

JAPANESE CRUSTOSE LICHEN GENERA FORMERLY REPORTED UNDER *LECIDEA* SENSU LATO

1. *Amygdalaria* NORMAN

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Sato's (1962) checklist of Japanese *Lecidea* (s. lat.—sensu Zahlbruckner 1926) includes 68 species. Taxonomic knowledge of *Lecidea* and allied taxa has been advanced in the subsequent 20 years by Hertel (1967, 1969, 1977), Vězda & V. Wirth (1976), Poelt & Vězda (1977, 1981), Schneider (1979), Hawksworth et al. (1980), and by Swinscow & Krong (1981). By their efforts Zahlbruckner's concept of the genus *Lecidea* has been demonstrated as a heterogenous genus.

In the course of my investigations on Japanese *Lecidea* (s. lat.), I segregated *Fuscidea* V. Wirth et Vězda, *Huilia* Zahlbr., *Lecidea* Ach. (s. str.), and *Lecidella* Körb. and presented some results of studies on those genera (Inoue 1979, 1981, 1982, 1983a-c). In this paper I will present some notes on the Japanese *Amygdalaria* as the first in a series of my revisions of *Lecidea* (s. lat.).

I am particularly indebted to directors and curators of the following herbaria for sending type and authentic specimens on loan: Drs. T. Ahti & O. Vitikainen of Helsingin Yliopiston Kasvitieteen Laitos (Department of Botany, University of Helsinki, H) and Drs. M. Merxmüller & H. Hertel of Botanische Staatssammlung, München (M). My deep appreciation is also expressed to Dr. S. Hattori of the Hattori Botanical Laboratory, Dr. I. Yoshimura of Kochi Gakuen College, Prof. Dr. H. Hertel of Botanische Staatssammlung, München and Prof. Dr. Janice M. Glime of Michigan Technological University who kindly read the manuscript and gave critical suggestions.

Amygdalaria Norman

Nyt magazin Naturw. 7: 230 (1853).

Type species: *Amygdalaria pelobotryon* (Wahlenb. in Ach.) Norman – lectotype, Choisy 1929: 525.

Thallus crustose, irregularly cracked-areolate or bullate-areolate, frequently cephalodiate, consisting of upper cortical layer, ecorticate below; medulla I-. Algae protococcoid. Hypothallus distinct or indistinct, black.

Apothecia immersed; with a ± obliterated margin; disc concave to plane. Excipulum very thin, reddish brown to dark brown, sometimes paler (K + reddish); hyphae obliquely subradiating, glued together. Epithecium brown. Subhymenium colorless, with perpendicular hyphae. Hymenium & subhymenium strongly amyloid. Hypothecium carbonaceous, brown with various tinge, K + reddish; hyphae more or less running perpendicular. Paraphyses coherent, anastomosed, branched, submoniliformed at the apical part, with ± swollen apices. Asci clavate; tholus prominent, I + faintly blue. Spores hyaline, simple, ellipsoidish, usually with a halo.

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The genus *Amygdalaria* was established by Norman (1853) with 2 species; *A. pelobotryon* and *A. verrucosa* (= *Aspicilia verrucosa* = *Pachyospora verrucosa*). Later Choisy (1929) limited the genus to *A. pelobotryon*, and then he (Choisy 1949) removed *A. verrucosa* to *Pachyospora*. However, no further information on the genus appeared until Hertel (1970), Hawksworth et al. (1980) and Hertel in Poelt & Vězda (1981) used the generic name.

The diagnostic characteristics for this genus are: the immersed apothecia with \pm obliterated margins, the rudimentary excipula, and the rather larger spores with a "halo".

Amygdalaria seems to be related to some species of *Huilia* (especially to *H. aeolotera* and *H. elegantior*), because of the presence of cephalodia, higher hymenia (100–170 μm high), strongly amyloid hymenia and subhymenia, paraphyses which are submoniliform at the apices, and thick-walled larger spores (23–35 \times 12–19 μm) each surrounded by a "halo". *Huilia* differs from *Amygdalaria* by the well developed excipula, adnate apothecia, and hypothecia of irregularly arranged hyphae.

Hertel in Poelt & Vězda (1981) proposed *Amygdalaria pelobotryon* and *A. consentiens* (Nyl.) ad int. as members of the genus. But Hawksworth et al. (1980) concluded that "*pelobotryon*" belongs to *Amygdalaria*, whereas "*consentiens*" belongs to *Huilia*. I agree with the uniting of *A. consentiens* and *A. pelobotryon* into one genus, from anatomical and morphological aspects.

KEY TO THE JAPANESE SPECIES OF *AMYGDALARIA*

1. Thallus bullate-areolate 2
1. Thallus irregularly cracked-areolate; surface plane or slightly convex 3
 2. Subhymenium low, 15–30 μm ; thallus C+ Chinese red, K–, gyrophoric acid present *A. pelobotryon*
 2. Subhymenium higher, 30–60 μm ; thallus C–, K+ yellow, stictic acid present *A. subdissentiens*
3. Thallus K+ yellow, stictic acid present *A. consentiens* var. *japonica*
3. Thallus K–, lichen substance absent *A. consentiens* var. *consentiens*

1. *Amygdalaria consentiens* (Nyl.) Hertel, Brodo et M. Inoue, comb. nov.

Basionym: *Lecidea consentiens* Nyl., Flora 49: 371 (1866). Type: England, Scotland, Ben Lawers, leg. Jones (H-Nyl, 15754).—*Huilia consentiens* (Nyl.) Hertel ex Hawksworth, P. James & Coppins, Lichenologist 12: 106 (1980).—*Amygdalaria consentiens* (Nyl.); Hertel in Poelt & Vězda, Bestimmungsschlüssel europäischer Flechten. Ergänzungsheft II: 111 (1981).

1-a. var. *consentiens*

Thallus effuse, moderately thickened, contiguous, irregularly cracked-areolate, with narrow fissures, livid-gray or paler; areolae plane or slightly convex, subtartareous; medulla I–; cephalodia brownish-gray, intermixed with areolae. Hypothallus black, \pm indistinct.

Apothecia 0.6–1.5 mm in diameter, immersed, solitary or congregated; disc naked, concave to plane, with a \pm obliterated margin. Excipulum thin, 20–60 μm thick, reddish-brown to dark brown, sometimes paler, K+ reddish; hyphae obliquely subradiating, glued together, 2–4 μm

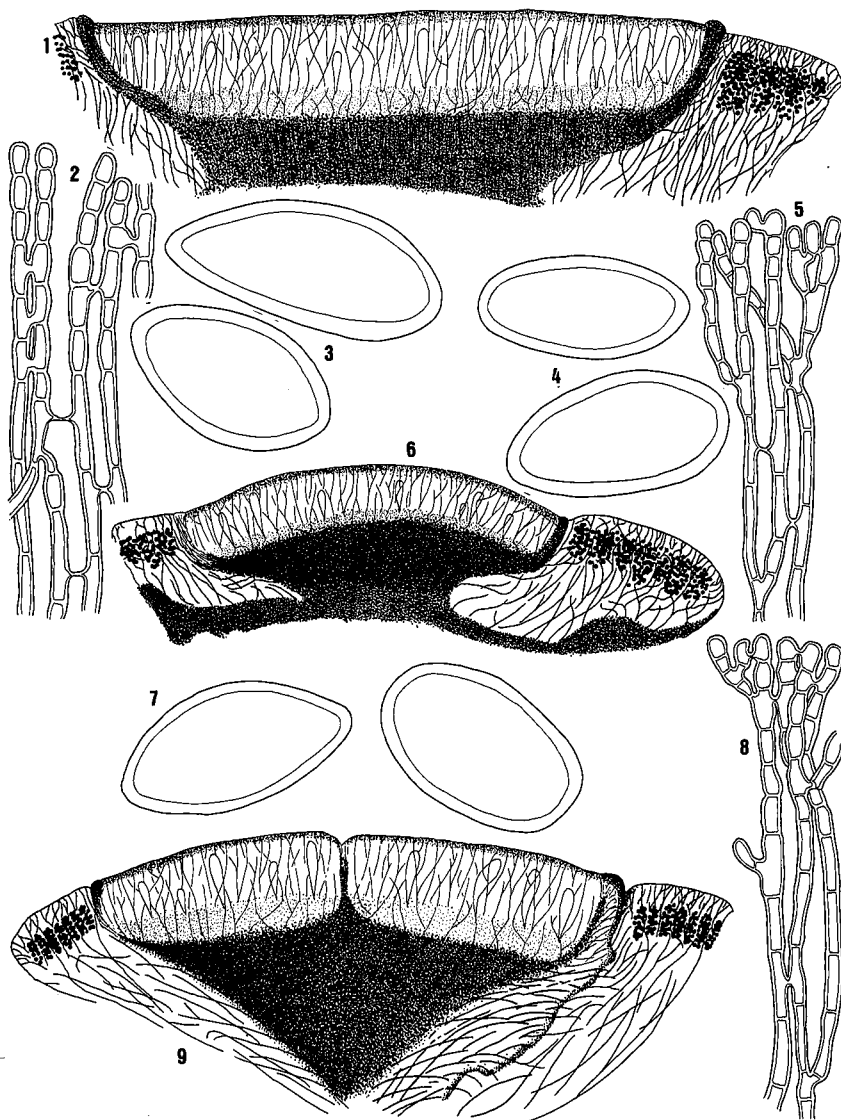


FIG. 1. *Amygdalaria consentiens* (Nyl.) Hertel, Brodo et M. Inoue var. *consentiens* (1-3, drawn from MI 8711); *A. pelobotryon* (Wahlenb.) Norman (4-6, drawn from MI 8521); *A. subdissentiens* (Nyl.) M. Inoue et Brodo (7-9, drawn from MI 11539). 1, 6, 9. Vertical sections of apothecia, $\times 60$. 2, 5, 8. Upper parts of paraphyses, $\times 1000$. 3, 4, 7. Spores, $\times 1000$.

thick, with a thin wall. Epithecium brown or paler. Hymenium $100-160(-180)\mu\text{m}$ high. Subhymenium $20-50\mu\text{m}$ high, colorless, with perpendicular hyphae. Hypothecium dark reddish-brown to dark brown, with various heights, up to $150\mu\text{m}$ high, K+ reddish; hyphae more or less perpendicular. Paraphyses coherent, anastomosed, branched, slender, $1-2\mu\text{m}$ thick,

submoniliformed at the apical part; apices non-thickened. Asci clavate, $80\text{--}150 \times 30\text{--}40 \mu\text{m}$. Spores ellipsoid, $25\text{--}35(-40) \times 12\text{--}18(-20) \mu\text{m}$; walls rather thickish, reaching $2 \mu\text{m}$ thick.

Reaction: thallus & medulla P-, K-, KC-, C-. Chemical substances: no lichen substances demonstrated in TLC.

Habitat: On non-calcareous rocks in alpine regions.

Range: Japan and Europe.

The type of *A. consentiens*, on which the following description was based, is very poor and bears only three apothecia: apothecia 0.7, 0.9, and 1.0 mm in diameter; epithecium brown or brown with green tinge; hymenium $90\text{--}110 \mu\text{m}$; subhymenium $20\text{--}30 \mu\text{m}$; hymenium and subhymenium strongly amyloid; hypothecium dark reddish brown; spores $26\text{--}33 \times 14\text{--}17$ (26×14 , 31×17 , 33×17) μm with a rather thick wall ($1\text{--}1.5 \mu\text{m}$ thick). TLC not treated.

The Japanese specimens agree very well with the type, in which, however, cephalodia are absent. According to Th. Fries (1874) in Scandinavia, to A. L. Smith (1926) in England, and to Hertel in Poelt & Vězda (1981) in Europe, this species only rarely has cephalodia. In the Japanese specimens, however, cephalodia are constantly present.

A. consentiens is distinguished from other species of the same genus by the cracked-areolate thallus whose surface is plane to slightly convex and by the production of no lichen substances.

Nylander (1890) reported this species (as *Lecidea consentiens*) from Japan (Mt. Fuji), but unfortunately I have not had a chance to reexamine the voucher specimen.

Specimens examined²: HOKKAIDO. Prov. Soya: *Rishiritou*, Mt. Rishiri, 1700 m, MI² 8144. Prov. Rumoi: *Kokuryo*, Mt. Syokanbetsu, 1440 m, MI 8262. Prov. Kamikawa: *Asahidake*, Mt. Cyubetsu, Mts. Daisetsu,

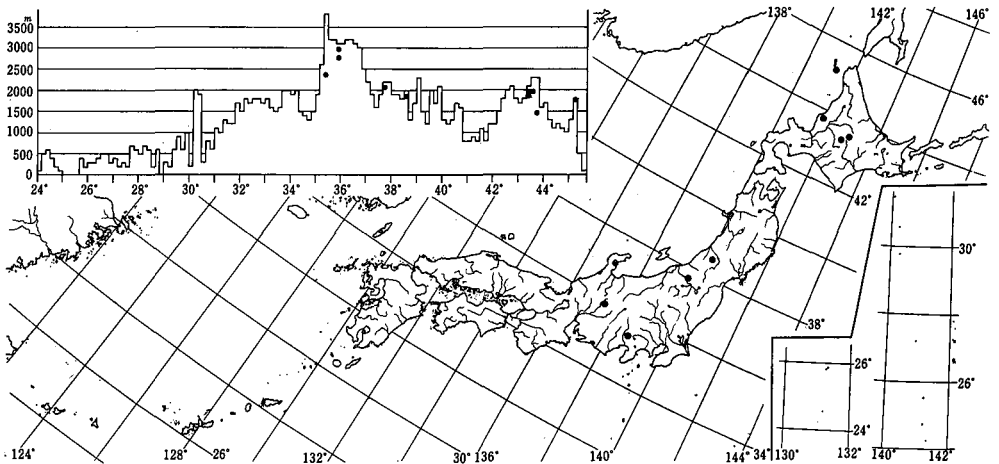


FIG. 2. Distribution of *A. consentiens* var. *consentiens*.

² In the enumeration of localities, names (shown in italics) from the topographic map (1:50,000) are indicated after the name of the prefecture. The collector, M. Inoue, whose name frequently appears, is abbreviated as MI. The specimens listed here are deposited in the herbarium of the Botanical Institute of Hiroshima University (HIRO).

1940 m, MI 8711, *Tokachidake*, Mt. Furano, 1810–1910 m, MI 7975, 7978 & 7986. HONSHU. Pref. Yamagata: *Gassan*, Mt. Gassan, 1850 m, MI 10819. Pref. Niigata: *Dainichidake*, Mt. Dainichi, 2000 m, MI 10672. Pref. Nagano: *Ontakesan*, Mt. Ontake, 2750–2950 m, MI 4632 & 4601. Pref. Yamanashi: *Fujisan*, Mt. Fuji, 2330 m, MI 11412. Additional specimens examined: FRANCE. Mont-Dore, leg. E. Lamy 1180, H-Nyl. 15759. ENGLAND. Scotland: Ben Lawers, leg. Crombie in 1867, H-Nyl. 15758.

1-b. var. *japonica* M. Inoue, var. nov.

Stratura atque morphologia thalli et apothecii ut in var. *consentiens*, sed differt ab ea acidum sticticum continente.

Reaction: thallus & medulla P+ brick red, K+ yellow, KC–, C–. Chemical substances: stictic acid and norstictic acid (\pm extremely trace).

Type: Japan, Honshu, Pref. Nagano, Kiso-gun, Mitake-mura, Mt. Ontake, ca. 2560 m alt., on rock, leg. M. Inoue 11474 – holotype (HIRO).

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

Range: Only known from Japan.

This variety is morphologically identical with var. *consentiens*, but differs in producing stictic acid. Judging from K-negative reactions mentioned in the literature, European *A. consentiens* does not contain stictic acid (Nylander 1866, Leighton 1879, Fries Th. 1874, Lamy 1878, A. L. Smith 1926, Hertel in Poelt & Vězda 1981, and Degelius 1982). Accordingly it is better that *A. consentiens* var. *japonica* is recognized as a distinct taxon. Actually the specimens from France and England which were cited in var. *consentiens* produce no lichen substances when tested by TLC.

The holotype specimen has few cephalodia, and other specimens are mostly without cephalodia. In Japan var. *japonica* has a rather wider distribution range than that of var. *consentiens* (Figs. 2, 4). It may be a southern strain of *H. consentiens*.

Specimens examined: HOKKAIDO. Prov. Soya: *Rishiritou*, Mt. Rishiri, 1350 m, MI 8153. Prov. Kamikawa: *Asahidake*, Mt. Midori, Mts. Daisetsu, 1620 m, MI 8544. HONSHU. Pref. Miyagi: *Kurikomayama*, Mt. Kurikoma, 1390 m, MI 10410. Pref. Yamagata: *Gassan*, Mt. Gassan, 1500–1810 m, MI 10789 & 10805; *Asahidake*, Mt. Asahi, 1780 m, MI 10552. Pref. Niigata: *Dainichidake*, Mt. Dainichi, 2070 m, MI 10666. Pref. Nagano: *Oomachi*, Mt. Kashimayari, 2700 m, MI 5556; *Yarigatake*, Mt. Yari, 2930 m, MI 4873; *Ontakesan*, Mt. Ontake, 2560 m, MI 11474 – holotype; 2950 m, MI 4580; *Akaho*, Mt. Hoken, 2660–2920 m, MI 6755, 6483 & 6481. Pref. Yamanashi: *Oogawara*, Mt. Ainotake, 3040 m, MI 1106. SHIKOKU. Pref. Ehime: *Ishizuchisan*,



FIG. 3. *Amygdalaria consentiens* var. *japonica* M. Inoue (MI 11474 – holotype), $\times 10$.

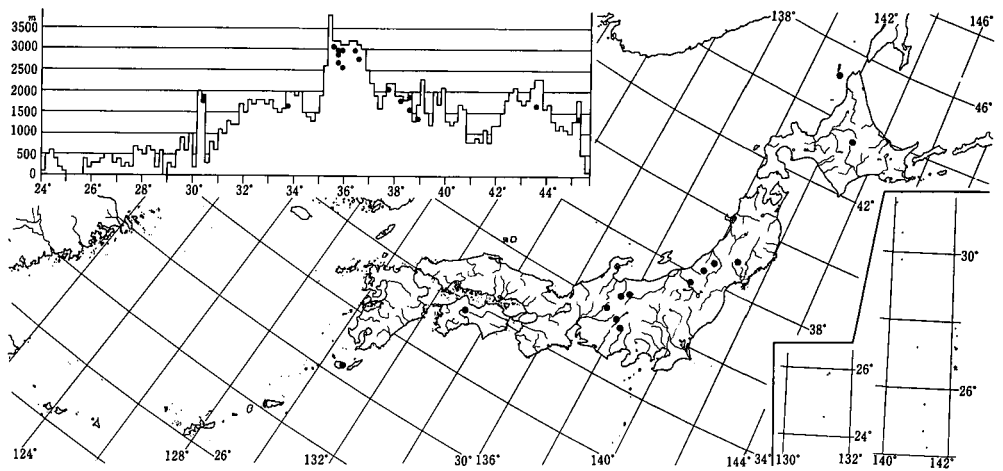


FIG. 4. Distribution of *A. consentiens* var. *japonica*.

Mt. Kamegamori, 1660 m, MI 11064. KYUSHU. Pref. Kagoshima: *Yakushimatohokubu*, Mt. Miyanoura, 1700–1850 m, MI 10023 & 10002.

2. *Amygdalaria pelobotryon* (Wahlenb. in Ach.) Norman

Nyt Mag. Naturvid. 7: 230 (1853). — *Urceolaria pelobotryon* (“*pelobotrion*”) Wahlenb. in Ach., Meth. Lich. Suppl.: 31 (1803). Type: Norway, Finnmark, Rastekaisse, leg. Wahlenberg, – isotype (H-Ach. 969 A). — *Lecidea pelobotryon* (Wahlenb. in Ach.) Leight., Lich. Flora Brit.: 298 (1871). — *Lecanora rhaetica* var. *hyperborea* Nyl., Flora 45: 82 (1862), syn. nov. Type: Greenland, leg. D. J. Vahl, – holotype (H-Nyl. 15751). — *Lecidea rhaetica* var. *hyperborea* (Nyl.) Zahlbr., Cat. Lich. 3: 683 (1925).

Thallus effuse, moderately thickened to thick, contiguous or rarely in part evanescent, irregularly bullato-areolate; areolae rather wide, crowded, or at times subscattered, livid-gray or rarely dull-white; medulla I–; reddish-gray cephalodia intermixed with areolae. Hypothallus blackish, ± indistinct.

Apothecia 0.5–1 mm in diameter, immersed, solitary or congregated, blackish-brown; disc naked, concave to plane, with a thin margin. Excipulum usually very thin, 20–50 μm thick, at times reaching 50–70 μm thick, reddish-brown to dark brown, K+ reddish; hyphae obliquely subradiating, glued together, 2–4 μm thick, with a thin wall. Epithecium brown to greenish brown. Hymenium 100–150(–170) μm high. Subhymenium 15–30 μm high, colorless, with perpendicular hyphae. Hypothecium dark reddish-brown to dark brown, with various heights, reaching 150 μm high, K+ reddish; hyphae more or less perpendicular. Paraphyses coherent, anastomosed, branched, 1–2 μm thick, submoniliform at the apical part; apices not or slightly thickened. Asci clavate, 100–140 \times 25–30 μm . Spores ellipsoid, (21–)23–35(–38) \times (10–)12–19 μm ; walls thick, up to 2 μm thick.

Reaction: thallus P–, K–, KC–, C+ chinese red; medulla P–, K–, KC–, C–. Chemical substances: gyrophoric acid.

Habitat: On non-calcareous rocks in alpine regions.

Range: Japan, China, Europe, Greenland, and North America.

Amygdalaria pelobotryon reminds one of a species of *Aspicilia* (= *Lecanora* s. lat.



FIG. 5. *Amygdalaria pelobotryon* (Wahlenb.) Norman (MI 8521), $\times 10$.

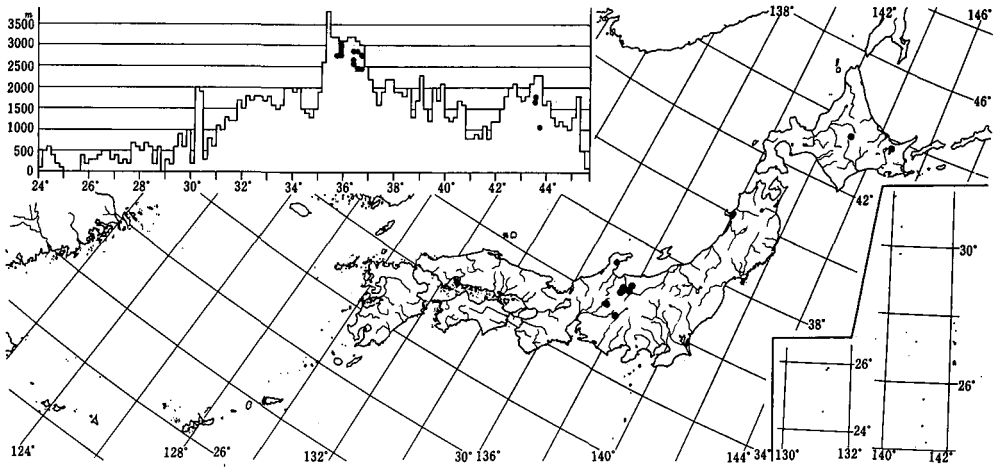


FIG. 6. Distribution of *A. pelobotryon*.

pr. p.) because of having innate apothecia and a poorly developed excipulum. Actually most lichenologists have regarded this species as a member of *Lecanora*. However, the examination of material has revealed that the species should be retransferred to Norman's old genus *Amygdalaria*, which is very closely related to *Huilia*.

As suggested by Vainio (1934) *Lecanora rhaetica* var. *hyperborea* Nyl. reported from Greenland cannot be separated from this species either morphologically or chemically, and should be reduced to a synonym of this species. This species was previously known from China, Europe and North America. However, the range has now extended to Japan and Greenland.

Specimens examined: HOKKAIDO. Prov. Kamikawa: *Asahidake*, Mt. Midori, Mts. Daisetsu, 1650 m, MI 8521, Goshikigahara, Mts. Daisetsu, 1760 m, MI 8669. Prov. Abashiri: *Syaridake*, Mt. Syari, 1090 m, MI 8353. HONSHU. Pref. Nagano: *Shiroumadake*, Mt. Norikura, 2430 m, MI 13009, Mt. Karamatsu, 2770 m, MI 5872,

Oomachi, Mt. Kashimayari, 2480 m, MI 5313; *Yarigatake*, Mt. Mitsudake, 2810 m, MI 5962, Mt. Momisawa, 2690 m, MI 4803, Mt. Mitsumatarenge, 2590 m, MI 4830; *Ontakesan*, Mt. Ontake, 2750–3050 m, MI 4613, 4668, 4750, 4753, 4760 & 11543, *Akaho*, Mt. Hoken, 2730 m, MI 6957. Pref. Toyama: *Tateyama*, Mts. Tateyama, 2820 m, MI 12773. Additional specimens examined: NORWAY. Umbunken, Krabbfeld, leg. H. Magnusson, M, Krypt. exsic. Vind. no. 2960, as *Lecanora pelobotryon*.

3. *Amygdalaria subdissentiens* (Nyl.) M. Inoue et Brodo, comb. nov.

Basionym: *Lecanora subdissentiens* Nyl., *Flora* 67: 212 (1884). Type: U.S.S.R., "Konyambay", leg. E. Almquist – holotype (H-Nyl. 15752). — *Aspicilia subdissentiens* (Nyl.) Hue, *Nouv. Archiv. du Museum*, ser. 5, 2: 117 (1912).

Thallus similar to *A. pelobotryon*, but somewhat thicker and well developed; cephalodia reddish-gray, intermixed with areolae.

Apothecia 0.5–1.4 mm in diameter, immersed, solitary or congregated, blackish-brown; disc naked, concave to plane, with a thin margin. Excipulum thin, 10–40 μm thick, reddish-brown to dark brown, sometimes paler, or rarely colorless, K+ yellow; hyphae obliquely subradiating, glued together, 2–4 μm thick, with a thin wall. Epithecium brown to greenish brown. Hymenium 100–150 μm high. Subhymenium 30–60 μm high, colorless, with perpendicular hyphae. Hypothecium dark reddish-brown to dark brown, with various heights, reaching 200 μm high; hyphae more or less perpendicular. Paraphyses coherent, anastomosed, branched, slender, 1–2 μm thick, submoniliformed at the apical part; apices not thickened, or slightly. Asci clavate, 100–140 \times 20–25 μm . Spores ellipsoid, (23–)25–35 \times 13–19 μm ; walls thickish, reaching 2 μm thick.

Reaction: thallus & medulla P+ brick red, K+ yellow, KC–, C–. Chemical substances: stictic acid, constictic acid, and norstictic acid (\pm extremely trace).

Habitat: On non-calcareous rocks in alpine regions.

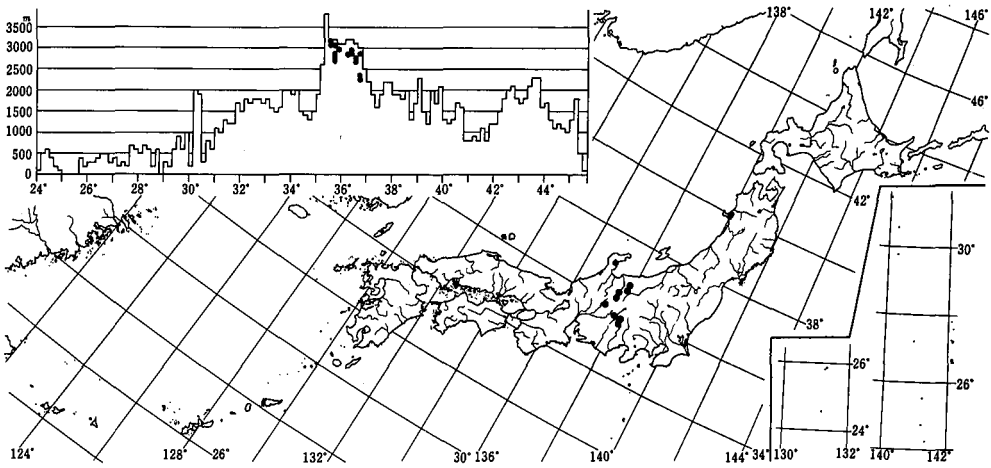
Range: Japan, Siberia and W coast of northern North America (Brodo, unpublished).

Amygdalaria subdissentiens is very closely related to *A. pelobotryon*, but is distinguished by having rather wider apothecia (up to 1 mm wide in *A. pelobotryon*), higher subhymenia (15–30 μm high in *A. pelobotryon*), and a production of stictic acid (gyrophoric acid in *A. pelobotryon*).

This species was previously known only from the type locality. However, the range now extends to Japan and North America.



FIG. 7. *Amygdalaria subdissentiens* (Nyl.) M. Inoue et Brodo (MI 11539), $\times 10$.

FIG. 8. Distribution of *A. subdissentiens*.

Specimens examined: HONSHU. Pref. Nagano: *Shiroumadake*, Tenuhara, Mts. Shirouma, 2200 m, MI 5640, Mt. Norikura, 2370 m, MI 13001, Mt. Tengu, Mts. Shirouma, 2820 m, MI 5769; *Oomachi*, Mt. Goryu, 2640 m, MI 5538 & 5594, Mt. Kashimayari, 2700 m, MI 5416; *Yarigatake*, Mt. Mitsu, 2830 m, MI 12738, Mt. Washiba, 2820 m, MI 5875, Mt. Yari, 2930 m, MI 4922, Kamikochi, Mt. Jonen, 2820–2850 m, MI 14179 & 14189; *Ontakesan*, Mt. Ontake, 2930 m, MI 11539; *Akaho*, Mt. Utsugi, 2660–2840 m, MI 6849, 6873 & 9766. Pref. Yamanashi: *Ichinose*, Mt. Kitadake, 3080 m, MI 12272, *Oogawara*, Mt. Ainotake, 3100–3185 m, MI 1013 & 1102. Pref. Shizuoka: *Oogawara*, Mt. Ainotake, 3030 m, MI 1188, 1189 & 1190.

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