

Lichens of Mt. O-akan and Its Adjacent Areas, Hokkaido, Japan

Yoshihito Ohmura¹ and Hiroyuki Kashiwadani²

¹Department of Biological Sciences, Graduate School of Science,
The University of Tokyo, Hongo 7-3-1, Bunkyo-ku, Tokyo, 113 Japan

²Department of Botany, National Science Museum, 4-1-1 Amakubo,
Tsukuba, Ibaraki, 305 Japan

Abstract In Mt. O-akan and its adjacent areas, 220 taxa of lichens are recognized as the results of taxonomic study of 950 specimens collected there. Most of them are common in other areas of Hokkaido and on various mountains especially of northern Japan. *Japewia subaurifera* and *Ochrolechia androgyna* are newly recorded for Japan and *Anisomeridium nyssaegenum*, *Calicium trabinellum*, *Chaenotheca brunneola*, *Chaenothecopsis pusilla*, *Hypocenomyce friesii*, *Lecanora imshaugii*, *Lecidea brachyspora*, *Ochrolechia akagiensis*, *Pannaria conoplea*, *Parmeliella grisea*, and *Placynthiella uliginosa* are new to Hokkaido. In addition, *Cladonia norikurensis*, *Glossodium japonicum*, *Lethariella togashii*, and *Tuckermannopsis microphyllica* have been known to be rare or endemic to Japan and are also found in the present area.

Key words: lichen, taxonomy, Mt. O-akan, Hokkaido, Japan.

Mt. O-akan (1371 m), a volcanic mountain, is located within the Akan National Park in eastern Hokkaido. Lake Akan, famous for the habitat of *Cladophora aegagropila*, is situated west of it and Mt. Me-akan (1449 m), an active volcano, is located further west of it. The present area includes also Mts. Akan-fuji (1476 m), Fuppushi (1226 m), Furebetsu (1098 m), and Hakuto-san (950 m). The fumaroles or *Bokke* in Japanese are distributed scatteringly in the present area (e.g. Akankohan, Mt. Hakuto-san and Mt. Furebetsu).

According to Igarashi (1986), the vegetation of the present area is composed of upper subalpine forest (*Pinus pumila* forest), upper broad-leaved forest (*Betula ermanii* forest), coniferous forest, mixed forest, and lower broad-leaved forest. The *Pinus pumila* forest is located at 1000 to 1371 m on Mt. O-akan, at 1000 to 1200 m on Mt. Me-akan and at 900 to 1200 m on Mt. Akan-fuji. Although the *Betula ermanii* forest usually exist just below the *Pinus pumila* forest in Hokkaido, it is found neither on Mt. Me-akan nor on Mt. Akan-fuji. Mountainside of Mt. O-akan (800-1000 m) is covered with the *Betula ermanii* forest. The NW base of Mt. Me-akan (710-920 m) and hilly areas around Mt. Akan-fuji and Mt. Fuppushi are covered with the *Picea glehnii* forests. The base of Mt. O-akan (430-

800 m) is covered with mixed forest dominated by *Abies sachalinensis*. Hills around Lake Akan (420–500 m) are covered with broad-leaved forests composed of *Acer mono* var. *glabrum*, *Alnus hirsuta*, *Fraxinus mandshurica* var. *japonica*, *Picea jezoensis* and so on.

Lichens of the present area have been very poorly explored and only a few of them were recorded in scattered papers by Japanese lichenologists such as Nakanishi (1966), Oshio (1968), Kashiwadani (1975), Inoue (1982), etc.

Materials and Methods

In September 1995, the authors carried out a field survey of lichens on Mt. O-akan and its adjacent areas. Collection of lichens was made along mountain trails and road crossing in this area and in forests around Lake Akan. The collection sites of the present study are shown in Fig. 1. Total 950 specimens of lichens were collected through the survey and the results of the taxonomic studies are presented in this paper. All the specimens examined are kept in the herbarium of the National Science Museum, Tokyo (TNS). Most specimens of *Acarospora*, *Arthonia*, *Arthothelium*, *Bacidia*, *Bactrospora*, *Biatora*, *Buellia*, *Caloplaca*, *Catillaria*, *Cliostomum*, *Diploschistes*, *Lepraria*, *Leproloma*, *Leptotrema*, *Micarea*, *Opegrapha*, *Rinodina*, *Schismatomma*, and *Thelotrema*, however, are excluded from the present study as further taxonomic revisions are required for identification of Japanese species of these genera. Chemistry of specimens was studied by means of thin layer chromatography (Culberson & Johnson, 1982) or micro-crystal tests if necessary. Only the solvent B system (Hexan:methyl *tert.*-butyl ether:formic acid=140:72:18) was employed for TLC tests. Sections of apothecia and thalli for anatomical studies were cut by hand-razor and mounted in GAW or lactophenol cotton-blue solution. The ascus structure was examined using by Lugol's iodine solution (Purvis *et al.*, 1992).

Results

Explanation of collection sites

The abbreviations of collection sites are listed below. Numbers in parenthesis after the abbreviations show the numbers in Fig. 1.

Akan-fuji I (1): Prov. Kushiro: 2.8 km SE of Mt. Akan-fuji, Akan-cho, Akan-gun (43°21'N, 144°03'E). *Abies sachalinensis* dominated forest mixed with *Sorbus commixta* and *Alnus hirsuta*. Elevation about 780 m. September 4, 1995.

Akan-fuji II (2): Prov. Kushiro: 2.3 km SE of Mt. Akan-fuji, Akan-cho, Akan-gun (43°21'N, 144°03'E). *Picea glehnii* dominated forest. Elevation about 750 m. September 4, 1995.

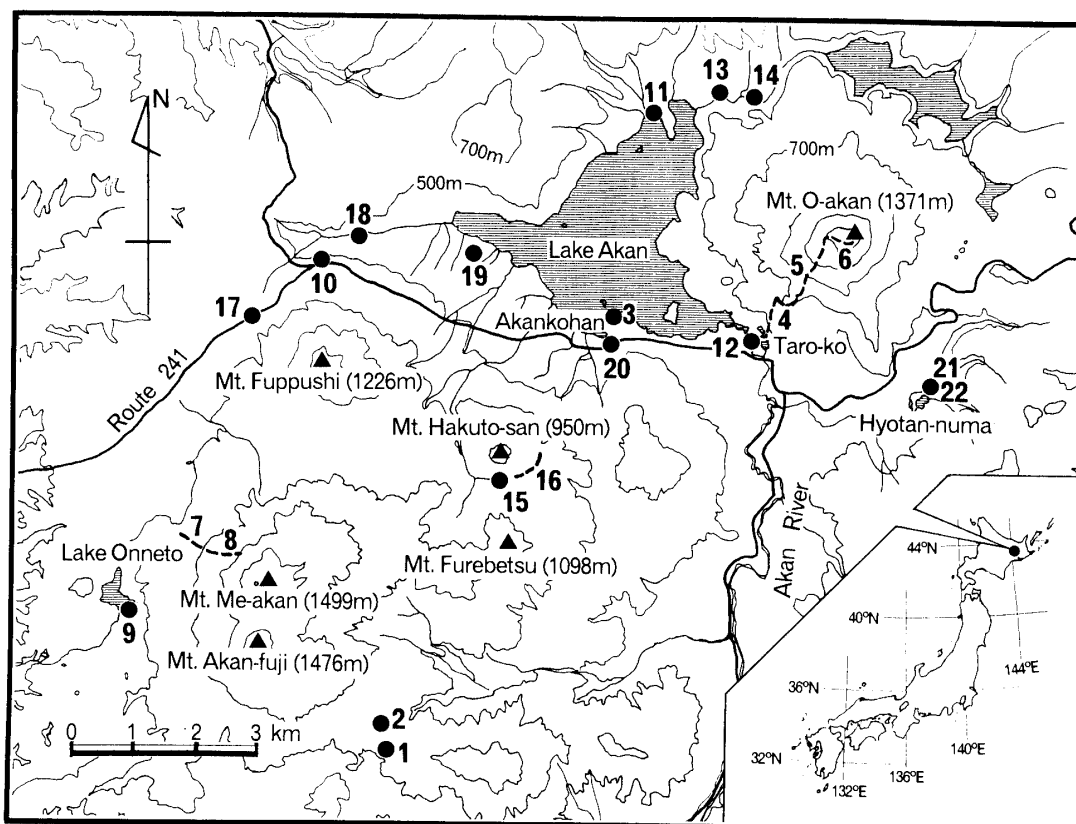


Fig. 1. Mt. O-akan and its adjacent areas showing collection sites (solid circles) and routes of the field survey (thick broken lines). Collection sites are numbered with the bold gothic characters, which are corresponded to the abbreviations of collection sites shown in the results.

- Chuurui (11): Prov. Kushiro: Special reservation area of *Cladophora aegagropila* around outfall of Chuurui river, Lakeside of Lake Akan, Akan-cho, Akan-gun ($43^{\circ}29'N$, $144^{\circ}07'E$). Open grove faced to Lake Akan, mixed with *Abies sachalinensis*, *Acer mono* var. *glabrum*, *Alnus hirsuta*, *Fraxinus mandshurica* var. *japonica*, *Picea jezoensis* and *Salix*. Elevation about 420 m. September 7, 1995.
- Fuppushi (17): Prov. Kushiro: SE slope of Mt. Fuppushi along Route 241, Akan-gun ($43^{\circ}26'N$, $144^{\circ}00'E$). *Abies sachalinensis* dominated forest mixed with *Acer ukurunduense* and *Sorbus commixta*. Elevation about 660 m. September 9, 1995.
- Furebetsu (15): Prov. Kushiro: Furebetsu Bokke, N slope of Mt. Furebetsu, Akan-cho, Akan-gun ($43^{\circ}24'N$, $144^{\circ}05'E$). Inactive fumarole area with *Pinus pumila*, *Picea glehnii*, *Betula ermanii* and *Sorbus commixta*. Elevation about 780 m. September 9, 1995.
- Hakuto (16): Prov. Kushiro: S slope of Mt. Hakuto-san, Akan-cho, Akan-gun

- (43°24'N, 144°05'E). *Picea glehnii* dominated forest mixed with *Abies sachalinensis*, *Acer ukurunduense*, *Betula ermanii* and *Picea jezoensis*; the soil temperature is higher than other area by volcanic activity. Elevation 790–950 m. September 9, 1995.
- Hyotan (22): Prov. Kushiro: Around Hyotan-numa, Akan-cho, Akan-gun (43°25'N, 144°11'E). *Abies sachalinensis* dominated forest at the gentle slope surrounding the pond, mixed with *Acer mono* var. *glabrum*, *Fraxinus mandshurica* var. *japonica*, *Picea glehnii* and *Tilia japonica*. Elevation about 440 m. September 10, 1995.
- Hyotan marsh (21): Prov. Kushiro: Around Hyotan-numa, Akan-cho, Akan-gun (43°25'N, 144°11'E). Forest in marsh dominated with *Betula ermanii*, *Salix* and *Alnus hirsuta*. Elevation about 460 m. September 10, 1995.
- Ishibetsu (14): Prov. Kushiro: Along Ishibetsu River, Akan-cho, Akan-gun (43°29'N, 144°09'E). *Abies sachalinensis*, *Picea glehnii* and *Acer mono* var. *glabrum* mixed forest. Elevation about 420 m. September 8, 1995.
- Ishibetsu marsh (13): Prov. Kushiro: Along Ishibetsu River, Akan-cho, Akan-gun (43°29'N, 144°08'E). *Abies sachalinensis*, *Betula ermanii* and *Picea glehnii* mixed forest in marsh. Elevation about 420 m. September 8, 1995.
- Kohan Bokke (3): Prov. Kushiro: Bokke, ca. 800 m NE of Akankohan, Akan-cho, Akan-gun (43°26'N, 144°06'E). *Abies sachalinensis*, *Acer mono* var. *glabrum*, *Fraxinus mandshurica* var. *japonica*, and *Tilia japonica* mixed grove in which the fumaroles present. Elevation about 430 m. September 4, 1995.
- Me-akan base (7): Prov. Tokachi: Along the trail from Me-akan hot spring to the top of Mt. Me-akan, Ashoro-cho, Ashoro-gun (43°24'N, 143°59'E). *Picea glehnii* dominated forest. Elevation 710–920 m. September 7, 1995.
- Me-akan middle (8): Prov. Tokachi: Along the trail from Me-akan hot spring to the top of Mt. Me-akan, Ashoro-cho, Ashoro-gun (43°23'N, 144°00'E). Rocky place with *Pinus pumila*. Elevation 920–1050 m. September 7, 1995.
- NW Akan-kohan (19): Prov. Kushiro: Lakeside of Lake Akan, ca. 3 km NW of Akan-kohan, Akan-cho, Akan-gun (43°27'N, 144°04'E). *Fraxinus mandshurica* var. *japonica* dominated grove. Elevation about 430 m. September 9, 1995.
- O-akan base (4): Prov. Kushiro: Along the trail from Taro-ko to the top of Mt. O-akan, Akan-cho, Akan-gun (43°26'N, 144°08'E). *Abies sachalinensis* dominated forest with *Acer*, *Alnus hirsuta*, *Betula* and *Picea glehnii*. Elevation 430–700 m. September 5, 1995.
- O-akan middle (5): Prov. Kushiro: Along the trail from Taro-ko to the top of Mt. O-akan, Akan-cho, Akan-gun (43°27'N, 144°09'E). *Abies sachalinensis*, *Picea glehnii*, *Betula ermanii* and *Sorbus commixta* mixed forest. Elevation 700–1180 m. September 6, 1995.
- O-akan top (6): Prov. Kushiro: Along the trail from Taro-ko to the top of

- Mt. O-akan, Akan-cho, Akan-gun (43°27'N, 144°10'E). Alpine meadow with *Pinus pumila* and *Empetrum nigrum* var. *japonicum*. Elevation 1180–1370 m. September 6, 1995.
- R241 (10): Prov. Kushiro: Ca. 6 km W of Akankohan along Route 241, Akan-cho, Akan-gun (43°27'N, 144°01'E). *Abies sachalinensis* dominated forest mixed with *Alnus hirsuta* and *Betula ermanii*. Elevation about 520 m. September 7, 1995.
- Seine (9): Prov. Tokachi: Around camp cite of Seine-no-ie at the lakeside of Lake Onto, Ashoro-cho, Ashoro-gun (43°23'N, 143°59'E). Open grove mixed with *Abies sachalinensis*, *Alnus hirsuta*, *Fraxinus mandshurica* var. *japonica*, *Picea jezoensis* and *Tilia japonica*. Elevation about 650 m. September 7, 1995.
- Shimokomabetsu (18): Prov. Kushiro: Around small bridge across the Shirikomabetsu River, Akan-cho, Akan-gun (43°27'N, 144°02'E). Open forest scattered with *Acer mono* var. *glabrum*, *Fraxinus mandshurica* var. *japonica*, *Phellodendron amurense* and *Populus sieboldii*. Elevation about 450 m. September 9, 1995.
- Shrine (20): Prov. Kushiro: Akandake Shrine, Akankohan, Akan-cho, Akan-gun (43°26'N, 144°06'E). Precinct in small shrine with *Ulmus laciniata*. Elevation about 430 m. September 9, 1995.
- Taro-ko (12): Prov. Kushiro: Lakeside of Lake Akan, other side of Taro-ko, Akan-cho, Akan-gun (43°26'N, 144°08'E). *Abies sachalinensis* dominated forest mixed with *Magnolia obovata*, *Picea* and *Quercus crispula*. Elevation about 420 m. September 8, 1995.

List of lichens of Mt. O-akan and its adjacent areas

Numerals following abbreviations of localities indicate the collection numbers of the authors, unless otherwise indicated.

- 1) *Alectoria lata* (Taylor) Linds.; common on barks of *Abies sachalinensis* and *Picea glehnii*. O-akan base: 1330, 1419; O-akan middle: 1439; Seinen: 1746.
- 2) *Anaptychia hypoleuca* (Ach.) A. Massal.; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Seinen: 1755; Chuurui: 1818, 1823.
- 3) *A. isidiophora* (Nyl.) Vain.; common on barks of deciduous trees. Seinen: 1738; Chuurui: 1831, 1837; Shimokomabetsu: 2027.
- 4) *A. isidiza* (Kurok.) Kurok.; common on barks of deciduous trees. O-akan base: 1335, 1373; Seinen: 1756, 1757; Chuurui: 1811, 1834.
- 5) *A. microphylla* (Kurok.) Kurok.; common on tree barks. Kohan Bokke: 1139; O-akan base: 1326; O-akan middle: 1467; Seinen: 1734, 1765.
- 6) *Anisomeridium nyssaegenum* (Ellis & Everh.) R. C. Harris; occasional on barks of deciduous trees. Kashiwadani & Thor (1995) first reported this species from Japan, based on a single collection in Pref. Okayama. The specimens

from the present area are quite identical in morphological and chemical characters with that from Okayama (G. Thor 12222, TNS). Although they (1995) reported only one fertile specimen from Japan, all specimens from the present area are well fertile. This is the second locality for this species in Japan, and new to Hokkaido. Kohan Bokke: 1140; O-akan base: 1292, 1357.

7) *Anzia colpota* Vain.; rare, only collected at one locality where it grows on bark of *Acer ukurunduense*. O-akan middle: 1518.

8) *A. japonica* (Tuck.) Müll. Arg.; common on bark of *Abies sachalinensis*. O-akan base: 1182, 1307, 1392; Taro-ko: 1858.

9) *A. opuntiella* Müll. Arg.; common on tree barks. O-akan base: 1299, 1393, 1398, 1626; Hyotan: 2056.

10) *Arctoparmelia incurva* (Pers.) Hale; locally abundant where it grows on rocks at the summit area of Mt. O-akan. O-akan top: 1611, 1615, 1617; Hakuto: 1972.

11) *Baeomyces absolutus* Tuck.; rare, collected at only one locality on Mt. Me-akan where it grows on rocks in somewhat shaded condition. Me-akan base: 1682.

12) *B. fungoides* (Sw.) Ach.; common on soil at higher elevations (ca. 1000m) where it grows at open places under more or less humid condition. O-akan top: 1563, 1619; Me-akan middle: 1699.

13) *B. placophyllus* Ach.; occasional on rocks. O-akan base: 1378; Me-akan base: 1662.

14) *B. rufus* (Huds.) Rebert.; common on rocks. O-akan middle: 1442; Hyotan marsh: 2052.

15) *Brigantiaea ferruginea* (Müll. Arg.) Kashiw. & Kurok.; common over mosses on tree barks and rarely on rocks. Kohan Bokke: 1148; O-akan base: 1231, 1232, 1350, 1353, 1354; Seinen: 1736, 1795; Taro-ko: 1900.

16) *Bryoria trichodes* (Michx.) Brodo & D. Hawksw. ssp. *americana* (Motyka) Brodo & D. Hawksw.; common on trunks and branches of *Abies sachalinensis* and *Picea glehnii*. O-akan base: 1259, 1386, 1394; O-akan middle: 1463; Me-akan base: 1656; Seinen: 1739; Hakuto: 1963.

17) *Calicium abietinum* Pers.; occasional on dry and weathered woods of *Abies sachalinensis* and *Picea glehnii*. O-akan base: 1385; O-akan middle: 1435; Me-akan base: 1689.

18) *C. lenticulare* Ach.; common on dry and weathered woods of coniferous trees. This species has been known by Japanese lichenologists as *C. subquercinum* Asahina, which was reduced to a synonym of the present species by Tibell (1987b). O-akan base: 1181, 1253, 1257, 1278, 1281, 1383; O-akan middle: 1513; Me-akan base: 1653, 1665, 1686; Taro-ko: 1856b, 1888; Hyotan: 2065a.

19) *C. trabinellum* (Ach.) Ach.; rare, collected at only one locality where it grows on decayed wood of *Abies sachalinensis* in dry condition at lakeside of

Lake Akan. Although this species has wide distribution in the world, occurring in Europe, Africa, Australia, Tasmania, New Zealand, Sakhalin, Asia and North America (Tibell, 1987a; Asahina, 1939), only one locality (Ô-yama in Pref. Kanagawa) has been known in Japan (Asahina, 1932). This is the second locality for this species in Japan, and new to Hokkaido. Taro-ko: 1889.

20) *Candelaria concolor* (Dicks.) Stein; common on bark of *Ulmus laciniata*. Shimokomabetsu: 2014; Shrine: 2032.

21) *Candelariella vitellina* (Hoffm.) Müll. Arg.; common on barks of deciduous trees. O-akan middle: 1479; Shimokomabetsu: 2008, 2015.

22) *Cetraria laevigata* Rass.; common on soil with humus in alpine meadow, where *Empetrum nigrum* var. *japonicum* is dominated. O-akan top: 1570, 1574.

23) *Cetrelia braunsiana* (Müll. Arg.) W. L. Culb. & C. F. Culb.; common on barks of deciduous trees and occasionally on rocks. Kohan Bokke: 1165; O-akan base: 1284, 1286, 1288; Hyotan marsh: 2049.

24) *C. chicitae* (W. L. Culb.) W. L. Culb. & C. F. Culb.; common on tree barks and occasionally on rocks. O-akan base: 1309, 1371; O-akan middle: 1508, 1519, 1535; Taro-ko: 1867.

25) *C. nuda* (Hue) W. L. Culb. & C. F. Culb.; occasional on bark of *Abies sachalinensis*. O-akan base: 1325, 1399.

26) *Chaenotheca brunneola* (Ach.) Müll. Arg.; common on dry and weathered woods, occasionally growing mixed with *Calicium lenticulare*. Although this species has been known from Honshu (Kashiwadani *et al.*, 1996), it has not been reported from Hokkaido. New to Hokkaido. O-akan middle: 1514, 1516; Hakuto: 1968; Hyotan: 2065b.

27) *C. furfuracea* (L.) Tibell; rare, collected at only one locality where it was found on roots of a fallen but still living wood in marsh along Ishibetsu River. Ishibetsu marsh: 1936.

28) *Chaenothecopsis pusilla* (Ach.) A. F. W. Schmidt; rare, collected at only one locality where it grows on bark of *Picea glehnii* at mountainside of Mt. O-akan. This species has been known by Japanese lichenologists as *Calicium pusillum* Flörke, which was reduced to a synonym of the present parasitic or parasymbiotic species by Tibell (1987a). Although this species is widely distributed in the Northern Hemisphere, occurring in Europe, Asia and North America (Tibell, 1987a), only one locality has been reported at Nikko in Pref. Tochigi in Japan (Asahina, 1932). This is the second locality for this species in Japan, and new to Hokkaido. O-akan middle: 1501.

29) *Cladonia amaurocraea* (Flörke) Schaer.; common on soil in alpine meadow. O-akan top: 1555, 1560, 1565, 1567, 1576.

30) *C. cenotea* (Ach.) Schaer.; common on humus, decayed woods, and trunk base of *Picea glehnii*. Akan-fuji I: 1127; O-akan base: 1187, 1189, 1283.

- 31) *C. chlorophaea* (Flörke) Spreng.; occasional, collected on rocks often with mosses. Taro-ko: 1872, 1881.
- 32) *C. cornuta* (L.) Hoffm.; common on soil, humus, and rocks. Akan-fuji II: 1133b; O-akan middle: 1441, 1527; O-akan top: 1573.
- 33) *C. crispata* (Ach.) Flot.; common on soil. O-akan middle: 1526; Furebetsu: 1948.
- 34) *C. cyanipes* (Somm.) Nyl.; occasional on soil. O-akan middle: 1525.
- 35) *C. digitata* Schaer.; occasional on humus and trunk base of *Abies sachalinensis*. O-akan base: 1200, 1403.
- 36) *C. gracilis* (L.) Willd. ssp. *nigripes* (Nyl.) Ahti; rare, collected at only one locality where it grows on rocks with humus at the summit area of Mt. O-akan. O-akan top: 1566.
- 37) *C. gracilis* (L.) Willd. ssp. *turbinata* (Ach.) Ahti; common on soil, humus and trunk base of *Picea glehnii*. Akan-fuji II: 1130, 1133a; O-akan base: 1334, 1339; O-akan middle: 1528; Hakuto: 1961, 1962a.
- 38) *C. granulans* Vain.; common on rocks and soil. O-akan middle: 1529; O-akan top: 1568, 1586, 1596; Me-akan base: 1659, 1661.
- 39) *C. humilis* (With.) J. R. Laundon; occasional on soil. Kohan Bokke: 1161.
- 40) *C. macilenta* Hoffm.; common on soil and trunk base of *Picea glehnii*. This species has been reported by Japanese lichenologists under the name of *C. bacillaris* Nyl. Stenroos & Ahti (1994) revised Japanese taxa of *Cladonia* section *Cocciferae* and considered so-called *C. bacillaris* in Japan to be identical with *C. macilenta*. Akan-fuji I: 1126; Akan-fuji II: 1128; Kohan Bokke: 1155.
- 41) *C. merochlorophaea* Asahina; common on soil and decayed woods. O-akan middle: 1522; Taro-ko: 1874; Ishibetsu marsh: 1928; Furebetsu: 1946.
- 42) *C. metacorallifera* Asahina; collected on trunk base of *Picea glehnii*. O-akan middle: 1530.
- 43) *C. norikurensis* Asahina; rare, only collected on decayed wood at lakeside of Lake Akan. This species has been known as one of rare species endemic to Japan (Kashiwadani et al., 1996). This is the fourth locality in Japan. Taro-ko: 1855.
- 44) *C. ochrochlora* Flörke; occasional on decayed woods and soil. O-akan base: 1183; Me-akan base: 1660.
- 45) *C. pleurota* (Flörke) Schaer.; occasional on soil. O-akan middle: 1523.
- 46) *C. pleurota* (Flörke) Schaer. var. *dahlia* Asahina; rare, collected at only one locality where it grows on soil at the summit area of Mt. Oakan. O-akan top: 1569.
- 47) *C. ramulosa* (With.) J. R. Laundon; common on soil and rocks often among mosses. O-akan base: 1238a; Taro-ko: 1870, 1878.
- 48) *C. rangiferina* (L.) Weber; locally abundant where it grows on soil in

alpine meadow of Mt. Oakan. O-akan top: 1559, 1571, 1572.

49) *C. rei* Schaer.; occasional on rocks, often mixed with mosses. This species has been known by Japanese lichenologists as *C. nemoxyna* (Ach.) Nyl., which was reduced to a synonym of the present species by Østhaugen (1976). Taro-ko: 1885; Hyotan marsh: 2046.

50) *C. scabriuscula* (Delise) Nyl.; common on soil and rocks, often mixed with mosses. O-akan base: 1238b, 1322, 1380; O-akan middle: 1521; Taro-ko: 1875.

51) *C. squamosa* Hoffm.; common on soil and decayed woods. O-akan top: 1557, 1558; Hakuto: 1962b.

52) *C. squamosa* (Scop.) Hoffm. var. *subsquamosa* (Nyl.) Vain.; rare, collected at only one locality where it grows on soil in alpine meadow of Mt. O-akan. O-akan top: 1562.

53) *C. stellaris* (Opiz) Pouzar & Vězda; locally abundant where it grows on soil in alpine meadow of Mt. O-akan. O-akan top: 1553, 1554, 1561, 1564, 1620.

54) *C. vulcani* Savicz; common on soil, humus and trunk base of *Picea glehnii* in the areas rich in sulfur. This species has been known by Japanese lichenologists as *C. theiophila* Asahina, which was reduced to a synonym of the present species by Ahti (1974). Akan-fuji II: 1132, 1134, 1135; Me-akan base: 1654, 1655, 1658; Furebetsu: 1947.

55) *Coccocarpia palmicola* (Spreng.) Arv. & D. J. Galloway; occasional on barks of *Alnus hirsuta* and *Sorbus*. O-akan base: 1211; O-akan middle: 1480; Taro-ko: 1891.

56) *Collema complanatum* Hue; occasional on barks of *Fraxinus mandshurica* var. *japonica* and *Salix*. Chuurui: 1821c; Hyotan marsh: 2043.

57) *C. japonicum* (Müll. Arg.) Hue; occasional on bark of *Acer mono* var. *glabrum*. Hyotan: 2061.

58) *C. leptaleum* Tuck.; common on barks of *Acer japonicum*, *Fraxinus mandshurica* var. *japonica* and *Salix*. O-akan middle: 1544; Chuurui: 1821b, 1829; Ishibetsu marsh: 1930.

59) *C. leptaleum* Tuck. var. *bilosum* (Mont.) Degel.; rare, collected at only one locality where it grows on bark of *Acer japonicum*. O-akan middle: 1543.

60) *C. pulcellum* Ach. var. *subnigrescens* (Müll. Arg.) Degel.; occasional on bark of *Acer mono* var. *glabrum*. O-akan base: 1366.

61) *C. subflaccidum* Degel.; common on barks of deciduous trees. O-akan base: 1236, 1328; Seinen: 1750, 1752; Chuurui: 1821a; Ishibetsu marsh: 1924; Shimokomabetsu: 2012.

62) *Dimerella lutea* (Dicks.) Trevis.; common on mosses and occasionally on tree barks. O-akan base: 1243, 1342; Taro-ko: 1879.

63) *Evernia mesomorpha* Nyl.; common on barks of *Abies sachalinensis*, *Picea jezoensis* and *Betula*. O-akan base: 1302, 1381; Taro-ko: 1860, 1905.

- 64) *Flavoparmelia caperata* (L.) Hale; occasional on bark of *Abies sachalinensis* and decayed woods. O-akan base: 1376, 1391; Taro-ko: 1887.
- 65) *Fuscidea mollis* (Wahlenb.) V. Wirth & Vězda; occasional on rocks. Hakuto: 1993, 1994.
- 66) *F. submollis* Mas. Inoue; occasional on rocks. Me-akan middle: 1704.
- 67) *F. verruciformis* Mas. Inoue; common on barks of *Acer ukurunduense*, *Pinus pumila* and *Sorbus commixta*. Me-akan middle: 1701; Furebetsu: 1953; Hakuto: 1987, 1988.
- 68) *Glossodium japonicum* Zahlbr.; occasional on decayed stumps of coniferous trees in primeval forests. Akan-fuji II: 1138; O-akan base: 1312, 1360; Me-akan base: 1663; Taro-ko: 1852; Furebetsu: 1944.
- 69) *Graphis proserpens* Vain.; occasional on barks of *Betula*. O-akan middle: 1532
- 70) *G. rikuzensis* (Vain.) M. Nakan.; common on tree barks. Kohan Bokke: 1157; O-akan base: 1177, 1193, 1199, 1240b; Seinen: 1717, 1754; Fuppu-shi: 1995.
- 71) *G. scripta* (L.) Ach.; common on tree barks. O-akan base: 1195, 1196, 1400; O-akan middle: 1455; Me-akan base: 1657; Seinen: 1726, Taro-ko: 1859.
- 72) *G. tenella* Ach.; rare, collected at only one locality where it grows on bark of *Tilia japonica* at lakeside of Lake Onneto. Seinen: 1780.
- 73) *Haematomma lapponicum* Räsänen; common on rocks but seems to be restricted to the summit area of Mt. O-akan. O-akan top: 1598.
- 74) *H. ochrophaeum* (Tuck.) A. Massal.; occasional on barks of *Picea*. O-akan base: 1273, 1348, 1356.
- 75) *Hypocenomyce friesii* (Ach.) P. James & Gotth. Schneid.; occasional on barks of *Picea glehnii*. In Japan, three localities have been known for the present species; Mt. Moriyoshi in Pref. Akita, Nikko and Sannoh Pass in Pref. Tochigi (Inoue, 1988). This is the fourth locality in Japan, and new to Hokkaido. Akan-fuji II: 1137; Me-akan base: 1667.
- 76) *Hypogymnia fragillima* (Hillmann) Rass.; rare, collected at only one locality where it grows on rock at the base of Mt. O-akan. O-akan base: 1282.
- 77) *H. hokkaidensis* Kurok.; rare, collected at only one locality where it grows on bark of *Picea glehnii* at the base of Mt. O-akan. O-akan base: 1251.
- 78) *H. hypotrypella* (Asahina) Rass.; rare, collected at only one locality where it grows on bark of *Abies sachalinensis* at the summit area of Mt. O-akan. O-akan top: 1630.
- 79) *H. mundata* (Nyl.) Rass. f. *sorediosa* (Bitter) Rass.; common on barks of *Abies sachalinensis* and *Picea glehnii*. O-akan base: 1175, 1184, 1247, 1318, 1390, 1409; O-akan middle: 1531; Seinen: 1743.
- 80) *H. physodes* (L.) Nyl.; occasional on barks of *Abies sachalinensis* and *Picea glehnii*. O-akan base: 1320; Seinen: 1744.

81) *H. pseudophysodes* (Asahina) Kurok.; common on twigs of *Pinus pumila* and on barks of *Abies sachalinensis*, *Betula ermanii* and *Sorbus commixta*. O-akan base: 1397; O-akan middle: 1499; O-akan top: 1621, 1623, 1627, 1631; Furebetsu: 1945; Hakuto: 1965.

82) *H. submundata* (Oxner) Rass.; occasional on bark of *Picea glehnii*. O-akan base: 1388.

83) *H. vittata* (Ach.) Parrique; occasional on barks of *Picea*. O-akan base: 1245, 1365.

84) *Icmadophila ericetorum* (L.) Zahlbr.; common on decayed woods and occasionally on moist soil. O-akan base: 1280, 1311, 1314; O-akan top: 1556; Me-akan base: 1664.

85) *Imshaugia aleurites* (Ach.) S. L. F. Mey.; common on barks of *Abies sachalinensis* and *Picea glehnii*. Me-akan base: 1685, 1691, 1669, 1679; Furebetsu: 1960.

86) *Japewia subaurifera* Muhr & Tønsberg (Fig. 2). This species has been reported from north-west Europe and western North America (Tønsberg, 1990). In the present survey, however, it was found on trunks of coniferous trees, such as *Abies sachalinensis*, *Picea glehnii* and *Pinus pumila* at elevations between 700 and 1370 m. Japanese specimens were quite identical with the authentic speci-

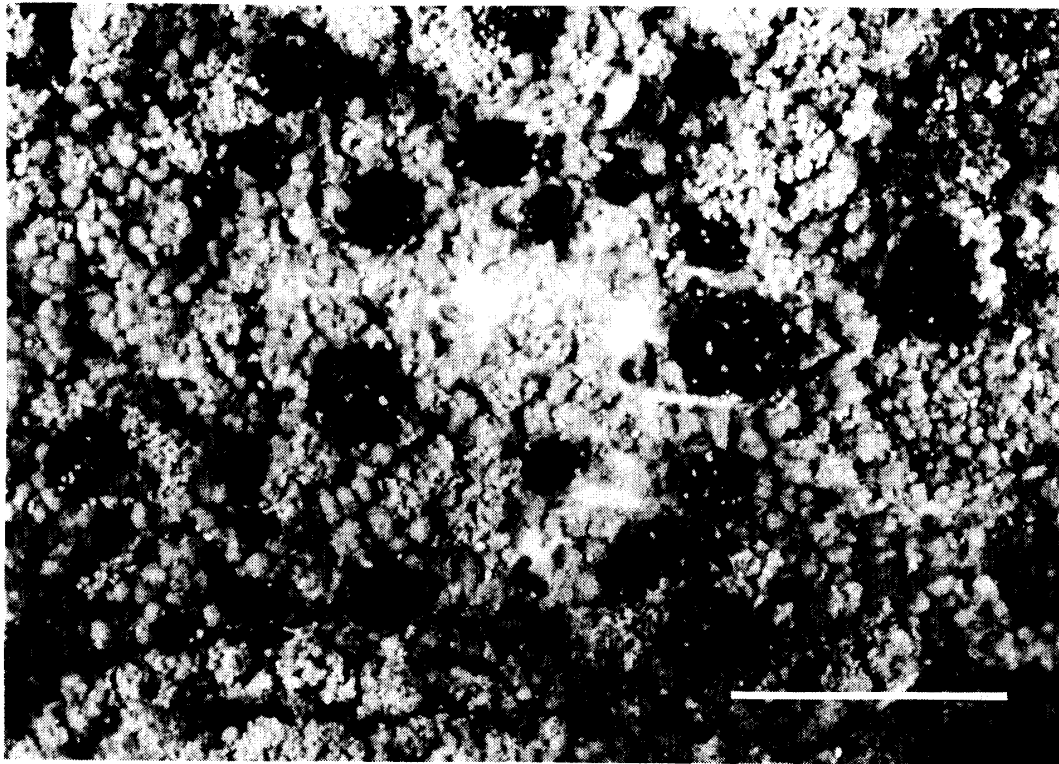


Fig. 2. *Japewia subaurifera* Muhr & Tønsberg, Y. Ohmura 1675, TNS. Scale = 2 mm.

mens collected in Europe (T. Tønsberg 6589a, 6954a, 17228, BG) both in morphological and chemical characters. The description based on Japanese materials is as follow:

Thallus green-brown to brown, more or less rimose with brown-yellow to golden yellow soralia. Apothecia biatorine, chestnut-brown, up to 0.9 mm in diameter; disc convex, flat to uneven when aged. Asci subglobose to broadly ellipsoid, 8-spored. Spores colorless, simple, ellipsoid to globose, $8.0\text{--}14.0 \times 7.5\text{--}9.0 \mu\text{m}$, spore walls thick, ca. $1.0 \mu\text{m}$ thick. Pycnidia not seen. Chemistry: subaurifera unknown 1, 3, 4 (Tønsberg, 1992), and lobaric acid.

Although Tønsberg (1990) was of opinion that lobaric acid was as an accessory substance in the European and North American specimens, it was found in all specimens collected in Japan.

Even though this is rarely fertile (7%) in Europe and North America (Tønsberg, 1990), ten of eighteen specimens from the present area bear apothecia. Akan-fuji II: 1131, 1136; O-akan middle: 1536; O-akan top: 1635; Me-akan base: 1675, 1676, 1678, 1680, 1681, 1684, 1687, 1694, 1695; Me-akan middle: 1709; Furebetsu: 1949, 1954, 1956, 1959.

87) *Lecanora chionocarpa* Hue; common on tree barks. O-akan base: 1422; Seinen: 1774, 1775, 1779; Taro-ko: 1899; Shimokomabetsu: 2022; Shrine: 2037.

88) *L. cinereofusca* H. Magn.; common on tree barks. Two chemical races are known in the present species (Kashiwadani *et al.*, 1996); race 1 with atranorin and pannarin and race 2 with atranorin, pannarin and placodialic acid. In the present area, both races were found, and the race 2 was more common than the race 1. O-akan base: 1180, 1412; O-akan middle: 1473, 1489, 1497, 1547; Seinen: 1782, 1790; Fuppushi: 1996.

89) *L. fuliginosa* Brodo; common on rocks. O-akan base: 1355; O-akan middle: 1507; Taro-ko: 1911.

90) *L. imshaugii* Brodo; rare, collected at only one locality where it grows on bark of *Fraxinus mandshurica* var. *japonica* at lakeside of Lake Akan. This species is widely distributed in Honshu, Shikoku and Kyushu (Miyawaki, 1988 & 1994). New to Hokkaido. Chuurui: 1812.

91) *L. megalocheila* (Hue) H. Miyaw.; occasional on bark of *Sorbus commixta*. Seinen: 1723.

92) *L. pulicaris* (Pers.) Ach.; occasional on twigs of *Pinus pumila*. O-akan top: 1641.

93) *L. yasudae* Zahlbr.; common on tree barks. Kohan Bokke: 1150; O-akan base: 1179, 1421; O-akan middle: 1549; Seinen: 1727, 1771; Chuurui: 1807; Fuppushi: 2002.

94) *Lecidea brachyspora* (Th. Fr.) Nyl.; occasional on rocks. New to Hokkaido. O-akan top: 1605.

95) *L. plana* (J. Lahm) Nyl. Although Inoue (1982) reported this species

from Mt. O-akan (1340 m, mi-8763, herb. Akita Univ.), we could not collect it in the present area.

96) *Leprocaulon arbuscula* (Nyl.) Nyl.; occasional on rocks in shaded condition. O-akan base: 1427.

97) *Leptogium asiaticum* M. Jørg.; common on bark of *Fraxinus mandshurica* var. *japonica*. Chuurui: 1816, 1817, 1819, 1820, 1828; NW Akan-kohan: 2029a.

98) *L. azureum* (Sw.) Mont.; common on barks of deciduous trees and occasionally over mosses on rocks. O-akan base: 1317, 1327; Seinen: 1749.

99) *L. burnetiae* C. W. Dodge; occasional on barks of *Cercidiphyllum japonicum* and *Fraxinus mandshurica* var. *japonica*. O-akan base: 1321; Hyotan: 2053.

100) *L. moluccanum* (Pers.) Vain. var. *myriophyllum* (Müll. Arg.) Asahina; occasional on bark of *Acer japonicum* and on mosses. O-akan base: 1315, 1407.

101) *Lethariella togashii* (Asahina) Krog; rare, only collected on barks of *Abies sachalinensis* and *Picea glehnii* at the base of Mt. O-akan. This species has been known by Japanese lichenologists as *Letharia togashii* Asahina, which was treated under the genus *Letharia* by Krog (1976). This species has been recorded from only four localities in Japan, including Mt. O-akan (Kurokawa, 1969). O-akan base: 1258, 1260, 1262, 1375; Taro-ko: 1854.

102) *Lobaria crassior* Vain.; occasional on tree barks. O-akan base: 1264; Seinen: 1781.

103) *L. discolor* (Bory) Hue; occasional on barks of deciduous trees. O-akan base: 1374, 1389.

104) *L. fuscotomentosa* Yoshim.; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Seinen: 1753, 1769.

105) *L. japonica* (Zahlbr.) Asahina f. *exsecta* (Nyl.) Yoshim.; occasional on bark of *Ulmus davidiana* var. *japonica*. Chuurui: 1810.

106) *L. kurokawae* Yoshim.; occasional on bark of *Quercus crispula*. O-akan middle: 1509.

107) *L. orientalis* (Asahina) Yoshim.; occasional on bark of *Acer mono* var. *glabrum*. O-akan base: 1290; Ishibetsu: 1941.

108) *L. sachalinensis* Asahina; common on barks of *Fraxinus mandshurica* var. *japonica* and *Quercus crispula*. O-akan base: 1279; Seinen: 1764, 1767; Chuurui: 1824; NW Akan-kohan: 2030.

109) *L. spathulata* (Inumaru) Yoshim.; occasional on barks of *Alnus hirsuta* and *Betula ermanii*. O-akan base: 1291, 1368.

110) *L. tuberculata* Yoshim.; occasional on barks of *Salix*. Chuurui: 1808.

111) *Lopadium disciforme* (Flot.) Kullh.; common on tree barks. Kashiwadani & Thor (1995) reported this species from north of middle Honshu.

O-akan base: 1293, 1352, 1423, 1424; O-akan middle: 1478, 1539, 1485, 1487; Me-akan base: 1688; Taro-ko: 1895; Ishibetsu marsh: 1922; Hakuto: 1980; Hyotan: 2066.

112) *Megalospora tuberculosa* (Fée) Sipman; common on tree barks. O-akan base: 1217, 1222, 1226, 1269, 1361, 1414, 1418.

113) *Melanelia huei* (Asahina) Essl. Although Kashiwadani & Inoue (1993) reported this species to be common and locally very abundant on barks of *Alnus* and *Betula* in Kushiro Marsh, ca. 50 km south of the present area, only one specimen from the present area was collected on bark of *Salix*. It should be noted here that all specimens collected on barks of *Alnus* and *Betula* were identified with *M. olivacea* which is distinguished mainly by the absence of lecanoric acid. Seinen: 1770.

114) *M. olivacea* (L.) Essl.; common on tree barks. O-akan middle: 1475, 1510, 1542; O-akan top: 1629, 1638; R241: 1799, 1801; Ishibetsu marsh: 1929; Hakuto: 1967; Hyotan marsh: 2039, 2040, 2042.

115) *M. stygia* (L.) Essl.; common on rocks and locally abundant at the summit area of Mt. O-akan. O-akan top: 1600, 1603, 1604, 1609, 1610, 1616, 1618; Me-akan middle: 1706; Hakuto: 1982, 1985.

116) *Menegazzia terebrata* (Hoffm.) A. Massal.; common on tree barks. O-akan base: 1188, 1329, 1405; O-akan middle: 1459; Seinen: 1724.

117) *Mycoblastus affinis* (Schaer.) T. Schauer; rare, only collected on bark of *Picea glehnii* at Mt. Hakuto. Hakuto: 1977, 1981.

118) *M. sanguinarius* (L.) Norman; common on barks of *Abies sachalinensis*, *Picea jezoensis* and *Pinus pumila*. O-akan middle: 1496; O-akan top: 1646; Hakuto: 1976.

119) *Mycocalicium subtile* (Pers.) Szatala; occasional on decayed woods. O-akan base: 1289; Chuurui: 1803; Hyotan marsh: 2038.

120) *Myelochroa entotheiochroa* (Hue) Elix & Hale; occasional on bark of *Tilia japonica*. Kohan Bokke: 1146, 1167.

121) *M. irrugans* (Nyl.) Elix & Hale; common on barks of deciduous trees and rarely on rocks. Kohan Bokke: 1158; Seinen: 1785; Taro-ko: 1908; Ishibetsu marsh: 1937.

122) *Nephroma bellum* (Spreng.) Tuck.; occasional on barks of *Abies sachalinensis* and *Sorbus commixta*. O-akan middle: 1450, 1462.

123) *N. helveticum* Ach.; occasional on rocks. O-akan base: 1331; Taro-ko: 1876.

124) *N. resupinatum* (L.) Ach.; occasional on bark of *Acer mono* var. *glabrum* and on rocks. O-akan base: 1410; Ishibetsu: 1942; Hyotan: 2062.

125) *Nephromopsis endocrocea* Asahina; common on barks of *Abies sachalinensis* and *Quercus crispula*. O-akan base: 1337, 1395; O-akan middle: 1453.

126) *N. ornata* (Müll. Arg.) Hue; common on barks of *Abies sachalinensis*

and *Sorbus commixta*. O-akan middle: 1464, 1517; Seinen: 1784; Hyotan: 2063.

127) *N. pallescens* (Schaer.) Y. S. Park; occasional on bark of *Abies sachalinensis*. Taro-ko: 1920; Ishibetsu marsh: 1925.

128) *Normandina pulchella* (Borrer) Nyl.; common on tree barks and occasionally on lichen thallus of *Leptogium asiaticum*. NW Akan-kohan: 2029b.

129) *Ochrolechia akagiensis* Yasuda; occasional on barks of *Abies sachalinensis* and *Betula ermanii* with mosses. Although this species is common in Honshu and Shikoku (e.g. Kashiwadani, 1981; Harada & Ando, 1987; Okamoto & Iwatsuki, 1990; Matsumoto & Iwatsuki, 1996), it has not been reported from Hokkaido. New to Hokkaido. O-akan base: 1208, 1340.

130) *O. androgyna* (Hoffm.) Arnold (Fig. 3). Although this species is widely distributed in North America and Europe (Howard, 1970), it has not been reported from Japan. In the present survey, this species was found at Mt. O-akan where it grows on bark of *Abies sachalinensis*. The specimen was quite identical with Lich. Polon. Merid. Exs. 17 (TNS), Plantae Graecenses, Graz (lich.). 322 (TNS), Schade, Stolle & Riehmer: Lich. Sax. Exs. 491 (TNS) and Räsänen: Lichens Fenniae Exsiccati 887 (TNS) both in morphological and chemical characters.

Ochrolechia androgyna is distinguished from other Japanese species of

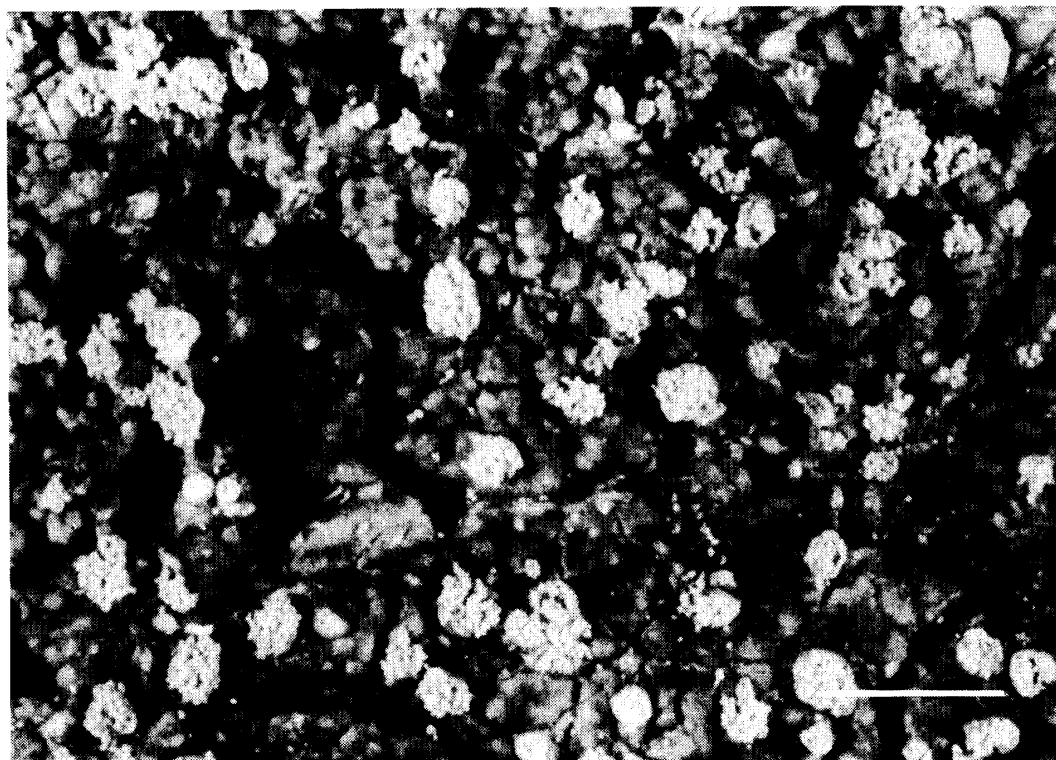


Fig. 3. *Ochrolechia androgyna* (Hoffm.) Arnold, Y. Ohmura 1493, TNS. Scale = 2 mm.

Ochrolechia in having sorediate thalli. This species might be confused with granular sorediate species of *Pertusaria*, from which it can be distinguished by the presence of gyrophoric and lecanoric acids (C+red). O-akan middle: 1493.

131) *O. pallescens* (L.) A. Massal.; common on barks of *Abies sachalinensis* and *Picea glehnii*. O-akan middle: 1436, 1451; Hakuto: 1964, 1973.

132) *O. trochophora* (Vain.) Oshio; common on bark of *Abies sachalinensis*. O-akan base: 1197; O-akan middle: 1457; Seinen: 1747.

133) *Pannaria conoplea* (Ach.) Bory; rare, collected at only one locality where it grows on bark of *Quercus crispula* at lakeside of Lake Akan. The specimen is identical with Follmann: Lich. Exs. Sel. A Mus. Bot. Berol. Ed., 233 (TNS) and Vězda: Lich. Sel. Exs., 1666 (TNS). Although this species is common in Honshu and Shikoku (e.g. Yoshimura & Harada, 1986; Kashiwadani & Sasaki, 1987; Okamoto & Iwatsuki, 1990; Matsumoto & Iwatsuki, 1996), it has not been reported from Hokkaido. New to Hokkaido. Taro-ko: 1918.

134) *Parmelia fertilis* Müll. Arg.; common on tree barks, and occasionally over mosses on rocks. O-akan base: 1210, 1341; O-akan middle: 1461, 1465, 1466; Seinen: 1731; Chuurui: 1839, Taro-ko: 1919; Furebetsu: 1943.

135) *P. laevior* Nyl.; common on tree barks. O-akan base: 1176, 1369, 1396; O-akan middle: 1458, 1468, 1520.

136) *P. omphalodes* (L.) Ach.; common on rocks. O-akan middle: 1443, 1444; O-akan top: 1577, 1613.

137) *P. praesquarrosa* Kurok.; common on barks of *Abies sachalinensis*, *Betula ermanii* and *Sorbus commixta*. O-akan base: 1185; Seinen: 1730; R241: 1802.

138) *P. saxatilis* (L.) Ach.; rare, only collected on bark of *Abies sachalinensis* at the base of Mt. Me-akan. Me-akan base: 1673.

139) *P. shinanoana* Zahlbr.; occasional on rocks, growing with or without mosses. Taro-ko: 1873, 1883.

140) *P. squarrosa* Hale; common on barks of *Abies sachalinensis*, *Acer ukurunduense* and *Betula ermanii*, and over mosses on rocks. O-akan base: 1250, 1404; Me-akan base: 1693; Taro-ko: 1871; Furebetsu: 1958; Hakuto: 1970; Fuppu-shi: 2004.

141) *Parmeliella grisea* (Hue) Kurok.; rare, collected at only one locality where it grows on rocks with mosses at lakeside of Lake Akan. Although this species has been known from Honshu, Shikoku and Kyushu (Kurokawa, 1958), it has not been reported from Hokkaido. New to Hokkaido. Taro-ko: 1866.

142) *P. incisa* Müll. Arg.; common on barks of *Abies sachalinensis* and *Quercus crispula*, and over mosses on rocks. O-akan base: 1296, 1308, 1323.

143) *P. subincisa* Zahlbr.; occasional on decayed woods. O-akan base: 1209.

144) *Parmeliopsis hyperopta* (Ach.) Arnold; common on barks of *Abies*

sachalinensis and *Pinus pumila*, and rarely on rocks. Me-akan base: 1668, 1670; Me-akan middle: 1703, 1711; Furebetsu: 1957.

145) *Parmotrema chinense* (Osbeck) Hale & Ahti; rare, collected at only one locality where it grows on bark of *Salix*. Chuurui: 1806.

146) *Peltigera aphthosa* (L.) Willd.; occasional on humus. O-akan base: 1406.

147) *P. canina* (L.) Willd.; common on trunk base of *Cercidiphyllum japonicum* and on mosses. O-akan base: 1190. 1382.

148) *P. collina* (Ach.) Schrad.; common on trunk base of *Acer mono* var. *glabrum* and decayed woods. O-akan base: 1377; Hyotan: 2058.

149) *P. degenii* Gyeln.; common on humus, decayed woods, rocks, and trunk base of *Prunus ssiori*. O-akan base: 1277; Seinen: 1720; Fuppushi: 1998; Hyotan marsh: 2047.

150) *P. dolichorrhiza* (Nyl.) Nyl.; common on decayed woods, mosses and soil. O-akan base: 1186, 1252, 1285.

151) *P. elisabethae* Gyeln.; occasional on trunk bases of *Betula*. O-akan base: 1430.

152) *P. leucophlebia* (Nyl.) Gyeln.; occasional on soil. O-akan base: 1237.

153) *P. nigripunctata* Bitter; occasional on soil. O-akan base: 1263.

154) *P. polydactyla* (Neck.) Hoffm.; common on humus, soil, and rocks with mosses. O-akan base: 1192, 1287; O-akan middle: 1524.

155) *P. praetextata* (Flörke) Zopf; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Chuurui: 1814.

156) *Pertusaria commutata* Müll. Arg.; common on barks of deciduous trees. O-akan base: 1204a, 1207, 1338; Seinen: 1751.

157) *P. composita* Zahlbr.; common on tree barks. O-akan middle: 1433, 1456, 1471, 1483; Fuppushi: 2001.

158) *P. lactea* (L.) Arnold. Although the present species has been known as saxicolous, this was occasionally found on bark of *Picea glehnii* in the present area. The specimen is identical with Kurokawa, S.: Lich. Rariores et critici exsiccati 377 (TNS). Taro-ko: 1856.

159) *P. mendax* Müll. Arg.; common on tree barks. Kohan Bokke: 1144; O-akan base: 1178, 1212; O-akan middle: 1452b; Chuurui: 1841.

160) *P. multipuncta* (Turner) Nyl.; occasional on bark of *Acer mono* var. *glabrum*. Kohan Bokke: 1164.

161) *P. nakamurae* (Räsänen) Dibben; common on barks of *Abies sachalinensis* and *Betula ermanii*. O-akan base: 1203, 1408; Hakuto: 1991.

162) *P. pertusa* (L.) Tuck.; common on tree barks. O-akan base: 1170, 1191b; O-akan middle: 1452a, 1533; Seinen: 1737, 1745; Taro-ko: 1896.

163) *P. subfallens* Vain.; common on tree barks and on rocks. Although two chemical substances, fumarprotocetraric acid and unknown-Pert-1, were

reported by Oshio (1976), the results of the TLC tests indicate that unknown-Pert-1 is identical with succinprotocetraric acid. O-akan base: 1173, 1174, 1194, 1201, 1204b, 1246, 1256, 1304; O-akan middle: 1481, 1486, 1498, 1515, 1534; Seinen: 1722, 1728; Taro-ko: 1857, 1915.

164) *P. submultipuncta* Nyl.; rare, collected at only one locality where it grows on bark of *Sorbus commixta* at lakeside of Lake Onneto. Seinen: 1732.

165) *P. subobductans* Nyl.; occasional on barks of *Acer japonicum* and *Betula*, and rarely on rocks. O-akan base: 1191a, 1205, 1428; O-akan middle: 1472.

166) *P. velata* (Turn.) Nyl.; occasional on barks of *Abies sachalinensis* and *Tilia japonica*. O-akan base: 1416; Seinen: 1787.

167) *P. violacea* Oshio; common on barks of *Abies sachalinensis* and *Picea glehnii*. O-akan base: 1206, 1301; O-akan middle: 1440; Hakuto: 1974.

168) *Phaeographis asteriformis* (Zahlbr.) M. Nakan.; occasional on bark of *Abies sachalinensis*. O-akan base: 1240a; Taro-ko: 1863.

169) *Phaeophyscia endococcinodes* (Poelt) Essl. Although the present species has been known as saxicolous, this was occasionally found on bark of *Fraxinus mandshurica* var. *japonica* in the present area. Chuurui: 1842.

170) *P. hirtuosa* (Kremp.) Essl.; common on barks of *Fraxinus mandshurica* var. *japonica* and *Ulmus davidiana* var. *japonica*, and on concrete. Seinen: 1778; Chuurui: 1830, 1835, 1840, 1844; Taro-ko: 1897; Ishibetsu marsh: 1938; Shimokomabetsu: 2028.

171) *P. imbricata* (Vain.) Essl.; occasional on bark of *Ulmus laciniata*. Shrine: 2036.

172) *P. limbata* (Poelt) Kashiw.; common on barks of *Fraxinus mandshurica* var. *japonica*, *Tilia japonica* and *Ulmus laciniata*. Kohan Bokke: 1149; Seinen: 1797; Shimokomabetsu: 2024; Shrine: 2035.

173) *P. rubropulchra* (Degel.) Essl.; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Ishibetsu marsh: 1938 (pr.p.).

174) *P. squarrosa* Kashiw.; common on barks of *Fraxinus mandshurica* var. *japonica* and *Ulmus laciniata*. Seinen: 1777; Chuurui: 1845, 1846; Ishibetsu marsh: 1934; Shimokomabetsu: 2023, 2025; NW Akan-kohan: 2031; Shrine: 2033.

175) *Physcia aipolia* (Ehrh.) Hampe; occasional on barks of *Fraxinus mandshurica* var. *japonica* and *Ulmus davidiana* var. *japonica*. Chuurui: 1838, 1843.

176) *P. stellaris* (L.) Nyl.; occasional on barks of *Fraxinus mandshurica* var. *japonica* and *Salix*. Chuurui: 1826, 1849.

177) *Physciella denigrata* (Hue) Essl.; collected on bark of *Acer mono* var. *glabrum*. Chuurui: 1825.

178) *Physconia detersa* (Nyl.) Poelt; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Chuurui: 1847.

- 179) *P. grumosa* Kashiw. & Poelt; common on barks of *Fraxinus mandshurica* var. *japonica* and *Ulmus*. Chuurui: 1833; Shimokomabetsu: 2021; Shrine: 2034; Hyotan: 2055.
- 180) *P. hokkaidensis* Kashiw.; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Seinen: 1773.
- 181) *P. kurokawai* Kashiw.; common on barks of *Fraxinus mandshurica* var. *japonica* and *Ulmus davidiana* var. *japonica*. Chuurui: 1836, 1848; Shimokomabetsu: 2010, 2026.
- 182) *P. lobulifera* Kashiw.; occasional on bark of *Ulmus laciniata*. Seinen: 1796.
- 183) *Pilophorus clavatus* Th. Fr.; common on rocks. O-akan base: 1319; Taro-ko: 1877.
- 184) *Placynthiella uliginosa* (Schrad.) Coppins & P. James; occasional on bare soil in somewhat humid condition. The occurrence of the species in Japan was recently first reported by Kashiwadani *et al.* (1996). New to Hokkaido. Furebetsu: 1950, 1951; Hakuto: 1978.
- 185) *Platismatia interrupta* W. L. Culb. & C. F. Culb.; common on barks of coniferous trees, and rarely over mosses on rocks. O-akan base: 1343, 1362; O-akan middle: 1438, 1454; O-akan top: 1628, 1632, 1634; Seinen: 1740, 1783; Taro-ko: 1869; Hakuto: 1979; Fuppushi: 1997.
- 186) *Porpidia albocaerulescens* (Wulfen) Hertel & Knoph; common on rocks. Taro-ko: 1906, 1914.
- 187) *P. crustulata* (Ach.) Hertel & Knoph; occasional on rocks. Taro-ko: 1910.
- 188) *P. macrocarpa* (DC.) Hertel & A. J. Schwab. The present species has been reported from Hokkaido and central Honshu, including Mt. O-akan (mi-8771, 8798) by Inoue (1983), though we could not collect it in the present area.
- 189) *Pseudopyrenula concatervata* (Nyl.) Vain.; occasional on barks of *Abies sachalinensis* and *Acer japonicum*. O-akan base: 1227, 1351, 1402.
- 190) *Pyrenula japonica* Kurok.; common on bark of *Abies sachalinensis*. O-akan base: 1244, 1248, 1370; Seinen: 1741; Taro-ko: 1861.
- 191) *P. shirabeicola* Kurok. & Nakan.; occasional on bark of *Abies sachalinensis*. O-akan base: 1223, 1242, 1417.
- 192) *Pyxine soreliata* (Ach.) Mont.; common on barks of deciduous trees. Kohan Bokke: 1145; O-akan base: 1372; Taro-ko: 1893.
- 193) *Ramalina conduplicans* Vain.; common on tree barks and twigs. Although three chemical races were reported by Kashiwadani (1986), two chemical races were found in the present survey; the homosekikaic acid race (=Race 1; Kashiwadani, 1986) and the stenosporic acid with divaricatic acid (\pm) race, whereas a race which has not been known before. The former race has wider branches (1.5–3.0 mm wide) and is very common throughout the present

area, the latter race has narrow and attenuate branches. It resembles *R. hokkaidensis* Kashiw., but can be distinguished by the absence of perlatolic acid, a constant component in *R. hokkaidensis*. O-akan base: 1306, 1333; Seinen: 1725, 1766; Chuurui: 1804, 1813, 1822; Taro-ko: 1864; Ishibetsu marsh: 1923, 1926.

194) *R. dilacerata* (Hoffm.) Hoffm.; common on barks of *Alnus hirsuta* and *Acer mono* var. *glabrum*. Two chemical races are known in this species (Kashiwadani & Inoue, 1986); the sekikaic acid race and the divaricatic acid race. The latter race is more common than the former in the present area. In addition, salazinic acid was detected along with divaricatic acid in one specimen. Kohan Bokke: 1141, 1154; Seinen: 1716, 1718; R241: 1800.

195) *R. roesleri* (Hochst.) Nyl.; common on tree barks and occasionally among mosses on rocks. Although two chemical races were reported by Kashiwadani (1986), only the sekikaic acid containing race was found in the present area. O-akan base: 1254, 1363; Seinen: 1715, 1721, 1762; Taro-ko: 1868; Ishibetsu marsh: 1927.

196) *R. sinensis* Jatta; occasional on bark of *Fraxinus mandshurica* var. *japonica*. Seinen: 1768.

197) *R. yasudae* Räsänen; locally abundant where it grows on rocks at lakeside of Lake Akan. O-akan base: 1324, 1379.

198) *Rhizocarpon eupetraeoides* (Nyl.) Blomb. & Forssell; locally abundant where it grows on rocks at the summit area of Mt. O-akan. O-akan top: 1594; Hakuto: 1966.

199) *Sphaerophorus fragilis* (L.) Pers.; common on rocks but restricted to the summit area of Mt. O-akan. O-akan top: 1602, 1614.

200) *Stereocaulon exutum* Nyl.; common on rocks. O-akan base: 1303; O-akan middle: 1445, 1446, 1447, 1448; O-akan top: 1588; Taro-ko: 1880; Hyotan marsh: 2041.

201) *S. octomerellum* Müll. Arg.; common on rocks. O-akan top: 1581, 1583, 1585, 1587, 1591, 1593; Hyotan marsh: 2051.

202) *S. pileatum* Ach.; occasional on rocks. Hakuto: 1984; Hyotan marsh: 2050.

203) *S. sasakii* Zahlbr.; occasional on rocks. O-akan base: 1305; O-akan top: 1595.

204) *S. tomentosum* Fr.; occasional on rocks. Hyotan marsh: 2044.

205) *S. vesuvianum* Pers.; common on rocks. O-akan top: 1606; Hyotan marsh: 2045, 2048.

206) *Sticta nylanderiana* Zahlbr.; common on barks of *Abies sachalinensis*, *Acer mono* var. *glabrum* and *Quercus crispula*. O-akan base: 1316; Seinen: 1742; Ishibetsu: 1940.

207) *Tephromela atra* (Huds.) Hafellner; occasional on barks of deciduous trees. Kohan Bokke: 1142; O-akan base: 1432; Seinen: 1792; Taro-ko: 1892.

- 208) *Trapelia coarctata* (Sm.) M. Choisy; occasional on rocks. Taro-ko: 1909.
- 209) *Tuckermannopsis gilva* (Asahina) M. J. Lai; common on bark of *Abies sachalinensis* and twigs of *Pinus pumila*. Kashiwadani *et al.* (1996) reported the presence of microphyllinic acid and alectoronic acid in this species. Although microphyllinic acid was detected in all specimens examined, alectoronic acid was not found in them. O-akan middle: 1494, 1495, 1512; O-akan top: 1652.
- 210) *T. microphyllica* (W. L. Culb. & C. F. Culb.) M. J. Lai; common on bark of *Abies sachalinensis*, and twigs of *Pinus pumila*. Only three localities are known; Mt. Ashibetsu, Mt. Daisetsu (Culberson & Culberson, 1967) and Mt. Petegari (Kurokawa & Nakanishi, 1971). All of localities are restricted to Hokkaido. This is the fourth locality for the species. O-akan top: 1649, 1650, 1651.
- 211) *Umbilicaria caroliniana* Tuck.; locally abundant where it grows on rocks at the summit area of Mt. O-akan. O-akan top: 1584, 1590, 1597.
- 212) *U. exasperata* Hoffm.; locally abundant where it grows on rocks at the summit area of Mt. O-akan. This species has been known by Japanese lichenologists as *U. hyperborea* (Ach.) Hoffm., which was reduced to a synonym of the present species by Wei & Jiang (1993). O-akan top: 1575, 1589, 1592.
- 213) *Usnea diffracta* Vain.; common on trunks of *Abies sachalinensis* and *Prunus ssiori*. O-akan base: 1387; Hyotan: 2064.
- 214) *U. longissima* Ach.; collected on barks of *Abies sachalinensis*, *Fraxinus mandshurica* var. *japonica* and *Prunus ssiori*. O-akan base: 1297; Seinen: 1790; Chuurui: 1805; Hyotan: 2060.
- 215) *U. longissima* Ach. ssp. *jezoensis* Asahina; collected on bark of *Acer mono* var. *glabrum*. Hyotan: 2059.
- 216) *U. longissima* Ach. ssp. *sensibilis* Asahina; collected on twigs of *Abies sachalinensis*. Taro-ko: 1853.
- 217) *Vulpicida juniperinus* (L.) Mattson & M. J. Lai; common on twigs and bark of *Pinus pumila*. O-akan top: 1624, 1633; Me-akan base: 1666.
- 218) *V. pinastri* (Scop.) Matsson & Lai; common on twigs and bark of *Pinus pumila*. O-akan middle: 1511, 1625.
- 219) *Xanthoparmelia hirosakiensis* (Gyeln.) Kurok.; locally abundant where it grows on rocks close to the fumaroles at lakeside of Lake Akan. Kohan Bokke: 1169.
- 220) *X. tuberculiformis* Kurok.; locally abundant where it grows on rocks, growing mixed with *X. hirosakiensis* close to the fumaroles at lakeside of Lake Akan. Kohan Bokke: 1168.

Discussion

In Japan, lichens of definite small areas have been studied in recent years: e.g., 169 lichens from Hidaka Mts. (Kurokawa & Nakanishi, 1971), 205 from Mt. Fuji (Kashiwadani, 1981), 176 from Mt. Hakkoda (Kashiwadani & Sasaki, 1987), 131 from Kushiro Marsh (Kashiwadani & Inoue, 1993), 212 from Mt. Nishi-Azuma (Kashiwadani *et al.*, 1996). In the present paper, 220 taxa of lichens, largest in number of taxa in restricted areas, are reported from Mt. O-akan and its adjacent areas. Some of the following reasons may be justifiable for the finding of such large number of lichens in the present area. At first, the nature in the present area has been well preserved and/or protected from the environmental disruption. Consequently, lichens of this area have well preserved and/or protected. The topographies of the present area are variable and complicated, for example, we could investigate lichens in some primary forests, alpine zone, lakeside, active volcanic mountains, fumarole areas, marsh, shrine, and so on, which give different environmental habitats to lichens. In addition, many monographs of lichen genera and regional studies on lichens have been published in the last decades. A number of sorediate or isidiate lichens in sterile condition, in addition, can also be identified following studies by Tønsberg (1992) at present.

Most species reported in this paper are commonly found in other areas of Hokkaido and on mountains especially of northern Japan. It is noteworthy that two species are new to Japan, eleven species are new to Hokkaido, and four rare species are found in the present area. *Japewia subaurifera*, a species new to Japan, is commonly found on barks of *Abies sachalinensis*, *Picea glehnii* and *Pinus pumila* in the present area. It is assumed that this species is widely distributed in Hokkaido and on mountains of northern Japan. *Ochrolechia androgyna*, another species new to Japan, resembles sorediate species of *Pertusaria*, but is easily distinguished by the production of gyrophoric acid. Although *Anisomeridium nyssaegunum*, *Calicium trabinellum*, *Chaenotheca brunneola*, *Chaenothecopsis pusilla*, *Hypocenomyce friesii*, *Lecidea brachyspora* and *Placynthiella uliginosa* were newly found in Hokkaido. They may have been overlooked by Japanese lichenologists since they are small and inconspicuous. *Lecanora imshaugi*, *Ochrolechia akagiensis*, *Pannaria conoplea* and *Parmeliella grisea* are found in Hokkaido, and their ranges have been extended to northward to Hokkaido. *Cladonia norikurensis*, *Glossodium japonicum*, *Lethariella togashii* and *Tuckermannopsis microphyllica* have been known as rare and endemic to Japan but they are rather common in Hokkaido.

Acknowledgements

The authors wish to express their grateful thanks to Dr. S. Kurokawa of Botanic Gardens of Toyama, Toyama, Dr. G. Thor of Swedish University of Agricultural Sciences, Uppsala, and Dr. M. Inoue of Akita University, Akita, for their valuable advices during the study and to Dr. M. Nakanishi of Hiroshima University, Higashihiroshima, and Mr. H. Shibuichi of Kumagaya Girls' High School, Kumagaya, for identifying *Graphis* and *Pertusaria* respectively. Dr. J. A. Elix of Australian National University, Canberra, kindly identified chemical substances of *Pertusaria*. Dr. T. Tønberg of University of Bergen, Bergen, is acknowledged for the loan of authentic specimens of *Japewia subaurifera*. Thanks are extended to Ms. Y. Takashima, Mr. K. Onimaru, Ms. K. Sugai, Ms. S. Yamamoto and Dr. K. Takita for thier kind help during the field study. The present study was partly supported by a Grant-in-Aid for Scientific Research from the Ministry of Education, Science, Sports and Culture (no. 07640945) for H. Kashiwadani. Y. Ohmura also received financial support from the Maeda Ippoen Foundation and the Charitable Takara Harmonist Fund.

References

- Ahti, T., 1974. The identity of *Cladonia theiophila* and *C. vulcani*. *Ann. Bot. Fennici*, **11**: 223–224.
- Asahina, Y., 1932. Notes on Japanese lichens. I. *J. Jpn. Bot.*, **8**: 1–5.
- Asahina, Y. (ed.), 1939. *Nippon inkashokubutsu zukan*. pp. 607–782. Sansendo, Tokyo.
- Culberson, W. L. and C. F. Culberson, 1967. A new taxonomy for the *Cetraria ciliaris* group. *Bryologist*, **70**: 158–166.
- Culberson, C. F. and A. Johnson, 1982. Substitution of methl *tert.*-butyl ether for diethyl ether in the standardized thin-layer chromatographic method for lichen products. *J. Chromat.*, **238**: 483–487.
- Harada, H. & H. Ando, 1987. Lichens of Mt. Kanmuri, westernmost Honshu, Japan. *Hikobia*, **10**: 83–93.
- Howard, G. E., 1970. The lichen genus *Ochrolechia* in North America north of Mexico. *Bryologist*, **73**: 93–130.
- Igarashi, T., 1986. Forest vegetation of the Akan National Park, Hokkaido, Japan. *Res. Bull. Exp. For. Hokkaido Univ.*, **43**(2): 335–494.
- Inoue, M., 1982. The genera *Lecide*, *Lecidella* and *Huilia* (Lichens) in Japan I. *Lecidea*. *J. Sci. Hiroshima Univ.*, Ser. B, Div. 2, **18**: 1–55.
- Inoue, M., 1983. Japanese species of *Huilia* (Lichens) (3). *J. Jpn. Bot.*, **58**: 225–236.
- Inoue, M., 1988. Notes on eleven lecideoid lichens new to Japan. *Hikobia*, **10**: 171–187.
- Kashiwadani, H., 1975. The genera *Physcia*, *Physconia* and *Dirinaria* (Lichens) of Japan. *Ginkgoana*, **3**: 1–77.
- Kashiwadani, H., 1981. Lichens of Mt. Fuji. *Mem. Natn. Sci. Mus., Tokyo*, (14): 45–59.
- Kashiwadani, H., 1986. Genus *Ramalina* (Lichens) in Japan (1). On *Ramalina calicaris* (L.) Fr. In Japan. *Bull. Natn. Sci. Mus., Tokyo*, Ser. B, **12**(3): 89–98.
- Kashiwadani, H. & K. Sasaki, 1987. Lichens of Mt. Hakkoda, northern Japan. *Mem. Natn. Sci. Mus., Tokyo*, (20): 67–81.

- Kashiwadani, H. and M. Inoue, 1993. The lichens of Kushiro marsh, Hokkaido, Japan. *Mem. Natn. Sci. Mus., Tokyo*, (26): 53–66.
- Kashiwadani, H. and G. Thor, 1995. Northern circumpolar crustose lichens new to Japan. *J. Jpn. Bot.*, **70**: 303–321.
- Kashiwadani, H., Kwang Hee Moon and M. Inoue, 1996. Lichens of Mt. Nishi-Azuma, Tohoku, Japan. *Mem. Natn. Sci. Mus., Tokyo*, (29): 71–92.
- Krog, H., 1976. *Lethariella* and *Protousnea*, two new lichen genera in *Parmeliaceae*. *Norw. J. Bot.*, **23**: 83–106.
- Kurokawa, S., 1958. Notulae miscellaneae lichenum japonicorum (4). *J. Jpn. Bot.*, **33**(4): 116–119.
- Kurokawa, S., 1969. A note on some rare lichens of Japan. *J. Jpn. Bot.*, **44**(8): 225–229, pl. 18.
- Kurokawa, S. and S. Nakanishi, 1971. Lichens of the Hidaka mountains, Hokkaido. *Mem. Natn. Sci. Mus., Tokyo*, **4**: 59–70, pl. 1.
- Matsumoto, T. and Z. Iwatsuki, 1996. Lichen flora of the Mt. Ishizuchi area, Shikoku, Japan. *Hikobia*, **12**: 69–84.
- Miyawaki, H., 1988. Studies on the *Lecanora subfusca* group in Japan. *J. Hattori Bot. Lab.*, **64**: 271–326.
- Miyawaki, H., 1994. *Lecanora imshaugii*, a lichen of eastern North America and eastern Asia. *Bryologist*, **97**(4): 409–411.
- Nakanishi, M., 1966. Taxonomical studies on the family *Graphidaceae* of Japan. *J. Sci. Hiroshima Univ.*, Ser. B, Div. 2, **11**: 51–126.
- Okamoto, T. & Z. Iwatsuki, 1990. Lichens of the Sandan-kyo area, western Honshu, Japan. *Hikobia*, **10**: 383–392.
- Oshio, M., 1968. Taxonomical studies on the family *Pertusariaceae* of Japan. *J. Sci. Hiroshima Univ.*, Ser. B, Div. 2, **12**: 81–163.
- Oshio, M., 1976. *Pertusaria variolosa* (Kremp.) Vain. and the allied species. *Misc. Bryol. Lichen.*, **7**: 114–116.
- Østhaugen, H., 1976. Nomenclatural note on *Cladonia nemoxyna*. *Bryologist*, **79**: 242–246.
- Purvis, O. W., B. J. Coppins, D. L. Hawksworth, P. W. James and D. M. Moore (ed.), 1992. The lichen flora of Great Britain and Ireland. pp. 710. The British Lichen Society, London.
- Stenroos, S. and T. Ahti, 1994. A synopsis of the Japanese taxa of *Cladonia* section *Cocciferae*. *J. Hattori Bot. Lab.*, **75**: 305–318.
- Tibell, L., 1987a. Australasian *Caliciales*. *Symb. Bot. Ups.*, **27**(1): 1–279.
- Tibell, L., 1987b. Typification of names of infrageneric taxa described by Acharius and placed by him in *Caliciales*. *Ann. Bot. Fennici*, **24**: 257–280.
- Tønnsberg, T., 1990. *Japewia subaurifera*, a new lichen genus and species from north-west Europe and western north America. *Lichenologist*, **22**(3): 205–212.
- Tønnsberg, T., 1992. The sorediate and isidiate, corticolous, crustose lichens in Norway. *Sommerfeltia*, **14**: 1–331.
- Wei, J. C. and Y. M. Jiang, 1993. The Asian *Umbilicariaceae*. pp. 218. International academic publishers, Beijing.
- Yoshimura, I. and H. Harada, 1986. Macrolichens of Mt. Tsurugi, Shikoku, Japan. *Bull. Kochi Gakuen College*, **17**: 303–326.