Nephroma Ach.
(PELTIGERACEAE)

After Wetmore (1960), and others

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Thallus foliose, dorsiventral, spreading, or forming irregularly globular masses when on twigs, 2-30 cm diam., ± loosely attached, ± rosette-forming or rarely fragmentary, often large, radiate, prostrate or ascending; lobes rounded to slightly elongate, entire, indented or with folioles, often ascending at the margins, usually quite thin (100-300 um); upper surface gray-brown or ± pale greenish yellow, or (non N. American spp.?) brownish red, ± smooth, matt or shining, sometimes ± maculate, smooth, wrinkled or faveolate-impressed; soredia, isidia or phyllidia sometimes present; pseudocyphellae absent; both surfaces with paraplectenchymatous cortex; attached by rhizoids; medulla white or yellow, of loosely woven hyphae, 40-260 um thick; lower surface black or pale brown or whitsih, bullate, or smooth and ± undulate, to subpubescent or tomentose, in one species with pale papillae.

Apothecia sessile (immersed according to Rogers) on lower surface of lobe tips which recurve upwards, rounded to reniform; disc pale brown to red-brown-black; thalline exciple present; true exciple absent; hypothecium pale; paraphyses unbrnached; asci clavate, "simplified Peltigera-type" unitunicate, I-; spores 8, fusiform, transversely 1-5-septate, pale brown, thin walled.

Pycnidia marginal, semi-immersed in small warts; ostiole black, pimple-like; fulcrum endobasidial, branched; pycnospores short, straight, bacilliform or constricted in the middle. Nephrin, zeorin, usnic acid, neprhoarctin, nephrolomin, anthraquinones, emodin, fragilin, phenarctin, stictic acid. [Several of these compounds are hopane tritepenes; others are depsides or pigments]. Photobiont green (Coccomyxa) or blue-green (Nostoc), in a lyaer 30-60 um thick; cephalodia (containing Nostoc) internal in species with a green photobiont, towards the lower surface. On bark, soil, or mossy rocks, in humid areas, oceanic to boreal-montane or arctic, often characteristic of ancient woodlands and sensitive to SO_2 pollution.

Close to Peltigera both morphologically and chemically, but characterized by the apothecia arising on the lower surface and the presence of a lower cortex. When fertile Nephroma is unlikely to be confused with any other genus; the only other genus with apothecia arising on the underside (at least in some species) is Tuckermannopsis.

1. Algal layer with green algae; blue-green algae limited to cephalodia. 2

1. Algal layer with blue-green algae; cephalodia absent. 4

> **2. Thallus yellow; cephalodia visible on upper surface; upper surface smooth.** 3
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> **2. Thallus dull green or brownish, greener when wet;cephalodia internal, visible on lower surface; upper glabrous, pruinose, scaly or slightly pubescent.** Lobes to 1.8 cm broad; edges entire or crisped, often with regeneration lobules; lower side light brown

at margins, dark centrally and with varying amounts of tomentum. Apothecia uncommon. All usual reagents negative; containing nephrin, zeorin, and neutral substance "B". On tussocks, hummocks, among mosses in crevices between rocks, commonly in Cassiope heaths. Arctic-alpine, south to southwest Alberta. ..... N. expallidum

3. Lower surface light brown or white near the margins, black centrally, tomentose, with cephalodia; lobes broad and plane, the margins crisped or entire; regeneration squamules common; upper side smooth. Thallus forming large mats. Apothecia to 20(-30) mm broad; disc light brown; exciple entire; spores subfusiform with thin walls, 23-27 x 4-6 um. Thallus K+ yellow, KC+ yellow, P+ yellow; medulla UV+. Containing nephroarctin ("carotenoid" of Wetmore), phenarctin, usnic acid, and zeorin. On soil or moss, on hummocks, over moist rock outcreops, and mossy banks, boreal-arctic (south to New England), common. ..... N. arcticum (typical phycotype)

3. Lower surface pale lemon yellow or ochraceous; lobes ± elongate and canaliculate, the margins often lacerate. On bark or wood, old growth forest, Pacific NW, rare. ..... Lobaria silvae-veteris (green algal phycotype)

4. Papillae present and conspicuous on lower surface; thallus usually tomentose below. Thallus gray-brown to brown, to 9 cm broad, the lobes to 1 cm broad; upper side pubescent in varying amounts; regeneration lobes common. Apothecia common, to 11 mm broad. No reactions, no substances. On rocks and trees in cool, moist, shady places, hemiboreal to low alpine, Alaska southward in the West, Greenland to Great Lakes area and New England in the east. ..... N. resupinatum

4. Papillae absent on lower surface; thallus tomentose or etomentose below. 5

5. Thallus with soredia. 6

5. Thallus without soredia. 7

6. Upper surface smooth, brown-gray, without usnic acid. Medulla K+ yellow or K-, usually containing zeorin, plus or minus nephrin and unkowns. Thallus ca. 8 cm broad, the loves to 5(-17) mm broad; upper surface with round soralia forming patches of bluish gray; soralia also on margins; lower side rugulose with variable amounts of tomentum; regeneration squamules often present. Apothecia rare. Common on moist, shaded rocks and trees, Alaska to California and south-central Rockies in the west, Greenland to eastern U.S. in the east. ..... N. parile

6. Upper surface reticulately ridged, greenish yellow (usnic acid). Medulla K+ light yellow, P+ orange, C+ yellow, KC+ yellow, UV(shortwave)+ yellow. Contains neprhoarctin, phenarctin, zeorin, sometimes nephrin. Lobes 0.4-1.5 cm wide, 1-2.5 cm long; margins entire, slightly upturned; upper surface (except for ridges) smooth or with small openings, with faint white reticulate lines near lobe tips; tops of ridges cracking and becoming sorediate; soredia granular to subisidiate (partly corticate), ca. 0.1-0.2 mm diam. Medulla white to slightly yellowish. Lower surface glabrous, cream to tan near margins, becoming brown towards center. Apothecia unknown. Rare, on bark in canopies of coniferous trees in old-growth forests, Pacific NW (Oregon,

Washington). ..... N. occultum

7. Upper surface yellow (usnic acid). Rare. 8
7. Upper surface brown-gray. 9

8. Lower surface whitish; lobes broad and plane, the margins entire. On soil or moss, arctic. ..... N. arcticum (blue-green phycotype)
8. Lower surface pale lemon yellow or yellowish white at margins, grading to pale or dark ochraceous; lobes somewhat elongate and weakly to strongly canaliculate, the margins undulate to becoming lacerate or lobulate. On bark or wood, old growth forest, Pacific NW. Thallus loosely attached, to 3.5-7.5 cm diam.; lobes stiff, averaging 3-5(-7) mm wide. Upper surface plumbeous gray (dry), matt, even, bearing conspicuous laminal maculae, these somewhat reticulate; isidia occasionally present as finger-like marginal projections to 0.5 mm long; green lobules sometimes present, laminal, peltate, averaging 1-3 mm wide. Lower surface corticate, somewhat shiny at margins, becoming densely hirsute inward, the hairs concolorous with lower usrface. Medulla white. Apothecia unknown. Upper cortex K-, C-, KC-, P-; medulla C-, KC-, K+ yellow, P+ pale orange, or apparently P-. Contains usnic acid, stictic, norstictic, constictic and crypotstictic acids, and trace of unknown. British Columbia and Washington. ..... Lobaria silvae-veteris (typical phycotype)

9. Medulla usually shades of yellow or yellow-orange, K+ pink to deep red-violet, P+ red (the anthraquinone nephromin). Morphologically rather similar to N. bellum, without isidia or teeth. Thallus 3-8 cm diam., spreading, rarely fragmentary, the lobes 2-10 mm wide, robust, often coraiaceous, the margins entire, decumbent or ± reflexed, rarely developing small folioles; upper surface gray-brown to deep red-brown, ± smooth or partly wavy; lower usrface smooth to longitudinally striate-ridged to wavy, pale at margins, becoming brown-black towards center, without tomentum. Apothecia frequent. On mossy rock or bark in moist shaded areas, ± oceanic, temperate, Pacific NW (California to British Columbia) and northeast (New England to Newfoundland) ..... N. laevigatum
9. Medulla usually white, K-. 10

10. Thallus with isidia and/or marginal teeth 11
10. Thallus without isidia or marginal teeth (but sometimes with small lobules or regeneration squamules). Lobes to 1 cm broad; upper side glabrous or slightly pubescent, brown; lower surface rugulose, pale to dark brown, pubescent to tomentose. Apothecia common, to 10(-15) mm broad, the margins entire to crenulate; disk light brown; spores ellipsoidal with thickened walls, 17-21 x 5-6 um. All reagents negative, or P+ yellow (unknown substance); containing zeorin and nephrin, plus accessory "neutral substances". On mossy rocks and trees in shaded places, hemiboreal to alpine, Alaska to Oregon, south-central Rockies and Arizona in the west, Greenland to eastern U.S. in the east. ..... N. bellum

11. Isidia branching, usually arising in clusters on ridges of lacunose upper surface, coralloid, ca. 0.3 mm tall. Thallus brown, to ca. 5 cm broad; lower surface with dense, short, dark brown tomentum and short scattered rhizines. Apothecia unknown. No reactions.

Containing "3 neutral substances". On rocks, among mosses and at the base of woody plants. Alaska, with disjunct in Greenland, rare. ..... N. isidiosum

11. "Isidia" (lobules or phyllidia) unbranched, usually not in clusters; lacunose ridges absent. Thallus ca. 1-5(-8) cm diam., thin, lobate, orbicular to spreading. Upper surface brown, gray-brown or pale gray, wrinkled, matt or shining, ± faveolate and often ± maculate (x 10 lens). Apothecia common, to 8-10 mm diam.; discs dark brown or red-brown, matt or shining; margins thin, dentate, backs of apothecia often pubescent. All reactions negative; containing "several neutral substances", + nephrin (hopane-7α, 22-diol, 7ß-acetoxyhopane-22-ol and undidentified pigments, according to Galloway). Spores pale reddish brown, 3-septate, 20-25 x 6-9 um. 12

> **12. Thallus thin (0.1-0.16 mm); marginal teeth and isidia flat and short, or teeth lacking.** Upper surface with varying amounts of pubsecence and small isidia (0.1-0.2 mm wide); margins with indentations, broad lobules or small teeth 0.2-0.3 mm long; regeneration squamules common, sometimes covering the whole thallus; lower surface usually tomentose or densely pubescent, dark brown or black. On mossy rocks and trees in moist, cool, shady places. Boreal-temperate (Rocky Mountains and eastward), with scattered occurrences in northern Canada. ..... N. helveticum v. helveticum
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> **12. Thallus thick (0.25-0.29 mm); marginal teeth and isidia thick, roundish and long.** Upper surface ± pubescent; large (0.5 mm long and 0.2-0.5 mm wide) isidia usually present. Marginal teeth 0.3-0.5 mm long, 0.3 mm wide; lower surface evenly tomentose. Boreal-temperate, Rocky Mountains and westward. ..... N. helveticum v. sipeanum

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