

More, new Asian species in the lichen genus *Fuscopannaria*

Per M. JØRGENSEN

Abstract: In newly collected material from high altitudes in China and India three new species in the genus *Fuscopannaria* have been discovered: *F. albomaculata*, *F. granulifera* and *F. hirsuta*, all with unusual characters for the genus. The first one has remarkable tube-like structures exposing the white medulla above, the thallus thus appearing to be white-dotted. The second contains green algae, and the last one is the first regularly hairy species to be discovered in the genus.

Key words: *Fuscopannaria*, new species, unusual characters.

Introduction

As shown previously, the genus *Fuscopannaria* is particularly species rich in Pacific North America (Jørgensen 2002a) and East Asia (Jørgensen 2000), clearly with an evolutionary centre in the first region. However, new collections from the Himalayas have revealed that this region also contains a rather high number of species (*c.* 10), three of which are recognized as new below, all with unusual characters for the genus. The genus is characterized by the often brownish, small-squamulose thalli which are PD – (not containing pannarin, but often fatty acids and terpenoids) producing apothecia with variable development of thalline margins and hemiamyloid hymenia containing asci with distinct amyloid inner structures (sheets or tubular rings) (Jørgensen 1994).

Material and Methods

This study is based on material from herbaria GZU and LWU. The methods are the same as those described in Jørgensen (1978).

The Species

Fuscopannaria albomaculata P. M. Jørg. sp. nov.

Fuscopannariae poeltii similis sed thallo tubis apicibus albidis formantes; ascospores subgloboseae.

P. M. Jørgensen: Department of Biology, University of Bergen, Allégaten 41, N-5007 Bergen, Norway.

Typus: China, Sichuan, Daxue Shan, 57 km S of Kangding, Gongga Shan, Hailougou glacier and forest park, surrounding area of Hailougou Station, 2940–3130 m, 29 July 2000, W. Obermayer 08768 (GZU—holotypus).

(Figs 1 & 2)

Thallus squamulose, forming rosettes up to 2 cm diam., dark brown, marginal lobes often tubiformly rolled in and exposing the white medulla at the apex (Fig. 2), thus giving the thallus a white-dotted appearance. Thallus in section 250–350 µm thick with cellular upper cortex, 40–50 µm wide; photobiont *Nostoc* in clusters, individual cells 5–6 µm diam.

Apothecia flat to convex, *c.* 1 mm diam., tomentose below, with distinct, paraplectenchymatous proper margins, with indistinct thalline margins, usually comprising only a few granules; disc brown. *Ascospores* simple, colourless, subglobose, 14–18 × 10–12 µm with smooth exospore.

Chemistry. All reactions negative; terpenoids detected in TLC, one running unusually high; R_f values on the plates (classes: A6, B8, C7).

Notes. A most characteristic species, differing from all others in the white-spotted thallus. Its closest relative *F. poeltii* is white-pruinose only at the flat lobe-ends (Jørgensen

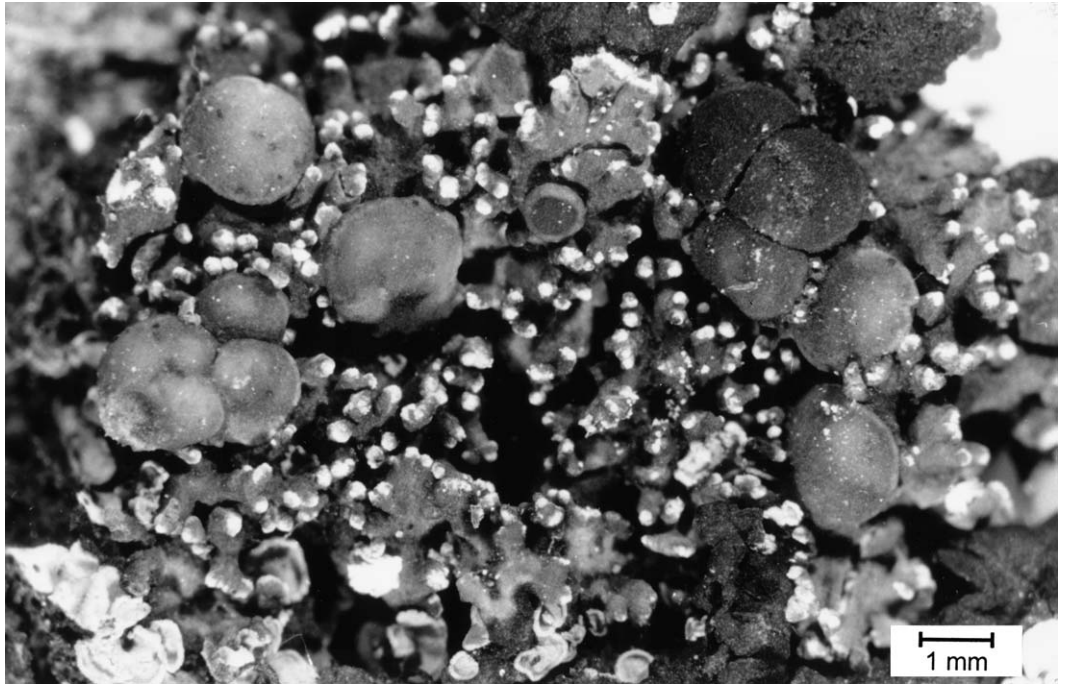


FIG. 1. *Fuscopannaria albomaculata*, holotype.

2000). *Fuscopannaria albomaculata*, however, produces these spots at the tips of inrolled lobes which form a tubular structure, on the apex of which medullary hyphae are exposed (Fig. 2). This appears to be a structure allied to dispersal, reminiscent of a chimney with white smoke. As no algae have been observed in association with the exposed hyphae, it is dispersing only the fungus, however, unlike most other vegetative dispersal units (except thalloconidia). It may also be related to gas-exchange, which could be facilitated during periods when the thallus is immersed in water.

Habitat and distribution. *Fuscopannaria albomaculata* is an epiphyte on deciduous trees (*Betula*, *Salix*) in montane forests near glaciers, very rarely on mossy rocks, at altitudes of about 3000–4000 m, in the border-region of Tibet (Xizang) and Sichuan in China. It probably has a rather localized distribution.

Additional specimens studied. **China:** *Sichuan:* Daxue Shan, 57 km S of Kanding, Gongga Shan, Hailougou glacier and forest park, surrounding area of Hailougou station, in forest, 2940–3130 m, 2000, *W. Obermayer* 08763 (GZU); *ibid.*, the glacier viewpoint, 3150–3200 m, lateral margin area of the glacier, 28 vii 2000, *W. Obermayer* (GZU). *Xizang* (SE Tibet): Gyala Peri N, Bong Chu to Gyala Peri N glacier, 2800–3300 m, 1994, *G. Miehe & U. Wündisch* 94-201-3b (GZU); W above Gyala Peri N glacier, 3820 m, 1994, *G. Miehe & U. Wündisch* 94-215-42/19 (GZU).

***Fuscopannaria granulifera* P. M. Jørg. & Upreti sp. nov.**

Fuscopannariae siamensis similis sed marginibus granuliferis; ascoporae magnae et alga symbiontica viridis.

Typus: India, Himachal Pradesh, Kullu distr., Great Himalayan National Park, Pardi, 3140 m, 5 November 2002, *S. Nayaka & R. Srivastava* (LWU—holotype).

(Fig. 3)

Thallus squamulose, forming rosettes up to 4 cm diam, individual lobes to 2 mm broad, to 250 µm thick with 50–70 µm wide cellular

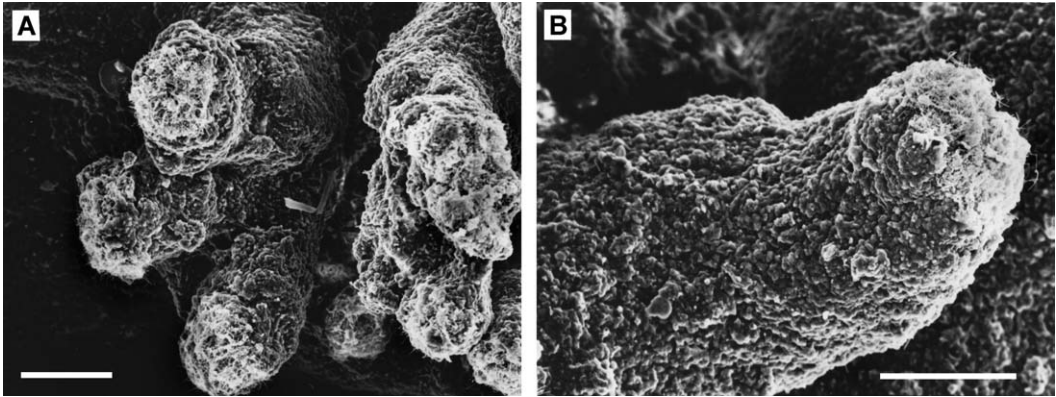


FIG. 2. *Fuscopannaria albomaculata*. SEM micrographs showing the chimney-like structures which create the white-dotted impression of the thallus. A, overview; B, detail showing the non-corticate apices exposing medullary hyphae covered in terpenoid crystals. Scales: A & B=100 μ m.

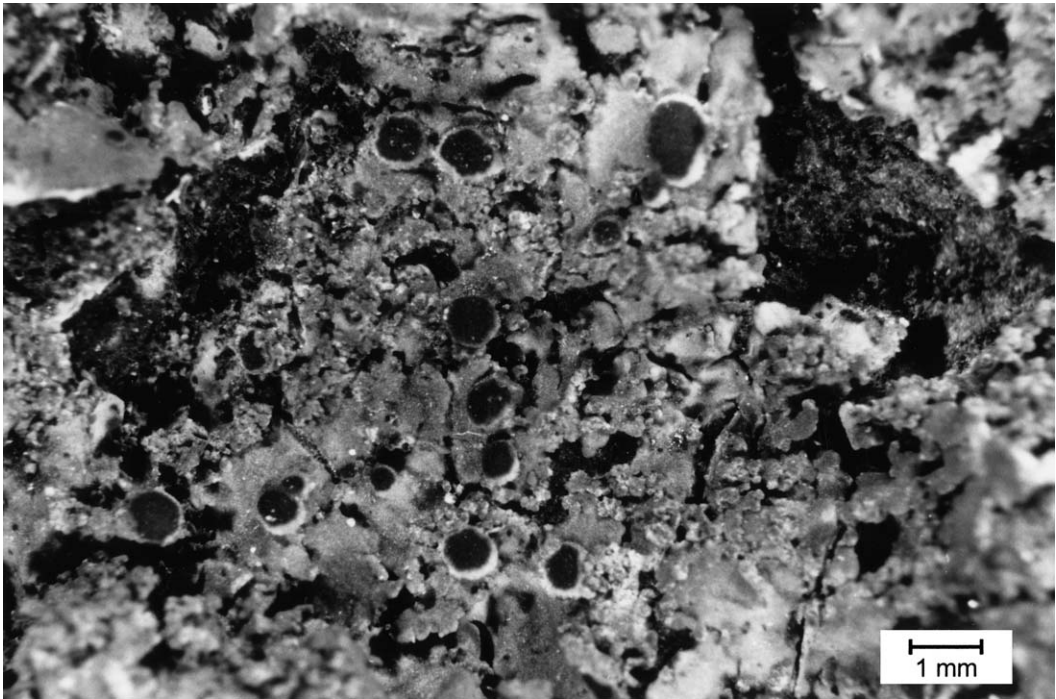


FIG. 3. *Fuscopannaria granulifera*, holotype

cortex; photobiont green (*Myrmecia*?), individual cells 7–10 μ m diam. Upper surface brown, smooth with ascending margins beset with granules, these eventually dislocating and leaving a seemingly sorediate border.

Apothecia scarce, up to 1 mm diam., dark brown with a paler, paraplectenchymatous proper margin with indistinct thalline margin, and tufts of hairs protruding from below. *Ascospores* simple, colourless, ellipsoid 25–27 \times 8–10 μ m with rounded ends.

Chemistry. All reactions negative; no substances found by TLC.

Notes. A remarkable species which may be taken for an extreme, reduced form of the variable *F. siamensis* P. M. Jørg. & P. Wolseley (Jørgensen 2002b). However, it differs in several basic characters such as the larger spore size different chemistry and photobiont. The subtropical *F. siamensis* has a thallus containing terpenoids and fatty acids and a cyanobiont, and the ascospores are 20–22 µm long (Jørgensen 2000). This collection undoubtedly represents a separate, hitherto undescribed species occurring in the alpine region. The difference in photobiont is the most noteworthy feature, *F. granulifera* being the first corticolous species of the genus known to contain green algae, and only the third in *Fuscopannaria*. The other two, *F. globigera* Fryday & P. M. Jørg. and *F. viridescens* P. M. Jørg. & Zhurb., are terricolous in the Arctic (Jørgensen & Zhurbenko 2002; Fryday 2004). It is not closely related to any of these, but to *F. poeltii* (P. M. Jørg.) P. M. Jørg., a species of the *F. leucosticta* group (Jørgensen 2000).

The change to a green photobiont in the harsh arctic-alpine environment is rather surprising and not easily explained (Fryday 2004), as one would assume that a cyanobiont should be a better partner in these nutrient poor communities.

Habitat and distribution. *Fuscopannaria granulifera* is a corticolous species, being collected in the upper forests of western Himalaya, not far from the upper forest limit. It is as yet known only from the type collection, but may prove to have a wider distribution in these scantily collected forests.

***Fuscopannaria hirsuta* P. M. Jørg. sp. nov.**

Fuscopannariae leucostictae similis, sed thallo hirsuto, sine acidiiis pinguibus.

Typus: China, Xizang (Tibet), Nyainqentanglha Shan, 370 km E of Lhasa, 55 km NNE of Nyingchi, valley at the west side of Gyala Peri, 2500 m, 17 August 1994, W. Obermayer 6560 (GZU—holotype).

(Figs 4 & 5)

Thallus forming circular, squamulose cushions up to 3 cm wide, with distinct peripheral lobes up to 2 mm wide. Upper surface pale brown with scattered, simple, hyaline hairs up to 150 µm long, usually aggregating, with scattered stellate or peltate structures in between (Fig. 5), possibly a hyphomycete. Thallus in section 250–350 µm thick with cellular upper cortex, 35–40 µm thick; photobiont *Nostoc* in clusters, individual cells 5–6 µm diam.

Apothecia rare, up to 2 mm diam. with strong, crenulate thalline margin, obscuring the proper margin, and brown disc; *ascospores* simple, colourless, ellipsoid, 17–22 × 8–11 µm, without apiculi, exospore rugulose.

Chemistry. All reactions negative; containing a trace of a terpenoid substance.

Notes. This is a remarkable species owing to the distinctly hairy upper thallus surface. It is the first species of the genus to exhibit this character (Fig. 5), which occurs in the related genus *Psoroma* (see Jørgensen & Kristinsson 2003), though there never with stellate-peltate structures. To my knowledge this feature has not been observed previously in any lichen [but in non-lichenized fungi asterosetae have been reported, see Kirk *et al.* (2001)]. This raises the question as to whether or not these structures belong to the lichen. Clearly they emerge from the surface, but they might belong to a parasite or parasymbiont, a question that has been impossible to study in necessary detail for a conclusive answer due to scanty material. Therefore, the possibility cannot be excluded that these hairs are formed by an ongrowing hyphomycete. The other hairs appear to occur regularly, and the specimen cannot be placed in any other known species on the basis of alternative characters. It belongs, however, in the *F. poeltii* complex, in spite of the very distinct thalline margin of the apothecia.

Habitat and distribution. This is a corticolous species, the type was collected on *Salix*, the other specimen on *Juniperus*, two quite different types of bark. Therefore this species may prove to have a rather wide

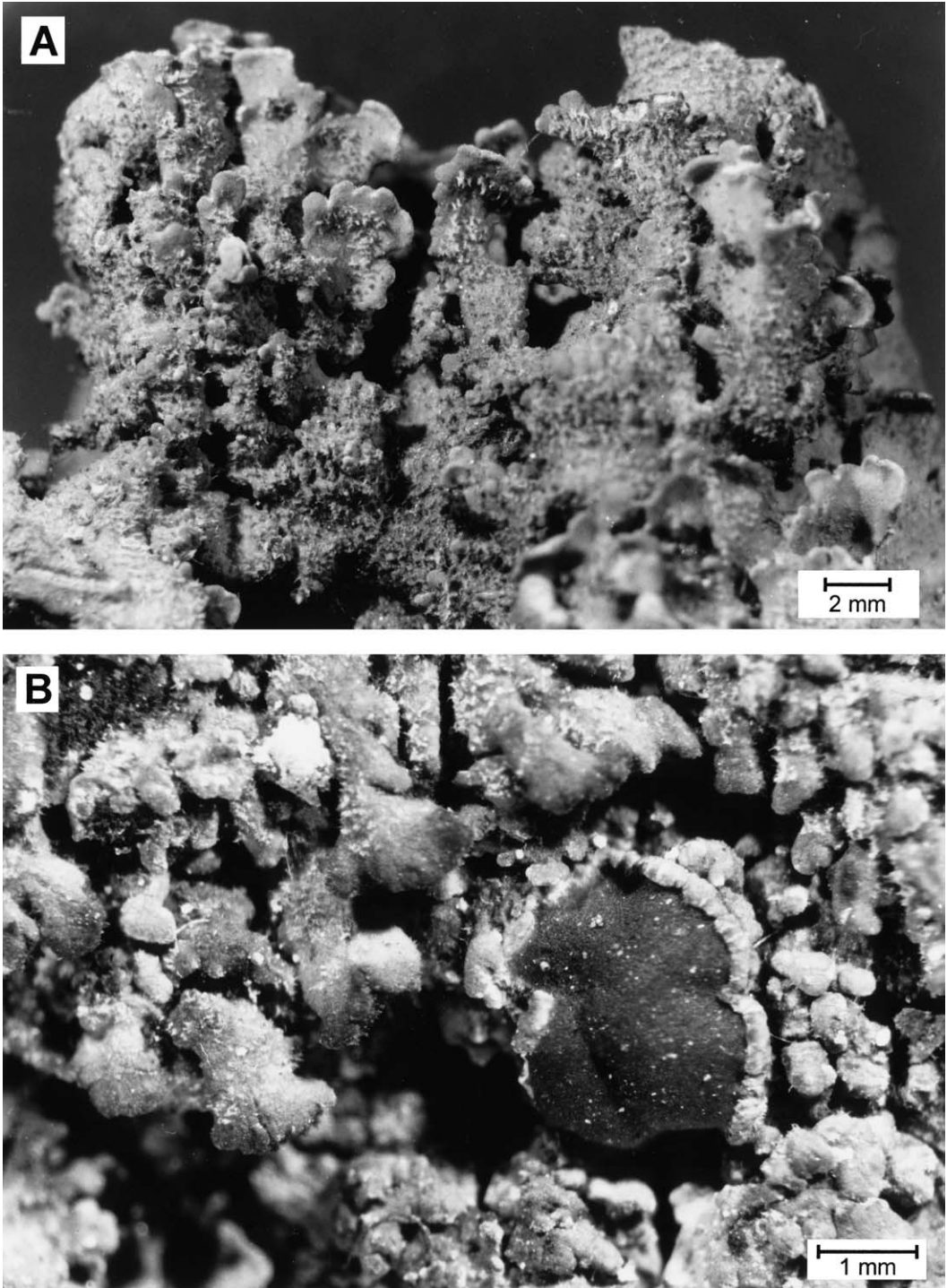


FIG. 4. *Fuscopannaria hirsuta*. A, part of the holotype; B, only known apothecium.

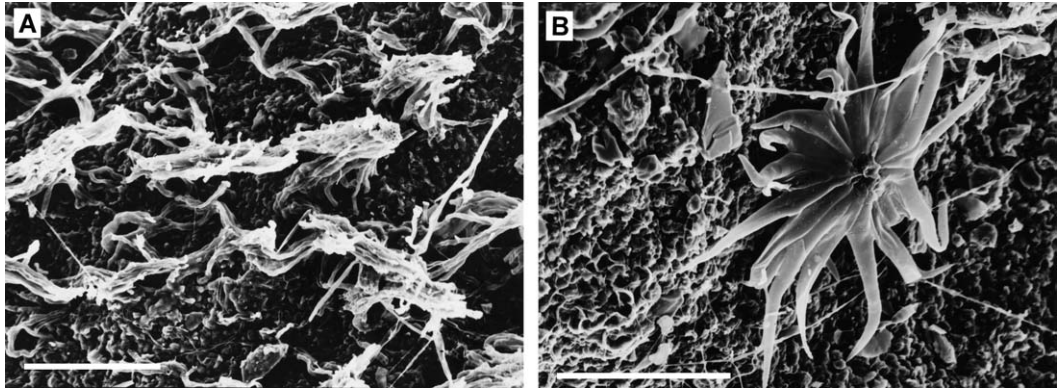


FIG. 5. *Fuscopannaria hirsuta*. SEM micrographs showing detail of the hairs. A, aggregating simple hairs; B, a stellate-peltate hair. Scales A & B = 100 µm.

ecological amplitude. Furthermore the type locality is in a river valley, whereas the other known collection is at the forest limit. As yet, *F. hirsuta* is known only from a restricted region in the eastern parts of the Nyainqentananglha mountain chain in Tibet.

Additional material examined. **China:** Xizang (Tibet): Nyainqentananglha Shan, 345 km E of Lhasa, 20 km NE of Nyingchi, 5 km E of the pass, near the timberline, 4200–4300 m, 1994, *W. Obermayer* 7447 (GZU).

Concluding remarks

The genus *Fuscopannaria* has been a constant surprise to me with its many unrecognized species. These show an unusually rich diversification of characters, which is hard to understand from an evolutionary point of view. The upper forests of the Himalayas and associated mountain chains appear to be full of species of this genus, some probably being rather local, unlike most other genera in this region, except the cetrarioid ones (Obermayer 2004). Though being superficially rather similar, they differ in a number of basic characters such as symbiont, chemistry and dispersal strategies (including spore size).

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REFERENCES

- Fryday, A. M. (2004) A new species of *Fuscopannaria* with a green photobiont, and other taxonomic innovations and new records of lichenized-fungi from Alaska. *Bryologist* **107**: 173–179.
- Jørgensen, P. M. (1978) The lichen family Pannariaceae in Europe. *Opera Botanica* **45**: 1–124.
- Jørgensen, P. M. (1994) Studies in the lichen family Pannariaceae VI. The taxonomy and phytogeography of *Pannaria* Del. s. lat. *Journal of the Hattori Botanical Laboratory* **76**: 197–206.
- Jørgensen, P.M. (2000) Notes on some Asian species of the lichen genus *Fuscopannaria*. *Journal of the Hattori Botanical Laboratory* **89**: 247–259.
- Jørgensen, P. M. (2002a) Survey of the lichen family Pannariaceae on the American continent, North of Mexico. *Bryologist* **103**: 670–704.
- Jørgensen, P. M. (2002b) Further notes on Asian species of the lichen genus *Fuscopannaria*. *Journal of the Hattori Botanical Laboratory* **92**: 225–229.
- Jørgensen, P. M. & Kristinsson, H. (2003) *Psoroma hirsutulium* Nyl., a lichen species new to the Northern Hemisphere found in Iceland. *Graphis Scripta* **14**: 55–57.
- Jørgensen, P. M. & Zhurbenko, M. (2002) Two new, remarkable, arctic species in the lichen genus *Fuscopannaria* (Pannariaceae, lichenized Ascomycetes). *Bryologist* **105**: 465–469.
- Kirk, P. M., Canon, P. F., David, J. C. & Staples, J. A. (2001) *Ainsworth and Bisby's Dictionary of the Fungi*. 9th edition. Wallingford: CAB International.
- Obermayer, W. (2004) Additions to the lichen flora of the Tibetan region. *Bibliotheca Lichenologica* **88**: 479–526.

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