CHAPTER 9

FAMILY LECANORACEAE

Characteristics of the Family Lecanoraceae

Thallus: corticolous or saxicolous, grey-white to pale creamy white or creamy grey or green-grey or creamy white, creamy grey or pale ochre, sometimes with orange dots at the edges of areoles, smooth to rough and/or verrucose or verruculose, continuous, areolate with irregularly shaped to angular or areolate to rimose; epruina; Soralia and Isidia absent; Prothallus not visible or bluish black to black or whitish gray; Photobiont chlorococcoid; Apothecia: very abundant, scattered or densely crowded together and margin prominent, entire, verrucose crenulated, verruculose, sessile, not constricted at base or sometimes semi-immersed; disc plane to convex, pale brown, grey-brown, orange, orange-brown, pale to dark red-brown, pale greenish brown and concolorous or red or orange-red inspersed with fine reddish granules at margin; epruina or slightly pruina; with lecideine (proper exciple) or lecanorine (thalline exciple) Cortex (*Lecanora* and *Vainionora*) hyaline: Amphithecium (*Lecanora* and *Vainionora*): with large crystals insoluble in KOH (*pulicaris*-type) or with small and large crystals (*melacarpella*-type) or with numerous small crystals insoluble in KOH (*allophana*-type); Parathecium: hyaline or yellowish to reddish brown, without crystals or

sometimes with crystals or inspersed; cortex: hyaline and gelatinous inspersed with small crystals or indistinct and inspersed or gelatinous and inspersed with small crystals or gelatinous and inspersed with numerous small crystals; Epihymenium: blackish green or green or dark red-brown to dark grey-brown or brown, pigmentation insoluble in KOH, without crystals (*glabrata*-type) or with crystals (*chlarotera*-type) or with small crystals (*pulicaris*-type); Hymenium: hyaline to very pale brown; Subhymenium: indistinct or hyaline; Hypothecium: hyaline or yellow to pale yellowish brown, reddish brown; Paraphyses: simple, rarely anastomosing or sparingly branched with thickened apically, apical not conspicuously swollen or slightly thickened apically; Asci: clavate, *Lecanora*-type; **Ascospores**: 32-50 or (6-) 8 per ascus, hyaline, narrowly ellipsoid or ellipsoid to broadly ellipsoid, simple or non-halonate, (11.2)11.3-11.8-12.0(12.5) × (5.1)5.4-6.0-6.4(6.9) µm; **Pycnidia** not observed or immersed; black ostiole; **Conidia** hyaline; filiform, curved.

***Key to genera of* Lecanoraceae**

1a. Asci containing 32-50 ascospores.....*Maronina*

1b. Asci containing 8 ascospores.....2

2a. Epihymenium red or orange-red.....*Ramboldia*

2b. Epihymenium reddish brown, blackish green or green.....3

3a. Apothecia lecideine.....*Lecidella*

3b. Apothecia lecanorine.....4

4a. Hypothecium reddish brown to dark brown.....*Vainionora*

4b. Hypothecium hyaline to pale yellow.....*Lecanora*

Description of the Genus *Lecanora*

Lecanora Ach., *Lichenogr. Universalis* 77 (1810) (Lumbsch & Elix, 2004, pp. 12-13).

Thallus: corticolous or saxicolous, whitish grey, yellowish green, yellowish grey, yellowish white, pale green, greenish grey, verrucose, continuous, 132.4-189.5 mm thick; epruina; Soralia and Isidia absent; Prothallus whitish gray; Photobiont chlorococcoid; Apothecia: common, dispersed to crowded and margin prominent, entire, verrucose crenulated, verruculose, immersed and/or sessile; disc plane, pale brown, grey-brown, orange, orange-brown, pale to dark red-brown, pale greenish brown and concolorous at margin; epruina, 0.5-1.7 mm diam.; cortex: 10-35 μm thick laterally and 15-45 μm thick basally; Parathecium: hyaline, without crystals or with small crystals or with numerous small crystals soluble in KOH, 10.0-25.0 μm thick; cortex: indistinct, inspersed or gelatinous and inspersed with small crystals or gelatinous and inspersed with numerous small crystals 10.0-35.0 μm thick laterally and 15.0-45.0 μm thick basally; Amphithecium: with small and large crystals (*melacarpella*-type) or with large crystals insoluble in KOH (*pulicaris*-type); Epihymenium: red-brown to brown, 10.0-16.0 μm thick, pigmentation insoluble in KOH, without crystals (*glabrata*-type) or with crystals (*chlarotera*-type) or with small crystals (*pulicaris*-type); Hymenium: hyaline, 50.0-75.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: hyaline or yellow to pale yellowish brown, reddish brown,

60.0-120.9 µm high; Paraphyses: simple or slightly thickened, apical not conspicuously swollen or slightly thickened apically, 30.5-41.9 µm high; Asci: clavate, *Lecanora*-type, 25.5-31.5 µm high; **Ascospores**: 8 per ascus, hyaline, narrowly ellipsoid or ellipsoid to broadly ellipsoid, simple, (11.1)11.2-11.8-12.0(12.5) × (5.1)5.4-6.0-6.5(6.8) µm; **Pycnidia** and **Conidia** not observed.

Chemistry: Atranorin, usnic acid or xanthones, and a wide range of depsides, depsidones, terpenoids and fatty acids.

Habitat: *Lecanora* grows on rocks and tree trunks. The species are widely distributed in lower montane scrub, coniferous forests, tropical rainforests, mixed deciduous forests, lower montane rainforests, dry dipterocarp forests and dry evergreen forests between 355 and 1,520 m.

Distribution: Worldwide in all climatic zones.

Key to Species of Lecanora Sensu Stricto

1a. Saxicolous.....2

1b. Corticolous.....4

2a. Apothecia remaining immersed in the thallus.....

.....*Lecanora subimmersa*

2b. Apothecia sessile.....3

3a. Discs dark brown to brownish black, thallus containing arthothelin.....*Lecanora flavoviridis*

3b. Discs dark red brown, shiny, thallus containing atranorin and zeorin……*Lecanora vainioi*

4a. Thallus containing usnic acid……*Lecanora achroa*

4b. Thallus lacking usnic acid……5

5a. Thallus containing gangaleoidin……6

5b. Thallus containing atranorin……7

6a. Discs pale orange to yellowish brown, epihymenium (*chlarotera*-type)……*Lecanora leprosa*

6b. Discs pale to dark red brown, epihymenium (*glabrata*-type)…… *Lecanora argentata*

7a. Hypothecium brownish yellow to reddish brown…… *Lecanora phaeocardia*

7b. Hypothecium hyaline to pale yellow……8

8a. Thallus containing 2'-*O*-methylperlatolic acid……9

8b. Thallus containing arthothelin, zeorin……10

9a. Discs pale brown to orange, epihymenium (*chlarotera*- type) …… *Lecanora helva*

9b. Discs dark red-brown to brownish red, epihymenium (*pulicaris*- type) …… *Lecanora toroyensis*

10a. Thallus containing zeorin…… *Lecanora tropica*

10b. Thallus containing arthothelin……*Lecanora austrotropica*

Description of the Species

1. ***Lecanora achroa*** Nyl., *in* J.M. Crombie, *J. Bot.* 14: 263 (1876) (Lumbsch & Elix, 2004, p. 18)

(see Figure 23)

Thallus: corticolous, yellowish grey to greenish grey, smooth, continuous to rimose, 130.7-262.5 mm thick; epruina; Soralia and Isidia absent; Prothallus blackish brown; Photobiont chlorococcoid; Apothecia: common, dispersed to crowded and entire to verruculose, sessile; disc plane, orange-brown and concolorous at margin; epruina to slightly grayish pruina, 0.3-0.8 mm diam.; cortex: hyaline, inspersed with numerous small crystals, 15-35 μm thick laterally and basally; Parathecium: hyaline, with small crystals, 10.0-15.0 μm thick; cortex: hyaline, inspersed with numerous small crystals 15.0-35.0 μm thick laterally and 15.0-20.0 μm thick basally; Amphithecium: with large crystals insoluble in KOH (*pulicaris*-type); Epihymenium: yellowish brown, 10.0-15.0 μm thick, pigmentation soluble in KOH, with crystals (*chlarotera*-type); Hymenium: hyaline, 50.0-70.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: hyaline, 65.0-110.5 μm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 31.5-41.9 μm high; Asci: clavate, *Lecanora*-type, 25.5-31.5 μm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid to broadly ellipsoid, simple, (9.9)10.3-12.9-15.8(16.3) × (6.02)6.1-7.3-8.4(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and apothecial margin P+ yellow, K+ yellow, C+ orange, KC-; containing usnic acid and atranorin.

Habitats: On tree trunks in lower montane scrub and dry dipterocarp forests at 700-1,487 m.

Distribution: North, Central and South America, Indian Ocean islands, Thailand, Papua New Guinea, the South Pacific; Sonoran Desert (Baja California Sur and Sinaloa), Australia, and North Island of New Zealand.

Specimen examined: Phu Luang Wildlife Sanctuary, Loei Province. around the helicopter landing spot, on trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC851, VC128, VC129, VC130 & VC131(RAMK); ibid., Phu Khon Substation, on trunk of an unidentified tree, 21 May 2009, Varaporn Sriprang—VC603, VC132, VC170, VC171, VC172, VC173, VC174, VC090, VC091, VC092, VC093 & VC093(RAMK).

Observation: *Lecanora achroa* is characterized by small, orange-brown apothecial discs, small ascospores and the presence of usnic acid in the thallus. Morphologically, *L. achroa* resembles *L. helva* and *L. leprosa* in having relatively small apothecia with orange-brown discs, but is distinguished by a different chemistry.

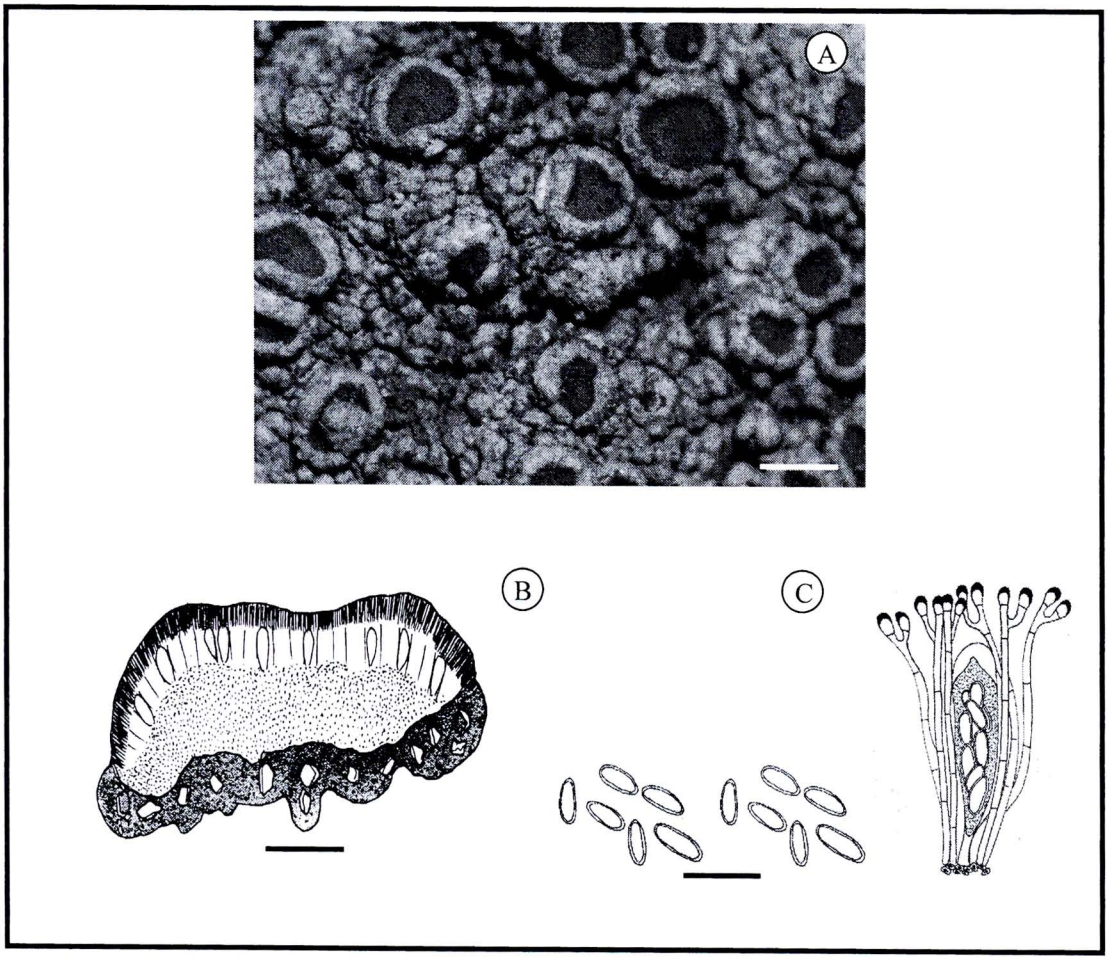

Figure 23 *Lecanora achroa* Nyl.

Note. A = Apothecia lecanorine, sessile, orange-brown [VC851(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [VC851(RAMK)] (scale = 11.2 μm)

C = Illustration of ascus with paraphyses and ascospores [VC851 (RAMK)] (scale = 5.64 μm)

2. ***Lecanora argentata*** (Ach.) Degel., as G. Nilsson, *Ark. Bot.* 24A: 78 (1931) (Lumbsch & Elix, 2004, p. 20)

Parmelia subfusca f. *argentata* Ach., *Methodus* 169 (1803)

(see Figure 24)

Thallus: corticolous, yellowish white to yellowish grey or whitish grey, smooth, continuous, 150.5-265.8 mm thick; epruina; Soralia and Isidia absent; Prothallus whitish to grayish white or not visible; Photobiont chlorococcoid; Apothecia: common, dispersed to crowded and entire, verrucose to crenulated, sessile; disc plane, pale to dark red-brown and concolorous at margin; epruina, 0.4-1.0 mm diam.; cortex: hyaline, gelatinous and inspersed with numerous small crystals, 15-25 µm thick laterally and 20-45 µm thick basally; Parathecium: hyaline, with numerous small crystals soluble in KOH, 10.0-15.0 µm thick; cortex: hyaline, gelatinous and inspersed with numerous small crystals 15.0-25.0 µm thick laterally and 20.0-45.0 µm thick basally; Amphithecium: with large crystals insoluble in KOH (*pulicaris*-type); Epihymenium: reddish brown, hyaline layer above, 10.0-15.0 µm thick, pigmentation insoluble in KOH, without crystals (*glabrata*-type); Hymenium: hyaline, 55.0-70.0 µm high; Subhymenium: hyaline, 10.0-15.0 µm high; Hypothecium: hyaline, 63.0-109.7 µm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 31.5-38.9 µm high; Asci: clavate, *Lecanora*-type, 25.5-30.5 µm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (9.4)10.0-12.8-15.6(16.3) × (4.6)5.1-6.02-7.4(8.6) µm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and apothecial margin P- or P+ pale yellow, K+ yellow, C-, KC-; containing arthothelin, atranorin and gangaleoidin.

Habitat: A corticolous species that occurs in various ecosystems in Phu Luang Wildlife Sanctuary, such as lower montane scrub and lower montane rainforests at 923-1,473 m.

Distribution: Thailand, Africa, Asia, Australasia, Europe, North America, and South America; Sonoran Desert (Arizona and Chihuahua).

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. the sideway to Lan Suriyan, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—VC682(RAMK); ibid., Khok Huai Toei, on trunk of an unidentified tree, 27 June 2008, Varaporn Sriprang—VC550 & VC553 (RAMK); ibid., Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—VC133, VC134, VC135, VC677 & VC733(RAMK).

Observation: *Lecanora argentata* is characterized by a non-granulose, red-brown epihymenium, the *pulicaris*-type amphithecium, and the presence of gangaleoidin in the thallus. While it is similar to *L. austrotropica* and *L. tropica*, these species have smaller apothecia and they contain xanthones and further lack gangaleoidin.

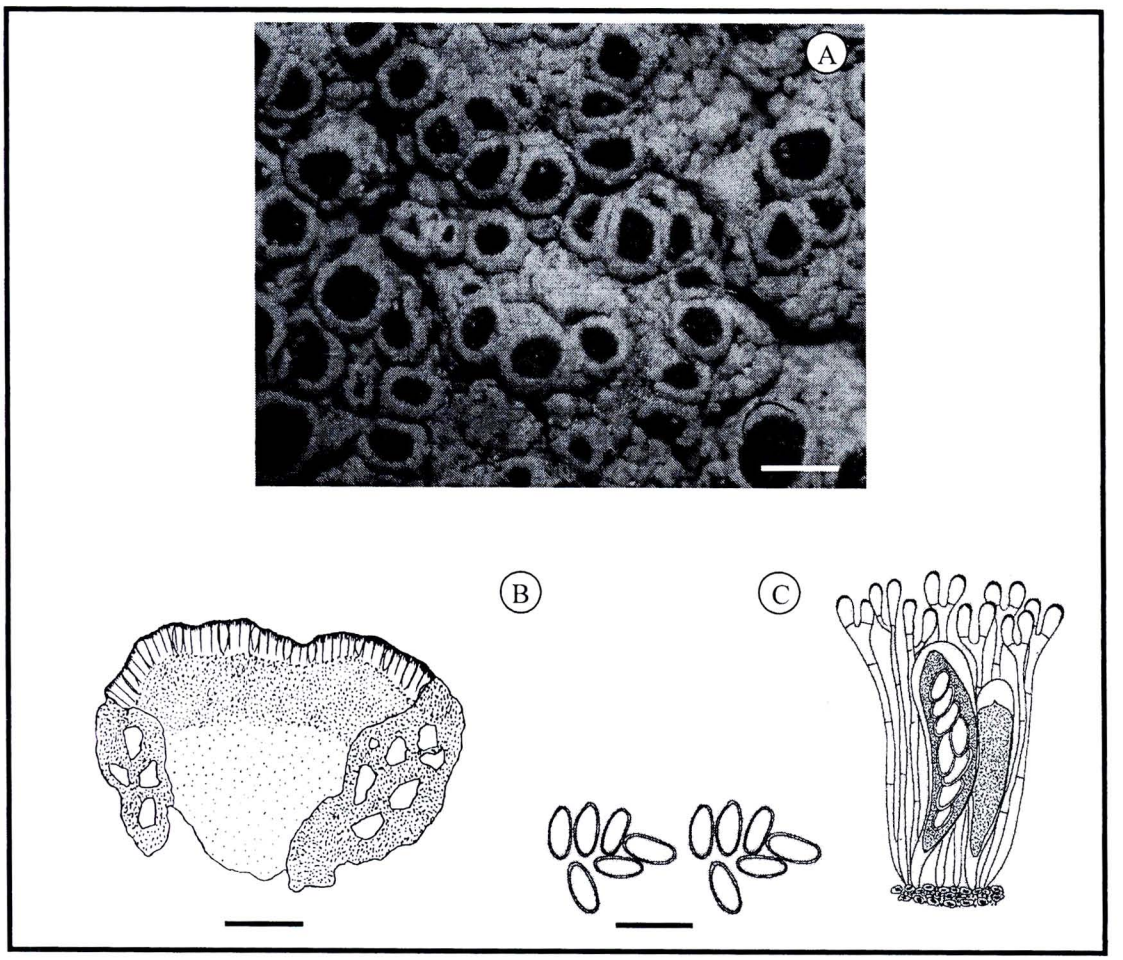

Figure 24 *Lecanora argentata* (Ach.) Degel.

Note. A = Apothecia lecanorine, sessile, dark red-brown [VC682(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [VC682(RAMK)] (scale = 11.7 μm).

C = Illustration of ascus with paraphyses and ascospores [VC682 (RAMK)] (scale = 6.5 μm)

3. ***Lecanora austrotropica*** Lumbsch, *J. Hattori Bot. Lab.* 77: 72 (1994) (Lumbsch & Elix, 2004, p. 23)

(see Figure 25)

Thallus: corticolous, yellowish white to yellowish grey or whitish grey, dispersed-verrucose to verruculose, continuous, 162.5-285.8 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; Apothecia: common, dispersed to crowded and entire, verrucose to crenulated, sessile; disc plane, pale to dark red-brown and concolorous at margin; epruina or slightly whitish grey pruina, 0.2-0.9 mm diam.; cortex: hyaline, 15 μm thick laterally and 15-20 μm thick basally Amphithecium: with large crystals insoluble in KOH (*pulicaris*-type); Parathecium: hyaline, with numerous small crystals soluble in KOH, 10.0-15.0 μm thick; cortex: hyaline, gelatinous and inspersed with numerous small crystals 15.0-25.0 μm thick laterally and 15.0-20.0 μm thick basally; Amphithecium: with large crystals insoluble in KOH (*pulicaris*-type); Epihymenium: reddish brown, hyaline layer above, 10.0-15.0 μm thick, pigmentation insoluble in KOH, without crystals (*glabrata*-type); Hymenium: hyaline, 50.0-65.0 μm high; Subhymenium: hyaline, 10.0-14.5 μm high; Hypothecium: hyaline, 60.0-107.7 μm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 30.9-37.9 μm high; Asci: clavate, *Lecanora*-type, 25.5-32.5 μm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (11.1)11.3-13.5-15.4(15.6) × (6.02)6.1-7.3-8.4(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and apothecial margin P+ pale orange, K+ yellow, C+orange, KC-; containing arthothelin and atranorin.

Habitat: A corticolous species, occurring in Phu Luang Wildlife Sanctuary in lower montane scrub, mixed deciduous forests, lower montane rainforests, dry evergreen forests and dry dipterocarp forests at 700-1,550 m.

Distribution: Thailand, Eastern and North-Eastern Australia.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. around the Khok Nok Grabra Forest Protection Unit, on trunk of *Lithocarpus truncatus* (King) Rehder & Wilson, 24 June 2008, Varaporn Sriprang—VC531(RAMK); ibid., Khok Huai Toei, on trunk of an unidentified tree, 30 July 2009, Varaporn Sriprang—VC603(RAMK); ibid., Huai Lat, on trunk of an unidentified tree, 30 July 2009, Varaporn Sriprang—VC907, VC909, & VC913(RAMK); ibid., Nam Ki Substation, on trunk of an unidentified tree, 22 June 2010, Varaporn Sriprang—VC930(RAMK); ibid., Nam Tob Substation, on trunk of an unidentified tree, 23 June 2010, Varaporn Sriprang—VC944(RAMK); ibid., Huai Baeng Forest Ranger Station, on trunk of *Lithocarpus calathiformis* Rehder & Wilson, 24 June 2010, Varaporn Sriprang—VC945(RAMK); ibid., Phu Ho Forest Station, on trunk of an unidentified tree, 29 July 2009, Mattika Sodamuk and Chutamat Phraphuchamnong—SM87(RAMK).

Observation: *Lecanora austrotropica* is characterized by the non-granulose, epihymenium, the small apothecia, the *pulicaris*-type amphithecium, and by its chemistry. It is morphologically similar to *L. tropica*

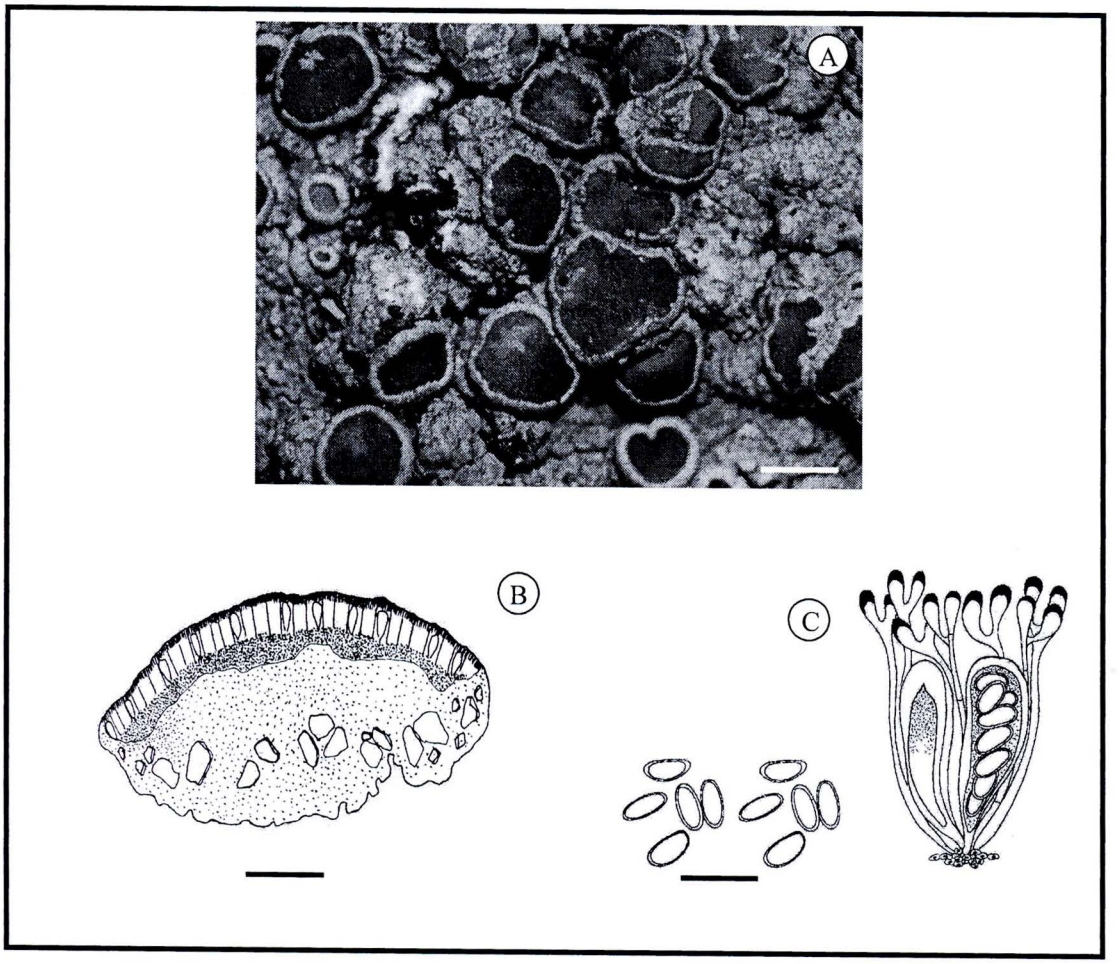

Figure 25 *Lecanora austrotropica* Lumbsch

Note. A = Apothecia lecanorine, sessile, pale to dark red-brown [VC531(RAMK)] (scale = 0.6 mm)

B = Illustration of vertical section of apothecia [VC531(RAMK)] (scale = 14 μm)

C = Illustration of ascus with paraphyses and ascospores [VC531 (RAMK)] (scale = 8.21 μm)

which has an overlapping distribution; the latter has smaller ascospores and a different chemistry.

4. ***Lecanora flavoviridis*** Krempelh. *Flora* 56: 470 (1873)

(see Figure 26)

Thallus: saxicolous, yellowish grey to yellowish green, verruculose, continuous to rimose-areolate, 105.0-142.8 mm thick; epruina; Soralia and Isidia absent; Prothallus blackish brown; Photobiont chlorococcoid; Apothecia: common, dispersed to crowded and indistinct, sessile; disc plane, dark brown to brownish black and concolorous at margin; epruina, 0.8-1.8 mm diam.; cortex: inspersed, 10-15 μm thick and Amphithecium: with small and large crystals (*melacarpella*-type); Parathecium: hyaline, with small crystals, 15.0-20.0 μm thick; cortex: indistinct, inspersed 10.0-15.0 μm thick laterally and 15.0-20.0 μm thick basally; Epihymenium: dark green brown to greenish black, 10.0-15.0 μm thick, pigmentation turning greenish in KOH, without crystals (*glabrata*-type); Hymenium: hyaline, 50.0-60.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: brownish yellow to dark brown, 65.0-109.6 μm high; Paraphyses: simple, or slightly thickened apically, 30.9-37.9 μm high; Asci: clavate, *Lecanora*-type, 25.7-32.5 μm high; **Ascospores**: 8 per ascus, hyaline, broadly ellipsoid, simple, (7.3)7.4-8.9-10.5(10.7) × (4.3)4.5-6.6-7.3(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and apothecial margin P+ pale yellow, K+ yellow, C-, KC-; containing atranorin, arthothelin and xanthone.

Habitat: A corticolous species, occurring in Phu Luang Wildlife Sanctuary in lower montane scrub at 1,510 m.

Distribution: Thailand.

Specimen examined: Phu Luang Wildlife Sanctuary, Loei Province. from Pha Chang Pan to Pha Somdet, on rocks, 22 May 2009, Chutamat Phraphuchamnong—CP453(RAMK).

Observation: This saxicolous species is characterized by a blackish brown epihymenium that turns green in KOH, and broadly ellipsoid ascospores.

5. ***Lecanora helva*** Stizenb., *Ber. Thätigk. St. Gall. Naturw. Ges.* 1888-89: 218 (1890) (Lumbsch & Elix, 2004, p. 36).

Lecanora albellaria MÜll. Arg., *Bull. Herb. Boissier* 3: 632 (1895).

Lecanora alligata Stirt., *in* F. M. Bailey, *Queensland Agric. J.* 5: 38 (1899).

(see Figure 27)

Thallus: corticolous, yellowish white to yellowish green or greenish grey, verruculose, continuous or rimose-areolate, 182.6-302.8 mm thick; epruina; Soralia: usually absent or granular with whitish to whitish grey and in roundish, patches and Isidia absent; Prothallus blackish brown; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and entire to verrucose, immersed when immature becoming sessile; disc plane, pale brown to orange or pale greenish brown and concolorous at margin; not to slightly pruina, 0.3-0.9 mm diam.; cortex: hyaline, gelatinous and inspersed with small crystals, c. 15 µm thick laterally and 15-25 µm thick basally; Parathecium:

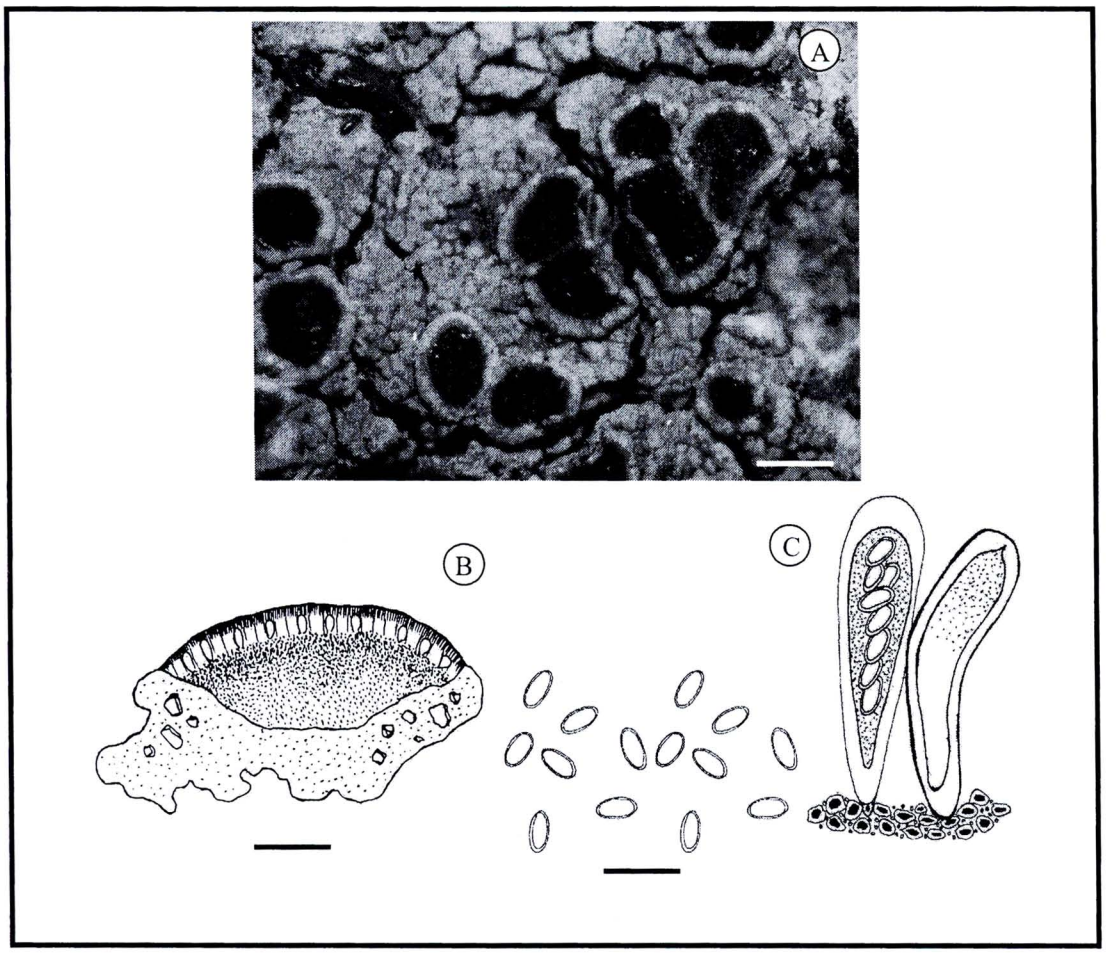

Figure 26 *Lecanora flavoviridis* Krempelh.

Note. A = Apothecia lecanorine, sessile, dark brown [CP453(RAMK)]

(scale = 1 mm)

B = Illustration of vertical section of apothecia [CP453(RAMK)]

(scale = 10.8 μm)

C = Illustration of ascus and ascospores [CP453(RAMK)]

(scale = 5.83 μm)

hyaline, with numerous small crystals insoluble in KOH, 15.0-20.0 μm thick; cortex: hyaline, gelatinous and inspersed with small crystals 10.0-15.0 μm thick laterally and 15.0-25.0 μm thick basally; Amphithecium: with large

crystals insoluble in KOH (*pulicaris*-type); Epihymenium: yellowish brown, 10.0-15.0 μm thick, pigmentation soluble in KOH, with crystals (*chlarotera*-type); Hymenium: hyaline, 55.0-65.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: hyaline, 65.0-109.9 μm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 31.5-38.5 μm high; Asci: clavate, *Lecanora*-type, 25.9-30.5 μm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (9.9)10.3-12.9-15.8(16.3) × (4.3)4.5-6.6-7.3(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and apothecial margin P+ pale orange, K+ yellow, C-, KC-; containing atranorin and 2'-*O*-methylperlatolic acid.

Habitats: On tree trunks in lower montane scrub and dry dipterocarp forests at 1,490 m.

Distribution: North and South America, Africa, South and East Asia (Thailand), Australasia, and New Zealand.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. around the helicopter landing spot, on tree trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC852(RAMK); ibid., Nam Ki Substation, on trunk of an unidentified tree, 22 June 2010, Varaporn Sriprang—VC094, VC095, VC096, VC097, VC098, VC098, VC099, VC0100 & VC0101(RAMK).

Observation: *Lecanora helva* is characterized by small, orange to pale brown apothecial discs, the nature of the epihymenium and amphithecium, and the chemistry of the thallus. Morphologically, it is similar to *L. achroa* and *L. leprosa*. However, those two species can be readily distinguished by

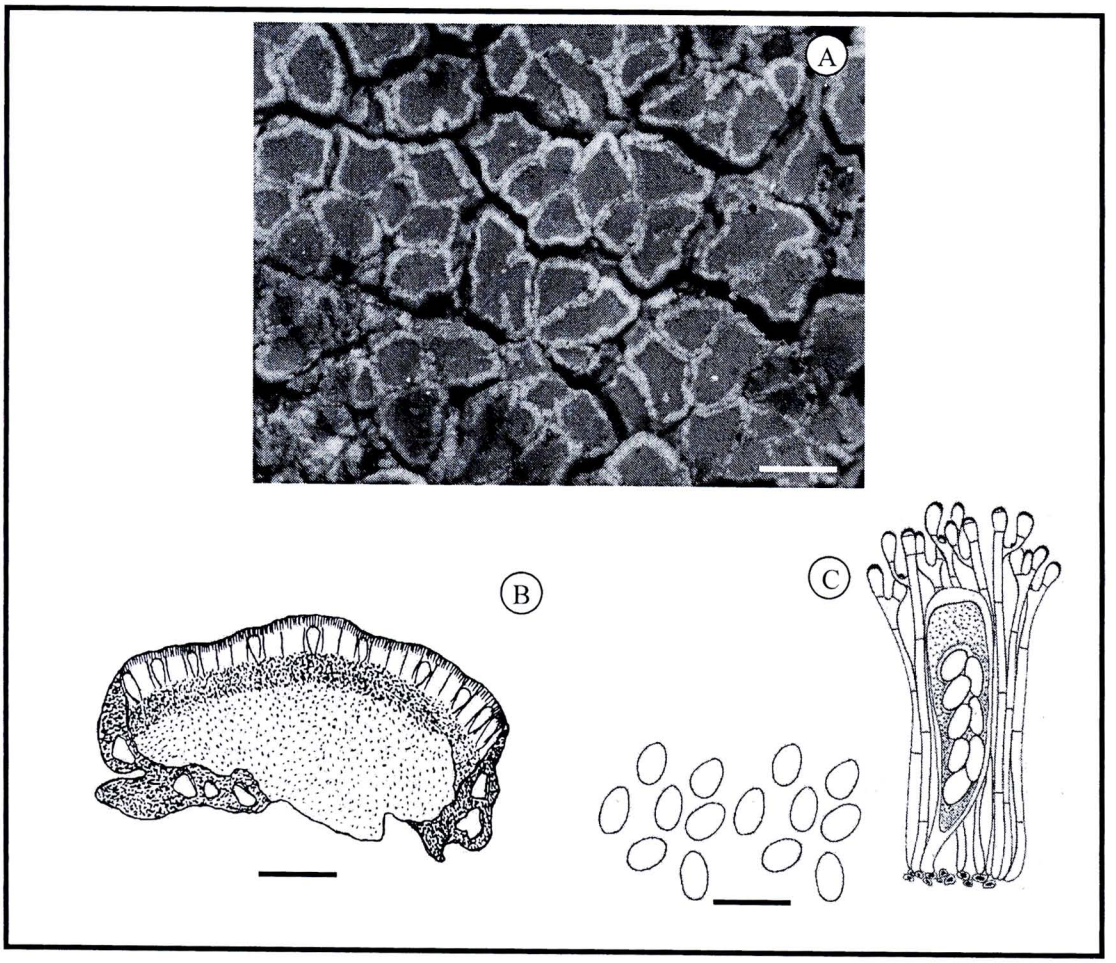

Figure 27 *Lecanora helva* Stizenb.

Note. A = Apothecia lecanorine, sessile, pale brown [VC852(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [VC852(RAMK)] (scale = 13.93 μm)

C = Illustration of ascus with paraphyses and ascospores [VC852(RAMK)] (scale = 9.87 μm)

their different chemistry. Moreover, *L. achroa* has slightly larger ascospores.

6. ***Lecanora leprosa*** Fée, *Essai Crypt. Écorc.* 118 (1824) (Lumbsch & Elix, 2004, pp. 39-40).

(see Figure 28)

Thallus: corticolous, yellowish white to yellowish grey or greenish grey, dispersed-verrucose to verruculose, continuous, 230.4-372.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible or whitish grey; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and entire, sometimes verrucose, immersed when immature becoming sessile; disc plane, pale orange to yellowish brown and concolorous at margin; not or slightly pruina, 0.2-1.3 mm diam.; cortex: hyaline, gelatinous and inspersed with small crystals, 10-15 μm thick laterally and 15-25 μm thick basally; Parathecium: hyaline, with numerous small crystals insoluble in KOH, 10.0-15.0 μm thick; cortex: hyaline, gelatinous and inspersed with small crystals 10.0-15.0 μm thick laterally and 15.0-25.0 μm thick basally; Amphithecium: with large crystals insoluble in KOH (*pulicaris*-type); Epihymenium: hyaline or yellowish brown, 10.0-14.5 μm thick, pigmentation rapidly soluble in KOH, with numerous small crystals; Hymenium: hyaline, 50.0-65.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: hyaline or yellow to pale yellowish brown, 60.0-110.9 μm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 31.5-38.5 μm high; Asci: clavate, *Lecanora*-type, 25.9-30.5 μm high; **Ascospores**: 8 per ascus, hyaline, narrowly ellipsoid, simple, (9.9)10.3-12.9-15.8(16.3) × (4.3)4.5-6.6-8.3(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and apothecial margin P+ pale orange, K+ yellow, C-, KC; containing atranorin and gangaleoidin.

Habitats: On tree trunks in dry dipterocarp forests at 700 m from sea level.

Distribution: Thailand, Western Australia, Northern Territory, Queensland, and New South Wales.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Phu Khon Substation, on trunk of an unidentified tree, 21 May 2009, Chutamat Phraphuchamnong—CP542(RAMK).

Observation: *Lecanora leprosa* is characterized by orange to yellowish brown apothecial discs a granulose epihymenium and the presence of the gangaleoidin chemosyndrome. It is morphologically similar to *L. helva* and *L. achroa*, which are both distinguished by their differing chemistry.

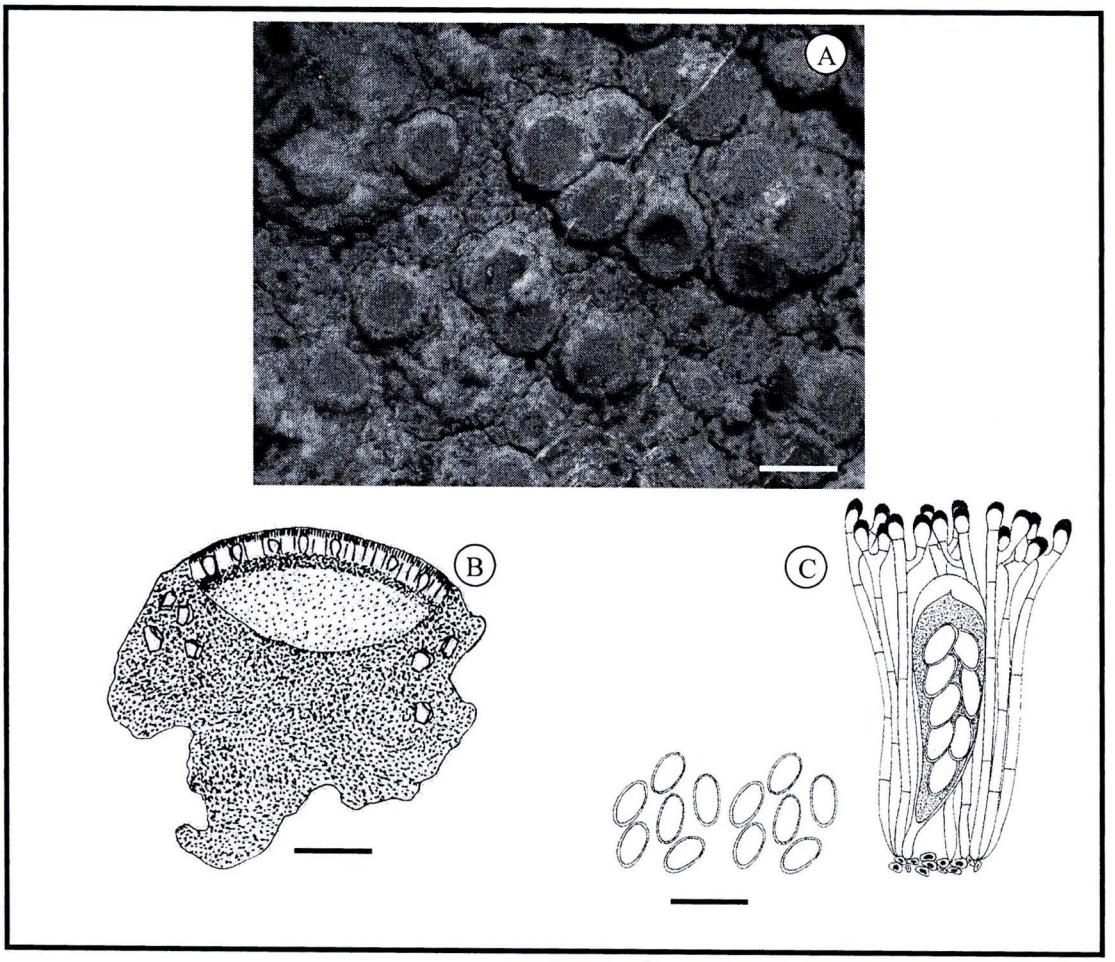

Figure 28 *Lecanora leprosa* Fée

Note. A = Apothecia lecanorine, sessile, pale orange to yellowish brown [CP542(RAMK)] (scale = 1.25 mm)

B = Illustration of vertical section of apothecia [CP542(RAMK)] (scale = 17.11 μm)

C = Illustration of ascus with paraphyses and ascospores [CP542(RAMK)] (scale = 7.90 μm)

7. ***Lecanora phaeocardia*** Vain., *Suomal. Elain-ja Kasvit. Seuran Vanamon Julk.* 1(3): 41(1921) (Lumbsch & Elix, 2004, pp. 47-48).

(see Figure 29)

Thallus: corticolous, whitish grey to yellowish white, verrucose to verruculose, continuous, 130.4-189.5 mm thick; epruina; Soralia and Isidia absent; Prothallus blackish brown; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and indistinct, sessile; disc plane, brown to red-brown and concolorous at margin; epruina, 0.6-1.5 mm diam.; cortex: gelatinous and inspersed with small crystals, 10-20 µm thick laterally and 20-40 µm thick basally; Parathecium: hyaline, without crystals, 15.0-25.0 µm thick; cortex: indistinct, gelatinous and inspersed with small crystals 10.0-20.0 µm thick laterally and 20.0-40.0 µm thick basally; Amphithecium: with small and large crystals (*melacarpella*-type); Epihymenium: red-brown, 10.0-16.0 µm thick, pigmentation soluble in KOH, with crystals (*chlarotera*-type); Hymenium: hyaline, 50.0-75.0 µm high; Subhymenium: hyaline, 10.0-14.5 µm high; Hypothecium: brownish yellow to reddish brown, 60.0-120.9 µm high; Paraphyses: simple, or slightly thickened apically, 30.5-37.5 µm high; Asci: clavate, *Lecanora*-type, 25.9-30.5 µm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (11.1)11.2-11.8-12.0(12.5) × (5.1)5.4-6.0-6.5(6.8) µm; **Pycnidia** and **Conidia** not observed.

Chemistry: thallus and apothecial margin P+ pale yellow, K+ yellow, C-, KC-; containing atranorin.

Habitats: on tree trunks in lower montane scrub, dry dipterocarp forests and lower montane rainforests from 355-1,507 m.

Distribution: Northern Territory, Queensland, South-east Asia (Thailand), Indonesia, and Australia.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. around the helicopter landing spot, on trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC866(RAMK); ibid., Khok Nok Kraba Forest Ranger Station, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—VC744, VC766, VC801 & VC808(RAMK); ibid., from Pha Chang Pan to Pha Somdet, on trunk of *Rhaphiolepis indica* (L.) Lindl. Ex Ker, 24 June 2008, Varaporn Sriprang—VC594(RAMK); ibid., Khok Phrommachan, on trunk of an *Rhododendron lyi* H. Lév., 24 June 2008, Varaporn Sriprang—VC556, VC563 & VC585(RAMK); ibid., Khok Phrommachan, on trunk of *Syzygium thorelii* (Gagnep.) Merr. & L.M. Perry, 26 June 2008, Varaporn Sriprang—VC576(RAMK); ibid., Seven Chanal Station, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—VC749, VC773, VC777, VC778, VC780, VC790, VC792 & VC796(RAMK); ibid., Khok Phrommachan, on trunk of *Rhododendron lyi* H. Lév., 26 June 2008, Varaporn Sriprang—VC545, VC551, VC565 & VC575 (RAMK); ibid., the sideway to Paek Dam, on trunk of an *Lyonia foliosa* (Fletcher) Sleumer, 25 June 2008, Varaporn Sriprang—VC539, VC567, VC606 & VC610(RAMK); ibid., the sideway to Lan Suriyan, on trunk of *Lyonia foliosa* (Fletcher) Sleumer, 25 June 2008, Varaporn Sriprang—VC535, VC540, VC543, VC544, VC546, VC596 & VC601(RAMK); ibid., Khok

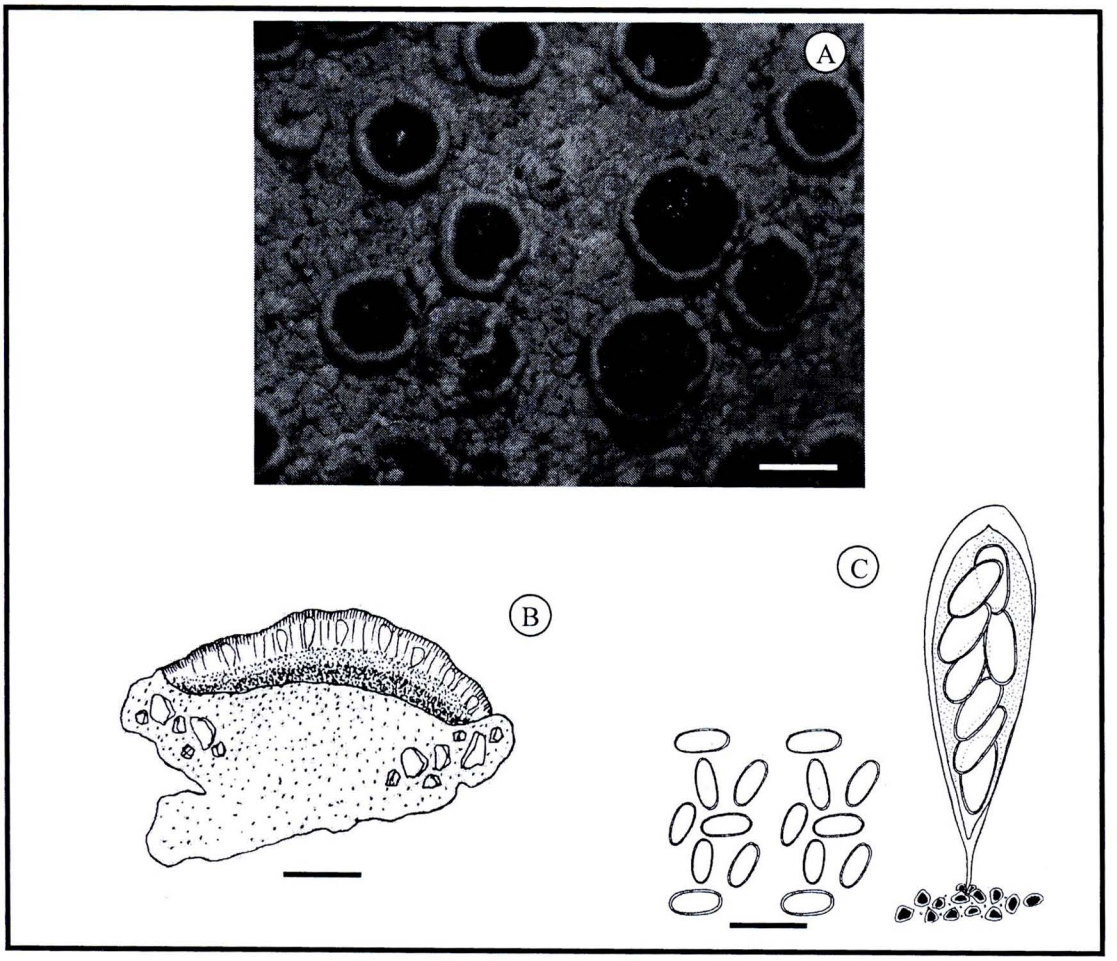

Figure 29 *Lecanora phaeocardia* Vain.

Note. A = Apothecia lecanorine, sessile, brown to red-brown [VC866(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [VC866(RAMK)] (scale = 9.85 μm)

C = Illustration of ascus and ascospores [VC866(RAMK)] (scale = 3.67 μm)

Huai Toei, on trunk of *Rhododendron lyi* H. Lév., 27 June 2008, Varaporn Sriprang—VC549 & VC595(RAMK); ibid., Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn

Sriprang—VC685, VC686 & VC687(RAMK); ibid., the sideway to Lan Suriyan, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—VC533, VC680 & VC683(RAMK); ibid., from Pha Chang Pan to Pha Somdet, on trunk of an unidentified tree, 24 June 2008, Varaporn Sriprang—VC560, VC134, VC135 & VC136(RAMK); ibid., Nam Ki Substation, on trunk of an unidentified tree, 22 June 2010, Varaporn Sriprang—VC137 & VC138(RAMK).

Observation: this species can be recognized by the brown apothecial discs, the *chlarotera*-type epihymenium, the relatively large ascospores, and the chemistry. Similar species include *Lecanora austrotropica, L. tropica* and *L. coronulans*. The latter species can be distinguished by the presence of a *glabrata*-type epihymenium, while the other two species differ in having a hyaline hypothecium, and in their xanthone containing chemistries (Lumbsch, 1994; Lumbsch & Elix, 2004; Lumbsch et al., 1996).

8. ***Lecanora subimmersa*** (Fée) Vain., *Ètude Lich. Brésil* 1: 98 (1890) (Lumbsch & Elix, 2004, p. 56)

Lecidea subimmersa Fée, *Bull. Soc. Bot. France* 20: 315 (1873).

Lecanora laevissima C. Knight, *in* J. Shirley, *Proc. Roy. Soc. Queensland* 6: 133 (1889).

Lecidea leioplaca Müll. Arg., *Flora* 70: 61 (1887).

Lecidea wilsonii Räsänen, *Arch. Soc. Zool. –Bot. Fenn. "Vanamo"* 3: 183 (1948).

(see Figure 30)

Thallus: saxicolous, yellowish white to whitish grey, verrucose to verruculose, continuous to rimose-areolate, 129.5-169.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and entire, verrucose to crenulated, immersed; disc plane, pale to dark red-brown and concolorous at margin; epruina, 0.2-0.7 mm diam.; cortex: absent; Parathecium: hyaline, inspersed with small crystals, 15.0-20.0 μm thick; cortex: indistinct, inspersed 10.0-15.0 μm thick laterally and 15.0-20.0 μm thick basally; Amphithecium: reduced to a thin layer, with numerous small crystals soluble in KOH; Epihymenium: reddish brown, 10.0-15.0 μm thick, pigmentation insoluble in KOH, without crystals (*glabrata*-type); Hymenium: hyaline, 50.0-70.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: hyaline, 60.0-103.9 μm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 32.5-35.9 μm high; Asci: clavate, *Lecanora*-type, 25.7-32.5 μm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (8.8)9.4-11.6-14.3(15.4) × (4.2)4.3-4.7-5.1(5.3) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: thallus P+ pale orange, K+ yellow, C-, KC-; containing atranorin and zeorin.

Habitats: occurring on rocks in mixed deciduous forests and dry dipterocarp forests at 397-787 m.

Distribution: Central and South America, Africa, Asia (Thailand), and Northern Australia.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province.

forest protection unit office, Phu Ho substation, on rocks, 30 July 2009, Sanya Meesim and Kawinnat Buaruang—MSPL290, MSPL492 & MSPL495 (RAMK); ibid., forest protection unit office, Phu Ho substation, on rocks, 30 July 2009, Chutamat Phraphuchamnong—CP639-1, CP649, CP667, CP669-1, CP696, CP671, CP701-1(RAMK); ibid., Phu Khon Substation, on rocks, 21 May 2009, Chutamat Phraphuchamnong—CP522, CP534-1, CP540, CP541, CP544, CP546 & CP551(RAMK); ibid., Nam Chan Forest Ranger Station, on rocks, 28 July 2009, Chutamat Phraphuchamnong—CP627 (RAMK); ibid., Huai Nam San, on rocks, 11 November 2008, Chutamat Phraphuchamnong—CP519(RAMK).

Observation: *Lecanora subimmersa* is easily distinguished from other *Lecanora* species in the area by its aspicilioid ascomata with red-brown to brown apothecial discs, a *glabrata* type epihymenium and a reduced amphithecium.

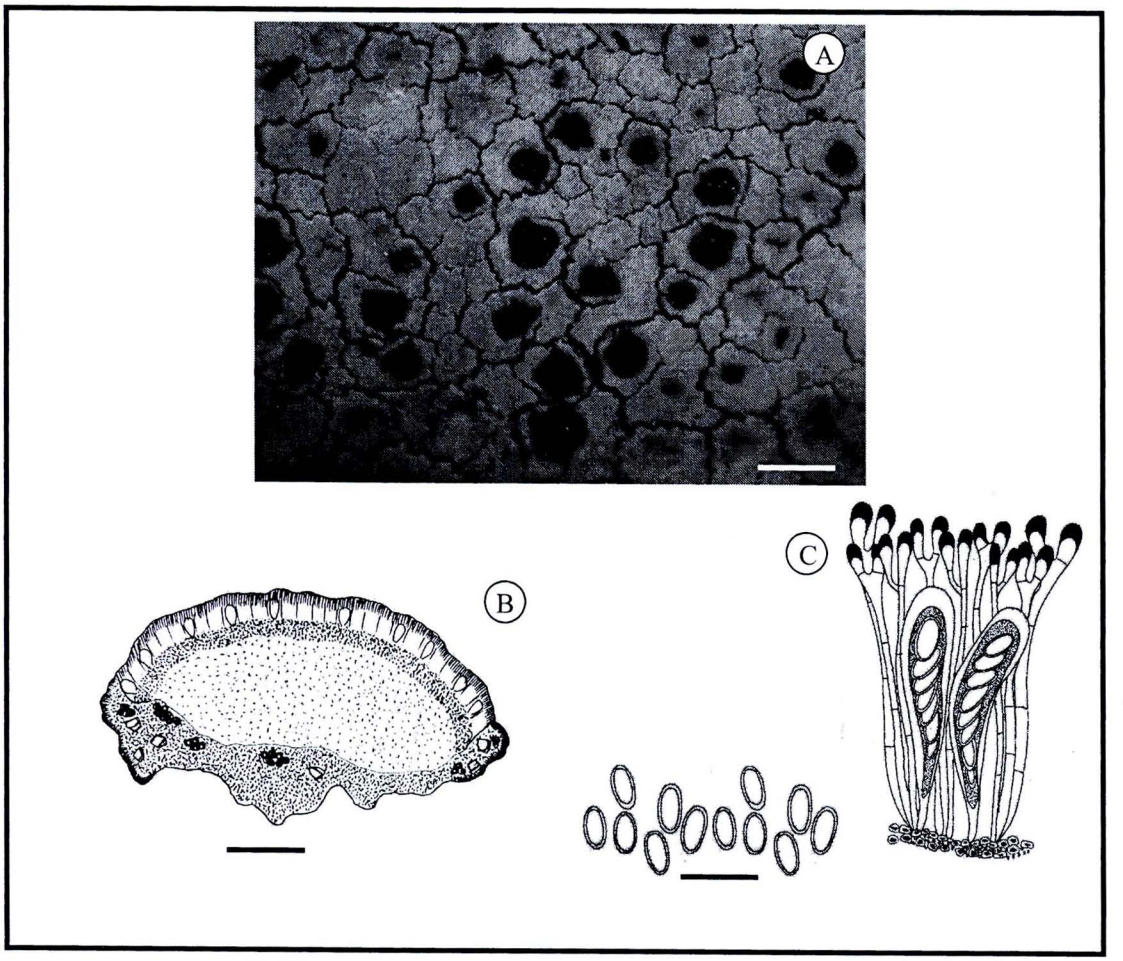

Figure 30 *Lecanora subimmersa* (Fée) Vain.

Note. A = Apothecia lecanorine, immersed, pale to dark red-brown [CP669-1(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [CP669-1(RAMK)] (scale = 10.57 μm)

C = Illustration of ascus with paraphyses and ascospores [CP669-1(RAMK)] (scale = 7.52 μm)

9. ***Lecanora toroyensis*** Zahlbr. *Feddes Rep.* 33: 52 (1933)

(see Figure 31)

Thallus: corticolous, pale green to greenish grey, smooth to dispersed-verrucose to verruculose, continuous, 105.4-142.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and entire, verrucose, sessile; disc plane, dark red-brown to brownish red and concolorous at margin; epruina, 0.3-1.2 mm diam.; cortex: inspersed with small crystals; Parathecium: hyaline, inspersed with small crystals soluble in KOH, 15.0-20.0 µm thick; cortex: indistinct, inspersed with small crystals 15.0-25.0 µm thick laterally and 15.0-20.0 µm thick basally; Amphithecium: with numerous small crystals insoluble in KOH (*allophana*-type); Epihymenium: reddish-brown, 10.0-15.0 µm thick, pigmentation soluble in KOH, with small crystals (*pulicaris*-type); Hymenium: hyaline, 55.0-75.0 µm high; Subhymenium: hyaline, 10.0-15.0 µm high; Hypothecium: hyaline, 65.0-103.6 µm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 30.5-37.9 µm high; Asci: clavate, *Lecanora*-type, 25.5-30.5 µm high; **Ascospores**: 8 per ascus, hyaline, broadly ellipsoid, simple, (8.8)9.4-11.6-14.3(15.4) × (6.02)6.1-7.3-8.4(8.6) µm; **Pycnidia** and **Conidia** not observed.

Chemistry: thallus Pd+ pale orange, K+ yellow, C-, KC-; containing atranorin and 2'-*O*-methylperlatolic acid.

Habitats: on tree trunks in tropical rainforests at 700 m from sea level.

Distribution: Thailand, and Taiwan.

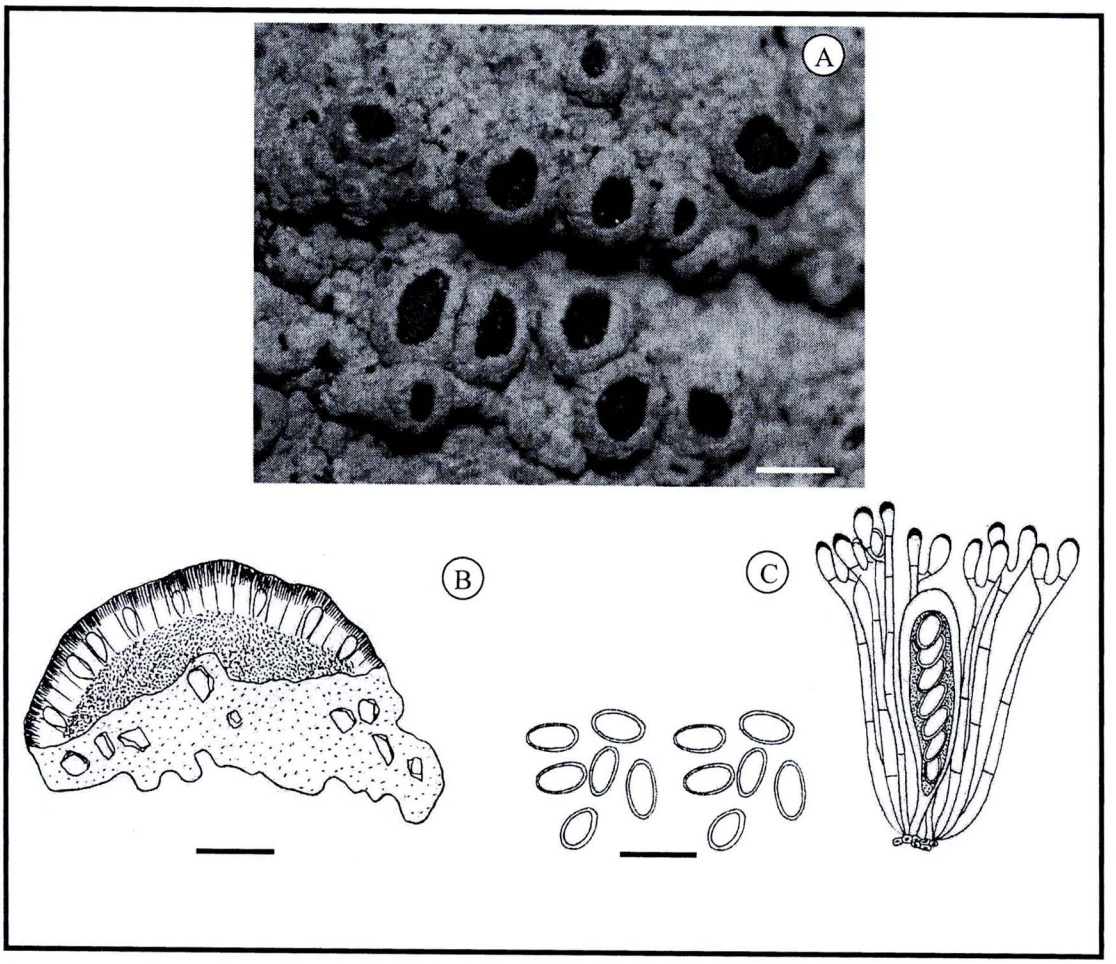

Figure 31 *Lecanora toroyensis* Zahlbr.

Note. A = Apothecia lecanorine, sessile, dark red-brown [VC824(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [VC824(RAMK)] (scale = 10.9 μm)

C = Illustration of ascus with paraphyses and ascospores [VC824(RAMK)] (scale = 10 μm)

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Head Quarter of Phuluang Wildlife Sanctuary, on trunk of an unidentified tree, 20 May 2009, Sanya Meesim and Kawinnat Buaruang—MSPL070

(RAMK); ibid., Head Quarter of Phuluang Wildlife Sanctuary, on trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC824(RAMK).

Observation: *Lecanora toroyensis* is characterized by dark red-brown discs, an *allophana*-type epihymenium a granulose epihymenium and presence the 2'-*O*-methylperlatolic acid. Morphologically similar is *L. tropica* which is readily distinguished by a different type of amphithecium and chemistry.

10. ***Lecanora tropica*** Zahlbr., *Cat. Lich. Univ.* 5: 589 (1928) (Lumbsch & Elix, 2004, pp. 59-60).

Lecanora subfusca var. *subcrenulata* Nyl., *Ann. Sci. Nat. Bot., sér.* 5, 7: 310 (1867)

Lecanora subcrenulata (Nyl.) Nyl., *Lich. Ins. Guineens*. 15 (1889)

Lecanora subcrenulata MÜll. Arg., *Flora* 71: 533 (1888).

(see Figure 32)

Thallus: corticolous, yellowish white to yellowish grey or whitish grey, dispersed-verrucose to verruculose, continuous, 127.4-179.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and verrucose to verruculose, sessile; disc plane, pale to dark red-brown and concolorous at margin; epruina, 0.2-1.0 mm diam.; cortex: hyaline, inspersed with small crystals, 15 μm thick laterally and 15-20 μm thick basally; Parathecium: hyaline, with numerous small crystals soluble in KOH, 10.0-15.0 μm thick;

cortex: hyaline, inspersed with small crystals 15.0-25.0 μm thick laterally and 15.0-20.0 μm thick basally; Amphithecium: with large and small crystals (*melacarpella*-type); Epihymenium: reddish brown, 10.0-14.5 μm thick, pigmentation insoluble in KOH, without crystals (*glabrata*-type); Hymenium: hyaline, 55.0-70.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: hyaline, 60.0-104.3 μm high; Paraphyses: sparingly branched, apical not conspicuously swollen, 32.7-35.5 μm high; Asci: clavate, *Lecanora*-type, 25.5-30.5 μm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (12.1)12.9-13.7-15.3(16.4) × (6.7)6.8-7.4-8.1(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: thallus and apothecial margin P+ yellowish orange, K+ yellow, C+orange, KC-; containing atranorin and zeorin.

Habitats: occuring on bark in dry dipterocarp forests, dry evergreen forests, lower montane rainforests and mixed deciduous forests between 355 and 1,501 m.

Distribution: Thailand, Western Australia, Northern Territory, and Queensland.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Pak Dang Forest Ranger Station, on trunk of an unidentified tree, 22 May 2009, Sanya Meesim and Kawinnat Buaruang—MSPL246, MSPL249, MSPL251, MSPL252, MSPL253 & MSPL254(RAMK); ibid., Nam Ki Substation, on trunk of an unidentified tree, 22 June 2009, Varaporn Sriprang—VC922, VC924, VC925, VC926 & VC927(RAMK); ibid., Khok Huai Toei, on trunk of *Quercus lineata* Blume., 27 June 2008, Varaporn

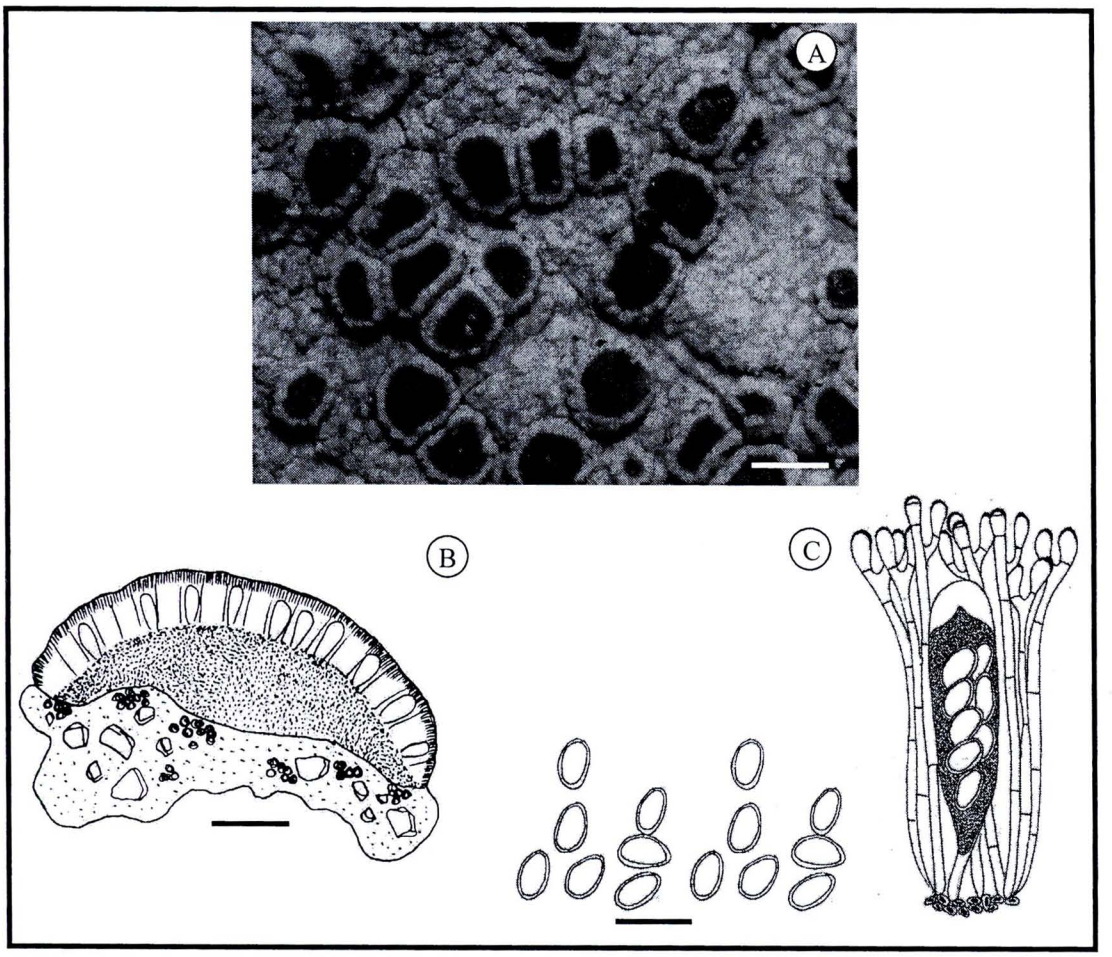

Figure 32 *Lecanora tropica* Zahlbr.

Note. A = Apothecia lecanorine, sessile, pale to dark red-brown [MSPL254(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [MSPL254(RAMK)] (scale = 9.71 μm)

C = Illustration of ascus with paraphyses and ascospores [MSPL254(RAMK)] (scale = 9 μm)

Sriprang—VC552 & VC600(RAMK); ibid., Phu Ho Forest Ranger Station, on trunk of an unidentified tree, 29 July 2009, Mattika Sodamuk and Chutamat Phraphuchamnong—SM88 & CP635-2(RAMK); ibid., Huai Lat, on

trunk of an unidentified tree, 30 July 2009, Mattika Sodamuk and Chutamat Phraphuchamnong—SM94(RAMK); ibid., Nam Tob Substation, on trunk of an unidentified tree, 23 June 2010, Varaporn Sriprang—VC940(RAMK); ibid., Nam Tob Substation, on trunk of *Acacia farnesiana* (L.) Willd., 23 June 2010, Varaporn Sriprang—VC939(RAMK); ibid., Nam Ki Substation, on trunk of an unidentified tree, 22 June 2010, Varaporn Sriprang—VC928, VC929, VC932 & VC935(RAMK); ibid., Huai Baeng Forest Ranger Station, on trunk of *Lithocarpus calathiformis* Rehder & Wilson, 24 June 2010, Varaporn Sriprang—VC946 & VC947(RAMK); ibid., Huai Lat, on trunk of an unidentified tree, 30 July 2009, Varaporn Sriprang—VC904, VC908, VC910, VC911 & VC912(RAMK); ibid., Nam Chan Forest Ranger Station, on trunk of an unidentified tree, 28 July 2009, Varaporn Sriprang—VC896 (RAMK); ibid., Phu Khon Substation, on trunk of an unidentified tree, 21 May 2009, Varaporn Sriprang—VC872 & VC873 (RAMK); ibid., Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—VC691, VC728, VC731 & VC739(RAMK).

Observation: *Lecanora tropica* is characterized by a non-granulose epihymenium, dark red-brown apothecial discs and a thallus containing zeorin.

11. ***Lecanora vainioi*** Vänskä, *Ann. Bot. Fenn.* 23(2): 123 (1986) (Vänskä, 1986, pp. 123-125).

(see Figure 33)

Thallus: saxicolous, yellowish grey to yellowish white, verrucose, continuous, 132.4-189.5 mm thick; epruina; Soralia and Isidia absent; Prothallus whitish gray; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and margin prominent, entire, verruculose, sessile; disc plane, dark red-brown to grey-brown and concolorous at margin; epruina, 0.5-1.6 mm diam.; cortex: inspersed, 15-25 μm thick laterally and 15-25 μm thick basally; Parathecium: hyaline, without crystals, 15.0-20.0 μm thick; cortex: indistinct, inspersed 15.0-25.0 μm thick laterally and 15.0-20.0 μm thick basally; Amphithecium: with small and large crystals (*melacarpella*-type); Epihymenium: red-brown to brown, 10.0-14.5 μm thick, pigmentation insoluble in KOH, without crystals (*glabrata*-type); Hymenium: hyaline, 50.0-65.0 μm high; Subhymenium: hyaline, 10.0-15.0 μm high; Hypothecium: brownish red, 60.0-102.5 μm high; Paraphyses: slightly thickened, apical not conspicuously swollen, 32.9-35.5 μm high; Asci: clavate, *Lecanora*-type, 25.5-30.5 μm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid to narrowly ellipsoid, simple, (11.1)11.2-11.8-12.0(12.5) × (5.1)5.4-6.0-6.5(6.8) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: thallus and apothecial margin P+ yellow, K+ yellow, C-, KC+ yellow; containing atranorin and zeorin.

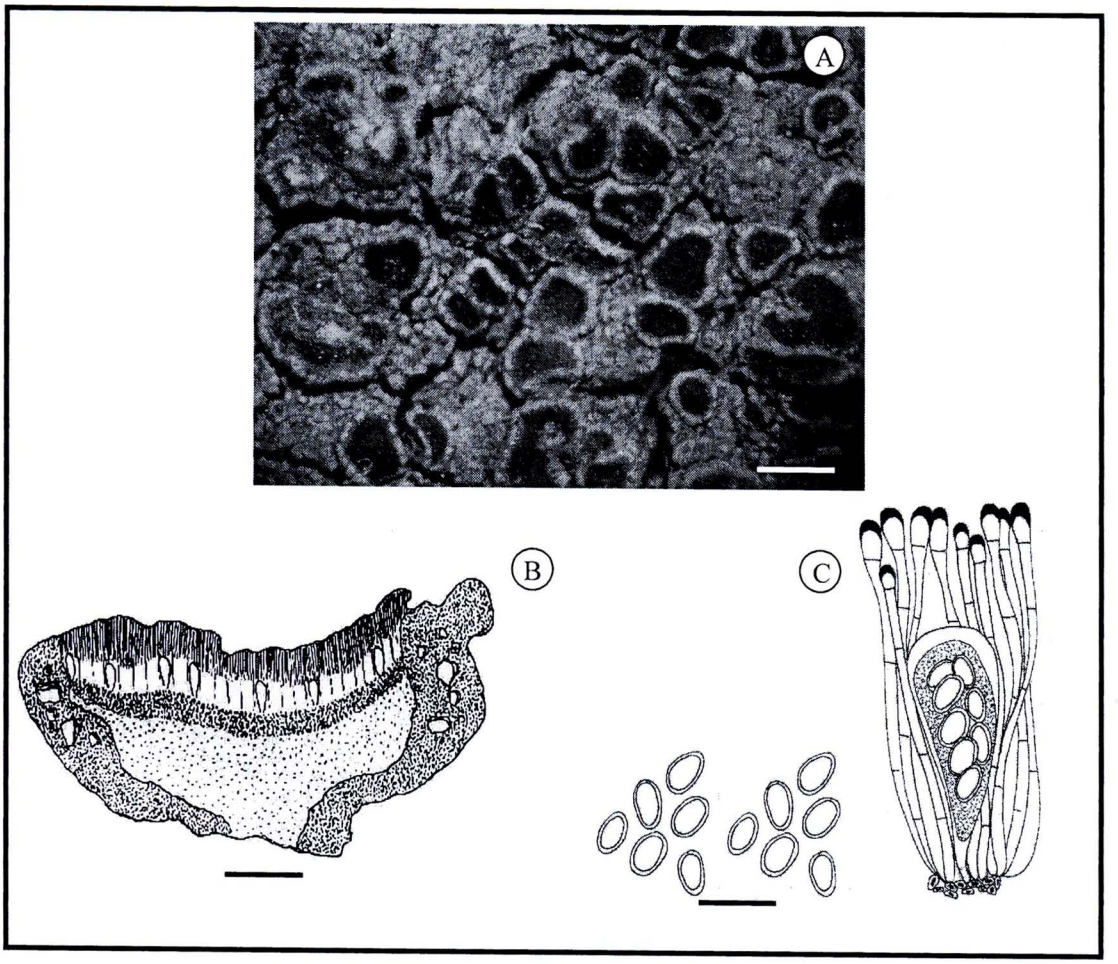

Figure 33 *Lecanora vainioi* Vänskä

Note. A = Apothecia lecanorine, sessile, dark red-brown [MSPL037(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [MSPL037(RAMK)] (scale = 12.43 μm)

C = Illustration of ascus with paraphyses and ascospores [MSPL037(RAMK)] (scale = 13.33 μm)

Habitats: occurring on rocks in lower montane scrub and dry dipterocarp forests between 355 and -1,487 m.

Distribution: Brazil, and Thailand.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Khok Phrommachan, on rocks, 26 June 2008, Chutamat Phraphuchamnong—CP445(RAMK); ibid., around the helicopter landing spot, on rocks, 20 May 2009, Sanya Meesim and Kawinnat Buaruang—MSPL024 & MSPL037 (RAMK); ibid., Nam Ki Substation, on rocks, 22 June 2010, Varaporn Sriprang—VC936(RAMK); ibid., from Pha Chang Pan to Pha Somdet, on rocks, 24 June 2008, Chutamat Phraphuchamnong—CP377-2(RAMK); ibid., Khok Phrommachan, on rocks, 26 June 2008, Chutamat Phraphuchamnong—CP439(RAMK); ibid., around the helicopter landing spot, on rocks, 20 May 2009, Chutamat Phraphuchamnong—CP511(RAMK); ibid., from Pha Chang Pan to Pha Somdet, on rocks, 24 June 2008, Chutamat Phraphuchamnong—CP378, CP382-1, CP383-1 & CP387(RAMK); ibid., around the helicopter landing spot, on rocks, 30 August 2005, Chutamat Phraphuchamnong—CP022, CP025, CP345, CP356 & CP357(RAMK); ibid., around the helicopter landing spot, on rocks, 27 June 2008, Chutamat Phraphuchamnong—CP451-3, CP455, CP458 & CP486(RAMK); ibid., Khok Nok Kraba Forest Ranger Station, 13 November 2008, Chutamat Phraphuchamnong—CP616(RAMK); ibid., Seven Chanal Station, 24 June 2008, Chutamat Phraphuchamnong—CP357 & CP361(RAMK); ibid., Dong Chang Doo, 25 June 2008, Chutamat Phraphuchamnong—CP409 & CP415 (RAMK).

Observation: *Lecanora vainioi* is characterized by a *glabrata*-type epihymenium, narrow ascospores, and a thallus containing zeorin.

Description of the Genus *Lecidella*

***Lecidella* Körber,** *Syst. Lich. Germ.*: 233 (1855)

Thallus: corticolous or saxicolous, white or yellowish white to whitish gray or yellowish gray to yellowish green, verrucose or verruculose, areolate, 85.2-125.6 μm thick; epruina; Soralia and Isidia absent; Prothallus not visible or bluish black to black or whitish gray; Photobiont chlorococcoid; **Apothecia**: scattered and entire, sessile, not constricted at base or sometimes semi-immersed; disc plane to convex, black and black at margin; epruina, 0.5-1.3 mm diam.; with lecideine (proper exciple); Parathecium: yellowish to reddish brown, without crystals or sometimes with crystals or inspersed, 10.0-15.0 μm thick; Epihymenium: blackish green or green, 4.5-7.5 μm thick; Hymenium: hyaline, 60.0-90.0 μm high; Subhymenium: indistinct; Hypothecium yellowish brown to brown, 17.0-24.9 μm high; Paraphyses: simple, rarely anastomosing or branched, apical not conspicuously swollen, 29.9-41.9 μm high; Asci: clavate, *Lecanora*-type, 5.5-9.5 μm high; **Ascospores**: 8 per ascus, hyaline, broadly ellipsoid, simple, (9.9)10.3-12.9-17.8(20.0) × (6.02)6.1-7.3-8.4(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Atranorin, Xanthones

Habitats: on barks and rocks.

Distribution: cosmopolitan.

Key to Species of Lecidella

1a. Thallus corticolous, continuous or granulose to verrucose.....

.....*Lecidella elaeochroma*

1b. Thallus saxicolous, areolate, verruculose or bullate.....

.....*Lecidella carpathica*

Description of the Species

1. ***Lecidella carpathica*** Körb., *Parerga Lichen.*: 212 (1861) (Knoph & Leuckert, 2004, p. 312).

Lecidea carpathica (Körb.) Szatala, Bot. Közlem. 15: 26 (1916)

(see Figure 34)

Thallus: saxicolous, white or yellowish white to whitish gray, verruculose, areolate, 88.2-125.6 µm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: scattered and entire, sessile or sometimes semi-immersed; disc plane to convex, black and black at margin; epruina, 0.5-1.0 mm diam.; with lecideine (proper exciple); Parathecium: reddish brown, without crystals, 10.0-15.0 µm thick; Epihymenium: green, 5.5-7.5 µm thick; Hymenium: hyaline, 60.0-80.0 µm high; Subhymenium: indistinct; Hypothecium brown, yellowish brown, 17.0-20.5 µm high; Paraphyses: simple, apical not conspicuously swollen, 29.9-34.7 µm high; Asci: clavate, *Lecanora*-type, 5.5-9.5 µm high; **Ascospores**: 8 per ascus, hyaline, broadly ellipsoid, simple, (9.9)10.3-12.9-15.8(16.3) × (6.02)6.1-7.3-8.4(8.6) µm; **Pycnidia** and **Conidia** not observed.

Chemistry: Thallus and medulla P+ yellow, K+ yellow, C-, KC-; containing atranorin and fumarprotocetraric acid.

Habitats: Occurs on rocks in lower montane scrub at 1,485 m.

Distribution: North and South America; Sonoran Desert, Europe Africa, and temperate parts of Asia (Thailand).

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. around the Khok Nok Grabra Forest Protection Unit, on rocks, 29 August 2005, Chutamat Phraphuchamnong—CP453(RAMK).

Observation: *Lecidella carpathica* is characterized by black apothecia and the simple, broadly ellipsoidal ascospores.

2. ***Lecidella elaeochroma*** (Ach.) M. Choisy, Bull. Mens. Soc. Linn. Lyon19: 19 (1950) (Knoph & Leuckert, 2004, pp. 313-314).

Lecidea parasema ß *elaeochroma* Ach., Methodus: 36 (1803)

(see Figure 35)

Thallus: corticolous, yellowish gray to yellowish green, verrucose, areolate, 85.2-120.6 µm thick; epruina; Soralia and Isidia absent; Prothallus bluish black to black; Photobiont chlorococcoid; **Apothecia**: scattered and entire, sessile, not constricted at base; disc plane to convex, black and black at margin; epruina, 0.5-1.2 mm diam.; with lecideine (proper exciple); Parathecium: yellowish to reddish brown, sometimes with crystals or inspersed, 10.0-15.0 µm thick; Epihymenium: blackish green, 4.5-7.0 µm

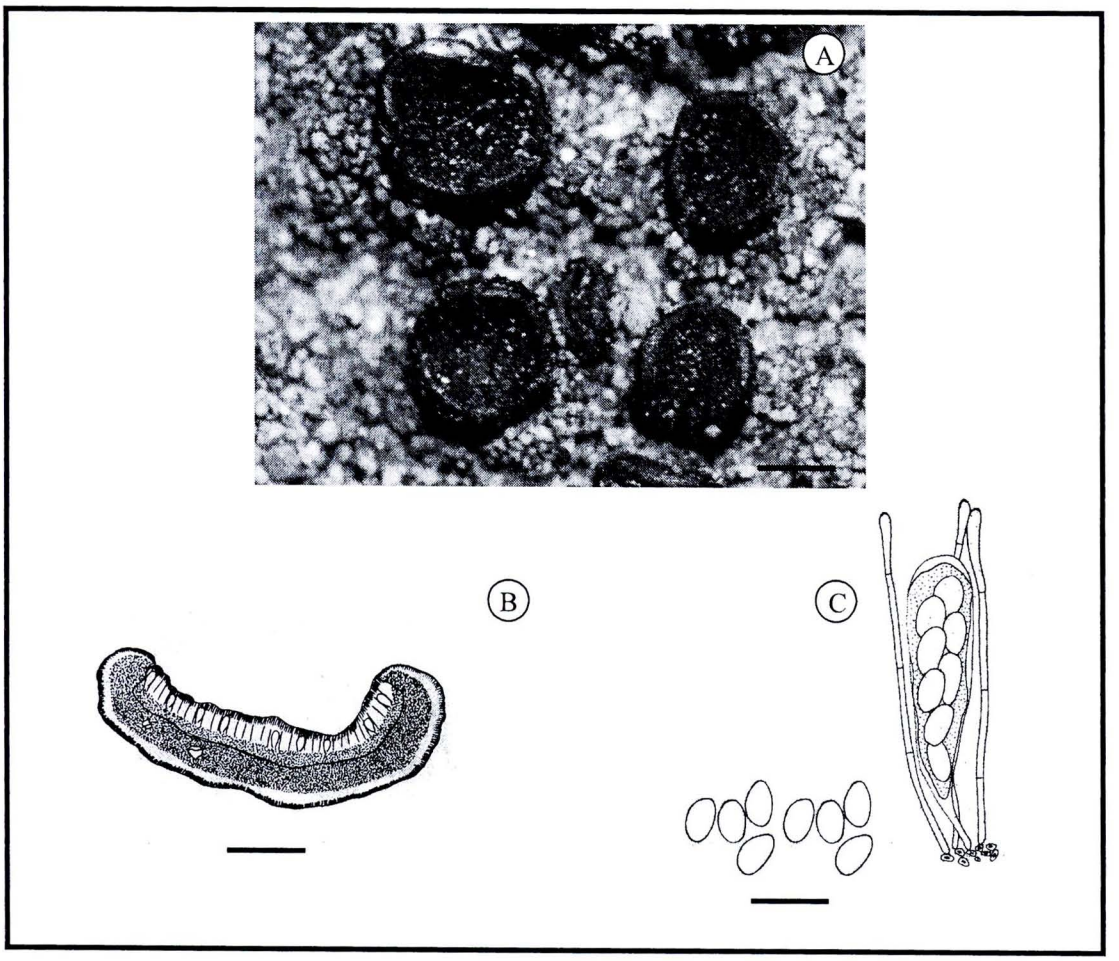

Figure 34 *Lecidella carpathica* Körb.

Note. A = Apothecia lecideine, sessile, black [CP453(RAMK)] (scale = 0.5 mm)

B = Illustration of vertical section of apothecia [CP453(RAMK)] (scale = 11.12 µm)

C = Illustration of ascus with paraphyses and ascospores [CP453(RAMK)] (scale = 7.76 µm)

thick; Hymenium: hyaline, 60.0-90.0 µm high; Subhymenium: indistinct; Hypothecium yellowish brown to brown, 17.0-24.9 µm high; Paraphyses: simple, rarely anastomosing or branched, apical not conspicuously swollen,

29.9-35.7 μm high; Asci: clavate, *Lecanora*-type, 5.5-9.5 μm high; **Ascospores**: 8 per ascus, hyaline, broadly ellipsoid, simple, (9.9)10.3-12.9-17.8(20.0) × (6.02)6.1-7.3-8.4(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: thallus and medulla P+ yellow, K+ yellow, C+ yellowish, KC+ orange; containing atranorin.

Habitats: occurs on barks in lower montane scrub at 1,507 m.

Distribution: North America, Sonoran Desert, Europe, Thailand, and Australasia.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. from Pha Chang Pan to Pha Somdet, on trunk of an unidentified tree, 24 June 2008, Varaporn Sriprang—VC532(RAMK).

Observation: *Lecidella elaeochroma* is characterized by black apothecia and the simple, broadly ellipsoidal ascospores.

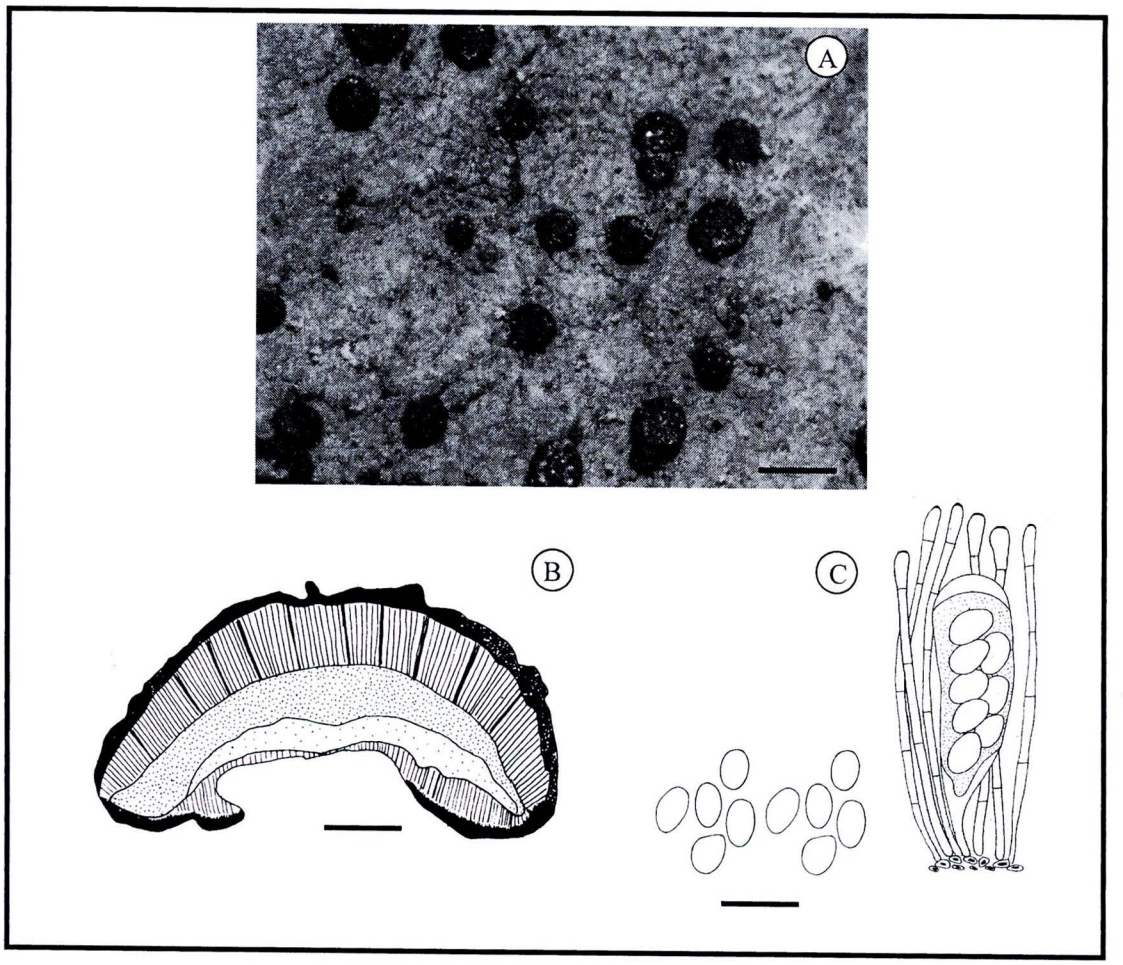

Figure 35 *Lecidella elaeochroma* (Ach.)

Note. A = Apothecia lecideine, sessile, black [VC532(RAMK)]

(scale = 1 mm)

B = Illustration of vertical section of apothecia [VC532(RAMK)]

(scale = 10.15 μm)

C = Illustration of ascus with paraphyses and ascospores

[VC532(RAMK)] (scale = 8.09 μm)

Description of Genus *Maronina*

Maronina Hafellner & R. W. Rogers, *Biblioth. Lichenol.* 38: 100 (1990) (McCarthy, 2004, p. 62).

Thallus: corticolous, dull grayish green to olive-green, more rarely pale greenish grey, verruculose, areolate, 60.0-120.0 µm thick; epruina; Soralia and Isidia absent; Prothallus dark brown to brown-black; Photobiont chlorococcoid; **Apothecia**: very abundant, scattered or densely crowded together and irregular in shape, superficial, sessile and becoming constricted at the base; disc plane, brown to dark brown and concolorous at margin; epruina, 0.5-2.0 mm diam.; with lecanorine (thalline exciple), Parathecium: indistinct; Epihymenium: brown, 15.5-21.0 µm thick; Hymenium: hyaline to very pale brown, 40.0-50.0 µm high; Subhymenium: indistinct; Hypothecium hyaline to very pale brown, 30.0-60.0 µm high; Paraphyses: branched and anastomosing, apical not conspicuously swollen, 45.5-49.7 µm high; Asci: clavate, *Lecanora*-type, 13.0-18.0 µm high; **Ascospores**: 32-50 per ascus, hyaline, narrowly ellipsoid, thin-walled, non-halonate, (8.8)9.4-11.6-14.3(15.4) × (2.4)2.5-2.9-3.36(3.4) µm; **Pycnidia** and **Conidia** not observed.

Description of the Species

Maronina orientalis. Kantvilas & Papong (Kantvilas, Papong & Lumbsch, 2010, pp. 557-559).

(see Figure 36)

Thallus: corticolous, dull grayish green to olive-green, more rarely pale greenish grey, verruculose, areolate, 60.0-120.0 μm thick; epruina; Soralia and Isidia absent; Prothallus dark brown to brown-black; Photobiont chlorococcoid; **Apothecia**: very abundant, scattered or densely crowded together and irregular in shape, superficial, sessile and becoming constricted at the base; disc plane, brown to dark brown and concolorous at margin; epruina, 0.5-2.0 mm diam.; with lecanorine (thalline exciple), Parathecium: indistinct; Epihymenium: brown, 15.5-21.0 μm thick; Hymenium: hyaline to very pale brown, 40.0-50.0 μm high; Subhymenium: indistinct; Hypothecium hyaline to very pale brown, 30.0-60.0 μm high; Paraphyses: branched and anastomosing, apical not conspicuously swollen, 45.5-49.7 μm high; Asci: clavate, *Lecanora*-type, 13.0-18.0 μm high; **Ascospores**: 32-50 per ascus, hyaline, narrowly ellipsoid, thin-walled, non-halonate, (8.8)9.4-11.6-14.3(15.4) × (2.4)2.5-2.9-3.36(3.4) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: medulla P-, K-, C+orange-yellow, KC+orange-red, UV+white; containing Alectoronic acid and dehydroalectoronic acid.

Habitats: Occurs on bark in lower montane scrub, tropical rainforests and lower montane rainforests at 700-1,468 m.

Distribution: Thailand, and south-eastern Queensland.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—VC675, VC679, VC694, VC139 & VC140(RAMK); ibid., around the Khok Nok Grabra Forest Protection Unit, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—

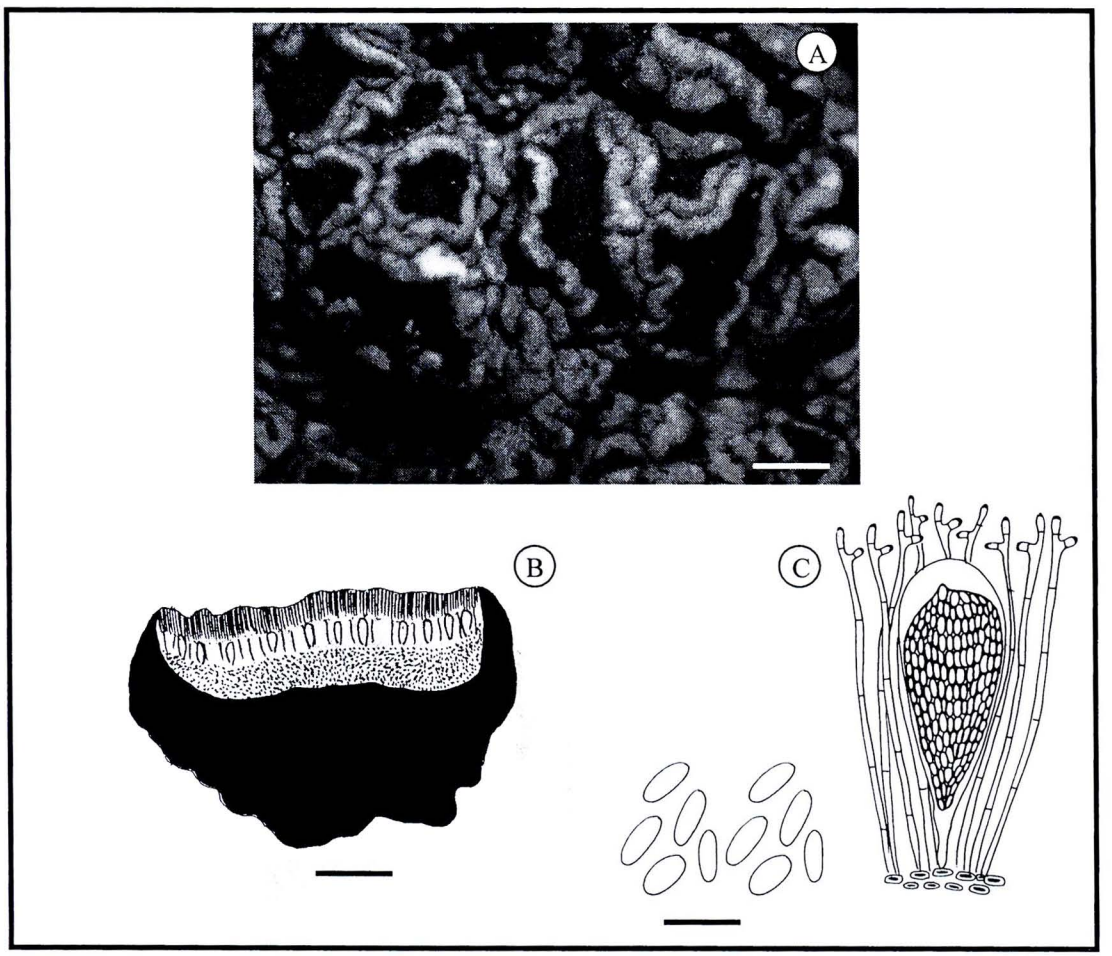

Figure 36 *Maronina orientalis* Kantvilas & Papong

Note. A = Apothecia lecanorine, sessile, brown to dark brown [VC675(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [VC675(RAMK)] (scale = 11.10 μm)

C = Illustration of ascus with paraphyses and ascospores [VC675(RAMK)] (scale = 5.31 μm)

VC597 & MS0252(RAMK); ibid., Seven Chanal Station, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—VC060, VC754 &VC794(RAMK); ibid., Head Quarter of Phuluang Wildlife Sanctuary, on

trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC141 (RAMK).

Observation: *Maronina orientalis* can be distinguished by its brown to dark brown apothecial discs, polysporous asci (*Maronina*-type) and the presence of alectoronic acid.

Description of the Genus *Ramboldia*

Ramboldia Kantvilas & Elix, *Bryologist* 97: 296 (1994) (Elix, 2004, p. 63).

Thallus: saxicolous, grey-white to pale creamy white or creamy grey or green-grey or creamy white, creamy grey or pale ochre, sometimes with orange dots at the edges of areoles, smooth to rough and verruculose, continuous, areolate with irregularly shaped to angular or areolate to rimose, 130.8-253.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible or black; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc plane to convex orange-red to bright red or dark red or red-brown and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.1-1.5 mm diam.; with lecideine (proper exciple), Parathecium: indistinct; Epihymenium: red or orange-red, 10.0-28.5 μm thick; Hymenium: hyaline, 32.0-120.0 μm high; Subhymenium: indistinct; Hypothecium hyaline or deep orange-red, 70.0-139.0 μm high; Paraphyses: mostly simple with strongly conglutinated

or sparsely branched, apical not conspicuously swollen, 40.0-49.4 µm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.7 µm high; **Ascospores**: (6-) 8 per ascus, hyaline, elongate-ellipsoid, non-halonate, (9.46)9.7-10.4-11.0(11.2) × (2.58)2.7-3.1-3.4(3.5) µm; **Pycnidia** not observed or immersed; black ostiole; **Conidia** hyaline; filiform, curved, 20.0-25.0 × 1.0-1.2 µm.

Chemistry: Chrysophanol, parietin, fumarprotocetraric acid, lichexanthone, norrussulone, protocetraric acid, russulone and an unknown substance with R_f values 52, 38, 48 in solvents A, B' and C respectively (orange spot after H_2SO_4 and charring).

Habitat: On barks and rocks in lower montane scrub, coniferous forests, lower montane rainforests, dry dipterocarp forests and mixed deciduous forests at 700-1,507 m.

Distribution: Central and South America, Africa and South Africa, Venezuela, Colombia, Brazil, Uruguay, and Thailand.

Key to Species of Ramboldia

1a. Thallus corticolous 2

1b. Thallus saxicolous.....3

2a. Disc orange-red to bright red, thallus containing fumarprotocetraric acid and lichexanthone.....*Ramboldia russula*

2b. Disc dark red or red-brown, thallus containing fumarprotocetraric acid and parietin..... *Ramboldia deficiens*

3a. Apothecia orange-red to bright red, red brown to dark brown, with lichexanthone (major) 4

3b. Apothecia red brown to dark brown, with lichexanthone (minor) or with chrysophanol ..... *Ramboldia* cf. *siamensis*

4a. Thallus ± continuous, areolae flat.....5

4b. Thallus bullate, areolae strongly convex ..... *Ramboldia* PL.1

5a. Thallus containing parietin, emodin and chrysophanol .... *Ramboldia siamensis*

5b. Thallus lacking anthraquinones..... ..*Ramboldia heterocarpa*

Description of the Species

1. ***Ramboldia deficiens*** Sriprang, Pachara & Kalb sp. nov. (ined.) (see Figure 37)

Thallus: corticolous, grey-white to green-grey, smooth to rough, continuous, areolate, 130.8-239.5 mm thick; epruina; Soralia and Isidia absent; Prothallus black; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc plane to convex, dark red or red-brown and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.2-1.2 mm diam.; with biatorine (proper exciple); Parathecium: indistinct; Epihymenium: red or orange-red, 15.5-19.6 µm thick; Hymenium: hyaline, 32.5-43.4 µm high; Subhymenium: indistinct; Hypothecium hyaline, 70.0-120.0 µm high; Paraphyses: mostly simple with strongly conglutinated, apical not conspicuously swollen, 45.7-49.4 µm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.0 µm high; **Ascospores**: (6-) 8 per ascus, hyaline, elongate-ellipsoid, non-halonate, (7.24)7.65-9.36-

11.05(11.48) × (1.5)1.7-2.3-3.11(3.4) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Medulla P+ orange, K+red, C-, KC-, UV +yellow; containing fumarprotocetraric acid, parietin, russulone, norrussulone and unknown 52, 38, 48 orange.

Habitats: Occurs on bark in lower montane rainforests and dry dipterocarp forests at 700-1,240 meter from sea level.

Distribution: Thailand.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—RU010523, RU010524, RU010525, RU010526 & VC638(RAMK); ibid., Phu Khon Substation, on trunk of an unidentified tree, 21 May 2009, Varaporn Sriprang—RU010528 & VC878 (RAMK) ibid., Khok Huai Toei, on trunk of *Quercus lineata* Blume, 27 June 2008, Varaporn Sriprang—VC506(RAMK).

Observation: *Ramboldia deficiens* is characterized by the dense, dark red or red-brown apothecia, the simple, narrowly ellipsoidal ascospores and the presence of fumarprotocetraric acid, russulone, norrussulone and unknown 52, 38, 48 orange. It is similar to *R. siamensis*, but differs by its corticolous habitat and the constant lack of lichexanthone.

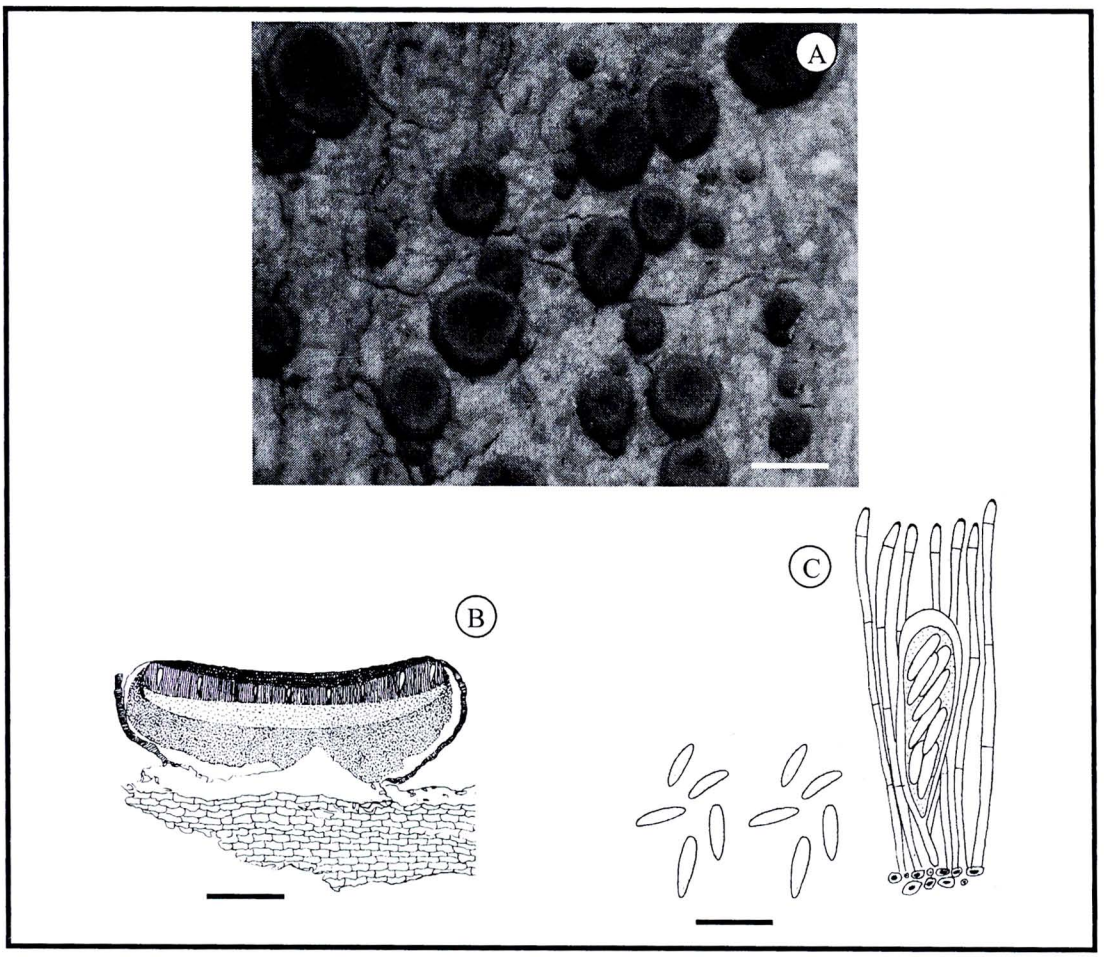

Figure 37 *Ramboldia deficiens* Sriprang, Pachara & Kalb sp. nov.

Note. A = Apothecia biatorine, sessile, dark red [RU010528(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [RU010528(RAMK)] (scale = 13.8 μm)

C = Illustration of ascus with paraphyses and ascospores [RU010528(RAMK)] (scale = 5.18 μm)

2. ***Ramboldia heterocarpa*** (Fée) Kalb, Lumbsch & Elix

Lecidea heterocarpa Fée, *Bull. Soc. Bot. Fr.* 20: 316 (1873).

Lecidea cinereofusca Fée (1873).

(see Figure 38)

Thallus: saxicolous, grey-white to pale creamy white or creamy grey, smooth to rough and verruculose, continuous, areolate to rimose, 140.4-230.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc convex, orange-red to bright red and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.2-1.2 mm diam.; with lecideine (proper exciple); Parathecium: indistinct; Epihymenium: red, 14.7-21.0 μm thick; Hymenium: hyaline, 32.0-43.0 μm high; Subhymenium: indistinct; Hypothecium hyaline, 110.0-135.0 μm high; Paraphyses: simple to sparsely branched, apical not conspicuously swollen, 45.0-49.0 μm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.7 μm high; **Ascospores**: 8 per ascus, hyaline, elongate-ellipsoid, non-halonate, (7.7)7.9-8.6-9.43(9.5) × (2.4)2.5-2.9-3.36(3.5) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Medulla P+ orange, K+ red, C-, KC-, UV+ yellow; containing fumarprotocetraric acid, lichexanthone, russulon and norrussulon.

Habitats: Occurring on rocks in lower montane scrub, dry dipterocarp forests and mixed deciduous forests at 569-1,480 m from sea level.

Distribution: Central and South America; Costa Rica, Venezuela, Colombia, Brazil, Uruguay, Africa (Tanzania), and Thailand.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Khok Phrommachan, on rocks, 26 June 2008, Chutamat Phraphuchamnong—CP405-1(RAMK); ibid., the sideway to Lan Suriyan, on rocks, 25 June 2008, Chutamat Phraphuchamnong—CP401(RAMK); ibid., Phu Ho Forest Ranger Station, on rocks, 30 July 2009, Sanya Meesim and Kawinnat Buaruang—MSPL501(RAMK); ibid., around the helicopter landing spot, on rocks, 27 June 2008, Chutamat Phraphuchamnong—CP457-1(RAMK); ibid., Pha Chang Pan, on rocks, 24 June 2008, Chutamat Phraphuchamnong—RU010701(RAMK); ibid., from Pha Chang Pan to Pha Somdet, on rocks, 24 June 2008, Chutamat Phraphuchamnong—RU010679 & RU013830 (RAMK); ibid., Phu Khon Substation, on rocks, 21 May 2009, Chutamat Phraphuchamnong—RU010691, RU010693 & RU010694(RAMK).

Observation: The thallus of *Ramboldia heterocarpa* is thick to very thick, sometimes exceeding 1 mm, rimose areolate and rough, that of *R. russula* is thin, continuous and smooth. Also the color of the apothecia in the latter is usually not red or orange red, but often brownish red to dark brown.

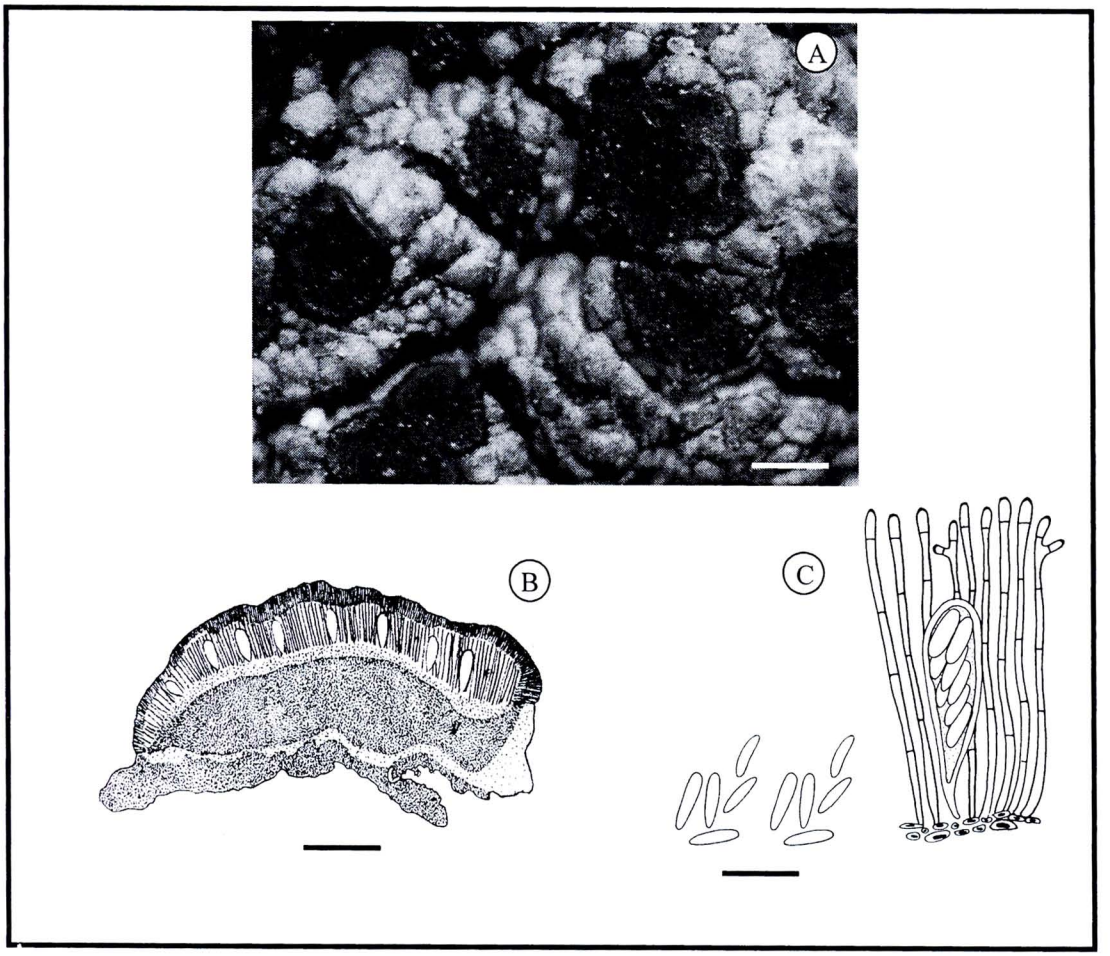

Figure 38 *Ramboldia heterocarpa* (Fée) Kalb, Lumbsch & Elix

Note. A = Apothecia lecidiene, sessile, orange-red [RU010701(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [RU010701(RAMK)] (scale = 14.83 μm)

C = Illustration of ascus with paraphyses and ascospores [RU010701(RAMK)] (scale = 4.50 μm)

3. ***Ramboldia russula*** (Ach.) Kalb, Lumbsch & Elix, *Nova Hedwigia* 86(1-2): 37 (2008) (Kalb, Buaruang, Papong & Boonpragob, 2009, pp. 116-117).

Lecidea russula Ach., Meth. Lich.: 61 (1803)

(see Figure 39)

Thallus: corticolous, grey-white to pale creamy white or creamy grey, smooth to rough and verruculose, continuous, areolate to rimose, 137.9-235.5 mm thick; epruina; Soralia and Isidia absent; Prothallus black; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc convex, orange-red to bright red and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.1-1.2 mm diam.; with lecideine (proper exciple), Parathecium: indistinct; Epihymenium: red, 10.0-20.0 μm thick; Hymenium: hyaline, 32.0-43.0 μm high; Subhymenium: indistinct; Hypothecium hyaline, 100.0-139.0 μm high; Paraphyses: simple to sparsely branched, apical not conspicuously swollen, 45.0-49.0 μm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.7 μm high; **Ascospores**: 8 per ascus, hyaline, elongate-ellipsoid, non-halonate, (7.3)7.4-8.9-10.5(10.7) × (2.58)2.7-3.1-3.4(3.5) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Medulla P+ yellow, K-, C-, KC-, UV- or UV+ yellow; containing fumarprotocetraric acid, lichexanthone, russulone and norrussulone.

Habitats: on bark and rock in lower montane scrub, coniferous forests,

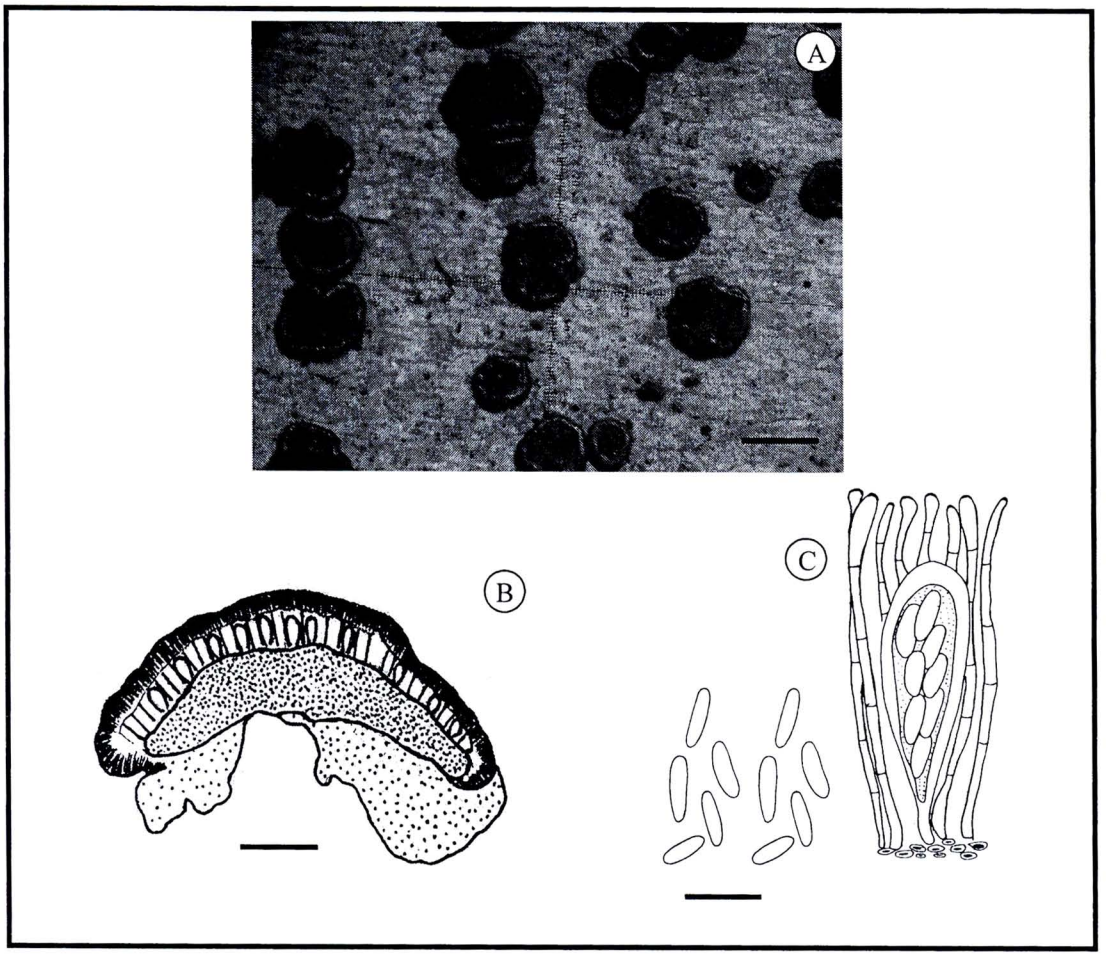

Figure 39 *Ramboldia russula* (Ach.) Kalb, Lumbsch & Elix

Note. A = Apothecia lecideine, sessile, orange-red [RU010519(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [RU010519(RAMK)] (scale = 10.29 μm)

C = Illustration of ascus with paraphyses and ascospores [RU010519(RAMK)] (scale = 5.26 μm)

lower montane rainforests and dry dipterocarp forests at 700-1,487 m.

Distribution: Pantropical, America, and Thailand.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province.

around the Khok Nok Grabra Forest Protection Unit, on trunk of an unidentified tree, 29 August 2005, Chutamat Phraphuchamnong—CP332 (RAMK); ibid., Phu Khon Substation, on trunk of an unidentified tree, 21 May 2009, Chutamat Phraphuchamnong—CP520, CP525, CP527, CP529 & CP530(RAMK); ibid., Khok Huai Toei, on trunk of *Quercus lineata* Blume, 27 June 2008, Varaporn Sriprang—VC471, VC 473, VC474 & VC475(RAMK); ibid., Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—RU010521 & RU010522(RAMK); ibid., Khok Huai Toei, on trunk of *Pinus merkusii* Jungh. & de Vriese, 27 June 2008, Varaporn Sriprang—RU010518(RAMK); ibid., Phu Khon Substation, on trunk of an unidentified tree, 21 May 2009, Varaporn Sriprang—RU010519, RU010529, VC881, VC875, VC877, VC879 & VC883(RAMK); ibid., Lon Tae Forest Ranger Station, on trunk of *Pinus merkusii* Jungh. & de Vriese, 12 November 2009, Sanya Meesim and Kawinnat Buaruang—MSPL695(RAMK); ibid., Khok Huai Toei, on trunk of *Quercus lineata* Blume, 27 June 2008, Varaporn Sriprang—VC472(RAMK); ibid., Phuluang Wildlife Research Station, on trunk of an unidentified tree, 12 November 2008, Varaporn Sriprang—VC630, VC631, VC632, VC633, VC634, VC635, VC636 & VC637(RAMK); ibid., Nam Ki Substation, on trunk of an unidentified tree, 22 June 2010, Varaporn Sriprang—VC951(RAMK).

Observation: this lichen is characterized by the dense, dark red or red-brown apothecia, the simple, narrowly ellipsoidal ascospores and the presence of fumarprotocetraric acid and lichexanthone.

4. ***Ramboldia* cf. *siamensis*** Buaruang, Elix & Kalb (Kalb, Buaruang, Papong & Boonpragob, 2009, pp. 117-118).

(see Figure 40)

Thallus: saxicolous, creamy white, creamy grey or pale ochre, sometimes with orange dots at the edges of areoles, smooth to rough, continuous, areolate with irregularly shaped to angular, 130.9-239.7 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc plane to convex, round to irregular in shape, dark red or red-brown and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.5-1.3 mm diam.; with biatorine (proper exciple), Parathecium: indistinct; Epihymenium: red or orange-red, 15.5-21.5 μm thick; Hymenium: hyaline, 100.0-120.0 μm high; Subhymenium: indistinct; Hypothecium deep orange-red, 70.0-100.0 μm high; Paraphyses: mostly simple with strongly conglutinated, apical not conspicuously swollen, 45.5-48.4 μm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.0 μm high; **Ascospores**: 8 per ascus, hyaline, elongate-ellipsoid, non-halonate, (9.46)9.7-10.4-11.0(11.2) × (2.58)2.7-3.1-3.4(3.5) μm; **Pycnidia** immersed; black ostiole; **Conidia** hyaline; filiform, curved, 20.0-25.0 × 1.0-1.2 μm.

Chemistry: Medulla K+ yellow, C-, Pd+ pale yellow; containing fumarprotocetraric acid, lichexanthone, parietin, russulone, norrussulone and chrysophanol.

Habitats: occurring on rocks in lower montane scrub 1,487 m from sea level.

Distribution: Thailand, and Taiwan.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. around the helicopter landing spot, on rocks, 20 May 2009, Chutamat Phraphuchamnong—RU010700(RAMK).

Observation: *Ramboldia* cf. *siamensis* is characterized by red-brown apothecia and a thallus containing chrysophanol.

5. ***Ramboldia siamensis*** Buaruang, Elix & Kalb (Kalb, Buaruang, Papong & Boonpragob, 2009, pp. 117-118).

(see Figure 41)

Thallus: saxicolous, creamy white, creamy grey or pale ochre, sometimes with orange dots at the edges of areoles, smooth to rough, continuous, areolate with irregularly shaped to angular, 147.9-253.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc plane to convex, dark red or red-brown and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.5-1.3 mm diam.; with lecideine (proper exciple), Parathecium: indistinct; Epihymenium: red or orange-red, 10.0-25.0 μm thick; Hymenium: hyaline, 100.0-120.0 μm high; Subhymenium: indistinct; Hypothecium deep orange-red, 100.0-135.0 μm high; Paraphyses: mostly simple with strongly

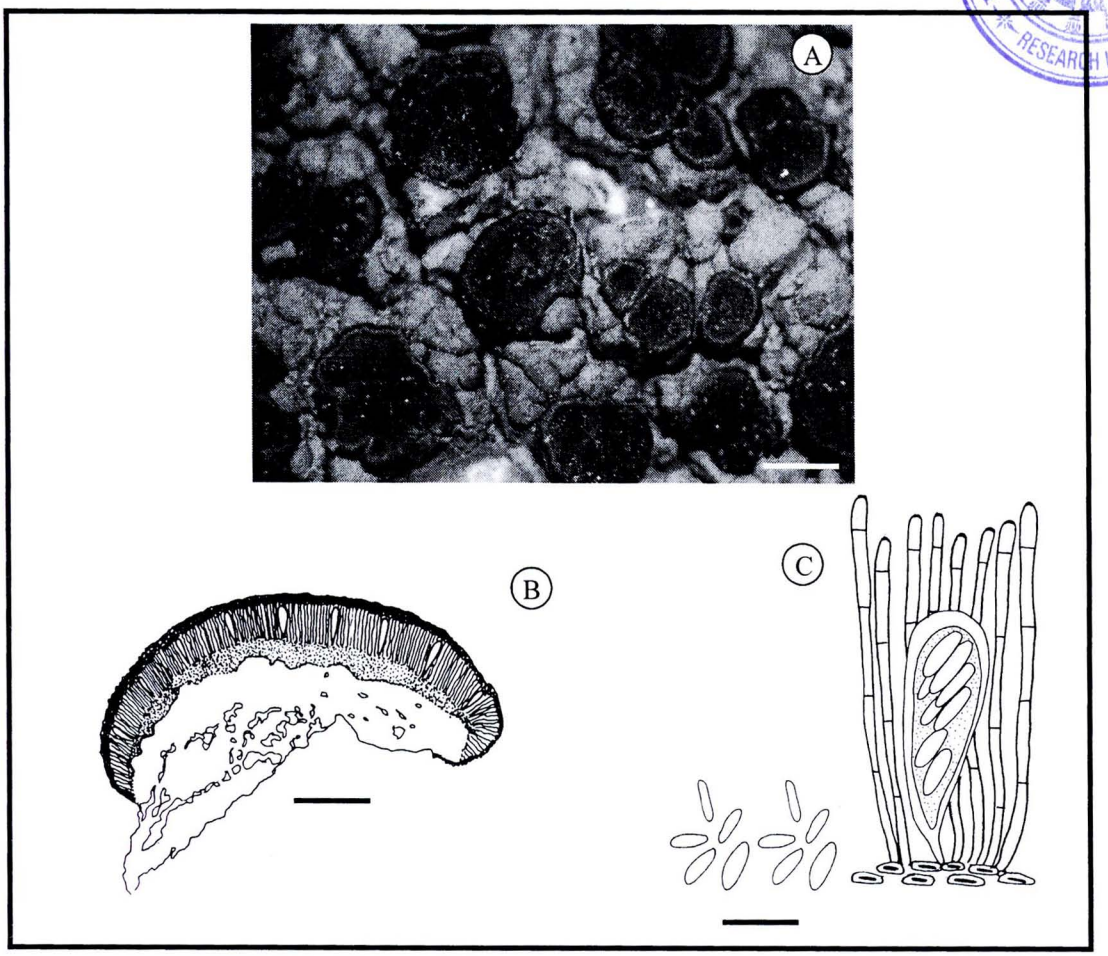

Figure 40 *Ramboldia* cf. *siamensis* Buaruang, Elix & Kalb

Note. A = Apothecia biatorine, sessile, red-brown [RU010700(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [RU010700(RAMK)] (scale = 16.31 µm)

C = Illustration of ascus with paraphyses and ascospores [RU010700(RAMK)] (scale = 5.78 µm)

conglutinated, apical not conspicuously swollen, 45.0-48.5 µm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.0 µm high; **Ascospores**: 8 per ascus, hyaline, elongate-ellipsoid, non-halonate, (9.46)9.7-10.4-11.0(11.2) ×

(2.58)2.7-3.1-3.4(3.5) μm; **Pycnidia** immersed; black ostiole; **Conidia** hyaline; filiform, curved, 20.0-25.0 × 1.0-1.2 μm.

Chemistry: Medulla K+ yellow, C-, Pd+ pale yellow; containing fumarprotocetraric acid, lichexanthone, parietin, russulone and norrussulone.

Habitats: occurring on rocks in lower montane scrub, lower montane rainforests and dry dipterocarp forests at 700-1,507 m.

Distribution: Thailand.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. Around the helicopter landing spot, on rocks, 20 May 2009, Chutamat Phraphuchamnong—RU010687, RU010686, RU010688, CP504, CP505, CP510 & CP514(RAMK); ibid., Pha Chang Phan, on rocks, 24 June 2008, Chutamat Phraphuchamnong—RU010680, CP371 & CP380-2(RAMK); ibid., Pha Somdet, on rocks, 24 June 2008, Chutamat Phraphuchamnong—RU010681, RU010682, RU010684 & CP419(RAMK); ibid., Khok Promachan, on rocks, 26 June 2008, Chutamat Phraphuchamnong—RU010683,CP379, CP 427-1, CP438 & CP444-1(RAMK); ibid., Khok Huai Toei, on rocks, 27 June 2008, Chutamat Phraphuchamnong—RU010685 & CP455(RAMK); ibid., around the Khok Nok Grabra Forest Protection Unit, on rocks, 13 November 2008, Chutamat Phraphuchamnong—CP592 (RAMK); ibid., the sideway to Lan Suriyan, on rocks, 25 June 2008, Chutamat Phraphuchamnong—CP402, CP405-1, CP406, CP407, CP408-1, CP408-2 & RU010698(RAMK); ibid., around the helicopter landing spot, on rocks, 27 June 2008, Chutamat Phraphuchamnong—CP 456-1, CP485-1, CP485-2 & RU010702(RAMK); ibid., around the Khok Nok Grabra Forest

Protection Unit, on rocks, 29 August 2005, Chutamat Phraphuchamnong—CP331 & CP331-1(RAMK); ibid., Pha Taloen, on rocks, 24 June 2008, Chutamat Phraphuchamnong—CP397(RAMK); ibid., Phu Khon Substation, on rocks, 21 May 2009, Chutamat Phraphuchamnong—CP520, RU010690, RU010692 & RU010697(RAMK); ibid., Huai Lad, on rocks, 25 June 2008, Chutamat Phraphuchamnong—CP 403, CP413 & CP416(RAMK); ibid., Lon Tae Forest Ranger Station, on rocks, 12 November 2009, Sanya Meesim and Kawinnat Buaruang—MSPL722(RAMK); ibid., Pha Taloen, on rocks, 21 May 2009, Chutamat Phraphuchamnong— RU010695 & RU010696 (RAMK); ibid., Huai Lad, on rocks, 25 June 2008, Chutamat Phraphuchamnong— RU010699(RAMK); ibid., Phuluang Wildlife Research Station, on rocks, 12 November 2008, Varaporn Sriprang— RU010527 (RAMK).

Observation: *Ramboldia siamensis* is characterized by the dense, dark red or red-brown apothecia, the simple, narrowly ellipsoidal ascospores and the presence of anthraquinones.

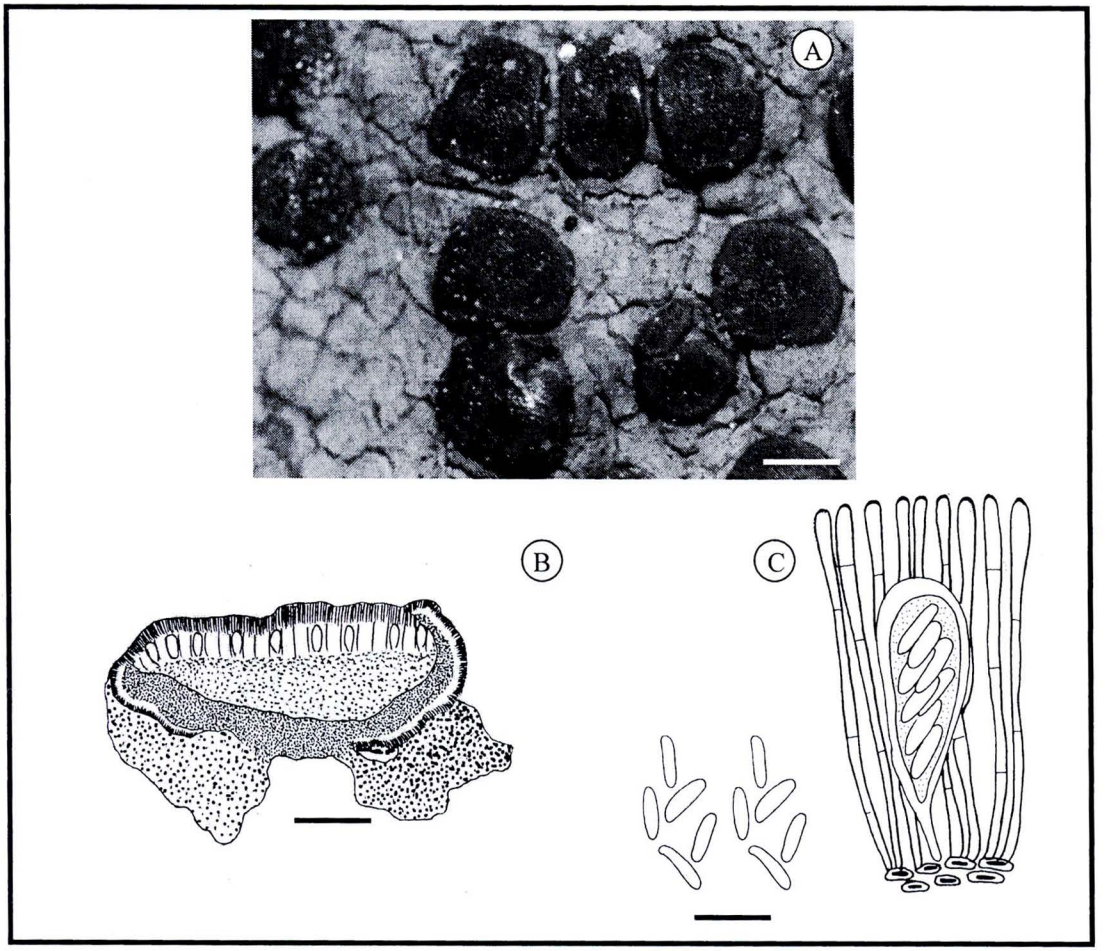

Figure 41 *Ramboldia siamensis* Buaruang, Elix & Kalb

Note. A = Apothecia lecideine, sessile, red-brown [RU010697(RAMK)] (scale = 0.5 mm)

B = Illustration of vertical section of apothecia [RU010697(RAMK)] (scale = 10.78 μm)

C = Illustration of ascus with paraphyses and ascospores [RU010697(RAMK)] (scale = 5.78 μm)

6. ***Ramboldia*** **PL. 1**

(see Figure 42)

Thallus: saxicolous, pale grey to greenish grey, sometimes with orange dots at the edges of areoles, smooth to rough and verruculose, continuous, areolate with irregularly shaped to angular, 149.4-235.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and round to irregular in shape, sessile; disc plane to convex, dark red or red-brown and red or orange-red inspersed with fine reddish granules at margin; epruina, 0.5-1.5 mm diam.; with lecideine (proper exciple), Parathecium: indistinct; Epihymenium: red or orange-red, 19.7-28.5 μm thick; Hymenium: hyaline, 60.0-110.0 μm high; Subhymenium: indistinct; Hypothecium deep orange-red, 100.0-125.0 μm high; Paraphyses: mostly simple with strongly conglutinated, apical not conspicuously swollen, 40.0-46.5 μm high; Asci: broadly clavate, *Lecanora*-type, 8.0-10.0 μm high; **Ascospores**: 8 per ascus, hyaline, narrowly ellipsoid, non-halonate, (9.46)9.7-10.4-11.0(11.2) × (2.58)2.7-3.1-3.4(3.5) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Medulla P+orange, K+ yellow to red, C-, KC-; containing fumarprotocetraric acid, lichexanthone, protocetraric acid, russulon and norrussulon.

Habitats: Occurring on rocks in lower montane scrub forests 1,487 m from sea level.

Distribution: Thailand.

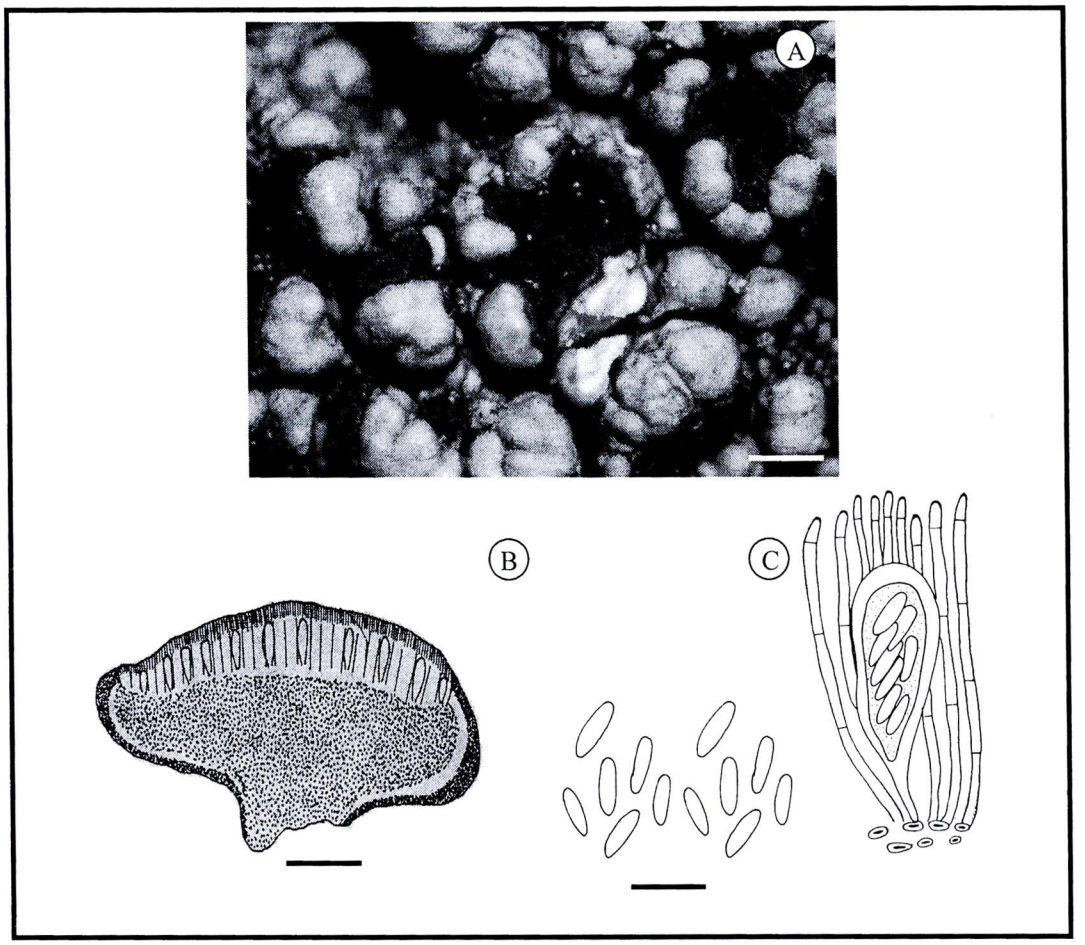

Figure 42 *Ramboldia* PL.1

Note. A = Apothecia lecideine, sessile, red-brown [RU010689(RAMK)] (scale = 1 mm)

B = Illustration of vertical section of apothecia [RU010689(RAMK)] (scale = 10.13 μm)

C = Illustration of ascus with paraphyses and ascospores [RU010689(RAMK)] (scale = 6.87 μm)

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. from Pha Chang Pan to Pha Somdet, on rocks, 24 June 2008, Chutamat Phraphuchamnong—RU010689(RAMK).

Observation: *Ramboldia* PL.1 is characterized by dark red or red-brown apothecia, and a bullate thallus with strongly convex areolate.

Description of the Genus *Vainionora*

Vainionora Kalb, *Lich. Netropici (Schedae), Fasc.*12: 3 (1991) (Kalb & Elix, 2004, pp. 556-557).

Thallus: corticolous, yellowish white to whitish grey, dispersed-verrucose to verruculose, continuous, areolate with irregularly shaped to angular, 135.9-225.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and entire, sometime + verrucose, sessile; disc plane, pale yellow to pale red-brown or grey brown and concolorous at margin; not or slightly pruina, 0.5-1.0 mm diam.; Cortex hyaline gelatinous inspersed with small crystals; Parathecium: hyaline, without crystals, 15.0-20.0 μm thick; cortex hyaline gelatinous inspersed with small crystals; Amphithecium: with large crystals insoluble in KOH (*pulicaris*-type) Epihymenium: dark red-brown to dark grey-brown, 10.0-15.0 μm thick, pigmentation rapidly soluble in KOH, with numerous small crystals (*chlarotera*-type); Hymenium: hyaline, 50.0-60.0 μm high; Subhymenium: indistinct; Hypothecium reddish brown, 60.0-130.9 μm high; Paraphyses: sparingly branched with thickened apically, apical not conspicuously swollen, 30.5-37.5 μm high; Asci: clavate, *Lecanora*-type, 25.9-30.5 μm high; **Ascospores**: 8 per ascus, hyaline,

ellipsoid, simple, (10.2)10.3-12.8-15.4(16.3) × (5.1)5.2-6.7-8.3(8.6) μm; **Pycnidia** and **Conidia** not observed.

Chemistry: Atranorin, 2'-*O*-methylperlatolic acid or xanthones.

Habitats: On bark and rocks.

Distribution: North, Central, and South America, Asia (Thailand), and Australasia.

Description of the Species

Vainionora flavidorufa (Hue) Papong & Lumbsch

Lecanora flavidorufa Hue, *Bull. Soc. Bot. Fr.* 36: 173 (1889).

Lecanora lividicarnea Vain., *Philipp. –J. Sci. sect. C*, 8:100 (1913).

Lecanora lividoglauca Vain., *Ann. Soc. Zool. Bot. Fenn.* 1(3): 41 (1923).

(see Figure 43)

Thallus: corticolous, yellowish white to whitish grey, dispersed-verrucose to verruculose, continuous, areolate with irregularly shaped to angular, 135.9-225.5 mm thick; epruina; Soralia and Isidia absent; Prothallus not visible; Photobiont chlorococcoid; **Apothecia**: common, dispersed to crowded and entire, sometime verrucose, sessile; disc plane, pale yellow to pale red-brown or grey brown and concolorous at margin; not or slightly pruina, 0.5-1.0 mm diam.; Cortex hyaline gelatinous inspersed with small crystals; Parathecium: hyaline, without crystals, 15.0-20.0 μm thick; cortex hyaline gelatinous inspersed with small crystals; Amphithecium: with large

crystals insoluble in KOH (*pulicaris*-type); Epihymenium: dark red-brown to dark grey-brown, 10.0-15.0 µm thick, pigmentation rapidly soluble in KOH, with numerous small crystals (*chlarotera*-type); Hymenium: hyaline, 50.0-60.0 µm high; Subhymenium: indistinct; Hypothecium reddish brown, 60.0-130.9 µm high; Paraphyses: sparingly branched with thickened apically, apical not conspicuously swollen, 30.5-37.5 µm high; Asci: clavate, *Lecanora*-type, 25.9-30.5 µm high; **Ascospores**: 8 per ascus, hyaline, ellipsoid, simple, (10.2)10.3-12.8-15.4(16.3) × (5.1)5.2-6.7-8.3(8.6) µm; **Pycnidia** and **Conidia** not observed. **Pycnidia** immersed in the thallus, **Conidia** bacilliform, 10.0-12.0 x 1.0 µm.

Chemistry: Thallus and apothecial margin P+ pale yellow, K+ yellow, C-, KC-; containing atranorin and 2'-*O*-methylperlatolic acid.

Habitats: Occurs on bark in lower montane rainforests, mixed deciduous forests, lower montane scrub at 787-1,504 meter from sea level.

Distribution: North, Central, and South America, Asia (Thailand), and Australasia.

Specimens examined: Phu Luang Wildlife Sanctuary, Loei Province. from Pha Chang Pan to Pha Somdet, on trunk of an unidentified tree, 24 June 2008, Varaporn Sriprang—VC581(RAMK); ibid., Pha Chang Phan, on trunk of *Rhaphiolepis indica* (L.) Lindl. Ex Ker, 24 June 2008, Varaporn Sriprang—VC579 & VC583(RAMK); ibid., around the helicopter landing spot, on trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC859, VC860, VC861, VC863, VC865, VC867, VC868 & VC869(RAMK); ibid., Lan Suriyan, on trunk of *Lyonia foliosa* (Fletcher) Sleumer, 25 June 2008,

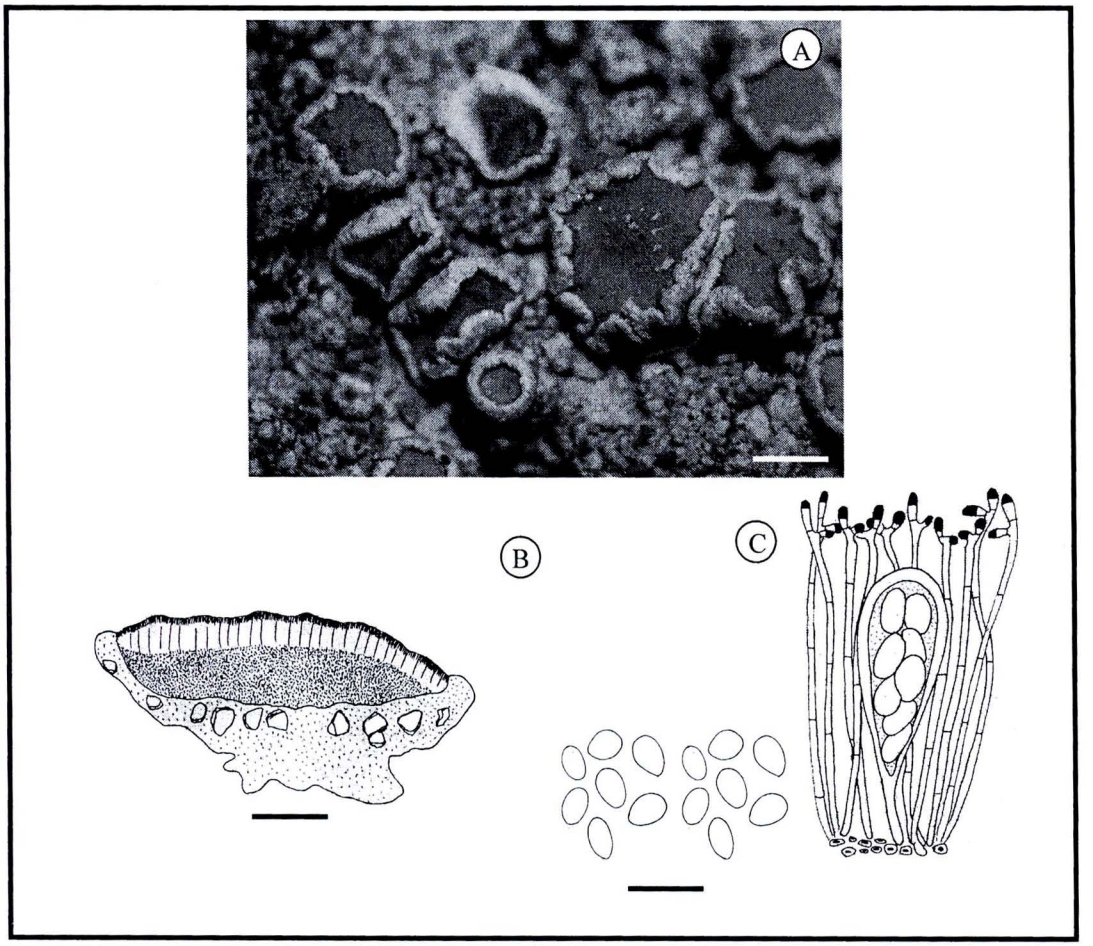

Figure 43 *Vainionora flavidorufa* (Hue) Papong & Lumbsch

Note. A = Apothecia lecanorine, sessile, pale yellow to pale red-brown [VC579(RAMK)] (scale = 0.6 mm)

B = Illustration of vertical section of apothecia [VC579(RAMK)] (scale = 13.47 μm)

C = Illustration of ascus with paraphyses and ascospores [VC579(RAMK)] (scale = 8.15 μm)

Varaporn Sriprang—VC536, VC552, VC562, VC566 & VC584 (RAMK); ibid., from Lan Suriyan to Khok Paek Dam, on trunk of an unidentified tree, 25 June 2008, Varaporn Sriprang—VC564 & VC590(RAMK); ibid., Pha

Chang Pan, on trunk of an unidentified tree, 24 June 2008, Varaporn Sriprang—VC578 & VC609(RAMK); ibid., Khok Nok Kraba Forest Ranger Station, on trunk of *Lithocarpus truncatus* (King) Rehder & Wilson, 24 June 2008, Varaporn Sriprang—VC580 & VC582(RAMK); ibid., Khok Nok Kraba Forest Ranger Station, on trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC586(RAMK); ibid., Khok Phrommachan, on trunk of *Lithocarpus truncatus* (King) Rehder & Wilson, 26 June 2008, Varaporn Sriprang—VC570, VC587 & VC611(RAMK); ibid., Khok Phrommachan, on trunk of *Rhaphiolepis indica* (L.) Lindl. Ex Ker, 26 June 2008, Varaporn Sriprang—VC588(RAMK); ibid., Pha Chang Pan, on trunk of an unidentified tree, 20 May 2009, Varaporn Sriprang—VC592 & VC607(RAMK); ibid., around the helicopter landing spot, on trunk of *Rhododendron lyi* H. Lév., 27 June 2008, Varaporn Sriprang—VC598(RAMK); ibid., from Lan Suriyan to Khok Paek Dam, on trunk of *Lyonia foliosa* (Fletcher) Sleumer, 25 June 2008, Varaporn Sriprang—VC602(RAMK); ibid., Lan Suriyan, on trunk of *Lithocarpus truncatus* (King) Rehder & Wilson, 25 June 2008, Varaporn Sriprang—VC604(RAMK); ibid., Pha Chang Pan, on trunk of *Lithocarpus truncatus* (King) Rehder & Wilson, 24 June 2008, Varaporn Sriprang—VC605(RAMK); ibid., Lan Suriyan, on trunk of an unidentified tree, 25 June 2008, Varaporn Sriprang—VC554 & VC608(RAMK); ibid., Seven Chanal Station, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—VC740, VC752, VC753, VC756, VC757, VC758, VC771, VC795, VC799, VC803 & VC805(RAMK); ibid., around the helicopter landing spot, on trunk of an unidentified tree, 13 November 2008, Varaporn

Sriprang—VC760, VC762 & VC763(RAMK); ibid., Khok Huai Toei, on trunk of an unidentified tree, 27 June 2008, Varaporn Sriprang—VC561 (RAMK); ibid., Khok Nok Kraba Forest Ranger Station, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—VC814(RAMK); ibid., Khok Nok Kraba Forest Ranger Station, on trunk of an unidentified tree, 21 May 2009, Varaporn Sriprang—VC885(RAMK); ibid., Phu Ho Forest Ranger Station, on trunk of an unidentified tree, 30 July 2009, Mattika Sodamuk and Chutamat Phraphuchamnong—SM89-1 & SM92(RAMK); ibid., Phu Ho Forest Ranger Station, on trunk of an unidentified tree, 29 July 2009, Chutamat Phraphuchamnong—CP638(RAMK); ibid., Khok Phrommachan, on rocks, 26 June 2008, Chutamat Phraphuchamnong—CP431 (RAMK); ibid., Khok Phrommachan, on trunk of an *Persea kurzii* Kosterm., 26 June 2008, Varaporn Sriprang—VC548, VC571 & VC572(RAMK); ibid., Khok Nok Kraba Forest Ranger Station, on trunk of an unidentified tree, 13 November 2008, Varaporn Sriprang—VC555 &VC743(RAMK); ibid., Khok Phrommachan, on trunk of *Rhododendron lyi* H. Lév., 26 June 2008, Varaporn Sriprang—VC534(RAMK); ibid., Khok Phrommachan, on trunk of *Lithocarpus calathiformis* Rehder & Wilson, 26 June 2008, Varaporn Sriprang—VC547(RAMK).

Observation: *Vainionora flavidorufa* has pale yellow to pale red-brown or grey brown apothecial disc, brown hypothecium. *chlarotera*-type epihymenium and presence of 2'-*O*-methylperlatolic acid and atranorin.