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Notes on *Halecania* species, with descriptions of two new species from Asia

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Abstract: Two species of *Halecania* from Asia, *H. lobulata* van den Boom & Elix and *H. pakistanica* van den Boom & Elix are described as new to science. In addition, the new combination *Halecania pepegospora* (H. Magn.) van den Boom is made. The ecology, distribution and chemistry of some selected species are discussed and a key to the fifteen species known worldwide is given.

Key words: Australasia, *Halecania australis*, *H. lobulata*, *H. pakistanica*, *H. pepegospora*, key, new combination, new species, taxonomy

Introduction

The genus *Halecania* was originally described by Mayrhofer (1987) to accommodate six saxicolous species from Europe, formerly included in *Lecania* s. lat. *Halecania*, with *H. alpivaga* (Th. Fr.) M. Mayrhofer as type species, belongs to the family *Catillariaceae* whereas *Lecania* s. str. belongs in the *Ramalinaceae*. Subsequently, Coppins (1989) and Fryday & Coppins (1996) described three further species from Scotland, the corticolous *H. viridescens* Coppins & P. James, the muscicolous *H. bryophila* Fryday & Coppins and the saxicolous *H. micacea* Fryday & Coppins. A further saxicolous species, formerly included in *Catillaria*, *H. rhypodiza* (Nyl.) Coppins, was transferred to *Halecania* by Coppins (1989). *Halecania australis* Lumbsch has been described from Australia (Lumbsch & Feige 1994). More recently, van den Boom & Etayo (2001) described *H. giraltiae* van den Boom & Etayo, from Spain and Portugal, a species which is both saxicolous and lichenicolous, illustrating the diversity of substrata occupied by members of this genus.

In the present paper we describe two new saxicolous *Halecania* species from Asia, *H. lobulata* and *H. pakistanica*; the first mentioned is also lichenicolous. After examining many collections of *H. alpivaga* from central Europe, North America and Greenland, it became apparent that this species either only occurs in association with *Placynthium nigrum*, rather than with *Physcia* species as has been reported previously, or it grows independently from other lichens. Overall, the species of *Halecania* are now known to occur on a wide range of substrata, from calcareous or acidic rocks (often in eutrophic conditions) in the mesic-supralittoral zone to montane areas to bark, lignum, bryophytes or lichens. In addition, we report significant range extensions for several species. *Halecania ralfsii* (Salwey) M. Mayrhofer is reported from acidic coastal rocks in New Zealand, the first collection of this species from outside of Europe. *Halecania australis*, previously known only from the type locality in south-eastern Australia and from western North America (van den Boom & Ryan in Nash *et al.* 2004), is now reported from New Zealand. Thus it is apparent that *Halecania* is a

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subcosmopolitan genus, widely distributed in Europe from the most northern boreal and arctic areas to the Mediterranean region, as well as in Asia, Australia, New Zealand and North America. The chemistry of a number of *Halecania* species has been re-examined and several compounds are recorded for the first time from the genus, including confluentic, cryptostictic, isousnic and stictic acids. A key to the fifteen known species of *Halecania* is also presented.

Materials and Methods

Specimens from CANB, B, GZU, UPS, and the private herbaria of P. van den Boom and M. Brand were examined. The majority of specimens from GZU were collected in Australia by Prof. H. Mayrhofer in 1988 and 1992 and by M. Lambauer in 2003. Measurements of ascospores and pycnospores were made in water at × 400 or × 1000 magnification. Amyloid reactions were tested using Lugol's iodine solution (K/I). The secondary metabolites present in most specimens were identified by TLC (Culberson & Ammann 1979; Culberson & Johnson 1982; Elix & Ernst-Russell 1993) and/or by HPLC (Elix *et al.* 2003).

The Species

Halecania alpivaga (Th. Fr.) M. Mayrhofer

According to Mayrhofer (1987), *H. alpivaga* is a lichenicolous species which grows over species of the genera *Placynthium* and *Physcia*. However, several of the specimens examined were clearly growing on rock without any other lichens being present. In other specimens *Placynthium nigrum* (Huds.) S.F. Gray was growing in association with *H. alpivaga*, and in one specimen *H. alpivaga* was growing over a *Dermatocarpon* species. *Physcia* has not been observed as host, but only as an accompanying species.

Selected specimens examined. **Austria:** Steiermark, Niedere Tauern, Schladminger Tauern, Großsölktal W of St. Nikolai in Sölktal, non parasitic, 2450 m, 1993, *A. Wilfling* 71 (GZU); Wölzer Tauern, Zinkenkogel N of Bretstein, on unidentified crust, 1980 m, 1993, *A. Wilfling* 2114 (GZU); Sandlerkogel N of Oberwölz, SW of Pusterwald, non parasitic, 2100 m, 1993, *A. Wilfling* 1452 (GZU); Steirisches Randgebirge, Stubalpe, Brandkogel W of Köflach, 3 km S of Gaberl Pass, non parasitic, 1630 m, 1994, *A. Wilfling* 2790 (GZU).

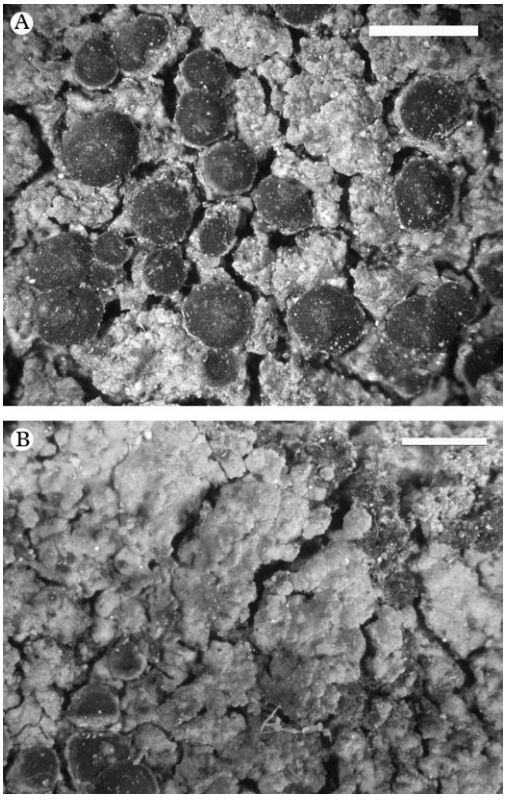

FIG. 1. Habitus of *Halecania australis*. A, rimose-areolate thallus with apothecia (Australia, *Elix* 31580); B, marginal part of the thallus with a few apothecia (Australia, *Mayrhofer* 10986). Scales: A & B = 1 mm.

Halecania australis Lumbsch

Descriptions of this species can be found in Lumbsch & Feige (1994) and van den Boom & Ryan (2004). However the description below presents additional data of some characters, including new data regarding the chemistry, based on additional rich material from southern Australasia.

(Fig. 1)

Thallus crustose, rimose, areolate to scurfy-squamulose; areoles 0·2–0·4 mm wide, 0·3 mm high, angular to roundish; squamules sometimes upturned at margin and often wavy, incised, sometimes imbricate, up to 0·5(–0.7) mm wide but not lobulate at the margin; *upper surface* pale

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brown, grey-brown to clay-brown, pale to dark olivaceous to rarely almost blackish; *upper cortex* not differentiated, mostly ecorticate, occasionally paraplectenchymatous, cells 2–5 µm, no epinecral layer, algal cells scattered throughout the thallus. *Prothallus* sometimes visible, thin and pale to mid-brown. *Photobiont* chlorococcoid, algal cells 5–12 µm diam.

Apothecia 0·2–0·5 mm wide, frequent, adnate to broadly sessile or somewhat immersed, scattered to grouped, sometimes crowded. *Disc* red-brown to dark brown, paler (reddish brown) when wet, plane, sometimes weakly convex; epruinose. *Thalline exciple* concolorous with the thallus, swollen when young, narrower when old, sometimes crenulate, not excluded, outer edge anatomically similar to cortex of the thallus, with a colourless, superficial, amorphous layer, intermixed with photobiont cells, with algae filling the entire margin and abundant at the underside of the hypothecium. *Hymenium* 60–70 µm high, hyaline; *epihymenium* brown, red-brown to orange, without granules, ± uniformly coloured, K −, N −; *hypothecium* up to 150 µm high, hyaline. *Paraphyses* slightly swollen (clavate) and short-celled in the upper third, cell walls in upper part often brown-black, mid-hymenium cells 1–1·5 µm wide, apical cells up to *c.* 4 µm wide, simple to occasionally branched. *Asci* narrowly clavate, *c.* 40–50 × 12–20 µm, with a thin amyloid outer gelatinous coat, lacking an ocular chamber, with K/I giving a uniformly amyloid apical dome, *Catillaria*-type, 8-spored. *Ascospores* ± ellipsoid, clavate or ovoid, (9–)10–14(–16) × 3–5 µm (in water), 1-septate, the septum sometimes central, but often situated toward the lower end, thin-walled, halonate, perispore swelling up to *c.* 2 µm in KOH, often not well developed.

Pycnidia occasionally present, inconspicuous, immersed in the thallus, *c.* 80–100 µm diam., pale brown around the ostiole, hyaline below. *Conidia* simple, short bacilliform, 3–4 × 1 µm.

Chemistry. Thallus K −, C −, KC −, P −; two chemical races containing unknown triterpenes detected by TLC (race 1: Rfc 80 major, Rfc 74 minor; race 2: Rfc 76 major, Rfc 79 minor).

Distribution and ecology. This species occurs on acidic rocks, including granite and sandstone, in coastal (supralittoral zone) or open inland areas at elevations from sea-level to 650 m. It is currently known from Australia (from Western Australia to New South Wales), New Zealand (South Island) and North America (USA, Arizona).

Notes. Halecania australis was originally reported only from the type locality (Lumbsch & Feige 1994). An examination of additional specimens from a wide range of localities in Australia and New Zealand, has established that the morphology of this species is quite variable. It can be distinguished by the finely areolate thallus, which often forms small, scattered squamules, or a thallus which is more or less completely subsquamulose to squamulose. Thalli vary in colour from pale brown to dark olivaceous brown and the apothecia may be adnate or more often sessile. Several unidentified triterpenes have been detected by thin layer chromatography (TLC). According to Lumbsch & Feige (1994) *H. australis* contained atranorin, zeorin (major) and chloroatranorin (minor). However re-examination of the holotype by TLC (using solvent C) established that this specimen contains two unidentified triterpenens (Rfc 76 major, Rfc 79 minor) but no trace of atranorin or chloroatranorin. Nine of the Australasian specimens examined by TLC contained these compounds – eight from New South Wales (Australia) and one from New Zealand. A further five specimens contained related compounds, namely two different unidentified triterpenes (Rfc 80 major, Rfc 74 minor). The latter specimens were from Western Australia, South Australia (Kangaroo Island) and Tasmania but as they were morphologically identical with the former material, we have included them in *H. australis*. In habitus, *H. australis* resembles *Lecania rabenhorstii* and *L. inundata*, but the *Lecania* species have

different asci, ascospores, paraphyses, and epihymenium, and lack a medullary chemistry. *Halecania australis* also resembles *Solenopsora* '*chihuahuana*' (Ryan & Timdal in Nash *et al*. 2002) especially in the squamulose growth form. The latter species has not been formally described but has rather similar paraphyses and asci, although the ascospores are not halonate. The chemistry is different with pannarin, zeorin and unidentified secondary products. Furthermore, the thallus is not clearly areolate, even in part (as is the case in *H. australis*), but it is squamulose throughout with relatively large squamules. None of the other known *Halecania* species growing on acidic rocks have a pale brown thallus which is partly (sub)squamulose.

One specimen (*Lambauer* 0075) has been found with discrete soralia. Interestingly, the sorediate part of the thallus lacks apothecia, whereas the fertile portion of the thallus lacks soralia. As the chemistry of the specimen is uniform and identical with that of the holotype of *H. australis*, we do not give this form any taxonomic status.

Additional specimens examined. Halecania australis with triterpenes Rfc 76(major), Rfc 79(minor). **Australia:** *Australian Capital Territory*: Murrays Corner, along Paddys River, on granite in *Casuarina-Acacia* woodland, 550 m, 1984, *J. A. Elix* 11804 (B); 14 km E of Canberra, Molongo Gorge Reserve, 35°16′S, 149°16′E, 650 m, 1992, *H. Mayrhofer* 10987 & *J. Elix* (GZU). *New South Wales*: Boulder Bay, Snapper Point, N exposed granite in spray zone, 32°45′33″S, 152°09′43″E, 10 m, 2003, *M. Lambauer* 0075 *& R. Filson* (GZU); Nelson Bay, Fisherman's Point, W of Birubi Beach NNW exposed ryolite rocks in spray zone, 32°47′17″S, 152°04′50″E, 10 m, 2003, *M. Lambauer* 0080 & *R. Filson* (GZU); Singleton, Putty Road between Milbrodale and Howes Valley, 26 km NE of Howes Valley, on sandstone, 100 m, 1992, *H. Mayrhofer* 11170 & *E. Hierzer* (GZU); Weddin Mountains National Park, 15 km SW of Grenfell, 1990, *H. Streimann* 44770 (GZU).—**New Zealand:** *South Island*: Nelson, Maitai River Road, opposite Baptist camp, S of Nelson, E-exposed shady acid rock along the road, 41°17′40″S, 173°19′33″E, 42 m, 2003, *M. Lambauer* 0210, *N. & B. Malcolm* (GZU).

Halecania australis with triterpenes Rfc 80(major), Rfc 74(minor). **Australia:** *Tasmania*: Spring Beach, S of Orford, coastal sandstone rocks, 42°35′S, 147°53′E, 1992, *H. Mayrhofer* 11251 *& E. Hierzer*; Midland Highway, Dysart, N of Bagdad, *c*. 250 m, sandstone cliffs, 42°35′S, 147°13′E, 1992, *H. Mayrhofer* 12072 *& E. Hierzer*. *South Australia*: Kangaroo Island, Hog Bay, 3 km E of Penneshaw, exposed coastal rocks in grasslands, 15 m, 35°43′S, 137°57′E, 1994, *H. Streimann* 54868a (B, CANB). *Western Australia*: Lower South West, Meelup, NW of Dunsborough, coastal granite rocks, 1988, *M., D. & H. Mayrhofer* 8535 (GZU).

Halecania australis not examined by TLC. **Australia:** *New South Wales*: Nelson Bay, Fisherman's Point, W of Birubi Beach, NNW exposed ryolite rocks in spray zone, 32°47′17″S, 152°04′50″E, 10 m, 2003, *M. Lambauer* 0080 *& R. Filson* (GZU); Putty Road, Boogy Swamp Creek, 5 km NE intersection to Putty, on NE exposed sandstone in *Eucalyptus* forest, 35°56′28″S, 150°42′06″E, 220 m, 2003, *M. Lambauer* 0085 (GZU); "Australian Rock" near Narooma, E exposed schistose rock, spray zone, 36°12′41″S, 150°08′02″E, 1.5 m, 2003, *M. Lambauer* 0007 (GZU); Shoalhaven River, Warri Bridge 13 km NW of Braidwood, on NW exposed granite along river, 35°20′29″S, 149°44′26″E, 640 m, 2003, *M. Lambauer* 0038 *& J. Elix* (GZU).

Halecania giraltiae van den Boom & Etayo

Halecania giraltiae, recently described from the Iberian Peninsula (van den Boom & Etayo 2001), is a sorediate species which grows directly on rocks or over thalli of *Aspicilia* or *Rhizocarpon* species. The distribution range of this species has now been extended to Greece. This specimen was previously misidentified as *H. alpivaga*.

Specimens examined. **Greece:** Pindis, katara-path, E of Metsovon, E exposed overhanging rock-face, 1580 m, 25 viii 1976, *H. Mayrhofer* s. n. (GZU).—**Spain:** *Castilla-Leon*: S of Ponferrada, Lago de Sanabria path from Ribadelago Viejo to San Martin, on vertical moderately shaded granite, on crust & *Rhizocarpon* sp. (yellow), 1100 m, 2001, *P. van den Boom* 27173 (hb. v.d. Boom).

Halecania lobulata van den Boom & Elix sp. nov.

Thallus parvus, plus-minusve arcte affixus, ad 0·5 cm diam., marginaliter distincte lobatus, ad 0·5 cm crassus, lobis ad 2 mm longis; superficies fulvas vel griseo-fuscescens, leniter albido-pruinosa versus apices loborum; cortex superficialis absens. Apothecia adnata vel sessilia, lecanorina, 0·5(–0·7) mm diam., discus fuscus, epruinosus; margo thallinus planus, tenuis, ad 0·1 mm crassus; apices paraphysorum pleurumque fusco-capitatis. Asci clavati, typo *Catillariae*. Ascosporae paucae et immaturae, hyalinae, uniseptatae, ellipsoideae vel oblongo-ellipsoideae 9–12 × (3·5–)4–5 µm (sine strato perisporico), stratum perisporicum

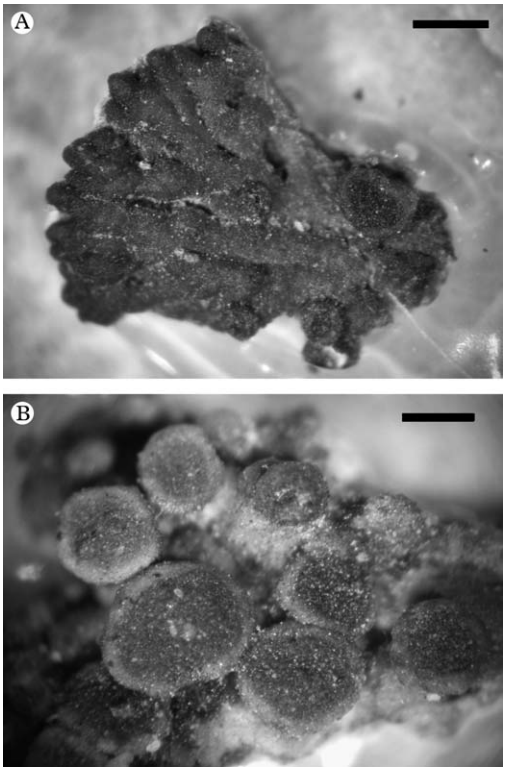

FIG. 2. Habitus of *Halecania lobulata* (holotype). A, lobulate thallus with a few apothecia; B, apothecia of the inner part of the thallus. Scales: A=0·5 mm; B=0·3 mm.

gelatinosum, 1–1·5 crassium in KOH. Conidia bacilliformia 3–3·5 × 0·8–1 µm. In thallo lichenis *Hymenelia* sp. crescit. Thallus substantia major acidum isousnicum continens; et substantias minores acida atranorinum, confluenicum, sticticum et cryptostictícum continens. Habitat ad saxa montana.

Typus: North Korea, Myohyangsam, Isoonam-Tal, am Wasserfall an aufrechter Granite-wand, auf Krustenflechten (aff. *Hymenelia* sp.), 7 October 1986, *S. Huneck* K-86-53 (GZU—holotypus, hb. van den Boom—isotypus).

(Fig. 2)

Thallus rosette-forming, closely adpressed, forming patches up to *c.* 0·5 cm wide, thin (0·1–0·3 mm); rimose-areolate in centre; *areoles* 0·3–1 mm wide, contiguous, irregularly angular to rounded or crenate, plane to somewhat convex or uneven; *lobes* contiguous, placodiform, separated at most by incomplete cracks, plane to often slightly convex, up to *c.* 2 mm long, 0·5–1·5 mm wide, entire and rounded or partly crenate-incised, the ultimate segments 0·3–0·5 (–0·7) mm wide; the tips somewhat raised from the substratum; *upper surface* smooth, matt to slightly shiny, epruinose, greyish- to yellowish brown, dark yellow-grey in the centre, pale brownish grey or slightly yellowish when wet, no cortex developed; in section, hyphae dark brown at the apices, interspersed with refractive granules which are up to 4 µm wide especially around the apothecia, granules soluble in KOH, no epinecral layer detected; *algal layer* not differentiated, algae filling the upper part of the thallus and almost reaching the upper surface; *photobiont* chlorococcoid, algal cells 7–15 µm diam.; *lower surface* pale brownish, consisting of interwoven hyphae which are 2–3 µm wide, thin-walled, lower cortex not developed. *Prothallus* sometimes visible, dark bluish black.

Apothecia common, adpressed to sessile, soon becoming narrowly sessile and constricted at base, often crowded in thallus centre, to *c.* 0·5(–0·7) mm wide. *Disc* plane to slightly concave, becoming somewhat convex, dark reddish brown, mid- to dark brown or brownish black, epruinose. *Thalline exciple c.* 0·1 mm wide, persistent, pale yellowish brown, entire to sinuous, ecorticate, algae filling most part of the margin and forming a continuous layer interspersed with fine granules, granules soluble in KOH. *True excipulum* poorly developed, present only in young apothecia, thickening towards surface of the margin, up to 20–30 µm wide, becoming brownish. *Hymenium* hyaline, 30–50 µm high; *epithecium* moderately brown, K−, N−; *hypothecium* 20–30 µm thick, hyaline. *Paraphyses* conglutinate in water, often branched, sometimes anastomosing, 1–1·5(–2) µm thick in mid-hymenial cells, tips clavate to capitate, 2–4 µm wide, the apical cell yellow-brown, darker at extreme tip. *Asci* narrowly clavate, 25–40 × 10–15 µm, *Catillaria*-type, ocular chamber not developed, with an uniformly amyloid apical dome in K/I. *Ascospores* mostly oblong-ellipsoid or ellipsoid, 9–12 × (3·5–)4–5 µm, thin-walled,

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1-septate, the septum half to two-thirds from the upper end, halonate; *perispore* not always distinct in water but obvious in KOH, 1–1·5 µm wide, often strongly thickened at septum.

Pycnidia immersed to somewhat raised, *c*. 50 µm wide, ostiole dark red-brown. *Conidia* short bacilliform, 3–3·5 × 0·8–1 µm.

Chemistry. Thallus K+ yellow, C −, P −, KC −; with isousnic acid (major), atranorin (minor), confluentic acid (minor), stictic acid (minor), cryptostictic (minor) (TLC in solvent C; HPLC).

Distribution and ecology. Lichenicolous over *Hymenelia* sp. on calcareous rocks, in an unknown community. Apart from the host (*Hymenelia*) there were no other associated species present in the type specimen, which was collected as many very small fragments (scrapings). The altitude of mountain Myohyangsan (summit) is 1909 m, but the altitude of the type locality was not specified. At present *H. lobulata* is known only from the type collection.

Notes. *Halecania lobulata* resembling a species of *Solenopsora*, the former is easily distinguishable by the halonate ascospores. The chemistry of *H. lobulata* is particularly interesting and adds several compounds new to the genus, namely isousnic, confluentic, stictic and cryptostictic acids.

Halecania pakistanica van den Boom & Elix sp. nov.

Halecania pepegospora similis, sed thallo papilloso, areolato, non granuloso, areolis differt, areolis interdum margine elevato, undulato, inciso, apotheciis majoribus et ascosporis majoribus differt, sine acidis lichenis.

Typus: Pakistan, Karakorum, Baltistan, Haramosh Range, 'Alm' Matumdus, NW Chutren, 3620 m, 6 July 1991, *J. Poelt* K 91-22 (GZU—holotypus; hb. van den Boom—isotypus).

(Fig. 3)

Thallus crustose, areolate, areoles 0·2–0·8(–1) mm wide, up to 0.3 mm high, angular, sometimes gently upturned at margin, not incised nor imbricate, more flattened and thinner towards the edge of the thallus; *upper surface* roughened, uneven to somewhat granular, granules 50–80(–100) µm, matt, pale brown or grey-brown to yellowish-brown, cortex not developed, no epinecral layer present, algal cells scattered throughout the thallus; *photobiont* chlorococcoid, algal cells 6–12 µm, without refractive granules. *Prothallus* generally visible, dark brown to blackish brown.

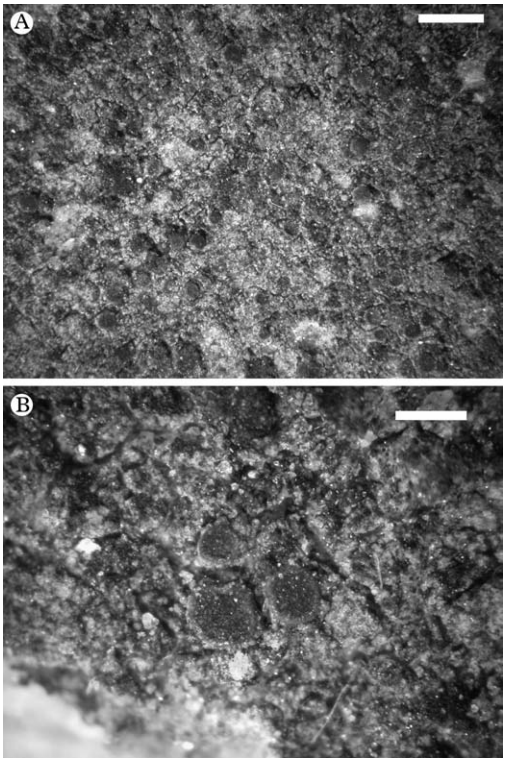

FIG. 3. Habitus of *Halecania pakistanica* (holotype). A, thallus with scattered apothecia; B, a group of apothecia. Scales: A = 1 mm; B = 0·5 mm.

Apothecia 0·2–1 mm wide, common, somewhat immersed to broadly sessile, scattered, rarely grouped. *Disc* mid-brown to dark brown, paler (reddish brown) when wet, plane, sometimes weakly concave when young to weakly convex when mature, epruinose; thalline margin not developed initially but present in mature apothecia, thin, 0·1 (–0·15) mm and ± crenulate, concolorous with the thallus, not excluded, with

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intricately hyaline hyphae (in section), ecorticate, outer edge with a thin rim of ± radiating brownish hyphae. *True excipulum* well developed, especially in young apothecia, with a colourless inner part, becoming moderately brown toward the outer rim, up to 100 µm wide. *Hymenium* 50–60 µm high, hyaline; *epihymenium* brown, red-brown to orange, without granules, K−, N−; *hypothecium* 150–200 µm thick in the centre including subhymenium, hyaline, hyphae not oriented except in the lower part where a narrow rim of paraplectenchymatous cells of 2–3 µm diam. is visible. *Paraphyses* conglutinated, slightly swollen (clavate) and short-celled in the upper part, 1·5–2(–2·5) µm wide in mid-hymenium cells, cell walls brownish black in apical cells, up to *c.* 5 µm wide, simple to occasionally branched. *Asci* narrowly clavate, *c.* 30–40 × 9–12 µm, with a thin amyloid outer gelatinous coat, lacking an ocular chamber, with a uniformly amyloid apical dome in K/I, *Catillaria*-type, 8-spored. *Ascospores* oblong-ellipsoid or rarely ovoid, (9–)10–12(–14) × (4–)4·5–6·5 µm (in water), 1-septate, thin-walled, halonate, perispore *c.* 1 µm wide, swelling up to *c.* 2 µm in KOH, sometimes thickened at septum.

Pycnidia occasionally present, inconspicuous, immersed in the thallus, *c.* 50–70 µm wide, dark brown around the ostiole, hyaline below, K−, N−, conidiogenous cells shortly branched, septate, *c.* 12 × 2·5 µm. *Conidia* simple, short bacilliform, 2·5–3 × 1(–1·5) µm.

Chemistry. Thallus K−, C−, KC−, P−; no substances detected by TLC or HPLC.

Notes. This species is known only from the type locality in Pakistan, where it was found on calcareous rocks at high altitude (3620 m). It is growing close to *Placynthium nigrum*, but it is not clear whether the *Halecania* is lichenicolous on this species. However, it is possible that *H. pakistanica* begins developing on that host but soon becomes autonomous. Associated species include *Lecidella stigmatea* (Ach.) Hertel & Leuckert and a poorly developed *Caloplaca* species.

The apothecia of *H. pakistanica* closely resemble those of *H. pepegospora*, but both the apothecia (0·2–1 mm vs. 0·4–0·5 mm wide) and the ascospores (10–12 × 4·5–6·5 µm vs. 8–10 × 4–5 µm) are somewhat larger in *H. pakistanica*. Furthermore, *H. pepegospora* has a different thallus (being granulate-warted and not clearly areolate) and contains argopsin and norargopsin. The new species resembles also *Halecania spodomela* but this species occurs on acidic rocks associated with blackish cyanobacteria, and the thallus consists of small scattered granules, the apothecia are dark brown to blackish with a well-developed lecanorine margin and a greenish epithecium which reacts N+ red.

Halecania pepegospora (H. Magn.) van den Boom comb. nov.

Basionym: *Lecania pepegospora* H. Magn., *Bryologist* **53:** 205 (1950).

Type: USA, Connecticut, Litchfield, Aton Forest, E of the 3 acre meadow, on gneiss rocks of a stone wall in a mixed wood, abundant, forming a large dark greenish crust over many shaded rocks, August 1949, *M.E. Hale Jr.* 139 (UPS—holotype).

(Fig. 4)

Thallus effuse, covering an area *c.* 7 cm wide, thin, rimose to weakly areolate, granulate-uneven, in part with confluent, low, irregular granules, mostly sordid, comprising a mixture of brownish and green-grey granules; *upper surface* areolate, areoles granular-warted; granules often confluent, 0·1–0·25(–0·3) mm wide, convex; up to 0·3(–0·4) mm thick; upper surface almost furfuraceous, light olive-grey to pale yellowish green mottled with olive-black to brownish black or black, inconspicuous soralia; soralia roundish, 25–50 µm, or up to 100 µm wide when confluent; *upper cortex* absent; *epinecral layer* not developed. *Photobiont* chlorococcoid, algal layer densely filling the thallus, algae 5–7 µm wide.

Apothecia 0·4–0·5 mm wide, usually rather scattered, rarely ± crowded or absent, sunk (with their base) into the thallus, gradually

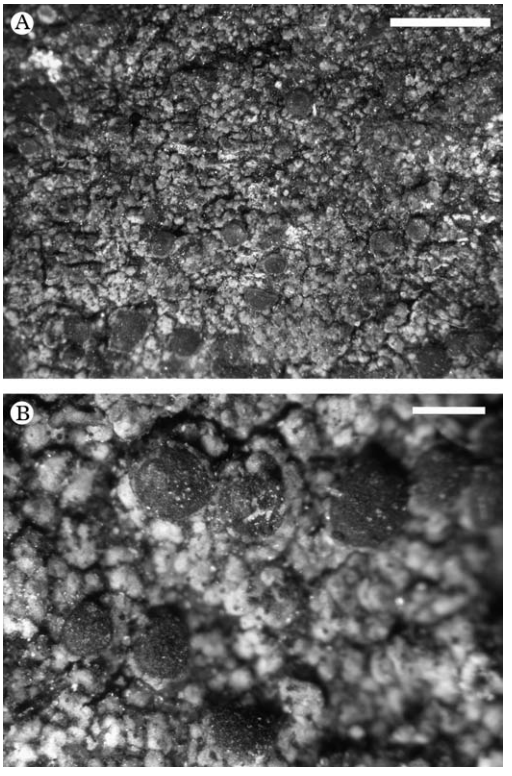

FIG. 4. Habitus of *Halecania pepegospora* (holotype). A, thallus with scattered apothecia; B, thallus with black soralia and some apothecia. Scales: A=1 mm; B=0·5 mm.

adpressed. *Disc* dark brown, paler when wet, ± plane at first, soon slightly to moderately convex; thalline margin concolorous with the thallus (not concolorous with disc as stated in the protologue), thin, below disc, sometimes granulate, becoming excluded, algal layer *c*. 30–50 µm thick, ± continuous, visible at the lower part of the apothecium. *True excipulum* often appearing as a dark rim, sometimes giving the apothecia a lecideine appearance, hyaline at inner part, dark reddish brown towards the outer rim, up to 50 µm wide. *Hymenium* hyaline, 50–60 µm high; *epithecium* dark reddish brown, K−, N−; *hypothecium* hyaline, up to 125 µm high, with paraplectenchymatous cells at lower part, cells 2–4 µm wide. *Paraphyses* conglutinate, 1–1·5 µm wide at the mid-hymenium cells, septate, tips at least partly thickened, 2–3 µm wide, *c*. 50% of the tips with an internal dark brown pigment, simple to sometimes sparingly branched. *Asci* 35–45 × 8–12 µm, oblong-clavate, wall much thicker at apex, with a uniformly amyloid apical dome in K/I, 8-spored, *Catillaria*-type. *Ascospores* 1-septate with a thin septum (*c*. 1 µm), when mature readily adhering in clusters, 8–10(–12) × 4–5 µm, with a gelatinous perispore, perispore (in KOH) *c*. 1·5 µm wide.

Pycnidia immersed to somewhat raised, 50–80 µm wide, inconspicuous, brownish black in appearance, cells around the ostiole dark brown, K−, N−; conidiophores branched, *c*. 10 × 2 µm. *Conidia* hyaline, simple, ± bacilliform to ellipsoid, 2–3 × 0·5–0·8 µm.

Chemistry. Thallus K−, C−, KC−, P+ red-orange, I−; argopsin (major), norargopsin (minor) by HPLC.

Notes. The description above is based on a re-examination of the holotype. The thin paraphyses with small brown apices, *Catillaria*-type asci, the halonate ascospores and chemistry confirm that this species belongs in *Halecania*.

Halecania ralfsii (Salwey) M. Mayrhofer

Descriptions of this species can be found in Mayrhofer (1987) and Coppins (1992). In north-western Europe (Norway, Sweden, British Isles and France) *H. ralfsii* is known from acid, sea-shore rocks in the supralittoral zone. According to Mayrhofer (1987), this species contains atranorin and zeorin whereas Coppins (1992) reported it to contain argopsin and zeorin. According to M. Brand (pers. comm.) *H. ralfsii* collections from France (west coast) contain zeorin and argopsin, while material from Norway lacks argopsin. In the specimen of this species from New Zealand we could detect only zeorin (major). However, its ecology and morphology, including the numerous pycnidia with short bacilliform conidia, were comparable with the European specimens. This is the first report from outside Europe.

Selected specimens examined. **New Zealand:** *South Island*: Nelson, Ataata Point, *c.* 25 km N of Nelson, 41°09′28″S, 173°24′37″E, 3–5 m from the sea, N exposed volcanic rocks, 2003, *M. Lambauer* 0196 & *B. Malcolm* (GZU).—**France:** *Brittany*: Camaret, Pointe du Toulinguet (N-side), N exposed shore, on sandstone 4°37·1′W, 48°16·8′N, 17 vii 1997, *A. M. Brand* s.n. (hb. Brand); *ibid.* 2 km SSE of Concarneau, 1 km SE of Pointe de Cabellou, sloping coastal rocks, 3°54·6′W, 47°51′N, 24 iv 1999, *A. M. Brand* s.n. (hb. Brand).

Key to all known *Halecania* species

1 Thallus lobulate, lobes up to 2 mm long and 0·5–1·5 mm wide; on *Hymenelia* sp. . . . . **H. lobulata**
Thallus not clearly lobulate 2

2(1) Thallus sorediate 3
Thallus esorediate 5

3(2) Thallus corticolous; with greyish-blue soralia . . . . . **H. viridescens**
Thallus saxicolous; with dark greyish to black soralia 4

4(3) Thallus with dark greyish to almost black soralia of 100–250 µm; apothecia rare; ascospores 9–12 × 5·5–6·5 µm; usually on various (mainly crustose) hosts . . . . . **H. giraltiae**
Thallus with very small inconspicuous black soralia of 25–50 µm; apothecia frequent; ascospores 8–10 × 4–5 µm; autonomous . . . . . **H. pepegospora**

5(2) Thallus growing over bryophytes on rocks 6
Thallus saxicolous, on acidic or calcareous rocks 7

6(5) Apothecia up to 0·5(–0·6) mm diam.; on calcareous mica-schist crags, Scotland . . . . . **H. bryophila**
Apothecia up to 1·5 mm diam.; on calcareous rocks in central Europe and arctic areas . . . . . **H. lecanorina** (Anzi) M. Mayrhofer & Poelt

7(5) Hymenium inspersed; thallus thick, bullate; ascospores 15–20 × 8–11 µm; northern Sweden . . . . . **H. tornensis** (H. Magn.) M. Mayrhofer
Hymenium not inspersed; thallus not bullate; ascospores smaller 8

8(7) Thallus rimose-areolate, smooth, oily, bluish to slate-grey, with greenish (N+ reddish) pigment, P ± red, K+ yellowish; ascospores 15–17 × 6–9 µm; on acidic rocks on sea-shore . . . . . **H. ralfsii**
Thallus not oily, without green pigment, K −, N −; ascospores smaller; not exclusively on sea-shores 9

9(8) Thallus thin, smooth, continuous to weakly rimose; apothecia biatorine-like; on calcareous rock . . . . . **H. elaeiza** (Nyl.) M. Mayrhofer
Thallus at least uneven, rimose-areolate, areolate, warted, or granular; apothecia lecanorine; on acidic or calcareous rock 10

10(9) Thallus with convex pinkish-brown areoles, P+ red . . . . . **H. micacea**
Thallus rimose-areolate, warted to granular or areolate but without pinkish brown pigment, P − 11

11(10) Thallus rimose, areolate to (sub)squamulose, areoles sometimes upturned at margin, yellowish-brown to dark olivaceous-brown; triterpenes present . . . . . **H. australis**
Thallus granular- to warted, not (sub)squamulose, grey to black; triterpenes absent 12

12(11) Epithecium greenish, N+ reddish; on acidic rock, lowland . . . . . **H. spodomela** (Nyl.) M. Mayrhofer
Epithecium brown, N − ; on calcareous rock, montane 13

13(12) Thallus blackish, minutely granular; thalline exciple soon receding **H. rhypodiza**
Thallus greyish to brown, granular- to warted or areolate; thalline exciple persistent 14

14(13) Thalline exciple thin, developed in mature apothecia; thallus thin, areolate, pale brown to yellowish-brown; not associated with cyanobacteria or lichens . . . . . **H. pakistanica**
Thalline exciple well-developed especially in young apothecia; thallus consists of ± clustered, pale to dark brown-grey, granular warts; often associated with cyanobacteria, *Aspicilia*, *Dermatocarpon* or *Placynthium* . . . . . **H. alpivaga**

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