

## Japanese Species of *Parmelia* Ach. (sens. str.), Parmeliaceae (5)

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(Received on March 12, 1994)

In the last paper of the present series, *P. shinanoana*, *P. squarrosa*, *P. subdivaricata*, and *P. sulcata* are revised. Among them, *P. shiananoana*, *P. squarrosa*, and *P. sulcata* have been well typified by various authors. Although *P. subdivaricata* was reduced as a synonym of *P. fertilis* (= *P. praesquarrosa* in this study) by Hale (1987), it is regarded as a distinct species, because it has linear elongate lobes with subentire margins, elevated white-rimmed laminal pseudocyphellae, and apothecia with amphithecium distinctly rugose with elevated white-rimmed pseudocyphellae. *P. subdivaricata* shows more southern distribution than that of *P. praesquarrosa*.

(Continued from J. Jpn. Bot. 69: 262–269, 1994)

***Parmelia shinanoana*** Zahlbr., Bot. Mag. Tokyo 41: 349, 1927. Type collection. Mt. Yatsugatake. Prov. Shinano, Japan, Y. Asahina 548 (lectotype in W and isolectotype in TNS).

Thallus adnate on rock or growing over mosses on rock, 8–20 cm broad or often covering cliffs of quite large area, fragile, pale greenish or dark brownish mineral gray, lobes sublinear, contiguous or less commonly subimbricate, 1.5–3.5 mm wide, sometimes lobulate on older parts, upper surface shiny, plane, continuous, marginal pseudocyphellae linear, forming a conspicuous white to blackish continuous rim, laminal pseudocyphellae lacking; medulla white; lower surface black, rather sparsely rhizinate, the rhizines simple to furcate, 0.5–2 mm long. Pycnidia not seen. Apothecia rather rare, adnate, 1–4 mm in diameter, disc chestnut brown to dark brown, margins sinuate at mature stages, amphithecium smooth distinctly pseudocyphellate near the margin of apothecia, hymenium 40–60  $\mu\text{m}$  high, spores poorly developed, 5–7 $\times$ 11–15  $\mu\text{m}$ .

Chemistry. Atranorin, gyrophoric acid, and 4-O-methyl-gyrophoric acid (sometimes in trace amount) in the cortex and salazinic acid in the medulla.

Distribution. Saghalien, Japan, and Korea.

This species (Fig. 15) is unique in having pseudocyphellae forming marginal conspicuous rim on the upper surface and in lacking laminal pseudocyphellae (Fig. 1A). It resembles *P. niitakana* Asah., a species endemic to Taiwan, in having similar lobes with marginal pseudocyphellae. However, it is clearly distinguished from the latter by the smaller spores (11–15  $\mu\text{m}$  long in *P. shinanoana* vs. 22–29  $\mu\text{m}$  long in *P. niitakana*). When apothecia are present, in addition, they are rather small (less than 4 mm in diameter) and the amphithecium is smooth in *P. shinanoana*, whereas they are usually more than 5 mm in diameter and the amphithecium is conspicuously rugose with elevated white-rimmed pseudocyphellae in *P. niitakana*.

The present species resembles *P. skultii* Hale, which also has continuous pseudocyphellae on the



Fig. 15. Isolectotype of *P. shinanoana*. Scale indicates mm.

margin of lobes and only rarely forms laminal pseudocyphellae. However, *P. skultii* is clearly distinguished from *P. shinanoana* by the production of norstictic acid in the medulla. In addition, it seems to be restricted to high latitudes, especially near the ocean, from the Aleutian Islands to Novaya Zemlya (Hale 1987) and is not known from Japan at present.

The production of gyrophoric acid in the cortex (Kurokawa and Takahashi 1970) is unique in the entire family Parmeliaceae. Gyrophoric acid is produced neither in *P. niitakana* nor in *P. skultii*, the closely allied species.

The present species is rather common through Hokkaido to Kyushu, where it sometimes covers a large area of cliffs in more or less shaded deciduous or coniferous forests 70–1700 m above the sea level in

Hokkaido and 1000–2000 m in central Japan. Fifty three specimens collected in Japan have been examined through the present study. Asahina (1951) reported this species also from Saghalien and Korea.

Exsiccatae examined. Kurokawa, Lich. Rar. Crit. Exs., no. 130. Kurokawa & Kashiwadani, Lich. Rar. Crit. Exs., no. 524.

***Parmelia squarrosa*** Hale, *Phytologia* **22**: 29, 1971. Type collection. Shenandoah National Park, Madison Co., Virginia, U. S. A., M. E. Hale 36494 (= Lich. Americani Exsic., no. 142) (holotype in US and isotype in TNS).

*Parmelia saxatilis* \**divaricata* Del. ex Nylander, Lich. Jap. 27, 1890 – *Parmelia saxatilis* f. *divaricata* (Del. ex Nyl.) Hue, *Nouv. Arch. Mus. Hist. Nat.*, ser. 4, **1**: 163, 1899. Type collection. Itchigome, (Mt. Fuji), Japan, Almquist in 1879 (lectotype in H, Nyl. Herb. 34853).

*Parmelia saxatilis* var. *angustifolia* Nyl. ex Hue, *Nouv. Arch. Mus. Hist. Nat.*, ser. 4, **1**: 164, 1899. Type collection. Canada, Newfoundland, de la Pylaire (holotype in PC) – not seen.

*Parmelia saxatilis* f. *furfuracea* Lind. in sensu Asahina in *J. Jpn. Bot.* **26**: 354, 1951.

Thallus adnate to loosely adnate on bark of trees or very rarely on rocks, pale greenish to whitish mineral gray, 5–15 cm broad, lobes sublinear to less commonly subirregular, divaricate or becoming imbricate, 1–5 mm wide, upper surface plane to foveolate, shiny but rarely white pruinose, continuous or cracking radially or along pseudocyphellae with age, pseudocyphellae marginal and laminal, more or less white rimmed, not elevated, marginal pseudocyphellae subcontinuous, not conspicuous, laminal pseudocyphellae angular to linear, 0.5–1.5 mm long, often fusing to form a subreticulate network sometimes developed on ridges on the surface, isidia abundant and dense, subclavate to cylindrical, clustered or coralloid; medulla white; lower surface black and

shiny, densely rhizinate, the rhizines simple or squarrosely branched, 0.5–2.0 mm long. Pycnidia rare, conidia cylindrical, about 6  $\mu\text{m}$  long. Apothecia rather rare, substipitate, 3–7 mm in diameter, the disc pale to dark brown, the amphithecium pseudocyphellate and isidiate, hymenium 50–60  $\mu\text{m}$  high, spores poorly developed, 6–8 $\times$ 12–13  $\mu\text{m}$ .

Chemistry. Atranorin, salazinic acid, consalazinic acid (Hale 1987) (chemical strain I) or atranorin, salazinic acid, consalazinic acid, and fatty acids (chemical strain II).

Distribution. Japan (Hokkaido, Honshu, Shikoku, and Kyushu), Kurile Islands, Saghalien, Korea, China, Nepal, Sikkim, Alaska, Canada, U. S. A., and Europe (Switzerland and Austria).

*Parmelia squarrosa* is one of the commonest corticolous lichens in eastern North America, Japan, and Korea. It is common on oak and other deciduous trees in montane open forests in North America (Hale 1971). In Japan, it grows on barks of *Acer* spp., *Fagus crenata*, *Tilia japonica*, *Quercus serrata*, *Pinus thunbergii*, etc. in lowlands to montane areas as well as on barks of *Abies mariesii*, *A. sachalinensis*, *A. veitchii*, *Betula ermanii*, *Picea jezoensis*, *Tsuga diversifolia*, etc. in subalpine areas. The sparse population in Saghalien and Kurile Islands in Asia and in Alaska to California in North America may in fact be a continuation of the disjunctive distribution of the species in Japan and eastern North America. The rare occurrence in the Alps in Europe was reported by Hyvönen (1985).

This species morphologically resembles *P. saxatilis*, which also occurs in Japan. It is readily distinguished from the latter by the squarrosely branched, at least in part, rhizines. The upper surface is commonly whitish to greenish gray in *P. squarrosa*, whereas it is brownish gray to blackish brown in *P. saxatilis*. Isidia of *P. squarrosa* are a little more concentrated on marginal parts of lobes than in *P. saxatilis*.

In Japan, *P. squarrosa* is a common epiphyte in rather humid deciduous and coniferous forests from the coast to subalpine areas, whereas *P. saxatilis* has been collected on rocks or on twigs of *Pinus pumila* at a few localities in alpine zones in central Japan.

As to the chemical ingredients of the present species, atranorin, salazinic acid, and consalazinic acid have been reported (Dey 1978, Hale 1987). Lobaric acid, which is produced in all Japanese specimens of *P. saxatilis*, is lacking in *P. squarrosa*. Fatty acids, which have never been reported before, are demonstrated in 33 of 142 Japanese specimens and in 14 of 18 North American specimens examined.

***Parmelia subdivaricata*** Asah., J. Jpn. Bot. **26**: 356, 1951. Type collection. Nimandaira, Mt. Arisan, Taiwan, Y. Asahina F-71 (lectotype in TNS).

Thallus adnate to loosely adnate on bark of trees or rarely over mosses on rocks, often more than 12 cm broad, lobes subdichotomously or rarely subpalmately branched, sublinear elongate or more rarely subirregular, divaricate to contiguous, 1.5–3 (rarely more than 4) mm wide, apically rotund, subentire at the margin, upper surface smooth or sometimes foveolate, tangentially fissured on older lobes, pseudocyphellae marginal and laminal, marginal pseudocyphellae subcontinuous, distinctly white-rimmed, laminal pseudocyphellae 0.5–1.5(–2) mm long, fusing with age but hardly forming a network, often split on older lobes, distinctly white-rimmed, the white rim well elevated and conspicuous; medulla white; lower surface densely rhizinate, the rhizines simple or densely squarrosely branched, 0.5–2 mm long, usually forming a dense mat on the lower surface, often projecting beyond the lobe margin. Pycnidia common, conidia cylindrical to weakly bifusiform, 5–6  $\mu\text{m}$  long. Apothecia substipitate, 4–8(–12) mm in diameter, disc brown to dark brown, fissured with age, amphithecium distinctly ridged with elevated and white-rimmed pseudocyphellae,

hymenium about  $50\ \mu\text{m}$  high, spores  $6\text{--}7\times 10\text{--}13\ \mu\text{m}$ .

Chemistry. Atranorin, salazinic acid, and trace of protocetraric acid (+ or -).

Distribution. Japan (Honshu, Shikoku, Kyushu) and Taiwan.

Hale (1987) considered this species as a synonym of *P. fertilis* (= *P. praesquarrosa* in this paper). These two species are in fact very similar, because they both have squarrosely branched rhizines and produce rather small spores of the same size. However, *P. subdivaricata* has divaricate lobes with subentire margins (Fig. 16), while *P. praesquarrosa* has shorter, crowded, and often imbricate lobes with more or less crenate margins. *P. subdivaricata* may be more reliably distinguished from *P. praesquarrosa* by more conspicuous pseudocyphellae with more or less elevated white rim (Fig. 2D). In *P. praesquarrosa*, pseudocyphellae are not elevated and only rarely a little white-rimmed (Fig. 2B).

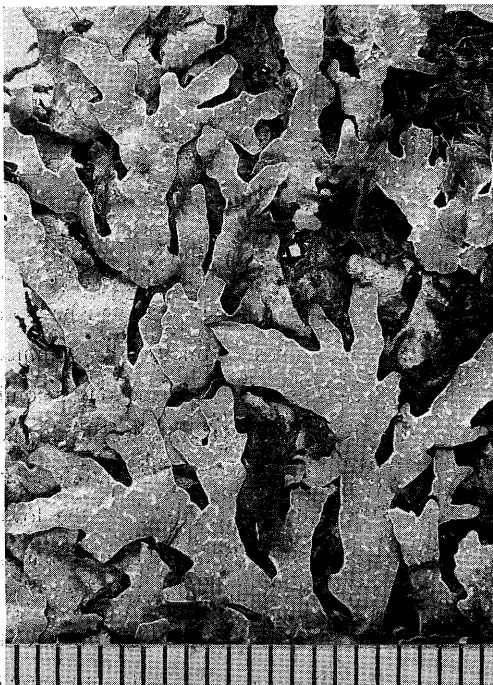


Fig. 16. Part of thallus of *P. subdivaricata* (M. Tagawa 264). Scale indicates mm.

This species has more southern distribution range than that of *P. praesquarrosa* and the range includes Japan and Taiwan. The northernmost locality known at present is Prov. Iwaki, which is located southernmost part of northeast Honshu.

Exsiccata examined. S. Kurokawa; Lich. Rar. et Crit. Exs., no. 85.

Specimens examined. Japan. Honshu, Prov. Iwaki: Mt. Kasshiyama, Nishishirakawa-gun, elevation about 1530 m, S. Kurokawa 78009. Prov. Shimotsuke: Mt. Koshin, Kamitsuga-gun, elevation about 1000 m, on trunk of *Alnus* sp., H. Shibuichi 7740; Mt. Takaharasan, Y. Numajiri s. n. - syntype; Mt. Nantaisan, Nikko, F. Fujikawa s. n. - syntype; Yumoto, Nikko, M. Ogata s. n. - syntype; the same locality, Y. Asahina s. n. - syntype. Prov. Musashi: Mt. Shiroywa, Chichibu, S. Kurokawa 50377. Prov. Sagami: Mt. Kamiyama, Hakone, S. Kurokawa 58050 (TNS, H. US). Prov. Shinano: Yumatazawa, Kitaazumi-gun, S. Kurokawa 51684, 51685. Prov. Ise: Ohsugidani-mura, Taki-gun, Y. Tanaka s. n. Prov. Yamato: Mt. Ohmine, M. Togashi s. n. (TNS, H); Mt. Gyozaageridake, Ohmine Mts., on tree trunk, alt. ca. 1500 m, Mt. Tagawa 264 (TNS, H, M, US). Shikoku Prov. Awa: Mt. Tsurugi, Miyoshi-gun, on rocks, elevation about 1800 m, H. Kashiwadani 6933, 6934; Mt. Kenzan, F. Fujikawa s. n. - syntype. Prov. Iyo: Mt. Ishizuchi, T. Yanagisawa 1590; the same, elevation about 1540 m, S. Kurokawa 72217 (TNS, H); the same, elevation 1850-1980 m, H. Kashiwadani 10370. Prov. Tosa: Mt. Tsutsujo, F. Fujikawa s. n. - syntype. Kyushu. Prov. Bungo: En route from Mt. Kurodake to Mt. Ohfune, elevation ca. 1300 m, M. Omura 709; Mt. Kurodake, Naoiri-gun, elevation ca. 1230 m, M. Omura s. n.; Mt. Kannojigoku Hot Spring, Mt. Kuju, M. Togashi s. n.; Mt. Katamuki, M. Togashi s. n.; Mt. Daisenzan, Mts. Kuju, S. Kurokawa 62356 (TNS, H, MEL). Prov. Higo: Futaenotoge Pass, Mt. Aso, N. Takaki 11. Taiwan. Taitung Pref.: Mt. Wunitoparu, elevation about 1900 m, S. Kurokawa 2585, 2586.

***Parmelia sulcata*** Tayl. in Mackay, Fl. Hiber. 145, 1836. Type collection. Dunkeerron, Kerry, Ireland, Taylor s. n. (lectotype in FH, Tayl. herb.).

Thallus adnate to loosely adnate on bark of trees, greenish to whitish mineral gray, 3–5 cm broad, lobes sublinear but rather short, crowded to imbricate, 2–5 mm wide, upper surface shiny, more or less foveolate, tangentially cracked with age, pseudocyphellae white-rimmed and more or less elevated, marginal and laminal, soon becoming soreciate, marginal pseudocyphellae subcontinuous, laminal pseudocyphellae suborbicular to linear, sparse and separate, hardly forming a network, 0.1–1.0 mm long, soralia marginal and laminal, the soredia powdery to granular; medulla white; lower surface black, densely rhizinate, the rhizines simple to densely squarrosely branched, less than 1 mm long. Pycnidia and apothecia not seen in Japanese material.

Chemistry. Atranorin, chloroatranorin, and salazinic acid (Galloway and Elix 1983).

Distribution. Temperate and subboreal regions in both hemispheres.

This species is easily distinguished from other Japanese species of *Parmelia* by the well developed laminal and marginal soralia (Fig. 17) and the richly squarrosely branched rhizines.

*Parmelia sulcata* is a widespread even weedy species in temperate and subboreal regions in both hemispheres. As pointed out by Kurokawa (1968), however, the rarity of the species in Japan is remarkable, since the species had been known from only two localities in Hokkaido. Recently, Yoshida (1987) reported the occurrence of the species in central Honshu and another locality in Hokkaido is added as follows.

Specimens collected in Japan. Hokkaido. Prov. Kitami: Hamatonbetsu, Esashi-gun, on trunk of *Abies sacharinensis*, elevation about 3 m, H. Shibuichi 7484. Prov. Kushiro: Mt. Meakan, on bark of *Picea jezoensis*, elevation 580 m, S. Kurokawa 65533 (TNS,

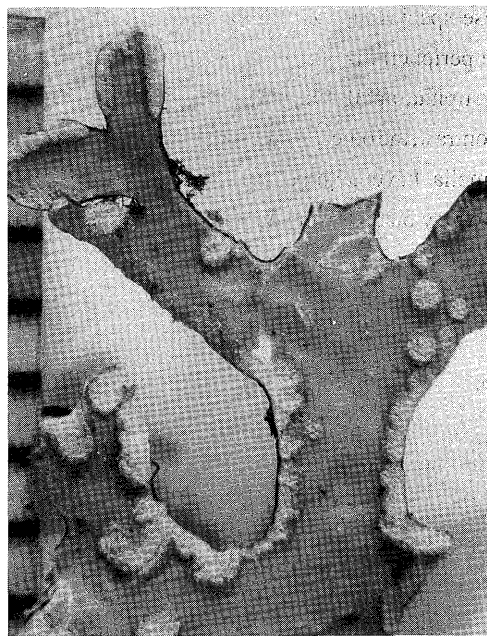


Fig. 17. Lobes of *P. sulcata*, showing marginal and laminal soralia (S. Kurokawa 65533). Scale indicates mm.

MEL). Prov. Ishikari: Furebetsu, Mt. Furano, elevation about 800 m, S. Kurokawa 65361. Honshu. Prov. Shinano: Azusayama, Kawakami-mura, Minamisakugun, on twigs of *Larix leptolepis*, elevation about 1400 m, K. Yoshida 7718.

### Summary

In the present series of papers, 17 species of *Parmelia* sens. str. were recognized as Japanese members of the genus and the distribution range of each species was discussed in detail mainly in Japan and the adjacent areas. Although species of *Parmelia* have generally been considered to be monophylletic and no subdivision of the genus has been proposed, evidence from these investigations shows that in fact they represent two very distinct assemblages of species that are clearly separated each other. Three Asian species with punctate pseudocyphellae, *P. isidioclada*, *P. laevior*, and *P. pseudolaevior*, were classified under the new subgenus *Nipponoparmelia*.

These species are also characterized by lobes with pale peripheral zones on the lower surface, more or less stipitate apothecia, and clavate to subclavate asci. In contrast, the other 14 species belonging to subgenus *Parmelia* have angular to linear pseudocyphellae, uniformly black lower surface, adnate to substipitate apothecia, and cylindrical asci.

The presence or absence of isidia, soredia, pustles, or lobules is one of the most easily recognized features which can be used in separating species. The location as well as the size and density of pseudocyphellae are also proper to each species of *Parmelia*, especially in subgenus *Parmelia*. The artificial key to the Japanese species as well as to subgenera was given. Among 17 species recognized in the present paper, two species, *P. marmorophylla* and *P. praesquarrosa*, were new species, and two species, *P. omphalodes* and *P. saxatilis*, were added to the Japanese lichen flora. *P. subdivaricata* was considered as a distinct species,

though it was once reduced as a synonym of *P. fertilis*.

#### Literature cited

- Asahina Y. 1951. Lichenes Japoniae novae vel minus cognitae (7). J. Jpn. Bot. **26**: 329–334.
- Dey J. P. 1978. Fruticose and foliose lichens of the high-mountain areas of the southern Appalachians. Bryologist **81**: 1–93.
- Galloway D. J. and Elix J. A. 1983. The lichen genera *Parmelia* Ach. and *Punctelia* Krog in Australasia. New Zealand J. Bot. **21**: 397–420.
- Hale M. E., Jr. 1971. *Parmelia squarrosa*, a new species in section *Parmelia*. Phytologia **22**: 29.
- 1987. A monograph of the lichen genus *Parmelia* Acharius sensu stricto (Ascomycotina: Parmeliaceae). Smiths. Contr. Bot. **66**: 1–55.
- Hyvönen S. 1985. *Parmelia squarrosa*, a lichen new to Europe. Lichenologist **17**: 311–314.
- Kurokawa S. 1968. New or noteworthy species of *Parmelia* of Japan. J. Jpn. Bot. **43**: 349–353.
- and Takahashi K. 1970. Gyrophoric acid as a chemical constituent in the cortex of lichen thallus. J. Jpn. Bot. **45**: 230–232.
- Yoshida K. 1987. Lichens of Chichibu (4): Three noteworthy species of lichens found on *Larix leptolepis*. Bull. Saitama Mus. Nat. Hist. **5**: 17–21.

#### 黒川 道: ウメノキゴケ科カラクサゴケ属の日本産の種(5)

日本産カラクサゴケ属の研究の最終報告として *P. shinanoana* (シナノゴケ 新称), *P. squarrosa* (カラクサゴケ), *P. subdivaricata* (オオナメラカラクサゴケ 新称), *P. sulcata* (コフキカラクサゴケ) の特徴や分布について報告した。Hale (1987) は *P. subdivaricata* をナメラカラクサゴ

ケの synonym としたが、裂片は線状に伸びて縁がやや全縁であり、表面の擬盃点は白く縁取られて隆起し、また子器の外側には著しく隆起した擬杯点が見られる点で明らかに区別され、分布も南に偏っているので独立種とした。