

Stereocaulon Hoffm.
(LECANORALES: STEREOCAULACEAE)

After Lamb, 1977 and Thomson, 1984

Rev. 5/94

Primary (horizontal, basal) thallus \pm crustose to squamulose, usually rudimentary and disappearing early but sometimes persistent, of basal granules or squamules ("phyllocladia"). Secondary thallus shrubby, erect to decumbent, composed of stalks (pseudopodetia), springing from a \pm well-developed holdfast in some species, solid, weakly to strongly branched, fruticose in appearance, corticate or not, bearing ecorticate (usually corticate according to Galloway), algae-containing, verrucose to granular, cylindrical, squamulose or foliose structures (phyllocladia) or phyllocladioid branchlets; depending on the distribution of these structures the pseudopodetia may appear dorsiventral; cephalodia rare to abundant on the pseudopodetia, mostly irregularly globose, various in structure. Medulla (of phyllocladia) loosely interwoven. Cartilaginous axis of thick-walled, longitudinal hyphae.

Apothecia terminal or lateral; disk flat to often convex, pale brown to red-brown, dark brown or black; exciple proper, raised to \pm soon disappearing, sometimes pale and appearing almost thalloid; hypothecium usually hyaline, brown in some species; paraphyses unbranched, apices mainly with a brown cap; asci clavate to cylindrical, unitunicate, I+ blue; tholus I+ blue; in K/I with a blue outer layer, and a blue apical dome with a \pm central, darker blue tubular structure, Porpidia-like; spores 8, ellipsoid, clavate, or fusiform, to cylindrical, acicular, or vermiform, transversely 1-13 septate, hyaline, thin walled.

Pycnidia terminal or sometimes lateral, immersed in the tips of phyllocladia, ovoid to spherical, darkened around ostiole; fulcrum exobasidial; pycnosporos filiform to cylindrical, straight or curved, simple. Containing atranorin (K+ yellow), and often various phenolic acids, especially lobaric, stictic, norstictic, or fatty acids. Photobiont Trebouxia; cephalodia with Nostoc, Stigonema or occasionally other genera (Scytonema or Chroococcus). Mostly on rocks and soil or amongst mosses, in cool to cold, humid areas, arctic-alpine to boreal-montane.

The genus is not likely to be confused with any other, except perhaps Leprocaulon, which has very fine, ecorticate branches.

Although many of the species are quite distinctive once you learn them, many others are extremely difficult to distinguish. The different types of phyllocladia intergrade and can be very difficult to understand from descriptions (good drawings or close-up photos, which are few, can help considerably, but it is even more helpful to closely study reliably identified material of species described as having primarily a single type of phyllocladia. The gradation from phyllocladia to soredia is also often confusing. It is essential to record in the field whether the species is growing on soil or moss, or directly on rock, and to collect the primary thallus if such is present; the degree of persistence of the primary thallus can be problematic, although in many cases when it is persistent, it is obviously dominant over the few or small pseudopodetia.

I. Thallus (at least phyllocladia) P+ orange or red

(Stictic Acid, ± Norstictic Acid)

1. Sorediate.2

1. Not sorediate.4

2. Phyllocladia (at least partly) peltate, with (weakly to strongly) darker (greenish or blue-gray) centers and paler, often tumid margins. Pseudopodetia ± erect, not dorisventral; phyllocladia separate; soralia effusely subcapitate. Primary thallus disappearing. Apothecia uncommon but occasionally abundant, lateral, 0.5-1 mm broad. Cephalodia rare, with Stigonema. Rather variable, with various infraspecific taxa. Central axis K-; with stictic acid, usually norstictic acid and in one variety (var. umbonatum (Wallr.) Lamb) porphyrilic acid (dendroidin); a strain lacking stictic acid has also been reported. On mossy rocks, usually in more or less wet places, often colonizing lava flows, boreal-arctic. Alaska (typical material), S along Pacific coast to central Oregon Cascades, rare inland to central British Columbia.S. vesuvianum

2. Phyllocladia not peltate, without darker centers.3

3. Phyllocladia coralloid; cephalodia sacculate. Tennessee.S. microcarpum

3. Phyllocladia verrucose, dissolving into granular soredia thickly covering the branch tips; cephalodia tuberculate-verrucose to botryose, not sacculate, with Nostoc. K+ red. Stictic and norstictic acids and unknowns. Pseudopodetia little or not branched, not woody; soredia diffuse or spatulate and apical. Apothecia rare. Often in sheltered micosites on siliceous rock in cool moist habitats. Boreal-arctic, amphiatlantic, Alaska to Oregon, rare on W slope of Cascades, with disjuncts in Great Lakes area and Greenland.S. spathuliferum

4. Cephalodia sacculate.5

4. Cephalodia, if present, verruculose to botryose, not sacculate.
.....6

5. Tips of pseudopodetia often with whitish, mealy, pseudosorediate efflorescences; pseudopodetia not ligneous. Phyllocladia coralloid. Tennessee.(S. microcarpum)

5. Tips of podetia without pseudosorediate efflorescences. Thallus mainly large and well developed, to 25 cm tall, with a very prominent holdfast which is yellowish brown and devoid of cortex and phyllocladia. Pseudopodetia ± complexly branching, of stout primary branches and smaller, more richly branched secondary branches towards apices; primary branchlets white, ± decorticate with prominent exposed fungal hyphae visible, appearing tomentose, ± fibrillose (lens), with occasional shallow, vertical grooves, often lightly invested with a thin layer of algae; secondary branches ± covered with a distinct greenish algal layer. Phyllocladia terete, corticate, conspicuously green when wet, simple, nodular and fingerlike at first (often densely clothing young pseudopodetia), soon becoming complex, coralloid-branched, conspicuous towards apices. Cephalodia numerous, sessile or occasionally shortly stalked, prominent, bluish gray when wet, folded, indented or wrinkled, smooth, never areolate or scabrid. Apothecia usually terminal but also subterminal and lateral, small, usually not wider than supporting branch; disc

always convex, pale red-brown to dark brown, never black; margin smooth, pale yellowish brown. Stictic, norstictic and traces of 5 unknowns according to Dey; Perlatolic acid, \pm anziac acid according to Galloway. Southern Appalachians; also reported from Oregon, by Fink.S. ramulosum

6. Pseudopodetia densely arachnoid tomentose, distinctly dorsiventral even when appearing partly erect, loosely attached, the base often thinner than above. Phyllocladia at least in part rounded foliose or rounded squamulose, the margins more or less crenate or incised, in part becoming granulose, appressed to the pseudopodetia. Cephalodia pale, inconspicuous, small, with Nostoc. Apothecia very small, numerous, sunken, lateral, convex. P+ yellow or orange-red. Stictic and norstictic. Usually on soil in open places, occasionally on gravel, arctic-boreal-montane. New York, Connecticut, Massachusetts, Maine, New Hampshire, Vermont, Michigan, Wisconsin, Iowa, Minnesota, Montana, Idaho, Colorado, Wyoming, California, Washington, Alaska, and throughout most of Canada.S. tomentosum

6. Pseudopodetia non-tomentose or tomentum thin or sparse.7

7. Phyllocladia (at least partly) with darker centers and paler margins, verrucose to squamulose, not coralloid.8

7. Phyllocladia not peltate, without darker centers.9

8. Pseudopodetia emorient (dying) below, loosely attached to substrate. Cephalodia with Nostoc, botryose, small, dark red-brown. Thallus forming dense tufts. K+ yellow, P+ yellow to orange. Containing stictic and small amounts of norstictic acid. Coarse gray tomentum dispersed in patches. Phyllocladia dense towards the tops of the pseudopodetia, when young distinctly peltate with greenish centers and pale margins, concave, slightly more granulose than in S. vesuvianum. Apothecia rare. On soil in meadows, and on gravel. Arctic. NW Territories, Alaska.S. arcticum

8. Pseudopodetia not emorient below, firmly attached to substrate, usually over 1 cm long. Cephalodia with Stigonema. Primary thallus mostly lacking. Stictic acid. On rock.(S. vesuvianum)

9. Phyllocladia at least partly coralloid.10

9. Phyllocladia not coralloid, coarse in comparison with the pseudopodetia, running together, whitish; often derived from ends of phyllocladioid branches. Pseudopodetia to 4 cm long, prostrate-decumbent, dorsiventral, very fragile, with very thin or no tomentum, white with a rosy tinge, forming confused entangled cushions or occasionally scattered, not clearly dorsiventral, loosely attached to soil. Apothecia flat, large, frequent. Greenland. (S. rivulorum)

10. Pseudopodetia 5-6(-9) cm long. Apothecia partly lateral, partly terminal.S. myriocarpum

10. Pseudopodetia to 2-4(-8) cm long; little or not tomentose. Apothecia all terminal. Cephalodia scarce but large and conspicuous, convex, grayish, with tuberculate surface; apothecia numerous, 1-1.4(-5) mm wide. Central cylinder of pseudopodetia K+ yellow. Stictic and small amounts of norstictic and other related

substances. Pseudopodetia not woody, with thin, patchy tomentum or glabrous; base \pm smooth, not longitudinally furrowed. Primary thallus usually absent. On rock. Mostly eastern arctic, amphi-Atlantic, southward to N. Carolina in eastern U.S.; also in Alaska and British Columbia. 11

11. Phyllocladia are distinctly fan-shaped, flattened with crenate margin, to 1.0 mm or more across. SE Canada. S. dactylophyllum var. flabellatum

11. Phyllocladia not distinctly fan-shaped, often coralloid or with cylindrical projections. 12

12. Pseudopodetia densely packed, forming low, flat, tight cushion-like tufts, rather loosely attached by a wide blackened area on the underside; marginal pseudopodetia decumbent, gray, finally somewhat tomentose and light colored, or bare and then blackish; phyllocladia a little broadened, crenulate or incised to digitate or coralloid, with distinctly cylindrical projections, squamulose-warty, not in cauliflower-like masses. Apothecia small, convex, dark. Pseudopodetia branching, ascending, more or less tomentose, the horizontal basal portion firmly attached to the substratum; phyllocladia warty, confluent with whitish tips that occasionally burst into soredia. S. dactylophyllum var. occidentale

12. Pseudopodetia more loosely arranged, 1 mm thick; phyllocladia coralloid, long cylindrical, 0.2-0.3 mm diameter, simple or pinnately or irregularly branched or coalescing into squamules. New York, Vermont, Massachusetts, new Hampshire, Maine, N. Carolina, Tennessee, Michigan; Quebec, Ontario, New Brunswick, Nova Scotia, Newfoundland. S. dactylophyllum var. dactylophyllum

II. Thallus P- or P+ pale yellow; sorediate.

(NOTE: This part of the key is full of redundancy, and perhaps should be eliminated by incorporating the species into Key III).

1. Phyllocladia (at least partly) peltate, with darker (green) centers and paler, often tumid margins. Pseudopodetia prostrate-decumbent, dorsiventral; phyllocladia confluent; pseudopodetia short, 0.3-1.0(1.5) cm long, with terminal, globose-capitate soralia; P+ pale or sulphur yellow (lobaric acid present). Cephalodia with Stigonema. Apothecia rare. Primary thallus usually lacking. On rock, Arctic, Alaska and northern Canada (to boreal, in Quebec).S. symphycheilum

1. Phyllocladia not as above.2

2. Primary thallus persistent.3

2. Primary thallus evanescent. 5

3. Primary thallus in the form of upright, flabellate, bifacial squamule-like phyllocladia (to 0.5 cm tall), sorediate on "lower" side; soredia on apices of pseudopodetia unifacial or effuse. Thallus scattered or forming swards. Primary phyllocladia at first widened at apices and appearing fan-shaped, later becoming irregularly branched in one plane. Pseudopodetia rather rare, to 1 cm tall, sparingly branched, the branches flattened, sorediate below; soredia occasionally delimited in \pm globular soralia. Cephalodia infrequent, bluish gray, on pseudopodetia and primary thallus. Lobaric acid. On sheltered rocks, often in rather damp situations, particularly on old mine spoil heaps associated with lead or zinc deposits. New Hampshire.S. nanodes

3. Primary thallus granulose or verrucose, not sorediate.4

4. Pseudopodetia erect, short, growing between the well-developed primary squamules; soralia terminal on ends of sterile pseudopodetia, globose-capitate; phyllocladia lateral, granular. P-. Without tomentum. With lobaric acid. Cephalodia with Stigonema. Apothecia pileate, 1-1.5 mm broad. On rocks (granite and sandstone) and clay, in very moist, usually more or less shaded places, boreal, Great Lakes area to southeast Canada, south to N. Carolina; possibly also in the arctic.S. pileatum

4. Pseudopodetia prostrate-decumbent, dorsiventral; soralia present only on certain localized areas of the thallus.S. saxatile f. sorediatum

5. Phyllocladia (at least partly) terete-coralloid; pseudopodetia not rigid and ligneous; prostrate, dorsiventral; phyllocladia partly squamulose.6

5. Phyllocladia verrucose to squamulose (or absent), not coralloid.

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6. Color whitish; cephalodia abundant, brown-blackish, scabrid.(rare form of S. paschale)

6. Color ash-gray; cephalodia rare, brown, minutely tuberculate. (S. saxatile f. sorediatum)

7. **Pseudopodetia rigid and ligneous (woody).**8
7. **Pseudopodetia not rigid and ligneous.**9

8. Phyllocladia absent (replaced by soredia); cephalodia protosacculate; ends of pseudopodetia often flabellately expanded; soredia P+ yellow (lobaric acid present), rest of thallus P-. Pseudopodetia little or not branched, tightly attached by holdfasts, little or not tomentose. Soredia diffuse. Cephalodia conspicuous, brown or glaucous gray, sacculate with a solid core, usually with Nostoc. Apothecia terminal, 1.5-4 mm broad. On rock, rarely on soil, apparently in rather moist places, e.g., in the spray of waterfalls, arctic (Alaska and Baffin Island).S. conioophyllum

8. Phyllocladia present, granulose to verrucose, small, the tips often cauliflower-like; cephalodia tuberculate-verruculose to subbotryose, not protosacculate; ends of pseudopodetia not expanded; porphyritic acid (dendroidin) present. Pseudopodetia branching, whitish, woody, the base lacking tomentum. UV-. Primary thallus usually absent. On rock.S. botryosum f. sorediatum

9. **Pseudopodetia firmly attached to substratum, not dying below.**
.....10

9. **Pseudopodetia dying below, loosely attached to substratum (tightly in S. lerrocephalum).**12

10. Prostrate, decumbent, dorsiventral; color ash-gray.S. saxatile
f. sorediatum

10. Erect or subdecumbent, not dorsiventral; color pale (whitish or glaucous cream-colored).11

11. **Soredia only very rarely and abnormally present; lobaric acid typically present.**
.....(see S. incrustatum)

11. Soredia regularly present, capitate; miriquidic, perlatolic and anziac acids typically present. Primary thallus at first well developed, becoming scant between the pseudopodetia, which arise from squamules similar to the phyllocladia. Pseudopodetia decumbent, not fragile, base persistent. Thallus UV+. Phyllocladia on upper side, flattened verruciform, glaucous white, soon disappearing into farinose soredia. Axis and phyllocladia K+ yellow, P-. Apothecia unknown. Cephalodia inconspicuous, containing Nostoc. On soil, Greenland.(S. capitellatum)

12. Pseudopodetia prostrate, decumbent, dorsiventral.(rare form of S. paschale)

12. Pseudopodetia more or less erect, not dorsiventral.13

13. Growing in heathland or grassland; pseudopodetia 2.5-4.0 cm long, fragile, with dying bases; apical soralia abundant, white, terminal, densely grouped, 0.5-1.3 mm diam., capitate; lobaric acid present; apothecia unknown. Primary thallus at first well developed, becoming scant between the pseudopodetia, which arise from squamules similar to the phyllocladia.

Phyllocladia sparse, mainly in lower part of pseudopodetia, broadly squamulose and digitate branched, white. Cephalodia sparse, inconspicuous, with Nostoc or Stigonema. Apothecia unknown. Thallus UV-. P+ pale yellow. Pseudopodetia fragile, dying at base. On the ground, Greenland. S. uliginosum

13. Growing on rock or mossy detritus; pseudopodetia 1-2(2.5) cm long; apical soralia capitate, up to 3 mm diam.; porphyritic acid or (Baffin Island specimen) lobaric acid present; apothecia small, lateral. Primary thallus usually lacking. Pseudopodetia \pm strongly branched, little or not tomentose, tightly attached by holdfasts. Phyllocladia warty or granular. Rare, arctic (Baffin Island--identification tentative; expected in Alaska). S. leprocephalum

III. Thallus P- or P+ pale yellow; not soresciate.

1. Primary thallus persistent.2

1. Primary thallus evanescent.5

2. Growing on rock; pseudopodetia more or less prostrate-decumbent (except in S. saviczii?). 2a

2. Growing on soil; podetia more or less erect.4

2a. Phyllocladia lateral, tubular, partly thickly coralloid, partly subglobose-verrucose; apothecia frequently present, large, to over 3 mm diam.; lobaric acid present. Primary thallus persisting and pseudopodetia short, growing between the well-developed primary squamules, according to Thomson. P-. Tomentum thin, roseate-white. Apothecia terminal, to 7 mm broad. Cephalodia to 5 mm broad, dark bluish-ashy to olive-brownish, with Scytonema. On rock, Alaska. S. saviczii

2a. None of the phyllocladia tubular or coralloid. 3

3. Pseudopodetia ligneous, glabrous; tufts firmly attached by a narrow holdfast area on the underside. Phyllocladia tiny (mostly 0.5 mm broad), granular to knob-like when young, becoming weakly flattened and crenulate-squamulose. Pseudopodetial base becoming longitudinally furrowed. Lobaric acid. Mostly in mountainous or alpine situations. N.E. North America (typical variety in New Hampshire, Vermont, Quebec).S. glaucescens

3. Pseudopodetia not ligneous, branching, usually gray-tomentose; forming low, flat cushion-like tufts, rather loosely attached by a wide blackened area on the underside; marginal pseudopodetia decumbent, always closely appressed to the substrate, partly intergrown, gray, finally somewhat tomentose and light colored to blackish, or bare and then blackish; phyllocladia a little broadened, crenulate or incised, squamulose-warty, not in cauliflower-like masses, absent from underside. Apothecia rare, small, highly convex, dark, blackish brown. Pseudopodetia in middle of cushion erect, the base whitish, becoming tomentose upwards, the tips much branched and covered with flat, squamulose, and granulose white phyllocladia. Pseudopodetia often thinner at the base. P+ faint yellow. Lobaric acid. Phyllocladia squamulose, forming an almost continuous blue or slate gray crust. Cephalodia rare, with Stigonema. Firmly attached on rock (or loosely attached on soil?). Widely distributed, boreal to arctic, especially in the Great Lakes area and the Northeast. Differs from S. paschale in habitat, higher hymenium (55-65 um), wider spores (3.5-4 um), and rarity of cephalodia.S. saxatile

4. Cephalodia abundant on the pseudopodetia, whitish rose to brownish violet, brown or reddish brown (rarely blue-greenish), smoothly subglobose, large (up to 2-3 mm diam.), often with fissured surface, containing Nostoc. Pseudopodetia strong, erect, but short, only 1-2.5 cm tall, rather tightly attached. Phyllocladia more or less equally distributed around the pseudopodetia at least on the erect fruiting stalks, abundant, projecting beyond the tomentum, elongate, cylindrical or the tips somewhat thicker, clavate, mainly irregularly massed. Entirely tomentose. Apothecia rare, finally flat with a distinct, thin clear margin. Containing lobaric acid (but P-, KC- according to Thomson). Usually on bare soil, on frost boils, or among mosses on acid soils, boreal-

arctic, south to Colorado and Mexico.S. glareosum

4. Cephalodia frequent on the primary thallus, smaller and rarer on the pseudopodetia, red-brown to brown-blackish or blackish, hemispherical, irregularly pulvinate with scabrid surface, smaller (resembling those of S. paschale), usually containing Stigonema. Pseudopodetia short, growing between the well developed primary squamules, with scanty granular structures. Phyllocladia lateral, granular. Apothecia common, terminal, 1-2 mm, dark brown, soon convex, often breaking into smaller parts. Central medulla K-; cortex K+ yellow. Phyllocladia P+ yellow or P-, with or without lobaric acid. On sand or soil, boreal-subarctic, southeast to Great Lakes area and New England.S. condensatum

5. Phyllocladia represented by spatulate apical foliar expansions at the ends of the pseudopodetia. Lobaric acid, P-. Pseudopodetia short, growing between the well developed primary squamules, but primary thallus disappearing. Cephalodia blackish brown, verrucose, containing Stigonema. Apothecia apparently rare. On rocks, Alaska.S. apocalypticum

5. Phyllocladia lateral on pseudopodetia, not forming apical foliar expansions.
.....6

6. Phyllocladia (at least partly) peltate, with darker centers and paler margins.
.....7

6. Phyllocladia not peltate, without darker centers and paler margins, but sometimes darker at base than at tips.8

7. Growing on rock or stones; phyllocladia tubular, partly thickly coralloid, partly subglobose-verrucose; lateral; apothecia frequently present, large, to over 3 mm diam.; lobaric acid present. Primary thallus persisting and pseudopodetia short, growing between the well-developed primary squamules, according to Thomson. Alaska. (S. saviczii)

7. Growing on sandy or gravelly soil or among mosses (or rock according to Thomson); phyllocladia verrucose to peltate-squamulose (none coralloid); apothecia rare, small, up to 1 mm diam.; thallus P- or P+ pale yellowish; porphyritic acid (dendroidin) present. Primary thallus usually absent. Pseudopodetia in dense tufts. Tomentose above. Cephalodia with Nostoc. On moss and Dryas heaths on hummocks or gravelly soil. Arctic-subarctic. Alaska, NW Territories, Quebec.S. arenarium

8. Growing on soil, humus, or among mosses, usually quite loosely attached (except, e.g., in S. glareosum).KEY III-A

8. Growing directly on rock, usually firmly attached, rarely somewhat loosely attached.KEY III-B

ADD:

Cephalodia sacculate. Perlatolic and anziac acids. (S. ramulosum strain)

III-A Growing on soil, etc.

9. Tomentum gray, smooth, spongy; phyllocladia small (ca. 0.2 mm diam.), grain-like, scattered, half-concealed in the tomentum, often crowded in small groups, more or less equally distributed around the pseudopodetia (at least the fruiting ones). Apothecia terminal, soon swollen and split. Cephalodia dark brown, smooth, containing Nostoc. Pseudopodetia not very fragile, mainly erect or plainly ascending (at least the fruiting ones). Primary thallus usually absent. P-, with or without lobaric acid. Usually on sandy soil, Alaska and NW Canada, with disjuncts in eastern Canada and Colorado. Var. abduanum (Anzi) Grey in Rabenh. has larger phyllocladia more piled up, over the tomentum, in part coralline.S. incrustatum

9. Tomentum pale (whitish or cream-colored), pubescent to floccose, not spongy; phyllocladia larger, crenate-squamulose, elongate-squamulose or digitate-squamulose, fully exposed.10

10. Cephalodia abundant, distinct, dark olive brown or brown-blackish, flat, scabrid, containing Stigonema. Pseudopodetia not rigid, nor exceedingly fragile, mainly erect or plainly ascending (at least the fruiting ones), dying at the base, the mats easily lifted, the base thinner than above. With white to rosy tomentum above, naked below. Phyllocladia more or less equally distributed around the pseudopodetia at least on the fruiting stalks, botryose clustered, mostly small granular, spreading, digitately divided and radiating to all sides of the pseudopodetia, little more than 0.1 mm broad, seldom somewhat elongate and short irregularly finger-shaped. Primary thallus usually absent. Lobaric acid. Apothecia few, terminal, 1-3 mm broad, \pm flat. On soil, mainly among mosses, or on an accumulation of humus over rock, arctic, montane to boreal, south to Virginia, Wisconsin and California.S. paschale

10. Cephalodia not abundant, not brown-blackish or scabrid.11

11. Pseudopodetia prostrate-decumbent, forming dorsiventral mats.

.....12

11. Pseudopodetia more or less erect, not dorsiventral.14

12. Tomentum thick, floccose; apothecia lateral, small (up to 1 mm diam.). Lobaric acid. Boreal-temperate western N. America, east to Michigan.S. sasakii var. tomentosoides

12. Tomentum thin, adpressed-pubescent; apothecial terminal, larger (over 1 mm diam.).13

13. Phyllocladia verrucose to thickly crenate-squamulose, not formed from ends of pseudopodetial branchlets. Pseudopodetia not fragile. Apothecia 1-2 mm diam.; lobaric acid present. Tomentum usually pinkish. Pseudopodetia prostrate to somewhat ascending, with distinct main axis, forming low, flat cushions; underside without phyllocladia; tomentum whitish or pale rosy. Phyllocladia whitish, at most whitish gray, not blue-gray or dark gray, thick warty, always clearly swollen. Apothecia over 1 mm diam., finally flat, clear red-brown. Cephalodia gray-white, spherical, containing Nostoc. Usually on soil, loosely attached, the base of the pseudopodetia often thinner than above. Central axis K-. Phyllocladia P+ yellow, containing

lobaric acid and β -sitosterin. Growing especially under a late snow cover, arctic-alpine, south to New Hampshire, Colorado, and Washington. S. alpinum

13. Phyllocladia verrucose to elongate-squamulose, often formed from ends of pseudopodetial branchlets (i.e. phyllocladioid branchlets). Podetia very fragile. Apothecia frequent, larger, up to 3 mm diam., flat; perlatolic and anziac acids present (Ch. strain I), lobaric acid (Ch. strain II), stictic and norstictic acid (Ch. strain III, Greenland) or atranorin only (Ch. strain IV). Phyllocladia coarse in comparison with the pseudopodetia, running together, whitish. Pseudopodetia to 4 cm long, prostrate-decumbent, dorsiventral, very fragile, with very thin or no tomentum, white with a rosy tinge, forming confused entangled cushions or occasionally scattered, not clearly dorsiventral. Cephalodia infrequent, with Nostoc. Apothecia usually numerous, 1-3 mm broad. Loosely attached to soil, in low places below permanent snowbanks and along streams, arctic-alpine, south to Colorado and Washington. S. rivulorum

14. Pseudopodetia simple or subsimple; tomentum thick, floccose; apothecia lateral, small (up to 1 mm diam.) S. sasakii var. simplex

14. Psuedopodetia well branched; tomentum thin, adpressed-pubescent; apothecia terminal, larger (over 1 mm diam.). Cephalodia small. 15

15. Cephalodia aeruginose-gray, inconspicuous; phyllocladia verrucose to thickly crenate-squamulose; apothecia remaining undivided. S. alpinum var. erectum

15. Cephalodia pale brownish, usually subglobose, smooth to pulvinate and divided, containing Nostoc or Stigonema; phyllocladia verrucose, crenate-squamulose, or often digitate-squamulose; older apothecia dividing into compound heads of secondary discs. Pseudopodetia mainly erect or plainly ascending (at least the fruting ones), strong, rigid, mainly 4-5(-8) cm tall, with distinct main axis, thicker at the base, tapering up to the apothecia. Tomentum pale, rosy. Phyllocladia more or less equally distributed around the pseudopodetia at least on the fruting ones, abundant, projecting beyond the tomentum, a mix of S. alpinum types (verrucose to thickened squamuliform with incised margins) and S. paschale types (clustered granulose to clustered digitate, usually massed at regular intervals on fruting pseudopodetia). Apothecia to 3 mm broad, soon emarginate and fissured. With lobaric acid (but P- according to Thomson). Usually loosely attached, among mosses and in tundras over gravel soils, low arctic-boreal, south to New England and Oregon. Difficult to identify unless well-developed and typical. S. grande

III-B. Growing directly on rock, usually firmly attached.

1. **Phyllocladia exclusively coralloid.**2

1. **Phyllocladia not exclusively coralloid (or none coralloid)**3

2. **Hypothecium pigmented (brown); spores 4-7 μ m broad. Alaska.** Not mentioned by Thomson.S. octomerum

2. **Hypothecium not pigmented; spores 3-4 μ m broad. Eastern N. America.**

Pseudopodetia to 1.5-4 cm tall (but often less than 1 cm), 1-1.5 mm thick at base, blackish far upwards; lower branching \pm dendroid with several branches from one small space; upper part white, more divaricately branched, often \pm compressed, sometimes anastomosing; main axils indistinct; glabrous. Phyllocladia glaucescent white, shortly coralloid and \pm branched to lengthened verruciform, \pm uniformly distributed in uppermost part. Apothecia terminal, 1-2 mm across, often 2-4 together, convex, immarginate, irregularly, brown-black. Cephalodia conspicuous, olive-brown, containing Stigonema. With lobaric acid and traces of 1-3 unknowns. On exposed rock, southern Appalachians, rare.S. tennesseense

3. **Phyllocladia partly coralloid.**4

3. **None of the phyllocladia coralloid.**7

4. **Pseudopodetia not ligneous, forming dorsiventral mats widely and rather loosely attached to the substratum on underside; tomentum ash-gray.**(S. saxatile)

4. **Pseudopodetia ligneous, prostrate-dorsiventral or erect, firmly attached to the substratum by a small holdfast area; tomentum (when present) pale (whitish or cream-colored).**5

5. **Pseudopodetia large, 4-7(-8) cm long, 2-3 mm thick, erect (in f. compactum shorter and crustose-pulvinate), slightly tomentose;** phyllocladia partly coralloid, partly grain-like; cephalodia pale (aeruginose-gray); apothecia frequently present, large (to over 3 mm diam.), when young with pseudothalline margin. Central cylinder of pseudopodetia K-. With lobaric acid (but P- according to Thomson). Little or not tomentose. On rock. Beringial bilateral (Alaska to Washington, with disjunct in Newfoundland). Differs from S. grande in having high hymenium (55-65 μ m), blunt spores, free hyphae in main axis, thick cortex on lower side of apothecia and thin excipulum with thin hyphae.

.....S. intermedium

5. **Pseudopodetia shorter, 1.5-3.0 cm long, erect or prostrate-decumbent, glabrous;** phyllocladia partly coralloid, partly squamulose; cephalodia pale brown to brown-blackish; apothecia occasional to rare, smaller, 1-2 mm diam., without pseudothalline margin.6

6. **Pseudopodetia more or less erect, 1.5-2.5 cm tall; not tomentose; cephalodia abundant and conspicuous, brown-blackish, with Stigonema;** phyllocladia partly minutely coralloid, partly incised-squamulose, 0.2-0.4 mm long, congestedly branched with coralloid divisions 0.1-0.5 mm diam. Primary thallus usually absent. Central axis K-.

- Lobaric acid. Apothecia few, terminal. On rock. Boreal-arctic, Alaska to eastern Canada and New York.S. subcoralloides
- 6. Pseudopodetia usually prostrate-decumbent**, forming dorsiventral mats; cephalodia scarce, inconspicuous, pale brown to brown; phyllocladia partly coarsely difform-coralloid, partly digitate-squamulose. Apothecia very rare. Western (Alaska to California).S. sterile
- 7. Pseudopodetia tomentose.**8
- 7. Pseudopodetia glabrous.**12
- 8. Pseudopodetia prostrate-decumbent, forming dorsiventral mats.**
.....9
- 8. Pseudopodetia more or less erect, not forming dorsiventral mats.**
.....10
- 9. Pseudopodetial mats widely and not very firmly attached to substratum by a wide blackened central area below; tomentum ash-gray; phyllocladia ash-gray (except in f. paschaleoides).**S. saxatile
- 9. Pseudopodetial mats more narrowly and firmly attached to substratum, not blackened towards the base; tomentum pale (whitish or cream-colored); phyllocladia whitish or whitish gray.** Pseudopodetia not of ligneous appearance; not ferruginous-colored towards the base; tomentum thick, floccose; apothecia small (up to 1 mm diam.), not dividing into secondary discs; lobaric acid normally present. McCune & Goward regard this as a just a chemical strain of S. tomentosum.S. sasakii var. tomentosoides
- 10. Pseudopodetia ligneous, rigid, well-branched; apothecial terminal, becoming large (up to 5 or 6 mm diam.); lobaric acid absent.**11
- 10. Pseudopodetia not ligneous, subsimple or sparingly branched; apothecia lateral, small (up to 1 mm diam.); lobaric acid normally present.**S. sasakii var. simplex
- 11. Porphyritic acid (dendroidin) present; phyllocladia small, irregularly grain-like to verrucose, rarely subgranulose, often sorediiform, the tips often cauliflower-like. Thallus UV-, P-.** Pseudopodetia branching, whitish, woody, tomentose in upper parts, bare towards the base. Cephalodia rare, inconspicuous, with Nostoc. Apothecia, if present. terminal, 1.5-3 mm diam., dark brown. Primary thallus usually lacking. On rock, arctic-alpine or subalpine, south to Alberta, Great Lakes area and southeastern Canada.S. botryosum
- 11. Pelatolic, anziaic and miriquidic acids present (or sometimes atranorin only), UV+; porphyritic acid absent;** phyllocladia crenate- or digitate-squamulose, never sorediiform. Pseudopodetia erect, producing small dorsiventral cushions, robust, richly branching, whitish, woody, the base lacking tomentum. Primary thallus usually absent. Cephalodia inconspicuous or absent, with Nostoc. P+ pale yellow. Apothecia frequent, terminal, to 3-6 mm across. On rock and gravel, Greenland and Alaska. Very similar to S. rivulorum but with more woody pseudopodetia and often containing miriquidic acid.S. groenlandicum
- 12. Pseudopodetia erect, of cauliflower-like habitus; phyllocladia often very small, sorediiform; porphyritic acid present.**(S. botryosum)

12. Pseudopodetia erect or decumbent, not of cauliflower-like habitus; phyllocladia never sorediiform; porphyritic acid absent.13
13. Phyllocladia all regularly grain-like, subglobose, small (up to 0.2, rarely 0.4 mm diam.); cephalodia numerous, conspicuous, brown-blackish.S. depreaultii
13. Phyllocladia becoming crenate- or digitate-squamulose, over 0.4 mm diam.; cephalodia scarce, inconspicuous, pale brownish to brown.14
14. Perlatolic and anzaic acids normally present (or occasionally only atranorin); apothecia frequently present, large (3-6 mm diam.).(S. groenlandicum)
14. Lobaric acid present; apothecia rare, smaller (not over 3 mm diam.).
.....15
15. Phyllocladia grain-like to lobate-squamulose (in var. glaucescens becoming large and swollen-pulvinate), not elongate-squamulose. N. E. North America.(S. glaucescens)
15. Phyllocladia all or partly elongate-squamulose. Western N. America.
.....S. sterile

IV. Alternative Key, by Distribution and Ecology

A. Growing in eastern N. America.

(see S. glaucescens, S. dactylophyllum, S. microcarpum, S. pileatum, S. saxatile, S. tennesseeense, S. intermedium)

- 1. On rock.
- 1. On soil.

B. Growing in western N. America.

- 1. On rock.
- 1. On soil.

V. Alternative Key, by Obvious Morphology

A. Pseudopodetia conspicuously tomentose

S. tomentosum, S. sasakii v. tomentosum, S. alpinum, S. dactylophyllum, and others

B. Cephalodia conspicuous

S. paschale, S. glareosum, S. coniophyllum, S. depreaultii, and others

C. Pseudopodetia strongly dorsiventral

S. saxatile, S. alpinum, S. sasakii v. tomentosoides, S. sterile, S. tomentosum, S. rivulorum, S. symphycheilum

D. Phyllocladia peltate with dark centers

S. vesuvianum, S. symphycheilum, S. arcticum, S. arenarium

E. Apothecia present and \pm numerous

S. alpinum, S. botryosum, S. condensatum, S. coniophyllum, S. dactylophyllum, S. grande, S. groenlandicum, S. incrustatum, S. intermedium, S. paschale, S. pileatum, S. rivulorum, S. saviczii, S. tomentosum

F. Primary thallus conspicuous

S. saviczii, S. condensatum, S. pileatum, S. apocalyptum; sometimes (when young) also S. uliginosum and S. capitellatum

VI. Alternative key, by Chemistry

A. Stictic Acid (\pm Norstictic) present (P+ orange or red, KC-, UV-)

S. arcticum, S. vesuvianum, S. dactylophyllum, S. rivulorum strain III, S. spathuliferum, S. tomentosum

(see Key I)

B. Lobaric Acid present (P-, KC+ reddish, UV-)

S. alpinum, S. apocalyptum, S. symphycheilum, S. uliginosum, S. glaucescens, S. sterile, S. saviczii, S. rivulorum Strain II, S. condensatum strain I, S. coniophyllum, S. glareosum, S. grande, S. incrustatum strain I, S. intermedium, S. paschale, S. pileatum, S. saxatile, S. subcoralloides, S. uliginosum, S. leprocephalum strain II

(see Keys II and III)

C. Perlatolic and Anzaic Acids (& usually Miriquidic) present (P-, KC-, UV+)

1. Primary thallus at first well developed, then disappearing. S. capitellatum
1. Primary thallus soon disappearing. 2
 2. On soil, loosely attached. S. rivulorum Strain I
 2. On rock, tightly attached. S. groenlandicum strain I

D. Porphyrilic Acid present (P-, KC-, UV-)

1. Phyllocladia peltate with dark centers.
1. Phyllocladia not as above. 2
 2. On rock. Cephalodia with Stigonema. S. vesuvianum var. umbonatum
 2. On moss, soil, or gravel. Cephalodia with Nostoc. S. arenarium
3. Phyllocladia usually not sorediate, or at least without capitate soralia. S. botryosum
3. Phyllocladia dissolving into soredia, forming capitate soralia. S. leprocephalum strain I

E. Atranorin only present (P-, KC-, UV-)

1. Phyllocladia peltate with dark centers. S. vesuvianum strain III

1. Phyllocladia not as above. 2
 2. Primary thallus persistent. S. condensatum strain II
 2. Primary thallus soon disappearing. 3
3. Tightly attached to rocks. S. groenlandicum strain II
3. Loosely attached to soil. 4
 4. Pseudopodetia very fragile. Phyllocladia coarse, conspicuous. S. rivulorum Strain IV
 4. Pseudopodetia not very fragile. Phyllocladia small, partly hidden by tomentum. S. incrustatum strain II

ADDITIONAL INFO., TO BE INCORPORATED, WHEN DETAILED SPECIES DESCRIPTIONS ARE TRANSFERRED FROM THE KEY TO A SEPARATE SECTION:

S. alpinum f. platycladum Frey

Alberta, Saskatchewan, Colorado, Greenland

S. alpinum v. gracilentum (Th. Fr.) Magn.

Characteristic of movable dunes or alluvial sands, in either maritime or inland localities. Saskatchewan; Alaska.

S. botryosum

Contains atranorin and porphyritic acid. Alaska, NW Territories, Alberta, Oregon. The form congestum (Magn.) Frey is widely distributed and just as common as the typical form.

S. dactylophyllum

The varieties flabellatum (Frey) Grumm. and var. occidentale (Magn.) Grumm. are rather common and as widely distributed as the typical variety.

S. depreaultii

Contains atranorin and lobaric acid. Newfoundland, possibly Nova Scotia.

S. glareosum v. brachyphylloides

Alaska.

S. glaucescens

When typically developed; phyllocladia rather large, apically produced, convex, pileate-squamulose. Var. caespitosulum resembles S. evolutum and S. saxatile but is distinguished by its strongly ligneous, firmly affixed, non-tomentose pseudopodetia; the spores are 3-septate, 20-33 x 3-4 um. Typical variety not yet found with apothecia. New Hampshire, Vermont, Quebec. Var. caespitosulum more widespread, including New York, Massachusetts, Maine, Ontario, Nova Scotia, Newfoundland; some material from Michigan and Minnesota resembles var. caespitosulum but identity not fully established.

S. groenlandicum

Full chemical spectrum = atranorin, perlatolic, anziaic, miriquidic, and unknowns; miriquidic is accessory; specimens with only atranorin are also moderately common. NW Territories; Alaska

S. intermedium f. compactum Lamb

Thallus low, compact, crustose-pulvinate. Alaska, British Columbia, Washington, Newfoundland.

S. microcarpum

Chemistry quite variable; material from U.S. (Tennessee) includes "Deficient Phase" III (atranorin, stictic, constictic, norstictic, and perlatolic). Pseudopodetia often only 1-2 cm long, but sometimes up to 6 cm long; tall forms are scarcely distinguishable from S. ramulosum. In many specimens the apices of the pseudopodetia are whitened, mealy and decorticated, giving a pseudosorediose appearance, probably not due to damage by animals. Cephalodia of the normal ramulosum-type, loose-cored with gelatinized-palisadic cortex. Pycnoconidia filiform, curved, 8-11 x ca. 0.5 μ m. Pseudopodetia sometimes rusty-colored, when growing on iron-rich rocks.

S. myriocarpum

Podetia thinly tomentose to glabrous, \pm woody, 5-6(-9) cm tall. Contains atranorin, stictic, sometimes constictic, usually also sometimes norstictic. New Mexico, Colorado, California, Montana, Washington, Alaska, British Columbia, Mexico. Very similar to S. tomentosum and perhaps not a distinct species, but tomentum thinner, smoother; cephalodia more developed, subglobose, botryose-divided, bluish gray or darker.

S. octomerum

Spores normally 7-septate, but many 3-, 4- or 5-septate spores also occur, and occasionally a specimen is found with only 3-4-septate spores. Contains atranorin and lobaric acid. Alaska.

S. sasakii var. tomentosoides Lamb

Thallus habit similar to S. tomentosum, rather dorsiventral; phyllocladia congested and finally incised- to digitate-squamulose; cephalodia well developed, subglobose, aeruginose-glaucous or sometimes brownish, formed as in S. myriocarpa; apothecia small, lateral or sublateral; internal structure, spores, etc. as in typical form of S. sasakii and S. tomentosum. Washington, Oregon, California, Montana, Colorado, New Mexico, Minnesota, Michigan, Alaska, British Columbia, Yukon.

S. sasakii v. simplex (Riddle) Lamb

Distinguished by the simple to sparingly branched pseudopodetia and the scanty and scattered phyllocladia in a thick spongy tomentum. Atranorin and lobaric acid. Washington, Alaska, Oregon, British Columbia.

S. saxatile

Very variable; form with firm and wide attachment to rock, irregularly conrescent phyllocladial squamules, and persistent primary thallus is typical in nomenclatural sense, but uncommon and unusual in biological sense; "f. laxatum Lamb", with loosely spreading prostrate pseudopodetia, shows transitions to the common form; another modification has the pseudopodetia growing separately and \pm vertically, constrained by growth among erect moss-stems and lichens. Ontario, Quebec, Nova Scotia, Newfoundland, Labrador, Manitoba, New York, New Jersey, Connecticut, Massachusetts, Vermont, New Hampshire, Maine, Michigan, Wisconsin, Minnesota.

Thallus pale-colored, not slate-gray, but tomentum is gray; resembling S. paschale and also S. grande. Ontario, Labrador, Manitoba, New York, Wisconsin. f. paschaleoides (Hav.) Lamb

S. spathuliferum

Widely distributed and much more common than typical form. Lacking apical spathulate expansions, the soredia being effusely spread over the pseudopodetial apices. f. dissolutum (Magn.) Lamb

Apical soredia concentrated in \pm well-defined subglobose masses. Alaska; rare. f. globuliferum (Magn.) Lamb

Like a stunted, partly prostrate state of f. dissolutum with granular soredia effusely conrescent into a dense crust. Washington and Oregon. f. pygmaeum (Magn.) Lamb

S. tenneseense

Pseudopodetia fastigate-erect, rigid and ligneous, for the most part or at least towards the base brown-black; phyllocladia congested especially at apices of pseudopodetia, digitate-coralloid. Rather common in Adirondacks of New York; also found in N. Carolina.

S. tomentosum

Pseudopodetia very short, semi-prostrate, dorsiventral; tomentum dark gray, smoothly felted; phyllocladia crustose-conrescent. P+ orange-red. Apothecia sometimes botryosely divided; cephalodia often large. Canada (Prince Edward Island). f. botryocarpum (Magn.) Lamb

Morphologically resembling S. alpinum, but P+ red, with usually heavier tomentum, and apothecia, when present, small and lateral. Also similar to S. myriocarpum. Common and as widely distributed as typical variety, more frequent in very exposed situations. v. alpestre Flot.

Dark gray; habitus flattened and dorsiventral; tomentum often dark (grayish) on underside, strongly resembling S. saxatile. Widely distributed in N. America. v. compactum Frey

S. vesuvianum

Very variable. Usually on plutonic, metamorphic or sedimentary rocks, not lava. Tending to produce farinose soredia t tips of pseudopodetia, sometimes very distinct and conspicuous, but often only indistinctly or not a t all developed. Quebec, Labrador, Newfoundland, British Columbia, Oregon, Alaska, Mexico. v. nodulosum (Wallr.) Lamb

Thallus compacted, crustose. Similar in distribution to v. nodulosum, but penetrating to higher latitudes. v. nodulosum f. umbonatum (Wallr.) Lamb

In shaded or moist situations, possibly an ecotypic modification. Alaska. v. nodulosum f. umbricolum (Frey) Lamb

Soredia occurring rarely. Similar in distribution to v. nodulosum. v. nodulosum f. depressum (Magn.) Lamb

Thallus compact-caespitose but scarcely crustose, to 11 cm broad or more, dorsiventral; pseudopodetia radiating from center, glabrous. Phyllocladia crowded, verrucose, 0.2-0.4(-0.5) mm wide, without dark maculae, simple or sometimes confluent. Alaska. v. nodulosum f. verrucosum Lamb

Similar to S. symphycheilum in morphology, but has the characteristic chemical constituents of S. vesuvianum. Alaska. v. symphycheileoides Lamb

Apices of pseudopodetia coarsely granulose-sorediate, the granules derived by gradual diminution in isze of the upper granulose phyllocladia. Pseudopodetia glabrous. Lower phyllocladia sometimes partly confluent-expanded. Sometimes (in very exposed habitats at high altitude) decumbent, semi-crustose, and dorsiventral, with pruplish or violet-gray color. Oregon. v. efflorescens (Räsänen) Lamb

ADD:

Alaska. S. leprocephalum

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