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Little Known Crustose Lichens Bearing Lecideine Black Apothecia from Japan

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Abstract Eight new, or little known crustose lichens are reported. The genera *Arthrorhaphis*, *Cecidonia* and *Epilichen* are new to Japan. *Epilichen scabrosus* and *Rhizocarpon henssenіae* are new additions to the flora of Asia. *Arthrorhaphis citrinella*, *Cecidonia umbonella* and *Trapelia mooreana* are new additions to the flora of Japan. Descriptions including taxonomic and chemical data are provided. These are also provided for *Rhizocarpon hochstetteri*, *Trapeliopsis flexuosa* and *Tremolecia atrata*, which are the species previously little known in Japan.
Key words: lichens, taxonomy, Japan, *Arthrorhaphis*, *Cecidonia*, *Epilichen*, *Rhizocarpon*, *Trapelia*, *Trapeliopsis*, *Tremolecia*.

In the course of my investigations on Japanese Lecideaceae (s. lato-sensu Zahlbruckner 1926). I have been detecting the several new, or a little known crustose lichens being characterized by lecideine black apothecia. I will present some taxonomic notes on them.

In the list specimens examined, the locality name is followed by the citation of altitude, herbarium number and the date collected. The specimens listed here are preserved in the herbarium of Akita University and in the herbarium of the National Science Museum, Tokyo (TNS).

1. The genera which are new to Japan

1) **ARTHRORHAPHIS** Th. Fr., Acta reg. Soc. Sci, ups., ser. III, 3: 203–204, 1860.
   Type species: *Arthrorhaphis flavovirescens* (Dicks.) Th. Fr.
2) **CECIDONIA** Triebel & Rambold, Nova Hedw. 47: 279–309, 1988.
   Type species: *Cecidonia umbonella* (Nyl.) Triebel & Rambold
3) **EPILICHEN** Clem. ex Hafellner, Nova Hedwigia 30: 676, 1978.
   Type species: *Epilichen scabrosus* (Ach.) Clem. ex Hafellner

2. Enumeration of species

1) **Arthrorhaphis citrinella** (Ach.) Poelt (Pl. I: a)

Bestimmungsschlüssel Europäischer Flechten 126 (1969).—*Lichen citrinellus* Ach., Kongl. vetensk. acad. nya handl. 135 (1795). Type: Sweden,—lecto-

type (Obermayer, 1994) in H-Ach 262, vidi. —*Bacidia citrinella* (Ach.) Branth & Rostr., Bot. Tidsskr. 3: 235 (1869).

Thallus irregularly bullate-areolate forming patches reached to 2 cm in diameter; areolae with roughened surface, in parts sorediate, crowded, or at times subscattered, bright yellow with green tinge. Hypothallus indistinct.

Apothecia 0.3–0.5 mm in diameter, adnate, solitary or congregated, black; disc naked, concave to plane, with a thick margin. Excipulum 70–90 μm thick, dark brown externally becoming gradually paler internally, but not colorless; hyphae subradiating, irregularly entangled, 2–4 μm thick, leptodermatous to mesodermatous (Fig. 1). Epithecium colorless or pale. Hymenium crystalline, 60–70 μm high. Subhymenium colorless or pale, 20–40 μm high. Hypothecium pale brown, reaching to 100 μm high; hyphae more or less perpendicular. Paraphyses slender, 1.5–2 μm thick, coherent, branched, anastomosed; apices not swollen. Asci clavate, thick-walled apically, 55–65 $\times$ 6–8 μm. Spores acicular, 35–60 $\times$ 2–3 μm, 8–10 septate.

Reaction: thallus & medulla P−, K−, KC−, C−. Chemical substances: rhizocarpic acid, an unidentified substance (TLC).

Habitat: on humus, mosses, Nostoc and rocks (lava) in subalpine and alpine

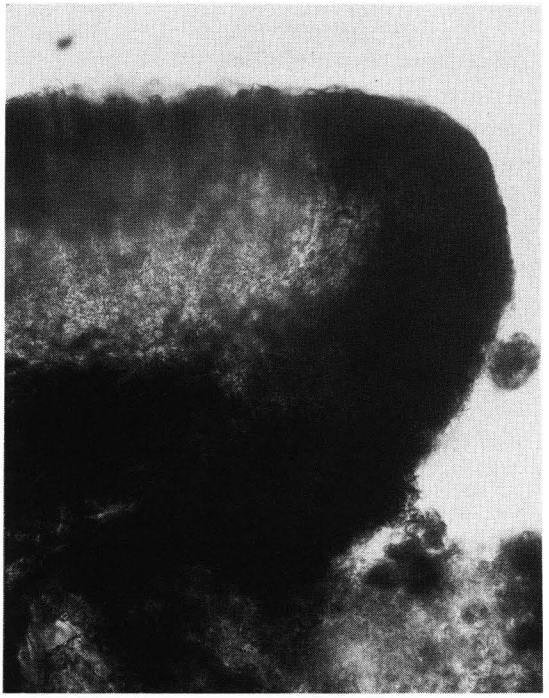

Fig. 1. Cross-section of an excipulum of *Arthrorhaphis citrinella* (M. Inoue no. 16031), $\times$100.

regions.

Range: Japan; China (Himalaya, Obermayer 1996); Nepal (Langton, Obermayer 1996); Malaysia (Mt. Kinabalu, Sipman 1993); Europe (Poelt & Vězda 1977; Scandinavia, Santesson 1993); Canada (British Columbia, Noble *et al.* 1987, Obermayer 1994); Subantarctic (Marion Island, Lindsay 1976).

Anatomically the Japanese representatives resemble the lectotype of *A. citrinella*, which, however, differs in having wider apothecia (0.8–0.9 mm wide in the type).

A. citrinella is easily recognized by acicular multi-septate spores and the bright yellow thallus bearing black lecideine apothecia, which looks like a yellow *Rhizocarpon.*

This species was previously known from Asia (China, Nepal and Malaysia) including North America, Europe and the Subantarctic. However, the range has now extended to Japan.

Specimens examined. HONSHU. Pref. Akita: Mt. Moriyoshi, 1270 m, M. Inoue no. 16026 (8 Oct., 1982), 1280 m, M. Inoue no. 22975 (23 Sept., 1984), 1400 m, M. Inoue no. 16031 (8 Oct., 1982); Mt. Kurikoma, 1420 m, M. Inoue no. 16735 (22 Aug., 1983). Pref. Iwate: Mt. Iwate, 650 m, M. Inoue no. 22042 (1 Sept., 1991), 1270 m, M. Inoue no. 21823 (1 Sept., 1991), 1350 m, M. Inoue no. 21932 (1 Sept., 1991); Mt. Yakeishi, 1450 m, M. Inoue no. 16652 (26 Aug., 1983), 1500 m, coll. K. Sasaki, M. Inoue no. 22978 (11 Aug., 1982). Pref. Yamagata: Mt. Chokai, 1370 m, M. Inoue no. 16916 (21 Aug., 1984).

An additional specimen examined. Sweden, Jemtlem, coll. S. Almquist, s. n. (in 1868), as *Arthrorhaphis flavovirescens*, TNS.

2) Cecidonia umbonella (Nyl.) Triebel & Rambold (Pl. I: b)

Nova Hedw. 47: 284 (1988). —*Lecidea umbonella* Nyl., Flora 49: 372 (1866). Type: Scotland, Perthshire, Ben More, —holotype in H (H-Nyl. 15535a), vidi.

Thallus subdeterminate, forming islets in thalli of *Lecidea lactea*, irregularly cracked-areolate, chalky or glaucous white; medulla I+violet.

Apothecia 0.2–0.5 mm in diameter, subimmersed, black, with a thick entire margin; disc with central umbo. Excipulum developed, dark brown; hyphae leptodermatous, radiating, conglutinating, 2–3 μm thick. Epithecium dark brown. Hymenium 70–90 μm high. Subhymenium colorless, reaching 50 μm high; hypothecium not obvious. Paraphyses coherent, anastomosed, 2–2.5 μm thick; apices not swollen. Asci clavate, 60–75 $\times$ 15–25 μm. Spores ellipsoid with obtuse ends, 11–13 $\times$ 7–9 μm; walls thin.

Reaction: thallus P+ yellow, K+ yellow, then red, KC−, C−. Chemical substances: norstictic acid (TLC).

Habitat: on the thallus of *Lecidea lactea* growing on rocks.

Range: Japan; Europe, Russia (Caucasus), U.S.A. (Colorado), Spitzbergen

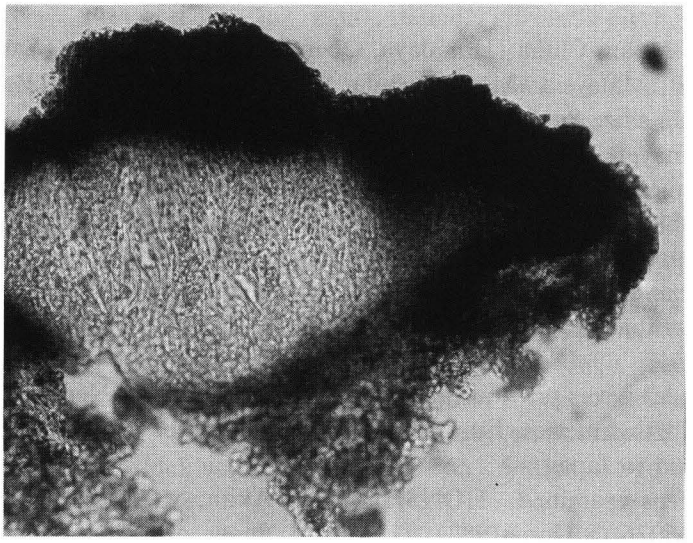

Fig. 2. Cross-section of an apothecium showing "central umbo" of *Cecidonia umbonella* (M. Inoue no. 12410), ×100.

& Greenland (Triebel & Rambold 1988); Alaska (Hertel 1991).

C. umbonella is distinctive by the chalky or glaucous-white thallus on the thallus of other lichens and by the subimmersed apothecial disc with central umbo (Fig. 2). This species is known in Japan only from one gathering, but the material is well developed. Since the species is very characteristic, the identification as this species seems justifiable.

This species was previously known only from Europe, North America, Arctic and western Asia. The range now extends to eastern Asia.

Specimen examined. HONSHU. Pref. Yamanashi: Mt. Ainotake near Mt. Kitadake, 3150 m, M. Inoue no. 12410 (18 Aug., 1978).

Additional specimens examined. Norway, Hordaland, 1350 m, H. Hertel no. 15667 (coll. in 1974), HIRO; Härfedalen Prov., 920 m, R. Santesson no. 31148, Aug., 1984 (Moberg, Lich. sel. Exsic. Upsal. no. 15, TNS). Austria, Carinthia, 2200 m, coll. H. Hertel, A. Vězda & V. Wirth, July 1978 (Vězda, Lich. sel. Exsic. no. 1591, TNS).

3) Epilichen scabrosus (Ach.) Clem. ex Hafellner (Pl. I: c)

Nova Hedwigia 30: 677 (1978).—*Lecidea scabrosa* Ach., Meth. Lich. 48 (1803). Type: Europe ?, leg. Swartz,—isotype in UPS, non vidi.—*Buellia scabrosa* (Ach.) A. Massal., Geneac. Lich., 20 (1854).

Thallus yellow with green tinge, polished, subsquamulose, on the thalli of *Baeomyces placophyllus* in juvenile, then free-living. Hypothallus indistinct.

Apothecia reaching to 1.0 mm in diameter, appressed-adnate, immarginate, convex, black. Excipulum thin, 30–50 μm thick, dark brown internally and becoming gradually paler externally; hyphae radiating, mesodermatous to pachydermatous, irregularly entangled, 4–6 μm thick (Fig. 3). Epithecium brownish green. Hymenium 100–120 μm high. Subhymenium 5–10 μm high, colorless. Hypothecium dark brown, reaching to 250 μm thick; hypae irregularly arranged. Paraphyses slender, 1.5–2 μm thick, coherent, branched, anastomosed. Asci clavate, 80–100 × 15–18 μm, with thin thollus. Spores brown, 1-septate, 12–15 × 15–18 μm.

Reaction: thallus P+ brick red, K+ yellow, KC−, C−. Chemical substances: rhizocarpic acid, stictic acid, an unidentified substance (TLC).

Habitat: on *Baeomyces placophyllus* in juvenile stage and later on humus.

Range: Japan; Europe, northern Russia & North America (Hafellner 1978); Greenland (Th. Fries 1860, as *Buellia scabrosa*).

In general appearance *E. scabrosus* is most reminiscent of saxicolous *Tephromela aglaea* (Inoue 1988, as *Lecidea aglaea*) because of the yellow thallus with immarginate black apothecia, but is easily distinguished by its two-celled spores and peculiar habitat; on the thalli of *Baeomyces* during juvenile stage.

Although this species was previously known from Europe, Northern Russia, Greenland and North America, the range now includes eastern Asia.

A specimen examined. HONSHU. Pref. Iwate: Mt. Yakeishi, 1450 m, M. Inoue no. 16651 (26 Aug., 1983).

Additional specimens examined. Norway, "Finmark, Aldiok", leg. Fries Th.

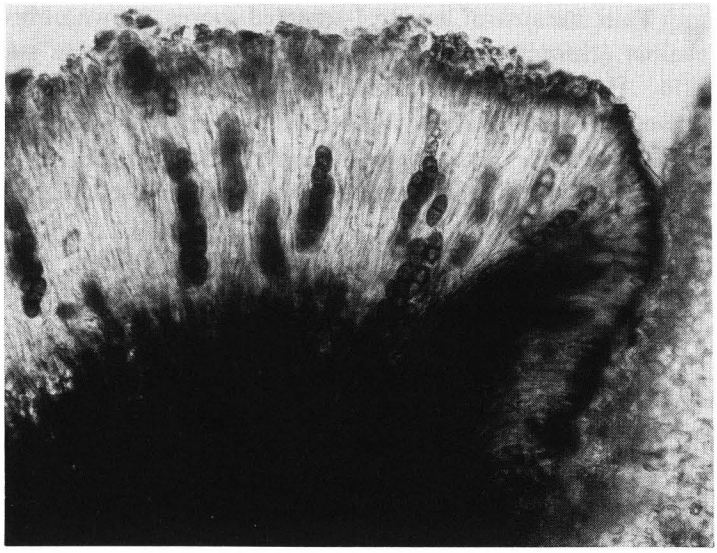

Fig. 3. Cross-section of an excipulum of *Epilichen scabrosus* (M. Inoue no. 16651), × 100.

in 1857, in H, s. n. Tirol? (without precise locality), Arnold ex. no. 97 b, TNS.

4) Rhizocarpon hensseniae Brodo (Pl. I: d)

Bibl. Lichenol. 38: 29–35 (1990). Type: Canada. British Columbia: Queen Charlotte Islands, Graham Island, Brodo no.10264, holotype in CANL, non vidi.

Thallus contiguous, thin to medium, irregularly cracked-areolate, with narrow fissures, violet-gray or paler, surrounded by blackish hypothalline lines; areolae plane, somewhat polished; medulla I−; cephalodia gray with violet tinge, hemispherical, intermixed with areolae.

Apothecia black, adnate or appressed-adnate, up to 1.5 mm or at times to 2.0 mm wide, moderately constricted at the base; margin thin or indistinct; disc epruinose, flat to slightly convex. Epithecium brown, rarely with green tinge. Excipulum narrow, 30–40 μm thick, brown in external part, and becoming paler towards the center; hyphae perpendicularly radiating, paraplectenchymatous. Hymenium (110–)130–160(–180) μm high. Subhymenium up to 200 μm high, dark brown, with irregularly shaped cavities. Hypothecium indistinct. Paraphyses coherent, anastomosed; apices slightly swollen. Asci clavate, 110–145 × 26–43 μm. Spores colorless at first, then becoming brown, 1-septate, with a halo, 32–42 × 13–20 μm.

Reaction: thallus & medulla P+ reddish, K+ yellow, KC−, C−. Chemical substances: stictic acid (TLC).

Habitat: on non-calcareous rocks in subalpine and alpine regions.

Range: Japan; northwest coast of North America (Brodo 1990).

R. hensseniae is closely related to *R. hochstetteri* and *R. cinnereovirens* (Müller Arg.) Vain. because of having 1-septated spores, brown or brownish gray areolated thallus (rhizocarpic acid is deficient) and producing stictic acid or norstictic acid. However, *R. hensseniae* can be easily distinguished from them mainly by the cephalodiate thallus, which is a quite exceptional character within the genus *Rhizocarpon.*

This species was previously known from North America. However, the range is now extend to Japan.

Amygdalaria subdissentiens (Nyl.) Mas. Inoue & Brodo, which is known from the northwest coast of North America (Brodo & Hertel 1987), Japan and Siberia (Inoue, 1984), appears to have a distribution similar to *R. hensseniae.* Brodo (1990) assumed that *R. hensseniae*, like some other lichens from the Charlotte, survived the Wisconsin glacier and speciated in refugia on that archipelago. *R. hennsseniae* and *A. subdissentiens*, of which vertical distribution range is rather higher regions in Japan, appears to have important phytogeographical implications.

Specimen examined. HOKKAIDO. Prov. Kamikawa: Mt. Midori in Mts. Daisetsu, 2070 m, M. Inoue no. 8555 (8 Aug., 1974). Prov. Rumoi: Mt.

Shokanbetsu, 1440 m, M. Inoue no. 8264 (21 Aug., 1974); 1470 m, M. Inoue no. 8293 (21 Aug., 1974). HONSHU. Pref. Yamagata: Mt. Chokai, 1360 m, M. Inoue no. 16923 (20 Aug., 1984); Mt. Ito in Mts. Asahi, 1640 m, M. Inoue no. 10448 (12 Aug., 1975); Mt. Iide, 1780 m, M. Inoue no. 10902 (9 Aug., 1975). Pref. Miyagi: Mt. Zao, 1570 m, M. Inoue no. 10691 (21 Aug., 1975); Mt. Kurikoma, 1570 m, M. Inoue no. 10359 (27 Aug., 1975). Pref. Nagano: Mt. Goryu, 2640 m, M. Inoue no. 5539 (30 July, 1973); Mt. Renge in Mts. Hida, 2790 m, M. Inoue no. 5011 (18 Aug., 1973); Mt. Noguchigoro in Mts. Hida, 2770 m, M. Inoue no. 5891 (19 Aug., 1973) & 2910 m, M. Inoue no. 12731 (18 Aug., 1979); Mt. Mitsudake in Mts. Hida, 2810 m, M. Inoue no. 5965 (20 Aug., 1973); Mt. Momisawa in Mts. Hida, 2750 m, M. Inoue no. 4831(21 Aug., 1973); Mt. Yari in Mts. Hida, 3110 m, M. Inoue no. 4912 (21 Aug., 1973); Mt. Hoken in Mts. Kiso, 2710 m, M. Inoue no. 6940 (10 Aug., 1973); Mt. Ontake, 2950 m, M. Inoue no. 4754 (7 Aug., 1973).

An additional specimens examined. U.S.A. Alaska, Juneau, ca. 700 m, O'Clair, R. M., s.n. (det. Brodo, I. M.) , Nat. Herb. Canada: CANAL no. 92425. Canada, Queen Charlotte Isls., Graham Isl., 180–210 m, Brodo, I. M. no. 26959 (Nat. Herb. Canada: CANAL no. 98879); Moresby Isl., Brod, I. M. no. 23677 (Nat. Herb. Canada: CANAL no. 107157).

5) Rhizocarpon hochstetteri (Körb.) Vain. (Pl. II: a)

Acta Soc. Fauna et Flora Fenn. 53: 332 (1922). — *Catillaria hochstetteri* Körb., Parerg. Lich. 195 (1861). Type: Germany, non vidi. — *Lecidea colludens* Nyl., Flora 53: 38 (1870); Nyl., Lich. Jap. 82 (1890), — *Rhizocarpon massalongi* f. *colludens* (Nyl.) Zahlbr., Cat. Lich. Univ. 4: 336 (1927). Type: Finland, "Holmiae", leg. W. Nylander in 1852 — lectotype (I. M. Brodo 1992 in Nylander Herbarium in H), in H (H-Nyl. 10047), vidi.

Thallus irregularly areolate, brown with grey tinge, somewhat polished; areolae dispersed on a black hypothallus, or in part, contiguous, surrounded by a conspicuous, extensive, fimbriate-radiating, dendritic hypothalline margin; medulla I−.

Apothecia reaching to 1.3(−1.5) mm in diameter, black, appressed-adnate, variable in shape, round or at times a few small ones clustered in groups; disc concave, epruinose; margin prominent, flexuose. Excipulum brown, medium in thickness, or often well developed, reaching to 130 μm thick, brown to dark brown; hyphae radiating. Epithecium brown. Hymenium 80–100 μm high. Subhymenium colorless or pale, 15–20 μm high. Hypothecium brown, reaching to 200 μm high. Paraphyses slender, 2–2.5 μm thick, well branched, anastomosed; apices not swollen. Asci clavate, 70–90 × 15–22 μm. Spores 1-septate, colorless, very often brownish when mature, 20–25 × 10–14 μm.

Reaction: thallus & medulla P+ reddish, K+ yellow, KC−, C−. Chemical

substance: stictic acid (TLC).

Habitat: on non-calcareous rocks in subalpine and alpine regions.

Range: Japan; Russian Arctic (Andreev *et al.* 1996); Europe (Santesson 1993, Purvis *et al.* 1992); North America (Noble *et al.* 1987).

Unfortunately I have not reexamined the type of *R. hochstetteri.* However, I did examine the lectotype of *Lecidea colludens* which Lamb (1940) proposed as a synonym of *R. hochstetteri.* The Japanese representatives agree well with the type both anatomically and morphologically. However they lack lichen substances.

R. hochstetteri is distinct due to one-septated spores and a greyish brown thallus, of which areolae are dispersed on a black hypothallus and surrounded by a fimbriate-radiating dendritic protothallus.

Nylander (1890) reported this species (as *Lecidea colludens*) from Japan, Mt. Fuji, but I could not find a voucher specimen in Nylander Herbarium at Helsinki University.

Representative specimens examined. HOKKAIDO. Prov. Soya: Mt. Rishiri, 1700 m, M. Inoue no. 8107 (18 Aug., 1974). Prov. Kamikawa: Mts. Daisetsu, 1860 m, M. Inoue no. 8694 (10 Aug., 1974). HONSHU. Pref. Akita. Mt. Chokai, 1600 m, M. Inoue no. 15877 (12 Aug., 1982). Pref. Yamagata. Mt. Chokai, 1400 m, M. Inoue no. 16418 (14 Aug., 1983); 2235 m (summit), M. Inoue no. 16493 (6 Aug., 1983). Pref. Toyama. Mt. Shirouma, 2650 m, M. Inoue no. 14146 (21 Aug., 1980). Pref. Nagano. Mt. Yari, 2590 m, M. Inoue no. 4801 (22 Aug., 1973).

Additional specimens examined. Tirol, Stubaier Alpen, ca. 1200 m, leg. M. Steiner, Poelt's Lich. Alp. 65 (Aug., 1958), in TNS.

6) Trapelia mooreana (Carroll) P. James (Pl. II: b)

In Hertel, Herzogia 3: 404–405 (1975).—*Lecidea mooreana* Carroll, Nat. Hist. Rev. 6: 529 (1859). Type: Ireland, non vidi.

Thallus medium to thick, whitish with yellow-brown tinge, bullate-areolate; areolae contiguous or, at times, dispersed, surface smooth and polished. Hypothallus indistinct.

Apothecia adnate, reaching to 1.0 mm diameter, markedly constricted at the base, variable in shape, black or blackish brown; disc concave, sparingly pruinose; margin thin to medium in thickness, sometimes flexuose, paler than the disc, at times concolorous to the thallus. Excipulum well developed 60–80(–100) μm thick, consisting of parathecium and amphithecium, brown at the margin, colorless within, gradually brownish internally, arachnoid; hyphae radiating, 2.5–3 μm thick, leptodermatous. Epithecium pale brown. Hymenium 100–130 μm high. Hypothecium indistinct, subhymenium distinct, reaching to 150 μm high, colorless. Paraphyses slender, 1.5–2 μm thick, richly branched, not thickened at the

apices. Asci clavate, 90–120 × 15–20 μm, with thin tholus, J−. Spores (13–)15–17 × 6–8 μm, with somewhat acute ends.

Reaction: thallus & medulla P−, K−, C+ orange. Chemical substance: gyrophoric acid (TLC).

Habitat: on non-calcareous rocks in subalpine and alpine regions.

Range: Japan; Indonesia (Hertel 1977); U.K. (Coppins & James 1984); Europe (Hertel 1969, as *Trapelia torelii*); Canada (Hertel 1969, as *T. torelii*); U.S.A. (Minnesota & Wisconsin, Fink 1910, as *Lecidea brujeriana*); Venezuela, Cuba & Costa Rica (Hertel 1970, as *Trapelia torelii*); Argentina (Hertel 1969, as *Trapelia torelii*); Tasmania (Hertel 1987 & 1989).

T. mooreana is easily recognized by the morphology of the thallus, well developed excipulum being arachnoid (Fig. 4), richly branched slender paraphyses and a production of gyrophoric acid.

This species was previously known from Southeast Asia, Europe, North & South America and Tasmania. However, the range has now extended to East Asia.

Specimens exmined. HONSHU. Pref. Akita: Hachimantai, 1580 m, M. Inoue no. 24352 (26 July, 1988); Mt. Akitakoma, 1540 m, M. Inoue no. 15943 & 15945 (24 July, 1981); Mt. Moriyoshi, 1270 m, M. Inoue no. 22097 (20 July, 1990), 1410 m, M. Inoue no. 16030 (8 Oct., 1982), 1420 m, M. Inoue no. 16021 (8 Oct., 1982); Mt. Chokai, 1250 m, M. Inoue no. 16534 (14 Aug., 1983); Mt. Kurikoma, 1230 m, M. Inoue no. 16780 (22 Aug., 1983), 1400 m, M. Inoue no. 16708 (22 Aug., 1983). Pref. Yamagata: Mt. Chokai, 1680 m, M. Inoue no. 16881 (20 Aug., 1984); Mt. Gassan, 1610 m, M. Inoue no. 10822 (24 Aug., 1975).

Fig. 4. Cross-section of an excipulum of *Trapelia mooreana* (M. Inoue no. 21792), × 100.

Pref. Miyagi: Mt. Kurikoma, 1550 m, M. Inoue no. 10371 (26 Aug., 1975); Mt. Zao, 1570 m, M. Inoue no. 10693 (21 Aug., 1975). Pref. Nagano: Mt. Naeba, 2145 m, M. Inoue nos. 372–374 (6 Aug., 1972); Mt. Asama, 2350 m, M. Inoue no. 11329 (23 Aug., 1976); Mt. Norikura, 2430 m, M. Inoue no. 12988 & 13002 (14 Aug., 1979).

Additional specimens examined. Ecuador, Zamora-Chinchipe, 2700 m, K. Kalb. Lich. Neotrop. no. 450, TNS. Brazil, Sanpaulo, K. Kalb., Lich. Neotrop. no. 248, TNS. Norway, Dammedalane, leg. J. J. Havaas (Sept., 1949), as *Biatora brujeriana*, TNS. Scotland, Ardnamurchan Peninsula, ca. 230 m, coll. P. James s. n. (11 July, 1966), as *Leciea lopadioides*, HIRO. Italy, Rhätische Alpen, Herb. E. Kernstock, s. n. (coll. in 1892), as *Biatora brujeriana* f. *deplanata*, W.

7) **Trapeliopsis flexuosa** (Fr.) Coppins & P. James (Pl. II: c)

Lichenologist 16: 258 (1984).—*Biatora flexuosa* Fr., Sched. crit. lich. suec. part 2 (fasc. 8): 11 (1826). Type: Sweden, Fries, Lich. Suec. exs. no. 221.—lectotype in UPS, non vidi; isolectotype in M, vidi.

Thallus effuse, bullate-areolate or irregularly areolate; areolae dispersed, or in part, contiguous, thickness medium, surface more or less polished, livid-gray or gray with green tinge, slightly convex, 0.2–0.3 mm wide; medulla I−. Hypothallus indistinct. Apothecia 0.3–0.5 mm wide, between or partly on the areolae, adnate, moderately constricted at the base, sometimes several small ones clustered in groups; disc dark brown to blackish brown, epruinose, plane or concave; margin prominent, flexuose, paler than the disc, or at times concolorous. Excipulum 30–50 μm thick, brown at the margin, paler within, I−, composed of thin-walled subradiating hyphae with inflated cell-lumina; hyphae 4–5 μm thick. Epithecium pale brown. Hymenium 40–60 μm high. Subhymenium 30–40 μm high, colorless. Hypothecium reaching 80 μm high, consisting of loosely interwoven hyphae, colorless. Thecium I+ pale bluish then turning reddish brown. Paraphyses slender, 2–2.5 μm thick, well branched, anastomosed; apices slightly or not thickened. Asci clavate, 35–50 × 7–10 μm, tholus prominent, I+ faintly blue. Spores 8–9 × 4–5(6) μm, ellipsoid, colorless.

Reaction: thallus P−, K−, KC−, C−; medulla P−, K−, C+ red. Chemical substances: gyrophoric acid (TLC).

Habitat: on a carbonized stump burnt by a forest fire and on decayed wood.

Range: Japan; Europe (Schreiner & Hafellner 1992; U. K., Coppins & James 1984; Norway, Tønsberg 1992); North America (Egan 1987; Alaska, Talbot *et al.* 1992; British Columbia, Noble *et al.* 1987); Australia (Weber & Wetmore 1972, as *Lecidea flexuosa*).

Trapeliopsis Hertel & Schneider originally contained only +/− squamulose taxa (Schneider 1979), but Hertel (1981) and Coppins & P. James (1984) placed some crustose taxa, like the present species, in this genus. I am inclined to be of

the same opinion as the latter.

Inoue (1994) reported *T. flexuosa* as a new addition to the flora of Japan and also of Asia without any descriptions.

The Japanese specimen differs from the type, in which apothecia are up to 0.4 mm wide and the hymenium 35–45 μm high, only by the somewhat wider apothecia and higher hymenium. But morphological-, anatomical- and chemical features as well as a peculiar habitat on "burnt lignum" of the Japanese specimen are very similar to those of the type and other European representatives.

Diagnostic features of *T. flexuosa* are: apothecia with flexuose margin which is prominent and paler than the disc, excipulum composed of hyphae with inflated cell-lumina, highly branched and anastomosing paraphyses, rather smaller spores for within the lecideoid lichens and a chemistry of producing gyrophoric acid.

External features, especially the apothecia with pale flexuose margin and dispersed bullate-areolate thallus of *T. flexuosa*, are most reminiscent of some species of *Trapelia* or *Fuscidea*. However, this species is easily distinguished by the hyphal structure of excipulum and by the well-branched anastomosing paraphyses.

The saxicolous *Trapeliopsis subconcolor* (Anzi) Hertel*, which was reported from Formosa (Taiwan), Nepal and Burma by Hertel (1977, as *Trapelia subconcolor*), is easily distinguished from *T. flexuosa* by the wider apothecia (reaching 1.6 mm wide) and longer spores (10–15 × 4–5 μm).

Many reports mentioned that *T. flexuosa* was growing on old wood, stumps, logs, and at times on decayed wood. But it is noteworthy that a Japanese specimen of *T. flexuosa*, like the type collection, is growing on a carbonized stump burnt by a forest fire and on decayed wood. The slow growth of lichens is legendary. But the growth in *T. flexuosa* seems rapid because this lichen established in its niche before carbonized layers of wood peeled off. Th. Fries (1874) and Tuckerman (1888) also reported *T. flexuosa* from the same habitat in northern Europe and North America respectively.

T. flexuosa has a world-wide distribution, but its occurrence in Japan seems to be rather rare; it is known only for one locality in Kyushu, Southern Japan.

Specimen examined. KYUSHU. Pref. Miyazaki: Mt. Ichifusa, 1410 m, on burnt lignum in beech (Fagus crenata) wood, leg. M. Inoue no. 10309 (23 March, 1975).

Additional specimens examined. Sweden, "Sodermanland", leg. S. Ahlner, s.n. (22.VII.1951), TNS; "Bohuslan", leg A. H. Magnusson no. 24564 (23.VII.

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* *Trapeliopsis subconcolor* (Anzi) Hertel, Herzogia 5: 460 (1981).—*Biatora subconcolor* Anzi, Comment. Soc. Critt. Ital. 1: 151 (1862). Type: Italy, non vidi.—*Lecidea ochrolechioides* Zahlbr., Feddes Repert. 33: 38 (1933). Type: Taiwan, leg. Y. Asahina F 155,—holotype in W, vidi;—isotype in TNS, vidi.—*Lecidea obsessa* Zahlbr. Feddes Repert. 33: 38 (1933). Type: Taiwan, leg. Y. Asahina F 140,—holotype in W, vidi;—isotype in TNS, vidi.—

1955), TNS.

8) **Tremolecia atrata** (Ach.) Hertel (Pl. II: d)

Khumbu Himal 6: 351 (1977).—Gyalecta atrata Ach., Kongl. Vetensk. Akad. Nya Handl. 229 (1808). Type: Norway, "Finmarkia", 9.VI,1802, G. Wahlenberg,—lectotype in UPS, vidi.

Based on the collection from the summit of Mt. Fuji Hertel (1977) added *T. atrata* to the lichen flora of Japan and gave a precise description; it was the only locality previously known. However, this species is apparently not rare in Japan, where it frequently grows in alpine regions.

Habitat: on non-calcareous rocks in alpine regions.

Range: Japan; Himalaya, Armenia, Tanzania, Canary isls., Europe, Iceland, Spitsbergen, Greenland, Russian Arctic region (Novaja Zemlja, Zemlja Frantsa Iosifa, Cukotski Pen.), North America, Venezuela, Chile, Tasmania & New Zealand & Marion is. (Hertel 1977); South America (Colombia; Argentina, Hertel 1989); Australia (Rambold 1989); Subantarctic region (Kerguelen is., King George is., South Georgia is. & Antarctic Peninsula, Hertel 1984 & 1987, Jacobsen & Kappen 1988, Inoue 1993).

Specimens examined. HOKKAIDO. Prov. Rumoi: Mt. Syokanbetsu, 1320 m, M. Inoue no. 8304 (21 Aug., 1974, forming tiny patches with *Fuscidea submollis* M. Inoue). HONSHU. Pref. Toyama: Mt. Shirouma–Mt. Hachidake, 2500 m, M. Inoue no. 14164 (21 Aug. 1980). Pref. Nagano: Yamada Pass near Mt. Shirane, 2060 m, M. Inoue no. 1764 (20 July, 1972) & 2100 m, M. Inoue no. 24745 (2 June, 1984); Mt. Yari, 3120 m, M. Inoue no. 4934 (21 Aug., 1973); Mt. Otensho, 2930 m, M. Inoue no. 25618 (22 Aug., 1973); Mt. Chogatake, 2600 m, M. Inoue no. 14305 (15 Aug., 1980), 2650 m, M. Inoue no. 14319 (15 Aug., 1980). Pref. Yamanashi: Mt. Kitadake, 2950 m, 3030 m, 3050 m alt. & 3140 m, M. Inoue nos. 12165, 12245, 12202 & 12215 respectively (17 Aug., 1978); Mt. Ainotake, 3150 m, M. Inoue no. 12364 (18 Aug., 1978).

Additional specimens examined. Sweden, Härjedalen, 900 m, coll. R. Santesson no. 27393 (Vezda, Lich. sel. Exsic. no. 1536), TNS. Portugal. "Beira Alta", 1150 m, coll. CN. Tavares, 5 Aug., 1962 (Tavares, Lich. Lusitaniae sel. Exsic. no. 154), as *Lecidea dicksonii*, TNS. Novaja Zemlja, Salbugtan, coll. Lynge (24 Aug., 1921), as *Lecidea dicksonii*, TNS. Greenland, Ferslew Pynt, 2–3 m, E. S. Hansen, Lich. Gröenland. Exsic. no. 311, TNS; Angmassalik, E. S. Hansen, Lich. Gröenland. Exsic. no. 290, TNS.

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Explanation of plates

Plate I. a. *Arthrorhaphis citrinella* (Ach.) Poelt (M. Inoue no. 16031). b. *Cecidonia umbonella* (Nyl.) Triebel & Rambold, on the thallus of *Lecidea lactea* bearing wider apothecia (M. Inoue no. 12410). c. *Epilichen scabrosus* (Ach.) Clem. ex Hafellner (M. Inoue no. 16651). d. *Rhizocarpon hensseniae* Brodo (M. Inoue no. 4754). The ruler is graduated in 0.5 mm units.

Plate II. a. *Rhizocarpon hochstetteri* (Körb.) Vain. (M. Inoue no. 8694). b. *Trapelia mooreana* (Carroll) P. James (M. Inoue no. 21792). c. *Trapeliopsis flexuosa* (Fr.) Coppins & P. James (M. Inoue no. 10309). d. *Tremolecia atrata* (Ach.) Hertel (M. Inoue no. 12165). The ruler is graduated in 0.5 mm units.

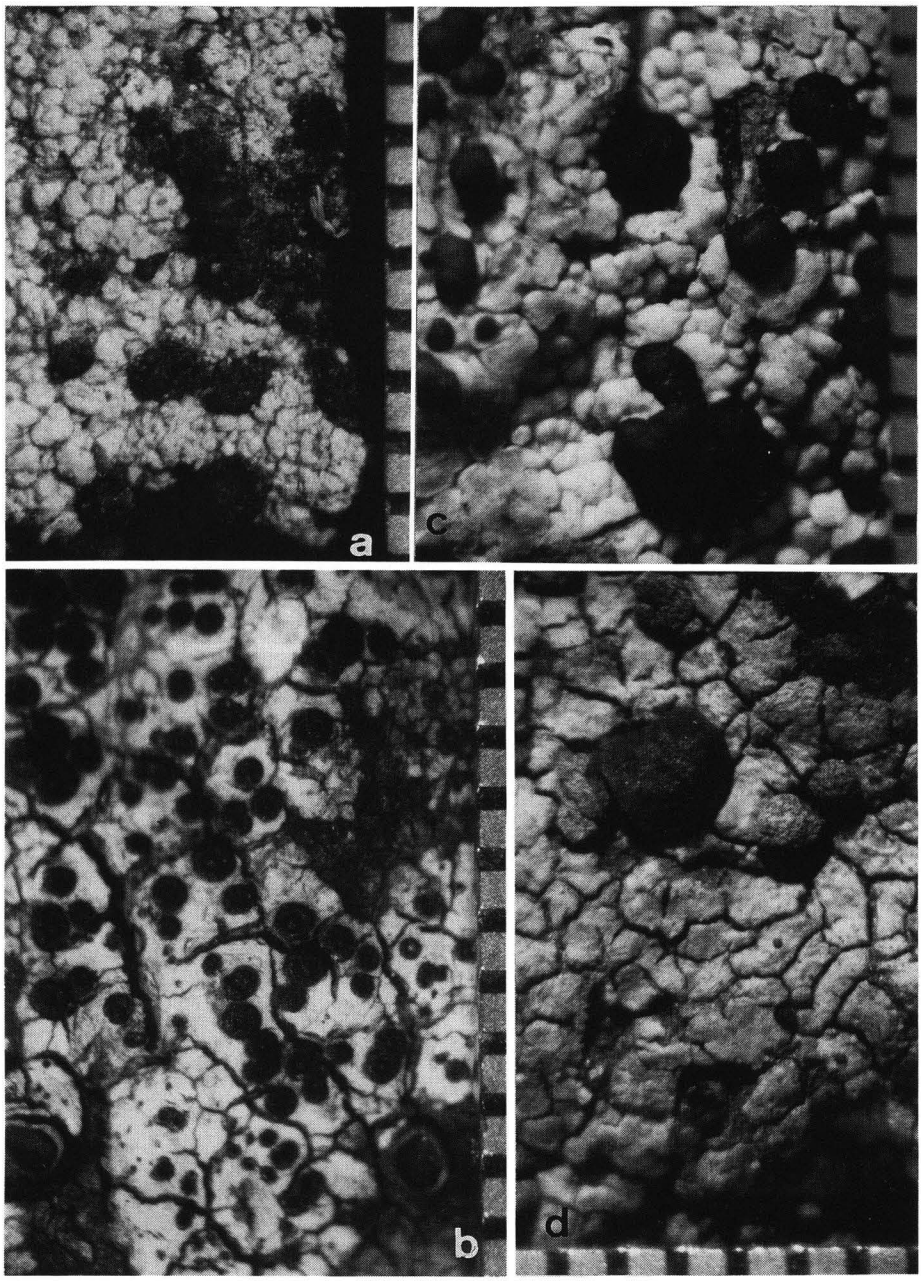

Plate I

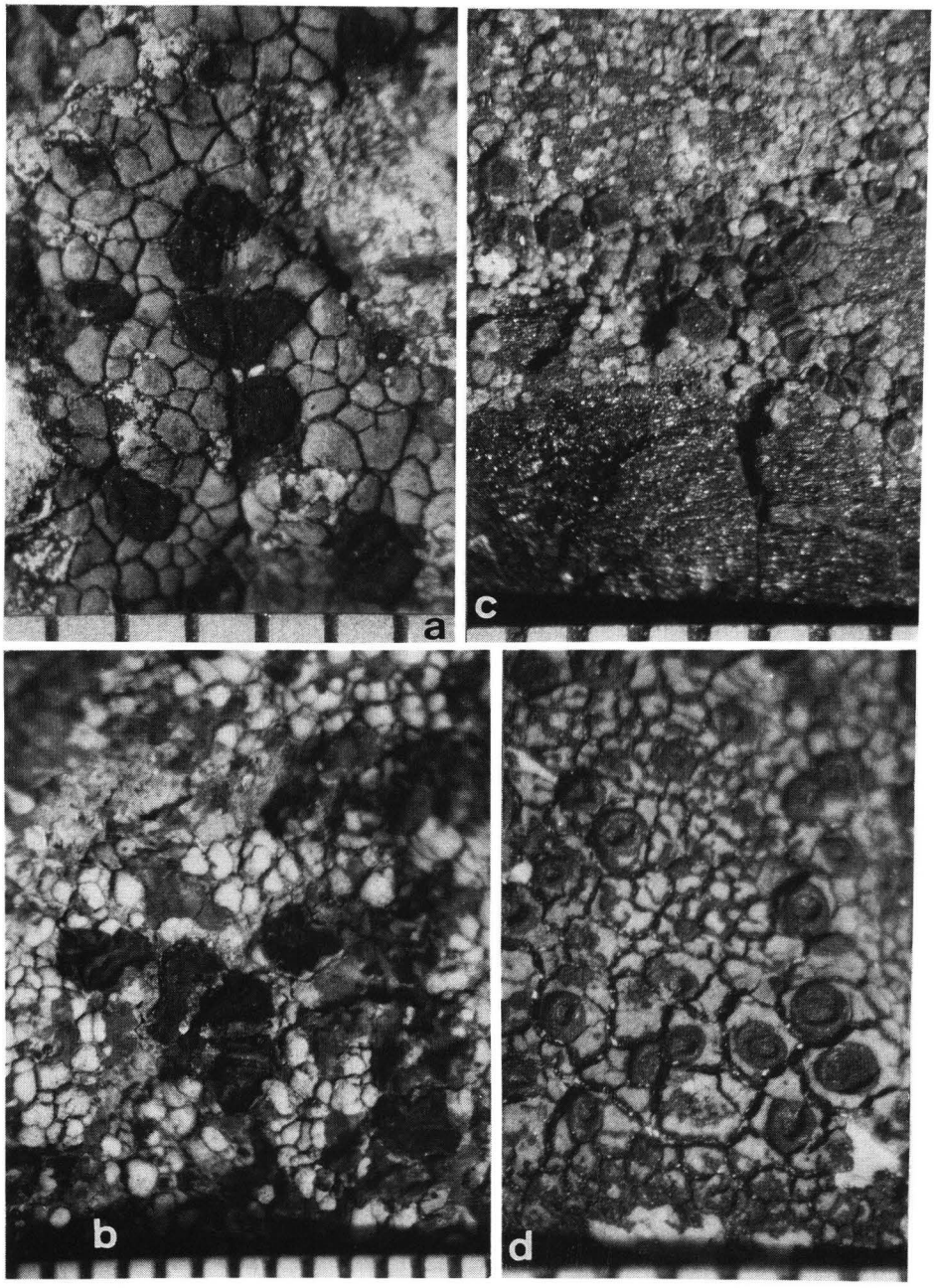

Plate II