NOTES ON *AMANDINEA PETERMANNII* COMB. NOV. (PHYSICIACEAE) FROM ANTARCTICA

M. MATZER*, H. MAYRHOFFER* and Ch. SCHEIDEGGER†

Abstract: The new combination *Amandinea petermannii* (Hue) Matzer, Mayrh. & Scheidegger is proposed. The taxonomy, morphology, anatomy, chemistry, ecology and distribution of this lichen are discussed. *Rinodina convoluta* D. C. Lindsay is a synonym of *A. petermannii*.

Introduction

In connection with a revision of material of the genus *Rinodina* (Ach.) Gray from Antarctica we consider the position of *Rinodina petermannii* to be somewhat aberrant within the genus because of its curved filiform spermatia and the presence of norstictic acid. The latter character is also known from *R. calculiformis*, which together with *R. angelica*, constitutes the new genus *Mobergia* (Mayrhofer *et al.* 1992). Because of the filiform spermatia, *Amandinea* Choisy ex Scheidegger & Mayrh. is considered to be the appropriate genus for *Rinodina petermannii*. Spermatia of *Rinodina* s. str. are bacilliform (see Figs 13–14).

Choisy (1950) separated the new genus *Amandinea* from *Buellia* De Not. because of the presence of filiform spermatia in the former. He included two species (*A. myriocarpa* and *A. coniops*). However, since a Latin diagnosis was not provided, *Amandinea* was not validly published (Art. 36.1 of the ICBN). Scheidegger & Mayrhofer in Scheidegger (1993) present a valid description and three new combinations: *Amandinea coniops* (Wahlenb. in Ach.) Scheidegger & Mayrh., *A. lecideina* (Mayrh. & Poelt) Scheidegger & Mayrh. and *A. punctata* (Hoffm.) Scheidegger & Coppins.

Within the family Physciaceae the form of the spermatia was also used as one of the delimitating characters between the genera *Physcia* and *Phaeophyscia* (Moberg 1977), *Physcia* and *Physciopsis* (= *Hyperphyscia*) (Choisy 1950, Hafellner *et al.* 1979), and for *Mobergia* (Mayrhofer *et al.* 1992).

Taxonomy

***Amandinea petermannii* (Hue) Matzer, Mayrh. & Scheidegger comb. nov.**

Lecanora petermannii Hue, *Deux. Expéd. Antarct. Franç. (1908–10)*, *Sciences Naturelles, Documents Scientifiques*: 96 (1915).—*Rinodina petermannii* (Hue) Darbishire, *Lichens, Brit. Antarct. ('Terra Nova') Exped., 1910, Nat. Hist. Rep., Botany*. 3: 61 (1923).—*Beltramia*

*Institut für Botanik, Karl-Franzens-Universität Graz, Holteigasse 6, A-8010 Graz, Austria.

†Eidgenössische Forschungsanstalt für Wald, Schnee und Landschaft, CH-8903 Birmensdorf/ZH, Switzerland.

Figs 1–5. *Amandinea petermannii*. Figs 1–2. Habit photographs showing thallus with lobate-effigurate margin and lecanorine apothecia. (Fig. 1: *Smith* 2252, AAS; Fig. 2: *Longton* 672, AAS). Figs 3–5. Ascospores (*Longton* 672, AAS; squash mounts in water). Fig. 3. Transmitted light; note the slight internal wall thickenings around the septum and the diffuse torus. Figs 4–5. Differential interference contrast in different focusing showing the spore-wall ornamentation in Fig. 5. Scales: Figs 1–2 = 2 mm; Figs 3–5 = 10 μ m.

petermannii (Hue) Dodge, *Lichen Flora Antarctic Continent Adjacent Islands*: 368 (1973); type: Petermann Island, on granodioritic rock, FAE 1908–10 No. 304 p. p. (PC—lectotype), not seen, citation after Lamb (1968: 68).

Rinodina convoluta D. C. Lindsay, *Br. Antarct. Surv. Bull.* 37: 86 (1973); type: Antarctica, South Georgia, on rocks by shore, alt. c. 10 ft, near Koppen Point, Royal Bay, GR 162 098, 19 February 1961, *S.W. Greene* 2230 (AAS!—holotype).

Icon.: Lamb (1968: 61, fig. 14a; pl. XII and XIV), Redón (1985, pl. 19, fig. 81), Figs 1–12 in the present paper. The illustrations in Filson (1974: 26, figs 6g–j) are based on a *Rinodina* sp. (MEL 1012047) and therefore do not show *A. petermannii* (see also below under ‘distribution’).

Thallus (Figs 1–2) thickly crustose to mostly squamulose, squamules partly nodulose, ascendent or imbricate, lobate-effigurate at periphery, not pruinose to strongly white pruinose, alutaceous to (light) ochraceous, when pruinose $\pm$ light grey to whitish, when moistened reddish brown, on pruinose thalli the apices of the peripheral lobes lack pruina and, therefore, appear darker. *Hypothallus* distinct or not, dark brown to black, partly rimose-areolate.

Apothecia (Figs 1–2) to 2.5 mm diam., sessile, constricted at the base, mostly distinctly lecanorine, very seldom zeorine to lecideine, thalline margin strongly

FIG. 6. *Amandinea petermannii*. Ascospores; the diffuse torus (not always distinct) is indicated by fine dots. (Smith 1607, AAS). Scale = 10 μ m.

developed, entire or crenate, mostly persistent, disc plane, becoming (strongly) convex in older apothecia, dark brown to black, epruinose or slightly white pruinose. *Hymenium* 90–130 (–160) μ m tall. *Epihymenium* (15–)20–30 μ m tall, reddish brown. *Hypothecium* to 250 μ m thick, nearly hyaline, (sordid) yellowish, more seldom brownish, often attenuated towards the base. *Parathecium* thin, hyaline, broadened and reddish brown above. *Paraphyses* 1–6 μ m wide, occasionally somewhat branched, upper cells often distinctly broadened and doliform or globose, with brown cell walls, apices 5–10 μ m wide, globose to clavate, reddish brown. *Asci* 70–100 (–130) $\times$ 14–19 μ m, clavate, occasionally with a very long stipe, with 8 or fewer ascospores. *Ascospores* (Figs 3–6) brown, 1-septate, with a slight, annular, internal wall-thickening at the septum, torus diffuse, not always obvious, spore wall distinctly scabrid, (12–)13–15.4–18 (–22) $\times$ (7–)8–8.6–10 μ m (sample size = 70; length: SD = 1.6; breadth: SD = 0.6; 1/b = 1.8).

Spermogonia frequently present, immersed in the thallus, often in minute swellings of the thallus, with a minute, reddish brown to blackish ostiole, unilocular, in longitudinal section cylindrical to somewhat cuneiform, c. 70–115 μ m wide and 80–230 μ m tall. *Spermatiophores* (Figs 7, 9, 11) septate, branched or unbranched, c. 1.5–3 μ m wide. *Spermatiogenous cells* (Figs 7–9, 11) usually terminally arranged, solitary or paired, oblong, c. 1–3 μ m wide. *Spermata* (Figs 7–12) are produced apically, filiform, curved, hyaline, non-septate, c. 19–30 $\times$ 1 μ m.

Chemistry: Norstictic acid (compare Lamb 1968: 69; Piovano *et al.* 1991). Ten specimens from different localities were tested by TLC. Norstictic acid was detected in low or trace concentrations in seven specimens. Where no norstictic acid was found it is likely that the concentration of the substance in the thallus and, especially, the thalline margin of the apothecia was too low.

FIGS 7–10. *Amandinea petermannii*. Fig. 7. Spermatophores with apically arranged spermatogenous cells and filiform spermata, intermingled with algal cells. Fig. 8. Spermatogenous cell with spermatium. Fig. 9. Uppermost cell of a spermatophore with two spermatogenous cells and immature spermata. Fig. 10. Released spermata. (Figs 7, 9–10: Lindsay 3686, AAS; Fig. 8: Lindsay 3560, AAS; squash preparations in water; differential interference contrast). Scale = 10 μ m.

Ergosterol peroxide was found by Piovano *et al.* (1991).

Discussion: *Amandinea petermannii* is characterized by its thickly crustose to mostly squamulose thallus, lecanorine apothecia, ascospores with a slight internal wall-thickening around the septum, curved filiform spermata and the presence of norstictic acid.

Rinodina convoluta is a new synonym of *A. petermannii*. Lindsay (1973: 85) distinguished *R. convoluta* from *R. petermannii* by the grey thallus and pruinose apothecial discs of the former. However, not only is the colour of the thallus largely determined by the thickness of the pruina, the apothecial disc of *R. petermannii* may or may not be slightly pruinose. We examined many specimens that, according to Lindsay, represent *R. convoluta* and *R. petermannii* and found a continuum of thallus colour and a presence or absence of apothecial pruina.

Amandinea petermannii is the only one of four known species of the genus to possess lecanorine apothecia. The other three species (see Scheidegger 1993), together with further taxa to be recombined by the authors as *Amandinea* spp. have lecideine or, occasionally, cryptolecanorine apothecia. Norstictic acid is the only lichen substance found in the genus and is limited to a few taxa, e.g. '*Buellia*' *augusta* Vain., '*B.*' *fulvonitescens* M. Lamb and '*B.*' *latemarginata* Darb. (Lamb 1968).

FIGS 11–14. *Amandinea petermannii*. Spermatophores with terminally arranged spermatogenous cells and filiform spermatia. (Lindsay 3560, AAS). FIGS 12–14. Spermatia of different genera and species. FIG. 12. *Amandinea petermannii*. (Lindsay 3560, AAS). FIG. 13. *Rinodina sophodes*. (Corse, Col de Prato, 10 May 1990, Mayrhofer & Ropin, GZU). FIG. 14. *Rinodina confragosa*. (Spain, El Connio, Hafellner 9744, GZU). Scale = 10 μ m.

Amandinea petermannii has frequently been confused with other superficially similar taxa, and incorrect determinations have been reported in the literature. Thus Lindsay (1973: 87) cited the specimen Lindsay 4296 (AAS) as *R. convoluta*; it is, in fact, *Pannaria hookeri*. Moreover, Lindsay 3907, 3909 and 3916 (all in AAS) do not represent *R. petermannii* as indicated by Lindsay (1973: 88) but *Acarospora macrocyclos*. Lindsay 87 (AAS) was incorrectly reported as *R. petermannii* (Lindsay 1971a: 18); it is '*Buellia*' *augusta*. The specimens Lindsay 4066 and Greene 3256 (both in AAS), cited as *Rinodina convoluta* and *R. petermannii* respectively in Lindsay (1973: 87, 88; Greene 3256 also in Lindsay 1971a: 18), are somewhat dubious. They resemble

A. petermannii in many respects but their often zeorine or lecideine apothecia are striking. Some specimens of *Thammodendron gerlachii* were also misidentified as *A. petermannii*. Lamb (1948) retracted *T. gerlachii* as a synonym into *T. brialmontii* whereas Øvstedal (1986: 46) regarded the two species as distinct. Hafellner (1984: 290) indicated that *Thammodendron* should probably be reduced to synonymy with *Lecania*, a view that was confirmed by Øvstedal (1986: 46) and Timdal (1991: 28).

Whereas the stipes of the asci in the holotype of *Rinodina convoluta* may be more than 30 µm long, in most of the collections the stipes are shorter but quite distinct. Thus, in the above description, maximum values for ascus length and the height of the hymenium are given in parentheses.

Ecology: *Amandinea petermannii* is a 'nitrophilous', mainly saxicolous lichen occurring in coastal regions on bird-perching stones and boulders or cliffs adjacent to coastal bird aggregations. Although usually growing on eutrophicated rocks, there exist a few records of non-saxicolous specimens. Lamb (1968: 71) cited mosses (Graham Land, Doumer Island; specimen in BM!) and weathered wood as substrata, and Lindsay (1971a: 17) reported one specimen from soil. Lamb (1968: 53, 71), Lindsay (1971a: 17; b: 68; 1975: 64, 65) and Smith (1972: 39–41; 1988), all provided information concerning other lichens which may be associated with *A. petermannii*.

Distribution: *Amandinea petermannii* is a common and conspicuous species in South Georgia, South Sandwich Islands, South Orkney Islands, South Shetland Islands, the Antarctic Peninsula and its adjacent islands. However, the record for the Windmill Islands, Wilkes Land, Continental Antarctica given by Filson (1974) must be rejected. A re-examination of the specimen (Peterson Island, 1970, Anderson, MEL 1012047) demonstrated that it is not *A. petermannii* but a species of *Rinodina*. A further record for *A. petermannii* from Wilkes Land was given by Smith (1988: 156, as *Rinodina* cf. *petermannii*).

Several authors have mentioned *A. petermannii*: e.g. Hue (1915), Darbishire (1923), Dodge & Baker (1938), Lamb (1968), Lindsay (1971a, b, 1973, 1975, 1977), Smith (1972, 1988), Dodge (1973), Filson (1974), Kappen (1985), Redón (1985), Jacobsen & Kappen (1988). Kappen (1985: 223, table 5) listed two erroneous literature references concerning further localities for *A. petermannii* on the Antarctic Continent, viz. Filson (1966) and Schofield & Ahmadjian (1973). Filson did not report *A. petermannii* from Mac Robertson Land. Schofield & Ahmadjian (1973: 135) did not cite specimens of *A. petermannii*, collected in the Ellsworth Mountains; rather they referred to Lamb's (1968: 53) inclusion of *R. petermannii* among lichens said to be associated with '*Buellia*' *latemarginata*. The distribution map of *A. petermannii* provided by Lamb (1968: 70) is not in accordance with current knowledge.

Additional selected specimens examined: **South Georgia:** Serling Valley, 1971, Smith (AAS); Nuñez Peninsula, 1970, Smith 1607 (AAS); Leith whaling station, Stromness Bay, 1972, Lindsay 4343 (AAS); Maiviken, Cumberland West Bay, 1972, Lindsay 4257 (AAS); Suza Point, Cumberland East Bay, 1971, Lindsay 3334 (AAS); Hope Point, Cumberland East Bay, 1971, Lindsay 3096 (AAS); Moltke Harbour, Royal Bay, 1972, Lindsay 3896 (AAS, S); Iris Bay, 1971, Lindsay 3634 (AAS); Gold Harbour, 1971, Lindsay 3585 (AAS); Bjornstadt Bay, 1971, Lindsay 3560 (ASS); Wirik Bay, 1971, Lindsay 3686 (AAS).—**South Sandwich Islands:** *Candlemas*

Island, 1964, *Longton* 672 (AAS).—**South Orkney Islands:** *Coronation Island:* Lynch Island, 1972, *Hooker* 34 (AAS). *Signy Island:* North Point, 1973, *Hooker* 220 (AAS); Thulla Point, 1966, *Smith* 1066 (AAS); Berntsen Point, Borge Bay, 1967, *Lindsay* 1565 (AAS); Knife Point, Borge Bay, 1966, *Lindsay* 1438 (AAS); Factory Cove, 1973, *Hooker* 411 (AAS); Observation Bluff, 1973, *Hooker* 451 (AAS); Paal Harbour, 1989, *Smith* (GZU); Pageant Point, 1973, *Hooker* 420 (AAS); Gourley Peninsula, 1973, *Hooker* 415 (AAS). *Laurie Island:* Cape Geddes, 1946, Falkland Islands Dependencies Survey C3-1001 (BM).—**South Shetland Islands:** *Kind George Islands:* Ardley, 1985, *Peter* (JE); Pinguinera, 1984, *Kappen*, A 772 (GZU). *Livingston Island:* Peninsula de Byers, 1990, *Sancho* (MAF). *Deception Island:* Baily Head, on rocks, 1961, *Killingbeck* 49 (AAS, as *Arthonia* spec. ined.).—**Antarctic Peninsula:** Astrolabe Is., 1981, *Smith* 4067 a/b (AAS); Trinity Peninsula, Hope Bay, between Scar Hills South and Mount Flora, 1961, *Brading* 44 (AAS); Cape Roquemaurel, 1981, *Smith* 3946 (AAS); Young Pt, Bone Bay, 1981, *Smith* 3917 a,b (AAS); Caleta Brialmont, Cabo Spring, Base Argentina 'Primavera', 1991, *Scutari*, BAFC 36816 (dupl.) (GZU); Cuverville Is., 1981, *Smith* 4206 (AAS); Graham Land, Palmer Archipelago, Port Lockroy, Goudier Island, 1945, *Lamb* A 2256 (BM); Palmer Archipelago, Doumer Island, over mosses, 1944, *Lamb* A 1929 (BM); Galindez Island, 1935, Brit. Graham Land ('Penola') Exped. 1116–84 (BM); Piñero Is., 1981, *Smith* 4816 (AAS); Rothera Pt, Adelaide Is., Loubet Coast, 1977, *Smith* 2262 (AAS); B.A.S. station, south-west Adelaide Is., Fallières Coast, 1977, *Smith* 2252 (AAS); Graham Land, Marguerite Bay, between Horseshoe Island and Camp Point, 1948, *Stonehouse & Blaiklock* (BM).

We are indebted to the directors and keepers of the following herbaria: AAS, BM, JE, GZU, KIEL-HA, MAF, MEL and S for arranging loans. We are especially grateful to Dr R. I. Lewis Smith (Cambridge) for providing the huge collections of AAS, Prof. Dr L. Kappen (Kiel) for his help with literature, and Dr P. M. McCarthy (Melbourne) for correcting the English text. The support of the Fonds zur Förderung wissenschaftlicher Forschung (Projekt P 8500-BIO) is acknowledged by M.M. and H.M.

REFERENCES

- Choisy, M. (1950) Catalogue des lichens de la region Lyonnaise. Fasc. 3. *Bulletin de la Société Linnéenne de Lyon* **19**: 9–24.
- Darbishire, O. V. (1923) Lichens. *British Antarctic ("Terra Nova") Expedition, 1910, Natural History Report, Botany*, **3**: 29–76.
- Dodge, C. W. (1973) *Lichen Flora of the Antarctic Continent and Adjacent Islands*. Canaan, New Hampshire: Phoenix Publishing.
- Dodge, C. W. & Baker, G. E. (1938) The second Byrd Antarctic Expedition—Botany. II. Lichens and lichen parasites. *Annals of the Missouri Botanical Garden* **25**: 515–718.
- Filson, R. B. (1966) The lichens and mosses of MacRobertson Land. *Australian National Antarctic Research Expedition Scientific Reports, B (II) Botany*, **82**: 1–169.
- Filson, R. B. (1974) Studies in Antarctic lichens II: Lichens from the Windmill Islands, Wilkes Land. *Muelleria* **3**: 9–36.
- Hafellner, J. (1984) Studien in Richtung einer natürlicheren Gliederung der Sammelfamilien Lecanoraceae und Lecideaceae. *Beiheft zur Nova Hedwigia* **79**: 241–371.
- Hafellner, J., Mayrhofer, H. & Poelt, J. (1979) Die Gattungen der Flechtenfamilie Physciaceae. *Herzogia* **5**: 39–79.
- Hue, A. M. (1915) Lichens. *Deuxième Expédition Antarctique Française (1908–1910) Sciences Naturelles, Documents Scientifiques*. Paris: Masson et Cie.
- Jacobsen, P. & Kappen, L. (1988) Lichens from the Admiralty Bay region, King George Island (South Shetland Islands, Antarctica). *Nova Hedwigia* **46**: 503–510.
- Kappen, L. (1985) Vegetation and ecology of ice-free areas of Northern Victoria Land, Antarctica 1. The lichen vegetation of Birthday Ridge and an inland mountain. *Polar Biology* **4**: 213–225.
- Lamb, I. M. (1948) New, rare or interesting lichens from the Southern Hemisphere I. *Liltoa* **14**: 203–251.
- Lamb, I. M. (1968) Antarctic lichens II. The genera *Buellia* and *Rinodina*. *British Antarctic Survey, Scientific Reports* **61**: 1–129.
- Lindsay, D. C. (1971a) Notes on Antarctic lichens: I. New records for *Buellia* and *Rinodina*. *Bulletin of the British Antarctic Survey* **24**: 11–19.

- Lindsay, D. C. (1971b) Vegetation of the South Shetland Islands. *Bulletin of the British Antarctic Survey* **25**: 59–83.
- Lindsay, D. C. (1973) South Georgian microlichens: I. The genera *Buellia* and *Rinodina*. *Bulletin of the British Antarctic Survey* **37**: 81–89.
- Lindsay, D. C. (1975) ['1974'] The macrolichens of South Georgia. *British Antarctic Survey, Scientific Reports* **89**: 1–91.
- Lindsay, D. C. (1977) Lichens of cold deserts. In *Lichen Ecology* (M. R. D. Seaward, ed.): 183–209. New York: Academic Press.
- Mayrhofer, H., Sheard, J. W. & Matzer, M. (1992) *Mobergia* (Physciaceae, lichenized ascomycetes), a new genus endemic to western North America. *Bryologist* **95**: 436–442.
- Moberg, R. (1977) The lichen genus *Physcia* and allied genera in Fennoscandia. *Symbolae Botanicae Upsaliensis* **22**: 1–108.
- Øvstedal, D. O. (1986) Crustose lichens of Bouvetøya. *Norsk Polarinstitutt Skrifter* **185**: 35–56.
- Piovano, M., Garbarino, J. A., Chamy, M. C., Zúñiga, V., Miranda, C., Céspedes, E., Fiedler, P., Quilhot, W. & Araya, G. (1991) Studies on Chilean lichens. XVI. Advances in the chemistry of secondary metabolites from Antarctic lichens. *Serie Científica, Instituto Antártico Chileno* **41**: 79–90.
- Redón, J. (1985) *Liquenes Antárticos*. Santiago de Chile: Instituto Antártico Chileno.
- Scheidegger, Ch. (1993) A revision of saxicolous species of the genus *Buellia* De Not. and formerly included genera in Europe. *Lichenologist* **25**: 315–364.
- Schofield, E. & Ahmadjian, V. (1973) Field observations and laboratory studies of some Antarctic cold desert cryptogams. In Antarctic terrestrial biology (G. A. Llano, ed.). *Antarctic Research Series* **20**: 97–142. Washington, D.C.: American Geophysical Union.
- Smith, R. I. L. (1972) Vegetation of the South Orkney Islands with particular reference to Signy Island. *British Antarctic Survey, Scientific Reports* **68**: 1–124.
- Smith, R. I. L. (1988) Classification and ordination of cryptogamic communities in Wilkes Land, Continental Antarctica. *Vegetatio* **76**: 155–166.
- Timdal, E. (1991) A monograph of the genus *Toninia* (Lecideaceae, Ascomycetes). *Opera Botanica* **110**: 1–137.

Accepted for publication 6 December 1992