenestrate, rigid, coriaceous; both sides corticate. Apothecia primarily terminal and/or clustered subapical, occasionally marginal or laminal, occurring to around half of the distance to the base; disc to 15 mm diam., usually cupped, pale. Spores 1-septate, ovate to ellipsoid, straight or gently curved, (10-)12-13(-20) x 5-8(-9) µm. Pycnidia not seen. Medulla with unidentified aliphatic substance, bourgeanic acid and unknown. On bark (primarily conifers, but also on Quercus agrifolia on the immediate coast), southern California.

R. complanata s. lato.

Thallus pale greenish yellow, tufted, leathery, 2-3(-7) cm long; branching dichotomous; branches compressed, canaliculate, to 2.5 mm wide; channels shallow, disappearing towards the tips; surface strongly papillate or papillate-striate (papillae sometimes appearing double lobulated or punctiform), nitid, stramineous, occasionally green. Cortex at first thin, then thick, cartilaginous to soft. Pseudocyphellae raised, punctiform or tuberculate. Chondroid tissue cracked. Apothecia numerous, terminal or marginal, rarely laminal, adnate, variable in size in accordance with the size of the thallus; disc concave, rarely convex, tan, pruinose; margin rugose; spores ellipsoid or ellipsoid-elongate, curved or bent, variable, 9-16 x 4-9 μ m. At least 7-8 chemotypes, with somewhat different distributions (see Landrón for discussion). Medulla K-, P- (divaricatic--R. complanata s. str. according to Landrón, or ramalinolic, or sekikaic), or K+ wine red, P- (cryptochlorophaeic), or K-, P+ red (protocetraric); strains with obtusatic, substance H, or substance A have also been reported. Common on tree trunks and branches in open areas along coast of Gulf of Mexico, and on palm trees along roadsides in southern Florida. Also reported from calcareous rocks and in salt sprayed habitats. Also reported from Ohio.

R. denticulata (= R. complanata according to Landrón, but type of R. denticulata not seen; according to Howe morphological distinctions can be seen when both occur together, but are not consistent)

Branches longitudinally rugose, margins uneven-denticulate. Thallus 3-5 cm long. Thallus \pm pale, greenish-olivaceous. Surface strongly papillate. Branches 1-5 mm wide. Lobes linear-elongate, subdichotomous; apothecia subterminal; discs concave, red, carneous-pruinose. Medulla K+ yellow then red, P+ orange. Salazinic acid major, norstictic trace. Baja California. Originally described from Brazil.

R. ecklonii Sprengel (= R. cumanensis Fée according to Landrón, but types of neither species were seen; N. American reports of R. ecklonii auct. = R. celastri v. celastri)

Thallus greenish yellow, thin, membranous and rather soft, 4-8(-20) cm long, caespitose to pendent; branches to 2-4(-1) cm wide, dichotomous, canaliculate, becoming flattened in large specimens; surface deeply striate longitudinally, not papillate. Apothecia numerous, minute, marginal and laminal; disc concave, flat or convex, tan, pruinose; spores ellipsoid, 11-18 x 4.5-8.5 μ m. Common on tree trunks and in scrub forests; also rarely on rocks. Southern California; Mexico.

R. evernioides Nyl. (= R. maciformis according to Krog & Osthagen, 1980; = a European name erroneously applied to R. lacera according to Riefner & Bowler, 1994, but not a synonym of R. lacera as stated by Esslinger & Egan, 1995; N. American reports are misidentifications of R. canariensis)

Thallus rigid, at least when dry; without cephalodia. Branches to 4 cm wide. Mechanical tissue (inner cortex) lacking; surface reticulately wrinkled.

Containing bourgeanic acid, plus either norstictic or salazinic acids. Laciniae developing from a broad holdfast, to 6 cm long, palmate, cuneate, or sublinear, sparingly divided, 0.5-6 cm broad, yellow-gray to pale yellow-green, smooth or scabrose, \pm reticulately ridged or cracked, with delimited, ulcerate areas on both sides producing granular soredia or corticate granules. Cortex one-layered (most other Ramalina spp. have two-layered cortex). Apothecia and pycnidia unknown. On rock in dry, sunny, exposed habitats, California. Somewhat similar to R. pollinaria but larger.

R. farinacea (L.) Ach. [s. lato]

Thallus coarse, rather firm, tough, rigid; branches 1-2(-3) mm wide, flattened or occasionally slightly channelled, sparsely (to sometimes richly) divided except toward tips. Soralia marginal or laminal, discrete, orbicular to elliptical, excavate to \pm flat, numerous; soredia 20-30 μ m diam., pale, farinose. Thallus tufted to \pm pendulous (but always arising from a delimited holdfast), 2-8(-10) cm long, surface pale yellowish green to dark gray-green, matt or \pm shiny, smooth to foveolate or longitudinally striated or pitted. Cortex thick, cartilaginous, rigid. Base darkening at point of attachment. Apothecia very rare, lateral, to 1.5 mm across; disc pale, concave; spores 8-15 x 5-7 μ m, subfusiform or broadly ellipsoid. Medulla K- or K+ pink to red, P- or P+ yellow to red, UV- or UV+ blue-white. Protocetraric acid, or salazinic acid, \pm norstictic ("R. reagens"), cryptochlorophaeic acid, hypoprotocetraric acid ("R. hypoprotocetrarica"), or no medullary substances). Usually on oaks, maples, alders, and other broadleaf trees, or wood, occasionally on rocks, in diverse habitats, ranging from shaded woodland to sunny, wind-exposed, isolated trees, coastal and montane forests and valley woodland, 500-3000 ft in California; Arizona south to Puebla, Mexico. Specimens in polluted habitats are often dark green, tufted, with short, decumbent, sometimes rather broad, contorted or recurved branches; conversely, in deep shade in woodland, material is often elongated, pale and rather sparingly branched with narrow branches.

R. fastigiata (Pers.) Ach.

Spores mainly kidney-shaped, rarely broadly ellipsoid. Branches not canaliculate, or only so at their bases, coarse. Thallus 2-5 cm long, usually erect, densely tufted and richly branched, pulvinate, occasionally becoming lax and \pm pendent, pale green to dull gray-green; branches terete or \pm angular, \pm flattened, \pm hollow with a lax, arachnoid medulla; surface \pm longitudinally striate, the fenestrations few to numerous. Apothecia terminal, often numerous, sometimes obscuring thallus; disc concave, becoming \pm convex when mature; spores 12-15(-18) x 5-6(-7) μ m, Polymorphic; thallus normally \pm globose, with the top-shaped apothecial branches forming a rounded cluster all at \pm the same level, but various modifications occur, especially in moist sites. On trunks or twigs on nutrient-enriched trees or shrubs, in exposed, well-lit areas, rarely on rocks, usually oceanic. Southern California. Earlier North American reports are

mostly based on misidentifications, often of R. americana, or perhaps sometimes of R. sinensis.

R. fraxinea (L.) Ach.

Thallus to 20(-30) cm long, \pm pendent, coarsely tufted, rarely monophyllous. Surface gray-green or olive to green-black, matt, rather soft in texture; lobes to 3 mm wide, flattened, sparingly branched, \pm twisted, tapering towards base and apices, flat or commonly \pm channelled, often with an uneven, finely, longitudinally and irregularly reticulately wrinkled or ridged surface, sometimes fenestrate or longitudinally lacerate; lateral branches usually arising near the distinct holdfast; pseudocyphellae frequent, inconspicuous, pale, rounded or oval. Apothecia marginal or laminal, usually frequent; stipitate, disc cup-like becoming flat or \pm convex; spores 10-17 x 4-7 μ m, kidney-shaped. Medulla K-, KC-, C-, P-, UV- (no medullary substances). Varies considerably in size, width and numbers of branches. On nutrient-rich bark in windy, well-lit sites, in woodlands. Arizona (misidentification?); California.

R. geniculata J. D. Hooker & Taylor (= R. inflata according to Landrón; treated as Fistulariella by Bowler & Rundel; Bowler (1987) refers to California material as "auct.")

Branches relatively compressed, abundantly branched. Thallus commonly over 20 mm tall; branching open. Branches to 1.5 mm broad at base, narrowing to 0.3 mm at tips, slightly flattened or rarely subterete. Apothecia numerous, subterminal or marginal, with a well-defined spur (geniculate), 1-3 mm diam., rounded, sub-pedicellate; thalline margin smooth, concolorous with thallus, becoming excluded when old; disc plane or convex, pale yellow-pink with a thick glaucous-yellow pruina; spores 6-8/ascus, biseriate, straight or curved, (10-)12-14 x 5-6 μ m. Thallus C-, P- K-, or P+ faintly yellow, K- or faintly yellowish or reddish (Containing divaricatic in the type according to Landrón and to Stevens; sekikaic acid, with ramalinolic or trace of salazinic have also been reported). Thallus loosely tufted, to 3 cm tall, of dichotomously branched laciniae. Branches smooth or in places obscurely faveolate but not canaliculate, \pm fistulose, here and there with rounded holes to 0.5 mm diam., exposing hollow cavity of interior; surface pale greenish yellow or glaucous, shining. On shrubs or in canopy twigs on small trees, mainly coastal and lowland. Southern California.

R. hoehneliana Müll. Arg.

Thallus pendulous; with laminal linear pseudocyphellae on subparallel branches bearing short divergent side branches. Branches flattened. Chondroid tissue non-cracked. Apothecia marginal and laminal. Spores straight to curved, 13-15(-17) x 5-6 μ m. Medulla without substances. On bark. Fog zone forests. Coastal central California. See Swinscow & Krog's African treatment for full description.

R. intermedia (Delise ex Nyl.) Nyl.

Thallus short (1-5 mm), much branched, more or less rigid, the branches generally less than 1(-1.5) mm across, flattened to subcylindrical, the apices tapering to isidioid tips; basal attachment plate-like; cortex greenish yellow, smooth and shiny. Soralia conspicuous, maculiform, not capitate, terminal or subterminal (to marginal), small, oval; soredia granular, whitish, occasionally bearing isidioid spinules. Medulla lax. Apothecia rare. Medulla K- or + slowly dingy pink, C-, KC- Pd- (chemical race 1: sekikaic and homosekikaic acids, no ramalinolic), K+ yellow then red, P+ yellow orange (chemical race 2: norstictic), or K- or + dingy brown, P+ orange-red (chemical race 3: protocetraric acid). Usually on moist cliffs and rocks (under overhangs) in shaded conditions, rarely on bark, boreal-temperate, to arctic. Arizona.

R. lacera (With.) J. R. Laundon (synonym: R. duriaei; "Dievernica"; will be put in a new genus by Riefner & Bowler)

Thallus flaccid when dry (medulla arachnoid, cortex under 30 um thick); with orange cephalodia. Soralia rather diffuse over the surface, in large laminal and marginal soralia. Branches to 5 mm wide. Thallus ranging from a single, often \pm convoluted lobe to \pm densely tufted, forming ragged clusters, erect or \pm pendent to partly decumbent; branches strap-like, flattened, concolorous or lower side paler, often with indented margins, with or without twisted and deformed marginal prolongations; surface matt, often \pm peeling, smooth or with a coarse reticulum of anastomosing ridges. Medulla dense, without prosoplectenchymatous tissue, without chondroid tissue. Soredia 20-40 um dima., farinose, derived from medulla, forming \pm ulcerose patches. Apothecia rare. Polymorphic. Medulla and soralia K-, Pd-, C-, KC-, UV- (bourgeanic acid). Mainly on wayside trees or scrub near the coast, usually in well-lit sites, also on rock in dry, sheltered situations, southern California; rare, may be nearing extinction because of development.

R. leptocarpha Tuck.

Thallus pale yellow-green, \pm pendulous, 3-10 cm long; branches flattened, rugose pitted with some longitudinal striations. Apices attenuate-acute. Surface greenish. Branches (0.3-)1-5(-8) mm wide. Apothecia very common, mostly lateral or marginal to subterminal, 1-6(-8) mm diam., mostly stipitate; disk tan. Spores (10-)12-17(-19) x (4-)5-7 um, mostly slightly curved, ellipsoid. No medullary substances; or bourgeanic; or bourgeanic and unidentified triterpene; or zeorin. On branches of oaks and other broadleaf trees or shrubs, rarely conifers, in valley and foothill woodland and north coastal forest, from sea level to over 1000 ft in California, south to Baja California, common.

R. linearis (Sw.) Ach.

Thallus erect, 2-4.5 cm high, repeatedly dichotomous; lobes divaricate, narrow to broad, 1-1.5(-2) wide, linear, compressed, canaliculate; surface

subnitid, striate, not papillate, not pseudocyphellae; without soredia. Apothecia marginal to sometimes appearing terminal, sessile, ca. 1-2 mm wide; margin thin, entire, persistent or rarely almost excluded, smooth below; disc carneous, often white-pruinose when young, plane or becoming convex; hymenium ca. 50 μ m; asci clavate; paraphyses branched and slightly thickened at tips; spores curved (straight to slightly curved according to Malme), oblong to narrowly ellipsoid, (9-)10-12(-13) x 3-4.5(-5) μ m, rounded at the tips. Medulla K-. No medullary substances. On bark. Southern California, Baja California. Described from New Zealand (but not mentioned in Galloway's book).

R. menziesii Taylor

Thallus netlike, 9-40 cm or more (to several m) long; branches 1-10 cm wide, flattened, twisted, simple to expanded and perforate and becoming delicately netlike (the number and size of perforations quite variable); surface with white striations (according to ?; not striate according to ?). Thallus K-, Pd-, C- (usnic only). Thallus yellow-green, pendulous, relatively soft, and often covering entire trees, Apothecia rare or common, 1-3 mm diam., scattered on surface of wider lobes; disk pale yellow-brown. On oaks and other broadleaf trees, shrubs, and conifers, in valley and foothill woodland and coastal forests, usually in relatively moist areas, from near sea level to 3500 ft elev. in California; on boojum trees in southern Baja California. Two main ecotypes, one in coastal areas and one in somewhat more inland areas (see papers by Nash, et al.). A form in fog zones becomes brownish and has narrow branches with few obvious reticulate perforations; it may not be recognized at first as a Ramalina.

R. moranii Bowler & Rundel

Thallus bushlike, to 8 cm long, dichotomously branching from a basal plate. Branches rigid, compressed, and flattened, basally to 5 mm wide, but usually ca. 2 mm wide. Branches not rugose, margins even. Cortices uniform, smooth for the most part, rigid, frequently displaying minute papillate structures. Branches usually two-edged, stramineous in old specimens. Medulla white. Apothecia common, subterminal, arising from the margins, often occurring the length of the branches. Discs pale, to 6 mm diam. Spores straight or slightly curved, 1-septate, "8.8-5.4" x 3.3-4.4 μ m. Medulla K+ yellow then red, P+ orange, containing salazinic acid. Baja California Sur.

R. obtusata (Arnold) Bitter

Soredia farinose. Thallus tufted, to 3 cm tall, partly hollow with a few fenestrations; branches 1.5-4 mm broad; cortex shiny smooth or obscurely spotted, pale green to straw-colored, pellucid when wet. Soralia mostly terminal, cupuliform (helmet-shaped) or occasionally labriform (usually capitate or labriform according to Clauzade & Roux). Medulla KC-, containing evernic and obtusatic acids. Apothecia unknown. On twigs of coniferous and deciduous trees in the boreal forest, rarely on rocks. Arizona, southern

California.

[R. ottolangei Riefner & Bowler ined.]

Thallus tufted, commonly growing in swards, to 6.5 cm long; branches to 5 mm wide, rather thin and friable; surface somewhat wrinkled, nearly shiny; primary branches straplike, radiating like fingers from a broad basal area up to 2 cm wide, dichotomously branched from a primary stem. Branches not canaliculate. Apothecia marginal, subterminal; disc to 5(-8) mm diam., cupped, bowl-shaped, sessile or partly immersed, pale. Spores 1-septate, ellipsoid, fusiform, or ovate, straight to gently curved, 12-14(-16) x 4-6 μ m. No medullary substances. On shaded bark of Quercus agrifolia, in mountain woodlands, southern California.

R. peruviana Ach.

Thallus erect, shrubby, 2-4(-8) cm tall, densely and intricately dichotomously branched; branches greenish-gray or sordid gray, solid, linear, weakly striate or ridged or subfenestrate in basal parts, pseudocyphellate, granulose; margins undulate; apices multifid; cortex with cartilaginous strands seen through the thin outer layer. Thallus delicate and fragile; branches 0.1-0.9(-1.5) mm wide, flattened, becoming terete or subterete towards apices, densely branched. Soralia mainly marginal, rarely laminal, often \pm knobby-protuberant, eroded, 0.05-0.6(-1.2) mm wide, punctiform or ellipsoid, often giving rise to minute branchlets which are deformed or granular; soredia farinose, white or greenish. Apothecia rare, 1-2 mm across; disc concave, brown; spores subfusiform or ellipsoid, \pm straight, 10-17.6 x 3-4.5 μ m. Medulla K-, C-, P-, or K+, C+, and KC+ faint pink (sekikaic, homosekikaic, ramalinolic, and related substances). On trees (e.g., royal palms) and shrubs. California.

R. pollinaria (Westr.) Ach.

Thallus solid. Branches usually relatively broad (1-2 mm). Thallus separate or in swards, 1-2(-6) cm tall, usually much branched, the lobes flat to terete, especially towards the apices, with numerous nodulose proliferations, sometimes deeply notched or incised; surface smooth, shiny, appearing cartilaginous; large lobes slightly foveolate. Soralia laminal to terminal (or occasionally marginal), maculiform, often seemingly labriform at the tips, irregularly formed and spreading, not well defined; soredia somewhat granular. Medulla with prosoplectenchymatous tissue. Apothecia rare. Thallus K-, C-, P-, containing evernic acid agg. and (sometimes?) obtusatic acids. On bark and twigs of conifers and broadleaf trees, dead wood, and rocks (usually steep or overhanging surfaces in sheltered areas). California; mountains of Arizona; rather rare.

R. polymorpha (Liljeb.) Ach.

Thallus 3-6 cm long, erect or \pm decumbent, in dispersed tufts or often forming extensive swards. Branches flattened, little or not branched, usually over 1 mm wide, dark green, strap-shaped or variously longitudinally

dissected, often \pm tapering towards the ends, often lacerate, contorted-twisted; surface irregularly lacunose and pitted, uneven, \pm scabrid, \pm longitudinally wrinkled or ridged, striate, commonly with scattered or confluent, concolorous or paler pseudocyphellae which may open into numerous fenestrations. Soralia ellipsoid or round, irregularly formed, scattered over thallus; soredia granular, 60-180 μm diam., singly or mainly clustered around the pseudocyphellae, concolorous with thallus, \pm smooth, corticate. Cortex rough. Apothecia rare, terminal or subterminal in small thalli, lateral and marginal in larger morphs, \pm persistently cup-like, rarely becoming convex; thalline exciple scabrid-verrucose; spores 12-16 x 4-6 μm , broadly ellipsoid. Medulla K-, Pd- (no medullary substances). On nutrient-enriched rocks, particularly below bird-roosting or -nesting sites on cliffs. Baja California (identification tentative).

R. puberulenta Riefner & Bowler

Thallus to 7.5 cm high with straplike or irregular branches arising from the base, varying from a single shallow lobed lamina or few-branched broad-lobed forms to densely branched cespitose morphotypes with very narrow blades; laciniae flattened, minutely puberulent (finely hairy), often sulcate; apices blunt with rounded rather than pointed tips in mature thalli; cortex coriaceous, extremely variable, smooth to irregularly corrugated or veined, lacunose, or ridged. Apothecia subterminal along lobe apices and often laminal on the distal half (on one side of the blade); disks cuplike to flat, to 14 mm diam., pale to pink-flesh colored; spores 1-septate, mostly gently curved to occasionally straight, (11-)12-16(-18) x (3-)4-7 μm . Chem.: usnic acid, pigment SV-1, atranorin; chemical races include: no additional substances; bourgeanic acid and zeorin; bourgeanic acid; zeorin. On bark, especially oak, mostly away from the immediate coast, southern to central California.

R. sinaloensis Bowler & Rundel

Thallus sparsely and diffusely branched, tufted, rigid and bushlike. Branches to 4 cm long, to 5 mm wide, strongly flattened, compressed, solid, arising from a thalloid attachment plate; upper and lower surfaces indistinguishable; tips tapering; surface somewhat wrinkled, with abundant characteristic white papillae along the length of the branches; cortex greenish; medulla white. Apothecia common and numerous, laminal, subterminal, to 4 mm diam., margins thalline; disk pale, concave; spores straight to slightly curved, 1-septate, 13.2-15.4 x 4.4 μm . Medulla K-, C-, KC-, P-; sekikaic (?) and unknown acid. On leguminous trees in thorn forest, Mexico: Sinaloa.

R. sinensis Jatta

Thallus 2-3.5(-6) cm long, erect or pendulous, loosely tufted or with \pm scattered or overlapping palmate lobes, flaccid when wet. Lobes often with lanceolate processes along the edges and at the tips, with abundant nerves

on the surface. Upper surface stramineous or gray-green; lower surface paler than upper. Lobes palmate, cleft almost to the base, forming several elongate, tapering extensions, or remaining almost entire with short to \pm extended digital extensions from the margins, occasionally also with numerous small multiseptate marginal outgrowths. Upper surface with irregular or \pm longitudinally oriented wrinkles, often fenestrate; lower surface with \pm longitudinally oriented anastomosing low ridges. Lobes rather thin, conspicuously flattened. Lower surface with partly decorticate white interspaces (pseudocyphellae), especially towards the holdfast but sometimes throughout the entire underside. Apothecia lateral, terminal or subterminal, rarely laminal on extensions of the lobes, 3-9 mm diam.; margin ridged-reticulate; spores 12-15(-17) x 6-7 μ m, curved. Evernic acid complex () or no substances (Swinscow & Krog). Arizona, California, Baja California.

R. sonorensis Kashiw. & Nash

Thallus to 8 cm long, shrubby, growing from a narrow holdfast, moderately branched. Branches solid, greenish yellow to greenish gray, matt, dorsiventral, weakly canaliculate, 4-7 mm wide; surface rugose towards tips, longitudinal ridges of chondroid layer of longitudinal white striations common. Pseudocyphellae subrotund or elliptic, slightly depressed, abundant on lower side. Thallus 200-600(-900) μ m thick; cortex distinct, 15-20 μ m; chondroid layer continuous or discontinuous especially in edged branches, smooth to weakly cracked, 100-250 μ m thick. Apothecia subterminal or rarely laminal, often with short spurs, to 7(-10) mm diam.; margin entire or radially split; disc concave to flat in young stages, convex in maturity; thalline exciple entire, reticulately ridged, often pseudocyphellate; hymenium 45-55 μ m thick; hypothecium 20-25 μ m thick; proper exciple 15-20 μ m; spores shortly fusiform, straight or slightly curved, 2-celled, usually with additional septa, 11-14 x 3.5-4 μ m. Pycnidia very common, laminal, with pale ostioles, mixed with tubercles; pycnospores rod-shaped, 3-4 x 0.5 μ m. Ch.: divaricatic and 4'-O-demethyldivaricatic acid. On shrubs and cacti, Baja California, very common. [Note: rare papillate forms of R. bajacalifornica, which contain salazinic acid, may also key out here]

R. subleptocarpha Rundel & Bowler

Thallus 3-6 cm long; branches 1-3 mm wide. Zeorin. Base of thallus not blackening; thallus rather stiff. Soralia linear or orbicular, mostly along margins. Thallus tufted to subpendulous. Branches flattened, shiny, slightly pitted. Typically with shallow marginal splitting of confluent soralia. Branching pattern basal. Apothecia rare. Thallus K-, P-, C- (medulla with zeorin, bourgeanic acid or acid deficient). On oaks and other broadleaf trees and fenceposts in north coastal forest and valley and foothill woodland in California, 1000-2500 ft., rather common.

[R. thomsonii Riefner & Bowler ined.]

Thallus tufted to pendulous, to 17 cm long, though often much smaller;

blades straplike, to 2.0 cm wide, compressed and flat; surfaces rather bright green, coriaceous, sometimes wrinkled and ridged; branching variable but usually sparse. Apothecia often abundant, occurring the length of the blade marginally or \pm subterminally, and laminally on both sides of the blade; disc sometimes extremely large (to 2.8 cm diam.), often abraded when large; disc pale, often cupped to plane, becoming flattened when large. Spores 1-septate, straight to curved, (10-)12-14(-17) x 4-6 μ m. Pycnidia not seen. Medulla containing unknown substances. On bark (usually Quercus lobata or Q. douglasii in interior savannas), southern California.

R. wigginsii Bowler & Rundel

Thallus to 8.5 cm long, tufted to subpendulous, decumbent, growing from a common holdfast, dichotomously branched; branches often ending with nodules; pseudocyphellae longitudinally arranged, continuous; chondroid layer non-cracked. Branches fine, usually ca. 0.5 mm wide, abundantly branching in a perpendicular manner from the central axis, becoming dense and intertangled. Branches ellipsoidal in cross-section, becoming flattened, especially basally; solid. Branches \pm terete and torulose. Finer branches and terminal segments displaying a lumpy, extruded appearance, with the branch tips recurvent and nodular. Cortex smooth and shiny, frequently thinning to form extensive longitudinal striations exposing the white medulla and producing a base for the formation of conspicuous corticate granules (ca. 100 μ m), leaving pits in the striae upon evacuation. Thallus stramineous. Apothecia usually present, subterminal, concave, to 2 mm diam.; underside of thalline margin crinkled; disk buff and dull; spores straight, 1-septate, longly fusiform, (8.8-)9.6-13.6 x 3.2-3.5(-4.4) μ m. Medulla K-, P-, C-, KC-. Ch.: boninic (Race 1) or homosekikaic (Race 2) acids major; 2'O-methylsekikaic and 4'O-methylpaludosic acids minor. On rocks around the summits of small hills. Baja California Sur; Sinaloa.

R. sp. (Kashiwadani, mentioned by Riefner & Bowler, unpublished)

Somewhat similar to R. celastri but thallus larger, more rigid, and apothecia larger, mostly marginal, concave. Spores 12-16 x 4-6 μ m, straight to gently curved, fusiform, ovate or ellipsoid. Apothecia marginal, \pm laminal, to 12 mm diam., plane to concave, crenulate, stipitate. Thallus leathery rigid; branches flattened to canaliculate. No substances. Mediterranean climate. Central California to Baja California, mostly coastal.

Literature

Bowler, P. A. 1977. Ramalina thrausta in North America. The Bryologist 80: 529-532.

Bowler, P. A. 1987. New combinations in Fistulariella (Ramalinaceae). Mycotaxon 29: 345-351.

Bowler, P. A. and P. W. Rundel. 1973. Two new lichens (Ramalina) from Baja California, Mexico. The bryologist 76: 211-213.

Bowler, P. A. and P. W. Rundel. 1974?5?. The Ramalina intermedia complex in North America. The Bryologist 77: 617-623.

Bowler, P. A. and P. W. Rundel. 1977. Synopsis of a new lichen genus Fistulariella Bowler & Rundel (Ramalinaceae). Mycotaxon 6: 195-202.

Galloway, D. 1985. Flora of New Zealand Lichens. P. D. Hasselberg, Wellington.

Hale, M. E. 1979. How to Know the Lichens. Wm. C. Brown, Dubuque.

Hale, M. E. and M. Cole. 1988. Lichens of California. U. of Calif. Press, Berkeley.

Howe, R. H. Jr. 1913-1919. North American species of the genus Ramalina. The Bryologist 16: 65-74, 81-89; 17: 1-7, 17-27, 33-40, 49-52. 65-69, 81-87.

Jones, R. E. 1964. The Lichen Genus Ramalina in the Gulf South Region of the United States. Ph.D. Dissertation, Louisiana State University.

Kashiwadani, H. and K. Kalb. 1993. The genus Ramalina in Brazil. Lichenologist 25: 1-31.

Kashiwadani, H. and T. H. Nash III. 1994. New or noteworthy species of the genus Ramalina (lichens) from northern Mexico. Acta Bot. Fennica 150: 87-92.

Krog, H. and P. W. James. 19___. Ramalina in Fennoscandia and the British Isles.

Krog, H. and P. W. James. The genus Ramalina in Fennoscandia and the British Isles. Norw. J. Bot. 24: 15-43.

Landrón, L. I. 1972. The Lichen Genus Ramalina in the West Indies with Notes on Its Role in the Vegetation of Puerto Rico. Ph.D. Diss., Michigan

State U.

Moore, B. 1968. The macrolichen flora of Florida. The Bryologist.

Purvis, O. W. and P. W. James. Ramalina. In: Purvis, et al., Lichen Flora of Great Britain and Ireland.

Riefner, R. E. and P. A. Bowler. 1994a. Ramalina baltica and Ramalina canariensis in North America. Mycotaxon 51: 495-501.

Riefner, R. E. and P. A. Bowler. 1994b. Ramalina puberulenta: A new lichen from California. Mycotaxon 52(1): 247-257.

Riefner, R. E. and P. A. Bowler. 1996? New and interesting fertile species of Ramalina from California. [Manuscript submitted for publication, probably in Mycotaxon; the draft I have a copy of is dated 1994]

Rogers, 19 . Genera of Australian Lichens.

Stevens, G. N. 1987. The lichen genus Ramalina in Australia. Bull. Brit. Mus. (Nat. Hist.), Bot. series 16(2): 107-223.

Thomson, J. W. 1984. American Arctic Lichens. I. Macrolichens.