

## METUS, A NEW AUSTRAL LICHEN GENUS AND NOTES ON AN AUSTRALASIAN SPECIES OF PYCNOTHELIA

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ABSTRACT. *Metus* D. Galloway & P. James, a new lichen genus in the Cladoniaceae is proposed for three Southern Hemisphere taxa. *Metus conglomeratus* (F. Wilson) D. Galloway & P. James *comb. nov.*, occurs in New Zealand, Tasmania and SE Australia; *M. pileatus* (Mont.) D. Galloway & P. James *comb. nov.*, is found in Chile, and *M. efflorescens* D. Galloway & P. James *sp. nov.*, also from Chile is described. *Pycnothelia caliginosa* D. Galloway & P. James, *sp. nov.*, first found on quartzite soil in New Zealand and subsequently in Tasmania, is also described.

### METUS

On 11 March, 1889 the Rev. F. R. M. Wilson (1832-1903) exhibited a list of lichens new to the State of Victoria, Australia (Wilson, 1889a) and also read a paper in which he described 41 Victorian lichens (Wilson, 1889b). Among these was listed *Pilophoron conglomeratum* F. Wilson (Wilson, 1889a) with a description in English of the plant from mossy trunks of dead trees in subalpine localities (Wilson, 1889b, p. 68). This description drew attention to the distinctive features of the lichen: the olivaceous green, effuse, granular thallus; the cylindrical, ridged or lacerate podetia  $\pm$  covered with green thalline granules; and the terminal, aggregated, brown apothecia, having a brown-pigmented hymenium and hypothecium, and asci with simple, colourless spores. Two years later, Wilson published the same description in Latin (Wilson, 1891, p. 372), giving the type locality as Black Spur, Victoria, and also providing an illustration of two spores. Lectotype material of *Pilophoron conglomeratum* (BM) is annotated by Crombie '...*Pilophoron conglomeratum*. Certainly not referable to *Pilophoron*. It is an erythrocarpous *Cladonia* with denigrate apothecia'. Subsequently, a New Zealand collection of the same species made by W. T. L. Travers was named *Pilophoron cariosum* by Hue (1898, p. 280).

In recent years many collections of this plant have been made from North, South and Stewart Islands of New Zealand (Galloway & Simpson, 1978; Galloway, 1985) and from Tasmania (Kantvilas, 1985; Kantvilas *et al.*, 1985; Kantvilas & James, 1987). In his monograph on *Pilophorus* Th. Fr. (syn. *Pilophoron* (Tuck.) Tuck.), Jahns (1981) includes a description of *P. conglomeratus* (p. 326) but excludes the species from *Pilophorus* s.str., because of the absence of cephalodia and the presence of brown-pigmented apothecial tissues. These reservations concerning the placing of the taxon in *Pilophorus* were endorsed by Galloway (1985, pp. 398-399) who had earlier raised the possibility of the plant being referable to a separate genus (Galloway & Simpson, 1978, p. 520). During recent work in the *Nothofagus* forests of southern Chile (November-December 1986)

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two additional taxa were found strongly reminiscent of *Pilophorus conglomeratus*: *Cladonia pileata* Mont., and an undescribed lichen. A close examination of all three taxa shows that they should be included in a new genus in the family Cladoniaceae which we call *Metus*\* and describe below.

A superficially similar cladoniiform lichen growing on quartzite sand in several localities in Nelson, New Zealand (Galloway, 1985, p. 399) is also recorded from similar habitats in SW Tasmania and is here referred to *Pycnothelia*.

Thin-layer chromatography (TLC) of all specimens examined was carried out according to standardized procedures (White & James, 1985).

***Metus* D. J. Galloway & P. James, gen. nov.**

Thallus cladoniiformis; thallus primarius granulatus, granulis variiformibus parvis contiguus, interdum suboreodiosis; photobiont viridis. Ascomata fruticosa, cava, teretia, sulcata vel cancellato-cariosa vel longitudinaliter fissa, simplicia vel apice fasciculatim divisa; apothecia fusca vel nigricantia, lecideina, primum solitaria globosa dein tuberculatim aggregata; hymenium fuscescens, hypothecium fuscum vel ferrugineum; sporae 8: nae, hyalinae, simplices, oblongae, utroque apice leviter attenuatae,  $8-12(-14) \times (2.5-3.4) (-4.5) \mu\text{m}$ . Acidum aliphaticum et atranorin ( $\pm$ ) continens. Genus ad Cladoniaceae pertinens.

Holotypus generis: *Metus conglomeratus* (F. Wilson) D. Galloway & P. James.

*Thallus* cladoniiform, vegetative thallus glaucous green to deep emerald green, granular-effuse on a thin to thick, pale to blackish prothallus irregularly spreading, muscicolous, corticolous, lignicolous, rarely terricolous or lichenicolous. *Photobiont* green, Trebouxioid. *Ascomata* fruticose (podetia), stipe to 1.5 cm tall and to 1–2 mm diam., hollow, terete or compressed, irregularly wrinkled to furrowed, to longitudinally fissured or  $\pm$  clathrate, simple, rarely furcate, subulate, covered with thalline granules to  $\pm$  decorticate; *hymenial discs* brown to brown-black,  $\pm$  globular and simple to clustered, convolute-conglomerate. *Hymenium* pale yellow-brown,  $40-50 \mu\text{m}$  tall, I+ blue; *paraphyses* numerous, slender, simple, furcate or with interconnecting lateral anastomoses, septate, to  $2 \mu\text{m}$  diam., not or only slightly swollen (to  $4 \mu\text{m}$ ) at apices. *Hypothecium* deep red-brown, granular-opaque, K+ brownish semi-opaque, to  $50 \mu\text{m}$  thick, I–. *Asci* cylindrical, tapering at foot,  $35-40 \times 5-8 \mu\text{m}$ ; apical tholus prominent,  $8-10 \mu\text{m}$  thick, I+ dark blue; 8-spored. *Ascospores* biseriata in ascus, simple, colourless, spindle-shaped or dacryoid,  $8-10(-14) \times (2.5-3.4) (-4.5) \mu\text{m}$ . *Anamorph* conidiomata, occasional to frequent, at apices of sterile, often decorticate podetia, or singly or clustered among thalline granules, minutely stalked, cylindrical, swollen or tapering at apices, mostly simple, occasionally 2–3-branched, black or brown-black. *Conidia* colourless, falciform,  $4-4.5 \times 1 \mu\text{m}$ .

*Chemistry*: Aliphatic acids are present in all three species and include caperatic, lichesterinic and protolichesterinic acids. Atranorin is present in

\**Metus* (Latin for terror). Named after *H.M.S. Terror*, one of the ships of the Antarctic expedition of 1839–1843 commanded by Sir James Clark Ross, which visited New Zealand and Tasmania during the course of the expedition. Joseph Dalton Hooker, assistant surgeon to the expedition, collected many lichens from his landfalls in New Zealand and Tasmania, and he also helped Thomas Taylor, Churchill Babington and William Mitten prepare these collections for publication (Hooker & Taylor, 1844; Taylor & Hooker, 1845; Hooker, 1847; Babington, 1855; Babington & Mitten, 1859).

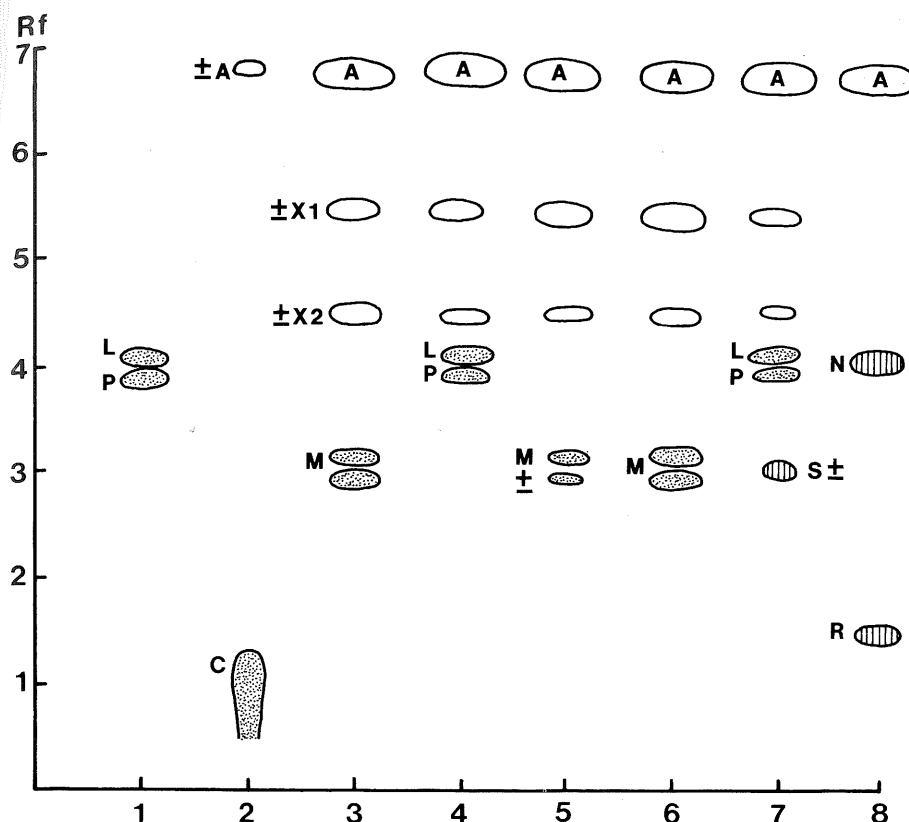


FIG. 1. Distribution of acetone-soluble compounds in solvent G (toluene: ethyl acetate: formic acid, 139:83:8): 1, *Metus conglomeratus* (Tasmania); 2, *M. conglomeratus* (New Zealand); 3, *M. efflorescens* (holotype); 4, *M. pileatus* (syntype); 5, *Pycnothelia caliginosa* (holotype, New Zealand); 6, *P. caliginosa* (Tasmania); 7, *P. papillaria* (British Isles); 8, control. Aliphatic compounds: C=caperatic acid; M=unidentified pair of substances; L=lichesterinic acid; P=protolichesterinic acid. Other substances: A=atranorin; N=norstictic acid; R=salazinic acid; S=squamic acid; X1, X2=unidentified substances, UV  $\pm$  greenish.  $\pm$ =present or absent.

low or trace amounts or is absent in some collections, and unidentified compounds, including aliphatic acids are also present (Fig. 1).

**Ecology:** All three species of *Metus* have a similar ecology and thrive in moist, humid conditions prevailing in stands of mature, primary or occasionally secondary forest, in areas of moderate to high rainfall. All are characteristic of markedly shaded habitats and many specimens collected are from the buttresses or basal parts of large forest trees or from other habitats (see below) in the forest interior where few other lichens are able to tolerate either reduced illumination or competition from bryophytes. The granular vegetative thallus of *Metus* develops on a pale or dark, arachnoid prothallus, and spreads over rotting or sometimes burnt stumps, or covers pteridophyte rhizomes and/or fronds, e.g. the brush of species of New Zealand tree-ferns such as *Alsophila*, *Dicksonia*

and *Sphaeropteris*, bryophytes or litter, investing these substrata with a thin or thick green crust.

*Metus conglomeratus* in New Zealand is a lowland forest species known from Lat. 35°S (North Auckland) to Lat. 47°S (Stewart Island), and being collected from coastal *Metrosideros*-*Weinmannia* forest in the south, through mixed *Nothofagus*-podocarp forests to *Beilschmeidia tawa*-podocarp forest and *Agathis*-*Nothofagus truncata* forest in the northern parts of its range. It is known in New Zealand from the following phorophytes: *Agathis australis*, *Beilschmeidia tawa*, *Dacrycarpus dacrydioides*, *Dacrydium cupressinum*, *Eleocarpus dentatus*, *Knightia excelsa*, *Metrosideros robusta*, *M. umbellata*, *Nothofagus fusca*, *N. menziesii*, *N. truncata*, *Phyllocladus trichomanoides*, *Podocarpus totara*, *Prumnopitys ferrugineus*, and *Weinmannia racemosa* and associates with a few other shade-tolerant lichens viz., *Bacidia wellingtonii*, *Clathroporina exocha*, *Phyllopsora congregans*, *Pseudocyphellaria dissimilis*, *Sticta caliginosa*, *S. filix* and *S. latifrons*.

In Tasmania, *Metus conglomeratus* is known from rotting logs of *Eucalyptus*, bark of *Eucryphia lucida* and bark and rotting logs of *Nothofagus cunninghamii*, and it associates with the following lichens: *Cladia aggregata*, *C. schizopora*, *Cladonia squamosula*, *Menegazzia globulifera*, *Mycoblastus* sp., *Phyllopsora congregans*, *Pseudocyphellaria ardesiaca*, *P. delisea*, *P. dissimilis*, *P. cf. insculpta*, *Siphula* cf. *dissoluta*, *Sphaerophorus* cf. *imshaugii*, *S. insignis*, *S. ramulifer* and *Thelotrema novaezealandiae*. Kantvilas (1985) notes 'The species also occurs on peat in alpine or subalpine heath. Such specimens are usually yellowish or blackened, with highly branched, fissured pseudopodetia.'

In Chile both *Metus efflorescens* and *M. pileatus* are known from living and dead trees of *Nothofagus dombeyi* and *N. pumilio* and more rarely from *Araucaria araucana* and *Podocarpus nubigena*. Occasionally both species grow together, as at Enco, but in our experience *M. efflorescens* is less common and is  $\pm$  confined to primary forest, while *M. pileatus* is widespread and grows also in secondary forest. Both species are most commonly found on the lower 2m of the trunks of large forest trees. Associated lichens include: *Coccotrema cucurbitula*, *C. porinopsis*, *Coenogonium implexum*, *Collema laeve*, *Dendroscocaulon* sp., *Dimerella diluta*, *D. lutea*, *Lepolichen granulatus*, *Leptogium* spp., *Menegazzia magellanica*, *Mycoblastus* sp., *Nephroma plumbeum*, *Parmeliella nigrocincta*, *Polychidium polychidioides*, *Psoroma caliginosum*, *P. microphyllizans*, *P. pholidotoides*, *P. soccatum*, *Pseudocyphellaria berberina*, *P. coerulescens*, *P. compar*, *P. divulsa*, *P. encoensis*, *P. flavicans*, *P. hirsuta*, *P. nitida*, *P. valdiviana*, *Roccellinastrum candidum*, *Sphaerophorus imshaugii*, *S. insignis*, *S. patagonicus*, *S. ramulifer*, *S. scrobiculatus*, *Sticta caulescens*, *S. cf. damaecornis*, *S. fuliginosa*, *S. hypochra* and *Thelotrema lepadinum*.

*Metus* is a cool temperate austral lichen genus (Galloway, 1987a) with vicariant taxa developed in South America, and Australasia, a pattern shown by many lichen genera (Galloway, 1987b, in press) and in accord with the area cladogram for austral biota illustrated in Humphries & Parenti (1986, fig. 4.8).

*Taxonomic affinity:* *Metus* has a dimorphic or cladoniiform (Ahti, 1982a, 1982b) thallus, the vegetative part of which is granular, the



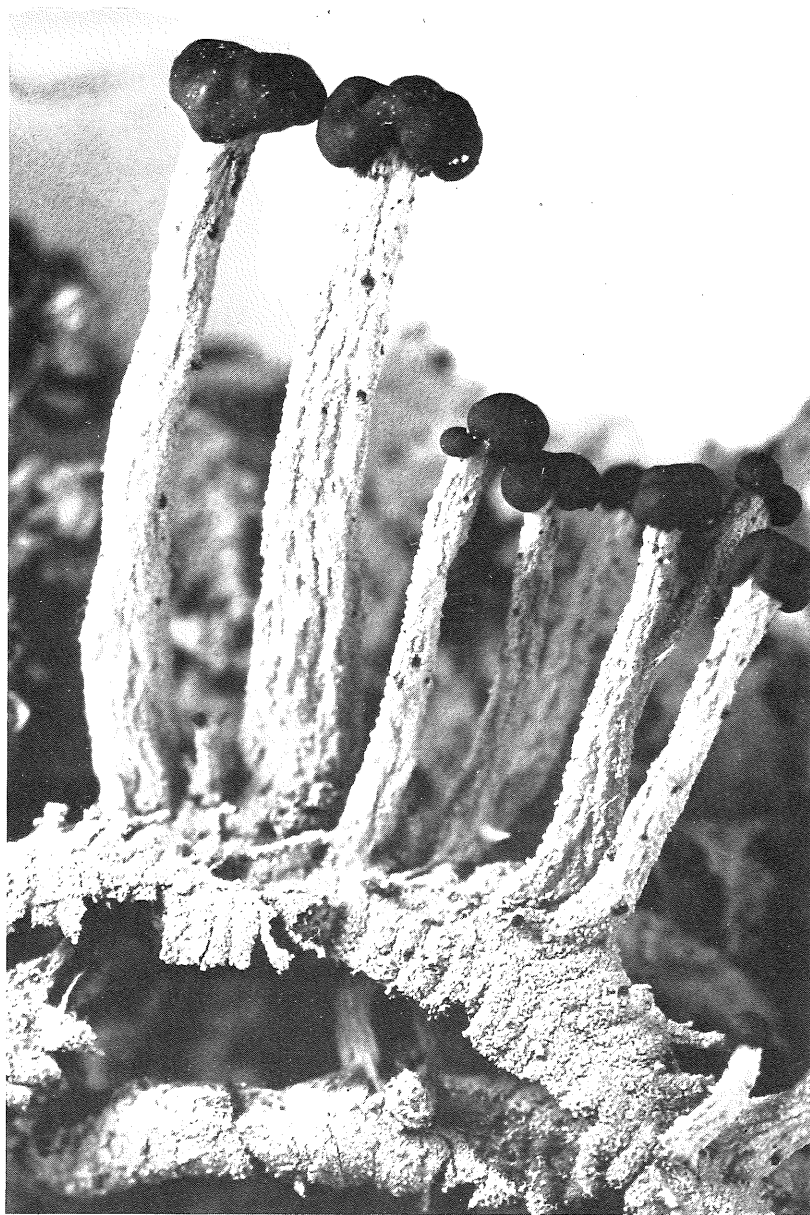


FIG. 2. *Metus conglomeratus*, Lake Skinner Track, Tasmania. Kantvilas 97/80(BM),  $\times 10$ .

granules being pale to dark glaucous or emerald green, and developed on a pale whitish to brown or blackened, fimbriate, prothallus; the ascomata are fruticose (podetia) and have a pale brown, I+ blue hymenium, a red-brown, opaque hypothecium (paler and less opaque in K), simple spores, and a chemistry marked by the presence of aliphatic acids and atranorin

( $\pm$ ), and an absence of  $\beta$ -orcinol depsides or depsidones, characters which unite its three taxa and which serve to distinguish it from other cladoniiform genera. Simple spores and a granular thallus immediately separate *Metus* from cladoniiform genera with septate spores: *Calathapsis* Lamb (Lamb et al., 1972); *Glossodium* Nyl. (Nylander, 1860; Jahns, 1970a); and *Heteromyces* Müll. Arg. (Müller Argoviensis, 1889). This combination of characters, together with the absence of cephalodia, segregates *Metus* from *Pilophorus* as suggested by Galloway & Simpson (1978, p. 520), Jahns (1981, p. 328) and Galloway (1985, p. 398). *Metus* also differs from other cladoniiform genera such as: *Cladia* Nyl. (Galloway, 1966; Jahns, 1970b; Filson, 1981); *Cladonia* Hill ex Wigg. (Ahti, 1982a, 1982b); *Gymnoderma* Nyl. (Yoshimura & Sharp, 1969; Chester & Elix, 1980; Galloway, 1985); *Ramalea* Müll. Arg. (Galloway, 1985); *Thysanothecium* Mont. & Berk. (Galloway, 1977; Galloway & Bartlett, 1983). In our view the three species of *Metus* form a good genus in the family Cladoniaceae and appear to be most closely related morphologically and chemically to *Pycnothelia* Dufour which has a pale white to grey-white nodular-squamulose thallus (terricolous or saxicolous), pale corneous to grey-white hollow podetia, convex brown to black hymenial discs, a pale to dark red-brown hymenium, a brown hypothecium and a chemistry consisting of aliphatic acids. It is assumed that *Metus* produces podetia rather than pseudopodetia but ontogenetic studies to establish this fact have not yet been carried out.

#### KEY TO SPECIES OF METUS

1. Thalline granules minute, powdery, c.0.02mm diam., discrete or crowded; prothallus whitish to pale brown or inapparent; ascomata rare to  $\pm$  common, hymenial discs 0.1–0.8mm diam [Chile]. . . . . 2
- + Thalline granules larger, 0.05–0.1mm diam., discrete at margins, forming a  $\pm$  continuous crust centrally; prothallus dark brown to black; ascomata frequent, hymenial discs 1–3mm diam. [Australasia]
- 1. *Metus conglomeratus***
2. Ascomatal stipe (podetium) 0.1–0.5mm diam., 2–8(–10)mm tall, decorticate or  $\pm$  delicately granular, subulate or  $\pm$  blunt, rarely furcate . . . . . **3. *Metus pileatus***
- + Ascomatal stipe 0.8–1.0mm diam., 2–6mm tall, coarsely granular, apices splayed, spreading, densely covered in thalline granules, appearing sorediate . . . . . **2. *Metus efflorescens***

**1. *Metus conglomeratus*** (F. Wilson) D. Galloway & P. James, **comb. nov.** Figs 2, 3. Type: Australia. Victoria, Black Spur, 'supra truncum arboris emortuum muscosum', *F. R. M. Wilson* 70 (holo. BM) [protolichesterinic, lichesterinic acids,  $\pm$  atranorin (trace)].

Syn.: *Pilophoron conglomeratum* F. Wilson\* in Victorian Naturalist 6:68 (1889), & in J. Linn. Soc. Bot. 28:372 (1891); Zahlbr., Cat. Lich.

\*These names are sometimes cited as '*Philophorus*', but we doubt if any of these cases represent valid new combinations. For a discussion of *Pilophorus* vs. *Pilophoron* see Hawksworth et al. (1972)

Univ. 4:433 (1927); Weber & Wetmore in Beih. Nova Hedwigia 41:88 (1972); Bratt & Cashin in Pap. & Proc. Roy. Soc. Tasmania 109:19 (1975); Bratt in Tasmanian Naturalist 47:2 (1976); Galloway & Simpson in New Zealand J. Bot. 16:520 (1978); Jahns in Mycotaxon 13:326 (1981); Filson, Checklist Aust. Lich.: 90 (1983), & op. cit. ed 2:116 (1986); Galloway, Fl. N.Z.Lich.: 398 (1985); Filson, Index Type Spec. Aust. Lich.:235 (1986); Kantvilas & James in Lichenologist 19:8 (1987).

*Pilophoron cariosum* Hue\* in Nouv. Arch. Mus. Hist. Nat. ser. 3, 10:280 (1898). Type: Nova Zelandia, sine loc., W. T. L. Travers (holo. PC-HUE) [caperatic acid,  $\pm$  atranorin (trace)]. Zahlbr., Cat. Lich. Univ. 4:431 (1927); Jahns in Mycotaxon 13:326 (1981); Galloway, Fl. N. Z. Lich.:398 (1985).

**Morphology:** *Thallus granular*, granules  $\pm$  globose, minute 0.05–0.1mm diam., round to irregular, scattered and  $\pm$  discrete on an inapparent pale brown to black fimbriate prothallus, coalescing in older parts of thallus to form a  $\pm$  continuous, uneven, subverrucose to diffract crust, dull to bright emerald green, occasionally suffused brownish or bronze. *Ascomata* (podetia) widely dispersed to 2–4-crowded, straight or curved, erect to  $\pm$  decumbent, 1.5–4mm diam., and to 10mm tall, surface uneven, furrowed, sometimes longitudinally lacerate or fistulose, decorticate, pale or brownish or with coalescing or scattered thalline granules (Fig. 3). *Hymenial discs* aggregate, pale to dark red-brown or brown-black, 1–3(–5)mm wide, immarginate, convex, at first globose becoming irregular-convolute with age, often with a central depression.

**Anatomy:** *Thallus* granules lacking a well-defined cortex but with an outer transparent layer, 3.5–5 $\mu$ m thick, of unorientated hyphae enclosing

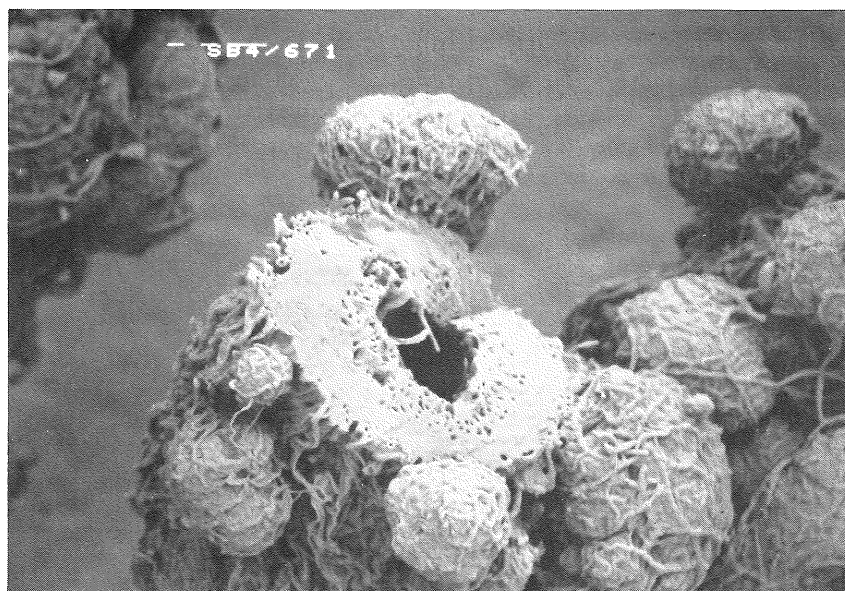


FIG. 3. *Metus conglomeratus*, fractured podetium with thalline granules,  $\times 500$ .

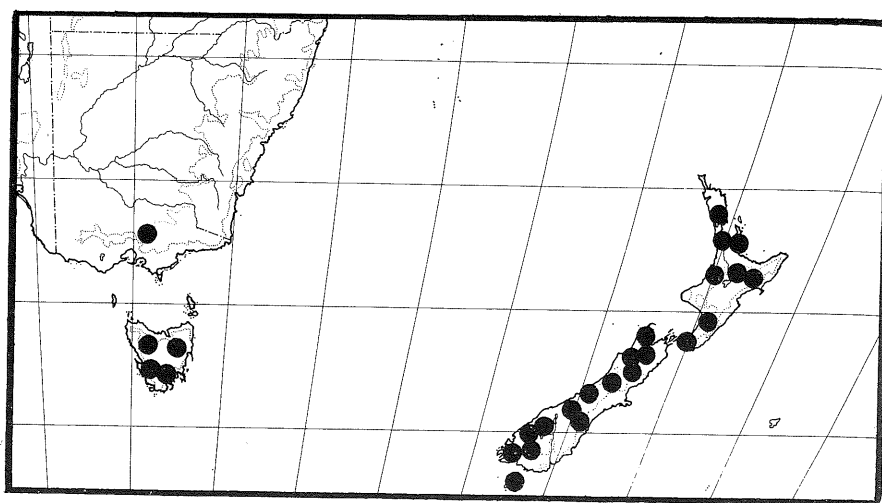


FIG. 4. Known distribution of *Metus conglomeratus*.

compacted clusters of rounded, green photobiont cells, 5–9  $\mu\text{m}$  diam, photobiont cells also interspersed with hyphae. *Hymenium* 45–50  $\mu\text{m}$  tall, pale brown to red-brown; paraphyses 1.5  $\mu\text{m}$  thick, to 2  $\mu\text{m}$  thick at apices. *Hypothecium* 50–70  $\mu\text{m}$  thick, dark to bright red-brown, of densely compacted, interwoven hyphae, K+ fuscous, semi-opaque. *Asci* 40–45  $\times$  5–8  $\mu\text{m}$ . *Ascospores* 8–13  $\times$  3–5  $\mu\text{m}$ .

*Chemistry*: i) caperatic acid,  $\pm$  atranorin (trace)—New Zealand populations; ii) protolichesterinic and lichesterinic acids,  $\pm$  atranorin (trace)—Australian populations.

*Distribution* (Fig. 4): New Zealand from North Auckland to Stewart Island; Tasmania; and SE Australia (Victoria).

Although *Metus conglomeratus* is the only described species of the genus from New Zealand, we have recently examined a single unusual gathering from near Stag Flat, Wangapeka, Nelson, collected by J. K. Bartlett in January 1981 (BM), which differs somewhat from other collections. The habit is typical for *Metus* and is widespreading mainly over mosses. The thalline granules are almost obscured by very abundant, short (less than 3 mm tall), straight or curved, often richly branched, podetia-like proliferations with elongate, terminal black conidiomata. In *Metus conglomeratus*, conidiomata are borne mainly on simple, rarely furcate, structures, and are often only sparingly developed. Unfortunately only two broken off ascomata remain, resembling those of *M. conglomeratus* in appearance and dimensions. The chemistry includes protolichesterinic and lichesterinic acids characteristic of *M. conglomeratus* from Australia but not from New Zealand where all other material tested gave caperatic acid. These differences in conidiomatal development and chemistry may indicate that another taxon is present in New Zealand but more and fertile collections are required in order to establish the status of this plant.

## Selected specimens examined:

AUSTRALIA. **Victoria:** Black Spur, *F. R. M. Wilson* 70 (BM). **Tasmania:** Savage River, Pipeline Road, 21 i 1982, *Kantvilas* 30/82 (BM); Ball Room Forest Track, Dove Lake near Cradle Mountain, 9 xii 1967, *G. C. Bratt* 67/585 (BM); Western side of Mt Arrowsmith near Franklin River, 1 i 1966, *M. H. Bratt* 3000 (BM); below Hartz Mt plateau, 16 v 1965, *G. C. Bratt* 2205 (BM); Mt Victoria track, 21 ii 1981, *Kantvilas* 50/82 (BM).

NEW ZEALAND. **North Island.** Gisborne: Lake Waikareiti, 31 viii 1978, *A. L. Wilkins* (BM). Wellington: Akatarawa Range, Waterfall Creek, 9 xii 1984, *B. H. Macmillan* (CHR 266274). **South Island.** Nelson: Lake Rotoroa, 31 x 1972; *M. J. A. Simpson* (CHR 240445); Mt Robert, Lake Rotoiti, 16 xi 1977, *Galloway* (CHR 240710); Maruia Valley, 22 ix 1981, *F. J. Walker* (BM); Stag Flat near Wangapeka, 15 i 1981, *J. K. Bartlett* (BM). Canterbury: Peel Forest, 1 ii 1970, *Galloway* (CHR 366883). Southland: Cascade Creek, Eglinton Valley, *G. A. M. Scott* (BM). **Stewart Island:** Glory Cove, Paterson Inlet, 9 ii 1967, *Galloway* (CHR 374037); Pegasus Creek, Port Pegasus, 1 xii 1969, *Galloway* (CHR 374038).

## 2. *Metus efflorescens* D. Galloway & P. James, sp. nov. Figs 5, 6.

*Meto conglomerato* similis sed granulis thallinis parvioribus dispersis, prothallo albedo vel fusco. Ascomata rariora, granulosa-pulverulenta, 0.8–1 mm diam., 2–6 mm alta, disco brunneo, rariore; ascospores 9–12(–14)  $\times$  4–4.5  $\mu$ m; acida aliphatica ignota continens.

Type: Chile, IX Region. Parque Nacional Conguillio, Laguna Captrén, at base of rotting log of *Nothofagus dombeyi* in *Nothofagus* forest on lake shore, 20 November 1986, *B. J. Coppins, D. J. Galloway, G. Guzmán & P. W. James* 4001 (holo. SGO; iso. BM, E). [Two unidentified aliphatic substances Rf 3 in TDA and G, atranorin in quantity and the two unidentified compounds also present in *Metus pileatus*].

**Morphology:** *Thallus* granular, granules 0.02 mm diam., scattered on a whitish to pale brown, often inapparent prothallus (Fig. 6), or contiguous to imbricate, glaucous green to bright emerald green. *Ascomata* (podetia) few and scattered, to numerous and  $\pm$  contiguous, erect, short, 2–6 mm tall and 0.8–1.0 mm diam., straight or somewhat curved, splitting apically and expanding at tip becoming irregularly contorted, fan-shaped or blunt candelabrum-shaped, the terminal parts thickly covered in thalline

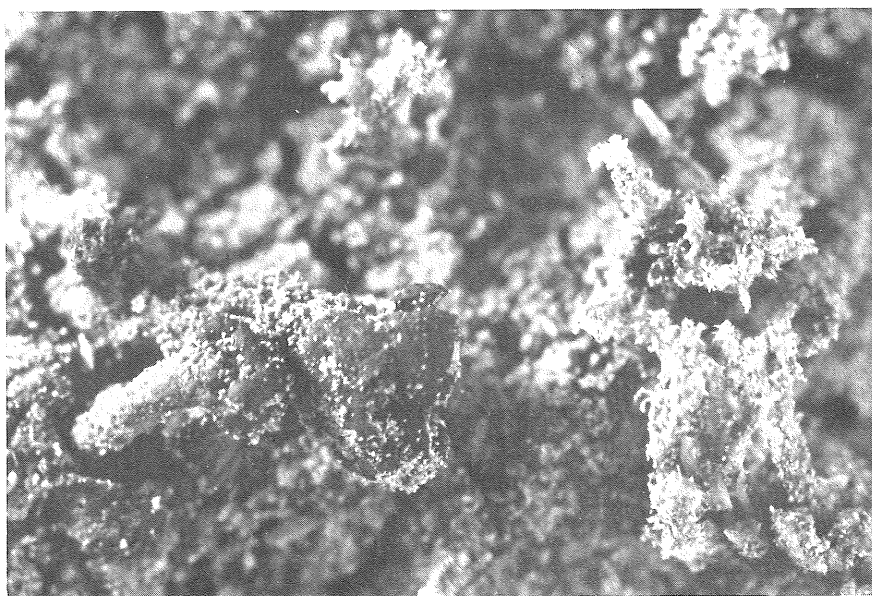


FIG. 5. *Metus efflorescens*, isotype (BM),  $\times 7.7$ .

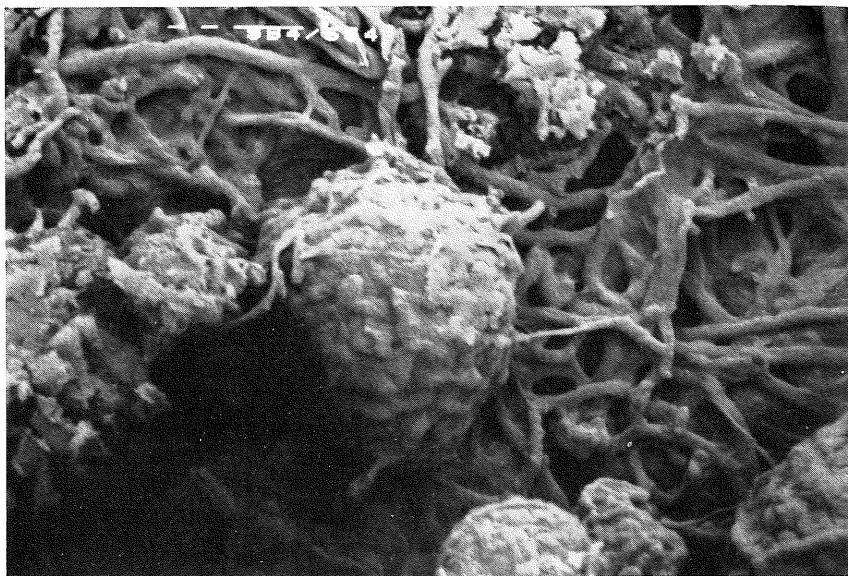


FIG. 6. *Metus efflorescens*, thalline granules on prothallus filaments,  $\times 1000$ .

granules and appearing ragged-sorediate. *Hymenial discs* rare, fertile specimens usually only sparingly so, capitate, solitary to 4-clustered, conglomerate,  $\pm$  convex, blackish brown,  $\pm$  shining.

*Anatomy*: *Thallus* granules as in *M. pileatus*, photobiont cells  $9\text{--}12\mu\text{m}$  diam., rounded, encapsulated in hyphal strands in  $\pm$  spherical glomerulae (Fig. 6). *Hymenium*  $50\text{--}55\mu\text{m}$  tall, dilute red-brown especially basally, K+ pale brownish; paraphyses c.  $1\mu\text{m}$  thick, apical cell slightly enlarged, to  $4\mu\text{m}$  long. *Hypothecium*  $50\text{--}70\mu\text{m}$  thick, densely compacted, opaque, red-brown, K+ brown or dark brown, dilute red-brown below. *Asci*  $40\text{--}45 \times 6\text{--}10\mu\text{m}$ . *Ascospores*  $9\text{--}12(-14) \times 4\text{--}5\mu\text{m}$ .

*Chemistry*: Two unidentified aliphatic substances Rf 3 in TDA and G, atranorin in quantity and the two unidentified substances recorded also in *Metus pileatus*.

*Distribution*: Chile.

*Metus efflorescens* appears closest to *M. conglomeratus* and shares with this species similar short, stout podetia which are either widely scattered or grouped on an extensively spreading thallus. Unlike the Australasian *M. conglomeratus*, however, only a few of the podetia become fertile, the majority becoming spliced and splayed towards the apices and there densely coated with thalline granules giving the appearance of efflorescent terminal soralia of capitate, flattened or candelabrum-like form. The aliphatic compounds of *M. efflorescens* are unidentified (and the same as those in *Pycnothelia caliginosa*) and do not correspond to either protolichesterinic and lichesterinic acids or caperatic acid of the two chemical strains of *M. conglomeratus*. *M. pileatus* has numerous thinner, often more decorticate podetia with subulate apices when sterile.



Other specimens examined:

CHILE. **IX Region:** Parque, Nacional Conguillio, Laguna Captrén, at base of rotting *Nothofagus dombeyi*, 20 xi 1986, *Coppins, Galloway, Guzmán & James* 4001 (BM, E); *ibid.*, road to Lago Conguillio, 2km from Administration centre, on rotting *Nothofagus*, 21 xi 1986, *Coppins et al.* 4002 (BM). **X Region:** 11km from Choshuenco on road to Enco, on vertical bole of *Nothofagus dombeyi*, with *Metus pileatus*, 26 xi 1986, *Coppins et al.* 4003 (BM).

**3. *Metus pileatus* (Mont.) D. Galloway & P. James, comb. nov.** Figs 7, 8. Type: Chile, *sine loco*. [?Coquimbo] *C. Gay* (syntypes: PC-MONTAGNE, n.v.; H-NYL 39141; M) [protolichesterinic and lichesterinic acids,  $\pm$  atranorin, two unidentified compounds].

Syn.: *Cladonia pileata* Mont. in *Annls Sci. Nat. Bot. sér.* 3, 18:310 (1852); Montagne in *Gay, Hist. Fis. Pol. Chile Bot.* 8:161 (1854); Montagne, *Syll. gen. sp. crypt.*: 336 (1856); Nylander, *Annls Sci. Nat. Bot. sér.* 4, 3:177 (1855); Nylander, *Enum. gen. lich.*: 96 (1858); Nylander, *Syn. meth. lich.* 1(2):225 (1860); Vainio, *Monogr. Clad. Univ. I*: 140 (1887); Nylander, *Lich. Fueg. Patag.*: 4 (1888); Vainio, *Monogr. Clad. Univ. II*: 444 (1894); Jahns in *Mycotaxon* 13:328 (1981).

*Pilophoron pileatum* (Mont.) Zahlbr. in *Cat. Lich. Univ.* 10:381 (1939); Jahns in *Mycotaxon* 13:328 (1981).

**Morphology:** *Thallus* granular, granules minute, 0.02mm diam., scattered on a whitish to pale brownish prothallus, or  $\pm$  contiguous, coalescing in older parts to form a lumpy crust 2–8 granules thick, glaucous grey-green to bright emerald green. *Ascomata* (podetia) numerous, erect to decumbent, slender, terete 0.1–0.5mm diam., 2–8(–10)mm tall, simple, rarely furcate, gradually tapering or  $\pm$  blunt at apices when sterile, apices slightly expanded when fertile, invested with thalline granules at base, granules thinly dispersed towards apices or often absent exposing a pale to brown-black, decorticate, chondroid, smooth to  $\pm$  delicately striate stipe. *Hymenial discs* convex, dark brown, 0.2–0.8mm diam, immarginate. *Conidiomata* terminal on short stalks or on short lateral branches of older podetia.

**Anatomy:** *Thallus* granules similar to those of *M. conglomeratus* in structure, photobiont cells 5–8 $\mu$ m diam., rounded, encapsulated in fungal hyphae (Fig. 8). *Hymenium* to 45 $\mu$ m tall, pale brown-red, K+ red-brown. *Hypothecium* 40 $\mu$ m thick, deep brown, K+ deep red-brown, opaque, in lower parts dilute brown, K $\pm$  tinged brown. *Asci* 35–45 $\times$ 6–10 $\mu$ m. *Ascospores* 9–12 $\times$ 4–4.5 $\mu$ m.

**Chemistry:** protolichesterinic and lichesterinic acids,  $\pm$  atranorin,  $\pm$  two unidentified compounds. Atranorin may be present in quantity or seemingly absent. The two unidentified compounds resolve at Rf 4–5 and Rf 5 in G, giving colourless spots on charring.

**Distribution:** Chile.

The wide-spreading effuse vegetative thallus of *Metus pileatus* usually originates on bark or decorticated wood of moribund trees and decaying stumps in moist, deeply shaded habitats, often spreading over bryophytes, leaves, detritus and other lichens. Podetia are often delicate and tapering when immature and frequently subulate and decorticate at the apices



FIG. 7. *Metus pileatus*, Chile, Choshuenco, *Coppins et al.* (BM),  $\times 10$ .





FIG. 8. *Metus pileatus*, thalline granules on prothallus filaments,  $\times 1000$ .

giving a superficial resemblance to species of *Multiclavula* R. Petersen. In young thalli, podetia are often widely scattered but in older plants they may be very numerous and crowded so as to partly obscure the vegetative thallus. All specimens examined contain protolichesterinic and lichesterinic acids. For differences between this species and *Metus conglomeratus* see notes under *M. efflorescens*.

Other specimens examined:

CHILE. **IX Region:** Parque Nacional Conguillio, near Lago Conguillio Administration centre, at base of ancient *Araucaria araucana*, 21 xi 1986, *Coppins, Galloway, Guzmán & James* 4004 (BM). **X Region:** 11km from Choshuenco on road to Enco, on moribund *Nothofagus dombeysi*, 26 xi 1986, *Coppins et al.* 4005 (BM); Banks of Rio Enco, on rotting wood, 26 xi 1986, *Coppins et al.* 4006 (BM); N of Valdivia, San Martin forest, on burnt stump in deep shade, 29 xi 1986, *Coppins et al.* 4007 (BM). Chiloé, Parque Nacional Chiloé, El Tepual, at base of *Podocarpus nubigena*, 6 xii 1986, *Coppins et al.* 4008 (BM).

#### PYCNOTHELIA

##### ***Pycnothelia caliginosa* D. Galloway & P. James sp. nov.** Figs 9, 10.

*Pycnotheliae papillariae* similis sed granulis thallinis albidis vel cinerascens-albidis; ascomata erecta, nigricantia vel minute granulosa; apothecia nigricantia, differt. Acidum protolichesterinicum et atranorin continens.

Type: New Zealand, South Island, Nelson, Denniston Plateau north of Westport, among quartzite sand on sandstone pavement, c.750m, 21 September 1981, *D. J. Galloway* (holo, CHR 381055; iso. BM, CHR).

**Morphology:** *Thallus* granular, appearing subsquamulose, granules convex at first, 0.1–0.5mm diam., occasionally discrete, normally contiguous, congested, forming flattened or convex, conrescent, irregular patches 2–20cm diam., often appearing somewhat areolate or spreading  $\pm$  uniformly over soil, sometimes on a thin to thick, fibrous, black

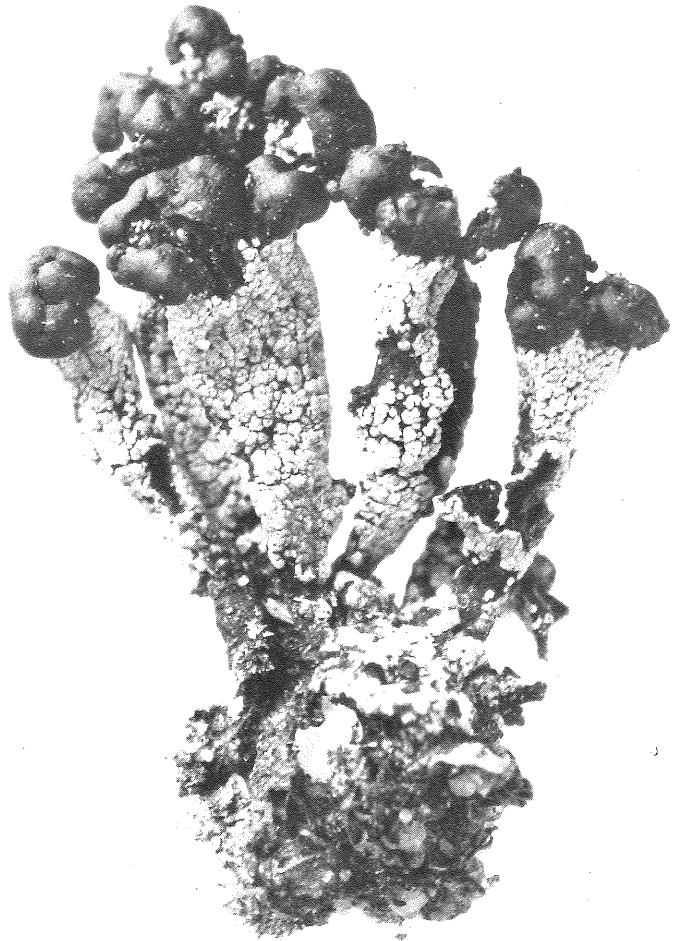


FIG. 9. *Pycnothelia caliginosa*, holotype (CHR),  $\times 10$ .

prothallus, granules pale grey-white, sometimes blackened in parts, surface smooth to roughened cerebriform (Fig. 10). *Ascomata* occasional to frequent, erect or decumbent, hollow, terete or somewhat flattened, simple, finger-like to branched, proliferating towards apices, 0.5–1.5(–2) cm tall, 1–3 mm diam., thinly or thickly covered with thalline granules from base to apex, or decorticate in patches or completely decorticate exposing brown-black cartilaginous medullary strands; sometimes longitudinally fissured or fistulose. *Hymenial discs* black, convex, spherical to  $\pm$  conglomerate, shining, immarginate, solitary or more often clustered, 0.5–1.5(–2) mm diam. *Conidiomata* at apices of short stalks, or on lateral branches of podetia (from base to apex), or on thalline granules, short

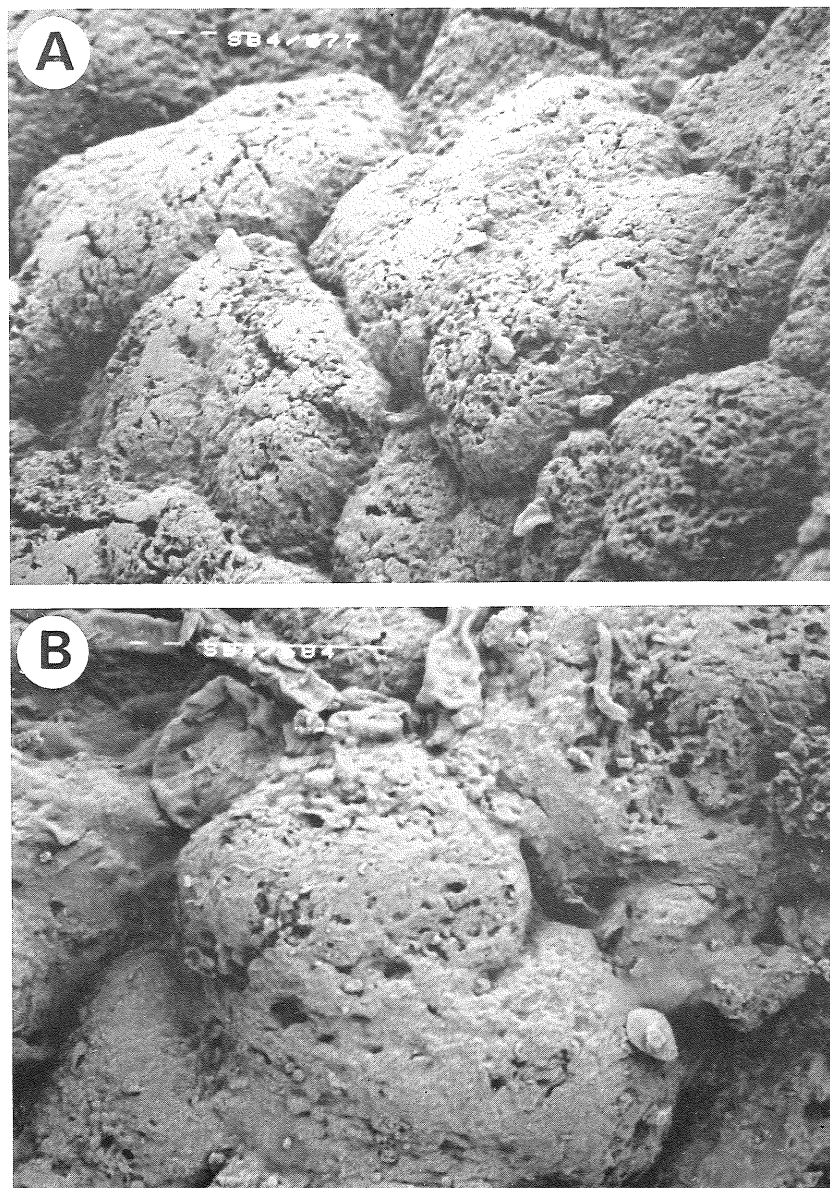


FIG. 10. Surface of vegetative thallus of A: *Pycnothelia caliginosa* (New Zealand); B: *Pycnothelia papillaria* (British Isles);  $\times 250$ .

(0.5mm or less), rather variable in shape, cylindrical or tapering, solitary to densely clustered, shining.

*Anatomy:* *Thallus* 240–400 $\mu$ m thick. *Upper cortex* 20–30 $\mu$ m thick, of colourless anastomosing hyphae. *Photobiont layer* 20–40 $\mu$ m thick, photobiont cells green, rounded, 8–11 $\mu$ m diam. *Medulla* colourless, 50–80 $\mu$ m thick, of densely interwoven hyphae grading into a zone 150–250 $\mu$ m

thick of thick-walled, red-brown hyphae in fascicles penetrating the substratum. *Epithecium* red-brown, granular, 2–7(–9)  $\mu\text{m}$  thick, unchanged in K. *Hymenium* 35–45  $\mu\text{m}$  tall, pale yellow-brown to red-brown, I–; paraphyses simple, septate, 2  $\mu\text{m}$  thick, apices swollen, to 4.5  $\mu\text{m}$  thick. *Hypothecium* densely granular, opaque, dark brown to red-brown, paler in K, 45–55  $\mu\text{m}$  thick. *Asci* cylindrical-clavate, tapering at foot, 30–35  $\times$  4.5–7  $\mu\text{m}$ ; walls I+ pale blue; apical tholus 7–9  $\mu\text{m}$  thick, I+ dark blue. *Ascospores* ellipsoid, colourless, simple, 10.5–12  $\times$  2.5–4(–4.5)  $\mu\text{m}$ . *Conidia* falciform, 4.5–5  $\times$  0.5  $\mu\text{m}$ .

*Chemistry*: atranorin in quantity, chloratranorin, unidentified compound (Rf 5 in G, charring colourless) and two unidentified aliphatic compounds, the same as those found in *Metus efflorescens* from Chile.

*Distribution*: New Zealand, South Island west of the Main Divide between latitudes 41 and 42°S. Also in Tasmania.

*Pycnothelia caliginosa* is an Australasian species and the sole Southern Hemisphere representative of a genus widespread in the Northern boreal zone and formerly thought to be monotypic (Laundon, 1986). Vegetative thalli in *Pycnothelia caliginosa* and *P. papillaria* are similar (Fig. 10), but the podetia and hymenial discs of the two species are quite distinct with *P. caliginosa* having a prominent black medullary tissue and black discs, whereas the discs of *P. papillaria* are red-brown or brownish and often poorly developed. Both species have chemistry dominated by aliphatic compounds, *P. papillaria* containing atranorin,  $\pm$  chloratranorin (trace),  $\pm$  unidentified compound (Rf 5 in G, charring colourless), protolichesterinic and lichesterinic acids and  $\pm$  squamatic acid (trace). In terms of both morphology and chemistry, *Pycnothelia* seems most closely related to *Metus*.

*Pycnothelia caliginosa* was first collected from the Denniston Plateau, New Zealand in February 1980 by D. J. Galloway and J. A. Elix from peaty soils and sandstone grit near the base of small sandstone outcrops in damp, sometimes inundated areas on the plateau. It was subsequently found to be widespread in this habitat on quartzite sand in grassland where considerable areas of exposed soil are present. The Tasmanian moss, *Pleurophascum grandiglobum*, was recently recorded from the Denniston Plateau (Simpson, 1986). *Pycnothelia caliginosa* is commonly associated in this habitat with species of *Siphula*, especially *S. decumbens*, *S. foliacea* and *S. fragilis*, all four taxa binding the grains of sand to a greater or lesser extent and arresting to some degree the process of erosion in a soil environment which is often inundated by surface water. The epithet (*caliginosa*) refers to both the occurrence of the species in rather dark sites shaded by rock overhangs, and to the misty, foggy conditions which are a regular feature of the Denniston and Stockton Plateaux. The Denniston Plateau is a raised platform north of Westport, composed of Tertiary sediments; quartzose coal measures (grit, sandstone and carbonaceous shale, locally with thick coal seams) are the usual basal beds of the Tertiary sequence (Suggate, 1978). The vegetation of the area is discussed by Townson (1907).

The species was first discovered in Tasmania in 1982 on the north-east ridge of Mt Anne by G. Kantvilas on soil in alpine heath, conditions analogous to the New Zealand habitat. *P. caliginosa* is confined to SW

Tasmania where it is most abundant on remote mountain peaks and ranges, e.g. Propsting Range, Wilmot Range, Greystone Bluff, Mt Hean. It is almost exclusively restricted to areas with a Precambrian metamorphic geology. The species occurs above c.750m in low alpine heathland, bolster moor or, more rarely, in buttongrass (*Gymnoschoenus*) moorland. Typical habitats include, exposed windswept sites amongst cushion vegetation (e.g. *Donatia novaezealandiae*) and small tufted sedges (species of *Oreobolus* and *Carpha*) where *Pycnothelia* is found either on well-drained peat (pH usually 4–5), or on moist, gritty, mineral soil. Lichens commonly associated with *Pycnothelia caliginosa* include: *Cladia aggregata*, *C. fuliginosa*, *C. inflata*, *C. moniliformis*, *C. retipora*, *C. sullivani*, *Cladonia mitis*, *Cladonia southlandica*, *C. murrayii*, *Micarea* sp., *Siphula decumbens* and *S. jamesii* in ed. (G. Kantvilas in litt.).

Other specimens examined:

AUSTRALIA. **Tasmania:** Northern foothills of Mt Curly, 3 ii 1985, *Kantvilas* 73/85 (BM); Hamilton Range, c.4km NW of Gordon Dam, 22 ii 1986, *Kantvilas* 94/86 (BM); Mt Hean, 25 iv 1985, *Kantvilas* 173/85 (BM); Mt Tyndall, 5 iii 1986, *Kantvilas* (hb. Kantvilas); NE ridge of Mt Anne, 12 xii 1982, *Kantvilas* (hb. Kantvilas); Propsting Range, 10 iv 1986, *Kantvilas* 112/86 (hb. Kantvilas); Greystone Bluff, 9 iv 1986, *Kantvilas* 101/86 (hb. Kantvilas); Mt Sprent, *Kantvilas* 32/87 (BM); Crater Peak, 16 ii 1984, *P. James & Kantvilas* (BM).

NEW ZEALAND. **South Island.** Nelson: Denniston Plateau, ii 1980, *Galloway & J. A. Elix* (BM); Lonely Lake, Tasman Mts, i 1981, *J. K. Bartlett* (hb. Bartlett).

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