Studies on New Zealand Lichens

Part III.—The Family Peltigeraceae

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Abstract

Keys and descriptions are given for the New Zealand species of *Nephroma, Peltigera,* and *Solorina.* Fourteen species and nine varieties are recognized, including two new varieties in *Nephroma.* A number of new combinations are made, and some New Zealand species reduced in status.

Of the three genera of the Peltigeraceae found in New Zealand, *Solorina* is almost confined to the Northern Hemisphere, but *Nephroma* and *Peltigera* are widely distributed in both temperate zones. Some species in these genera are of world-wide distribution, and there are also several pairs of related species, one in the Northern and the other in the Southern Hemisphere. As is often the case in other groups, the widely distributed species tend to exist in several varieties and forms which may have the range of the species. This is particularly true of *Peltigera* species, and the treatment of these subspecific taxa by lichen taxonomists has varied greatly. In my treatment of *Nephroma* and *Peltigera* I have avoided the excessive splitting of V. K.-Gyelnik, who has examined the New Zealand specimens most recently, and I have reduced his "species" to varieties or to synonymy.

It is possible that some species are in part introduced, and this is discussed particularly under *Peltigera canina* and *Solorina crocea.* Nevertheless there is little doubt that the common species are in large part truly native, judged from their distribution within the country, from early records and from the apparent absence of certain related European forms which are more common there.

Descriptions of most of the species are particularly inaccessible or are very incomplete by modern standards; consequently I have given fairly full accounts of each species based on examination of the New Zealand material unless otherwise stated. Complete references to the literature and lists of synonyms are not given—they may be found in Zahlbruckner's "Catalogus Lichenum universalis" Vols. 3, 8 and 10—and I have listed only those references which deal with New Zealand material of the species concerned.

Symbols for Herbaria are: CHR—Botany Division, D.S.I.R., Christchurch. WELT—Dominion Museum, Wellington. Mr.—Mr. W. Martin, Dunedin. T—J. S. Thomson collection in Botany Department, University of Otago. Sc.—Mr. D. Scott, Botany Department, University of Otago. Others are named in full, and my own specimens carry a number only.

Nephroma Ach.

Thallus foliose, algae green or blue-green, apothecia sessile on the undersurface at the margin or on marginal lobules. Spores elongate, septate, hyaline to brownish. There are probably about 20 species distributed in the temperate zones of both hemispheres. The genus is often split into two, *Nephroma* (with green algae) and *Nephromium* (with *Nostoc*) but the distinction although useful, seems too trivial to distinguish at the generic level. *Nephroma* has recently been segregated as a family, Nephromaceae (Galinou, 1955) separated from Peltigeraceae by reason of the structure of the ascus and the ventrally placed apothecia.

Key to New Zealand *Nephromata*

1. Algae green; thallus yellow to green or brownish, K ± Subgenus *Nephroma* ..... *australe*
   Algae blue-green; thallus shades of brown or blue, K — Subgenus *Nephromium* 2
2. Upper surface strongly foveolate-reticulate, lower bullate ..... *cellulosum*
   Surfaces smooth or weakly depressed 3
3. Dark reddish-brown to grey, more or less isidiose above, spores 3-septate ..... *helveticum*
   Brown or blue, isidia absent or confined to margins, spores 1-septate ..... *lyallii*

Key to Varieties and Forms

australe

1. K + yellow or orange ..... var. *australe* f. *homalodes*
   K — 2
2. Apothecia usually entire, thallus thin (100–200μ) ..... var. *australe*
   Apothecia commonly longitudinally divided, thallus thicker (250–280μ), more horizontal ..... var. *rigidum*

cellulosum

1. Without isidia ..... var. *cellulosum*
   With subsquamulose isidia centrally ..... var. *isidioferum*

lyallii

1. Thallus with no true isidia ..... the species
   With squamulose isidia along cracks and edges ..... f. *isidiatum*

helveticum

1. With short tomentum below ..... var. *helveticum*
   Glabrous or minutely pubescent below ..... var. *rufum*

Nephroma australe Rich. var. australe.

Nephroma australe Rich., Voy. de Découv. de l'Astrolobe, *Botanique* Vol. 1, 31, Tab. IX, 2 (1832).
Nyl., *Synopsis Lich.* Vol. 1, 318 (1860), and *Lich. N.Z.* 44 (1888).
Hellb., *Bihang Kgl. Svensk Vetensk. Akad. Handl., 21,* III (13), 27 (1896).
Hook., *Handb. N.Z. Flora,* 565 (1867).
Buch., *Trans. N.Z. Inst. 6,* 231 (1873).
Kirk. *Trans. N.Z. Inst. 4,* 235 (1871).
Nephroma antarcticum var. *tenue* Nyl., *Synopsis Lich.* Vol. I. 317 (1860).
J. Linn. Soc. Bot. 9, 246 (1865).
Linds., *Trans. Linn. Soc.* 25, 520 (1866).
Nephroma Homanii Gyelnik, *Annal. Cryptog. exot., 4,* 129 (1931).
Nephroma schizocarpum Lindau *apud* Cockayne, *Trans. N.Z. Inst., 42,* 320 (1909).
? *Nephroma resupinata* var. *pruinosa* Mont., *Voy. Pôle sud,* 192 (1837–40).
= *N. schizocarpum* Nyl., *Synopsis Lich.* Vol. I, 318 (1860).
Gyelnik, *Annal. Musei Nat. Hung.,* 11, (1935).
Hellbom, *Bihang Kgl. Svensk Vetensk. Akad. Handl., 21,* III, (13), 27 (1896).

Thallus usually thin, averaging about 140μ thick, but thicker near the apothecia, with lobes about 5 mm wide and 5–10 mm long, usually partly ascending and sometimes with marginal lobules about 2 mm in dia., K —, P —. Apothecia round to reniform or rarely shallowly lobed; hymenium about 65μ high, spores brownish, 3-septate, (17–) 19–22 (–24) x 6½–7½μ.

Habitat. Tree trunks, twigs, damp rocks, mosses.

Distribution. Tasmania, New Zealand, Juan Fernandez and Chile. North Island: Waiotapu Valley, Allison 269 and in CHR (G8 sub *N. lyallii*); Tauherinikau Valley, (Beddie) CHR (sub *N. zelandicum*). Nelson: Pelorus Bridge, Mr. 4164. Westland: Lake Kanieri, Mr. 6911. Otago: Huxley Valley, 1813; Matukituki Valley, 1,700ft (D. Scott *et al.*) 4390, 4391; Akatore, Mr. 577. Southland: Forest Hill, 090; Doubtful Sound, T 2919, 4036. Stewart Island: (Cockayne 08316) CHR (*N. Homanii* (isotype) and *N. schizocarpum*); Port William, Mr. 653.

Nephroma australe Rich. var. **australe** f. **homalodes** (Nyl.) Murray, comb. nov.

Nephroma homalodes Nyl., *Lich. N.Z.*, 43 (1888).
Gyeln., *Ann. Musei Nat. Hung., Pars Bot.*, 11 (1935).
Nephroma antarcticum Hellbom, *Bihang Kgl. Svensk Vetensk. Akad. Handl. 21*, III (13), 26 (1896).
Nephroma zelandicum Gyelnik, *Borbasia, 1*, 4 (1938).
Nephroma zelandicum f. *squamicolum* Gyelnik, *Borbasia, 1*, 5 (1938).
Nephroma neozelandicum Gyelnik *apud* Zahlbruckner, *Lich. N.Z.* 45 (1941), (*? lapsus*).

Thallus more or less orbicular where substrate allows, 2 to 10 cm dia., variously lobed with lobes ascending at least at tips and sometimes more or less imbricated, 100–150 (–200)μ thick, upper cortex 30–40μ thick (up to 60μ and rugose on backs of apothecia), algal layer 15–20μ thick with algal cells mostly 8μ dia., medulla white (rarely pink in parts of some specimens), K +, P —, C +, pink or —, lower cortex pseudoparenchymatous 6–10μ thick. Hymenium 60–90μ thick including epithecium, hypothecium very pale straw-coloured 20–40μ thick, asci 55–65 x 10–12μ, 8-spored, usually with spores in two series. Spores light reddish-brown, 3-septate, mostly 19–21 x 5½–7μ. Paraphyses 2μ thick.

HABITAT. As for var. *australe*.

DISTRIBUTION. New Zealand. North Island: Kaipokirikiri (Colenso 820), Ruamahanga R. (Colenso 2616); Napier (Colenso 3576 pr.p.); Taruarua (Colenso 4733); Manawatu (Colenso 5084); Te Hawera (Colenso 5112); Patangata (Colenso 5268); all in WELT. Nelson: Hundalee, Mr. 1264. Marlborough: Tophouse, Mr. 4236. Canterbury: Geraldine, 031; Niger River, 3,500ft, Sc 54; Bealey R., 3,000ft, Mr. 6919; Hook Bush (A. D. Campbell) 3700. Otago: Huxley River 1845, 1846; Routeburn Valley 0812, 0936, 1041; Greenstone Valley (Holloway) CHR (G 51 sub *N. neozelandicum* f. *squamicolum*); Eglinton Valley, Otago University Bot. Dept. 004590 and 004591; vicinity Dunedin, T 157, T 304, T 429, T 580, T 742, T877, T 1085, T 2384, CHR (G4 = T 429, G5 = T 580, G6 = T159, G7 = T 304, G54 = T 157 + T 742; all sub *N. neozelandicum*); Maungatua 1,200ft, Mr. 933; Akatore, Mr. 575, Mr. 576 (pr.p.), Mr. 573, 1500; Taieri Mouth, Mr. 769; Mt. Charles, 600ft, 3523 (on soil). Southland: Waihopai, Mr. 6912; Wilmot Pass, 2,000ft, 3923 (K nearly —). Stewart Island: Paterson's Inlet, Mr. 697 (K nearly —); Ulva, Mr. 696.

According to Nylander (1888) *N. homalodes* differs from *N. australe* in the larger size, more rugose cortex above the apothecia, larger spores, partly red medulla and orange reaction with KOH. *N. zelandicum* differs from *australe* in the yellow reaction of the medulla with KOH. *N. neozelandicum* is apparently an error for *N. zelandicum*. *N. Homanii*, a form of *australe* with rather closely appressed lobes and marginal squamules was based on specimens from Juan Fernandez and Stewart Island. *N. zelandicum* f. *squamicolum* is a K + form corresponding to *N. Homanii*.

Although specimens corresponding to each of these "species" can be found, examination of a considerable range of material shows that there are no clear morphological differences between them. A positive KOH reaction is not associated with larger specimens, and is in any case rather variable, being usually yellow rather than orange. One specimen, Mr. 575, develops a strong orange colour with separation of crystals in a few seconds, but in others the colour is yellow, changing to orange after 15 minutes or more. The reddish medulla described for *N. homalodes* appears to be an artefact and the condition can be seen in some lobes of specimens T 429, Mr. 573 and 1845. The normal range of spore size for *N. australe* covers the dimensions given by Nylander for *australe* and *homalodes;* I have not been able to associate larger spores with a positive KOH reaction. I have preferred, therefore to treat *homalodes* as a chemical form of *australe*. Specimens of *N. australe* vary considerably in form from large, broad-lobed plants on moss or rock to small lobed plants with marginal lobules or squamules growing on twigs. The production of marginal squamules ("isidia" of Gyelnik) appears to be of no taxonomic significance; it is apparently associated with regeneration following "insect

damage", and may be found on parts of otherwise normal plants. *N. pruinosum* (Mont.) Zahlbr. (= *N. schizocarpum*) is apparently known only from the type specimen collected by Hombron in 1839 on Banks Peninsula. Montagne's diagnosis states that the apothecia are white-pruinose and the plant "olivaceo-fuscus", while Nylander gives the pruina as a doubtful character and renamed the species *schizocarpum* in reference to the longitudinally divided apothecia; he put it in the subgenus *Nephroma* (bright green algae). Gyelnik mentions neither pruina nor divided apothecia and describes the algal cells as green but nostocaceous, transferring the species to subgenus *Nephromium*. Gyelnik apparently used the size of the cells as the most important character for distinguishing between the green and blue-green symbiotic algae in this group, but this is an unreliable character, and Lamb (1955) for instance has noted that *N. analogum* has Protococcoid algae, not *Nostoc* as stated by Gyelnik. On the assumption that Gyelnik made a similar mistake with regard to *N. pruinosum* I have referred it to *N. australe* var. *australe*. The microscopic structure (*sec.* Gyelnik) does not differ appreciably from that of *australe*. Although divided apothecia are sometimes seen in *australe* they seem to be due to drying and cracking since the edges are not, or hardly corticate. Possibly *pruinosum* is a form resembling the type specimen of var. *rigidum* with some apothecia entire and some divided. Although *pruinosum* is said to differ from *australe* in having the cortex on the backs of the apothecia almost smooth, this is seen also in *australe* occasionally.

Both forms of *australe* seem to be widely distributed in New Zealand in forested areas and are particularly common in the beech forests bordering the Southern Alps.

Nephroma australe Rich. var. **rigidum** Murray, var. nov.

Thallus lobatus, superne viridis, laevis, subtus albus, glaber, laevis; cortex superior hyalinus vel pallide fuscescens, 25–30μ crassus; stratus gonidiale 20–30μ crassum, gonidiis viridibus ad 12μ magnis; stratum medullare ca 200–220μ crassum, K —, hyphis 2μ crassis; cortex inferior 5–8μ crassus, hyalinus, pseudoparenchymatus. Apothecia rotundata, 5–10 mm dia., integra aut lobata vel bis terve divisa; hymenium ca 120μ crassum epithecium includendum; hypothecium pallidum 20–40μ crassum; medulla sub hypothecio 100–250μ crassa et stratum gonidiale illic ad 40μ crassum gonidiis ca 10μ dia.; cortex in dorsis apotheciorum continuus, 40μ crassus; paraphyses conglutinati ca 2μ dia.; asci cylindrici pro majore parte 75 x 10μ, 8-spori, sporae 4-blastae, 15½–17½μ longae et 6–6½μ crassae, pallide refuscenti-fuscae. Pycnidia globosa, brunnea, semi-immersa in margine thallino aut rare subtus, pycnidiosporae non visae.

HABITAT. Westland: Kokatahi River, on soil, Scott 142 (Type in my herbarium with isotype in Scott's herbarium).

Var. *rigidum* differs from var. *australe* in the thicker, flatter and more rigid thallus, in the higher hymenium and the generally longitudinally divided or lobed apothecia. The spores appear somewhat smaller and the backs of the apothecia smoother than usual for var. *australe*. *N. antarcticum* (Jacq.) Nyl. differs in having a foveolate upper surface and in having rather larger spores.

A specimen from Otago, Huxley River (1844) approaches this variety in the thickness of the thallus (180–220μ) and height of hymenium (90–100μ), but has the smaller gonidia (5–8μ dia.) and larger spores (19½–22 x 7½–8½μ) of var. *australe*. The specimen has the general appearance of var. *australe* also in the ascending lobes and rather dissected margins centrally; the backs of the apothecia are strongly rugose and their margins ragged and lobed apparently due to regeneration following insect damage.

Nephroma cellulosum (Sm.) Ach. var. **cellulosum**

Lichen cellulosus Sm. *apud* Ach., *Method. Lich.*, 289 (1803).
Nephroma cellulosum Ach., *Lich. Univ.*, 523 (1810).
Hook, *Handb. N.Z. Flora*, 566 (1867).
Nephromium cellulosum Nyl., *Synopsis Lich.* Vol. I, 321 (1860).

Thallus about 5 cm in diameter, livid chestnut to grey, reticulate-foveolate above, foveolae 2–3 mm wide (smaller towards the periphery), white below darkening to blackish centrally and more or less bullate, glabrous. Apothecia light to dark brown, 5–10 mm broad by 2–5 mm long, with a very narrow entire margin; cortex above apothecia not differentiated from that of the thallus proper, 30–40μ thick; algal layer 50–75μ thick with bluish to olive green algal cells 8μ in dia.; medulla 50–250μ thick of loosely woven crystal-encrusted 2½μ dia. hyphae; hypothecium hyaline to faintly brown 25–35μ thick, hymenium 75μ thick, including a thin brownish epithecium. Asci 6–8 spored, cylindrical-clavate with spores in two series; spores pale fuscous, 14–19½ x 7–8μ, 3-septate. Immature spores are hyaline, smaller and 1-septate.

HABITAT. On trees, rarely mosses.

DISTRIBUTION. Tasmania, New Zealand, Juan Fernandez, South America. Canterbury: Upper Godley River, 3,000ft, Sc 177, Sc 200, Sc 201; Selwyn Gorge (Beckett 7), Canterbury Museum. Otago: Kaka Point, 0875; Matukituki Valley, 1,700ft (D. Scott *et. al.*) 4392. Australia: Mt. Macedon, Victoria (Wilson in Knight coll.) WELT.

There is no definite record in the literature of this species from New Zealand, but it has been attributed to this country on Nylander's statement (1860) "quoque in Tasmania et Nova Zelandia". This appears to derive from Babington (1855), who says "*N. cellulosum* . . . may probably occur in New Zealand". The New Zealand specimens closely match the description (Wilson, 1893) and illustration (Babington and Mitten, 1860) of the species, which is apparently uncommon here.

Nephroma cellulosum (Sm.) Ach. var. **isidioferum** Murray var. nov.

Thallus 5–15 cm latus, lobatus, castaneo-lividus, superne reticulato-costatus, foveolis ca 3 mm latis, versus centrum isidiis squamiformibus in venis; isidia thallo concolora, 0.2 mm crassa et 0.1–0.5 mm dia. Apothecia fusca vel rufo-fusca, 5–10 mm lata et 4–8 mm longa, rotundata bis reniformia, margine integro et tenue. Cortex superior ca 25μ crassus, K —, ex cellulis major minusve oblongis, 2 x 5μ; stratum gonidiale subcontinuum, in rugas excepto, 25–40μ crassum, gonidiis sordide viridibus 5μ dia.; medulla K —, 100–250μ crassa; cortex inferior parum distinctus 5–10μ crassus, saepe traversim diffractus. Hymenium ca 65μ altum, hypothecium hyalinum, 25–35μ crassum, asci 55 x 16–19μ, 6–8 spori, sporae lente rufo-fuscescentes, 4-blastae, (16–) 19 (–22½) x (5½–) 6½ (–8)μ; paraphyses non septati, conglutinati, 1½μ crassi sunt. Pycnidia non visa.

DISTRIBUTION. Otago: Flagstaff, 1,200ft, on *Fuchsia excorticata* T 1884 (Type). Southland: Sutherland Falls, T 2918.

The variety does not seem to differ very significantly from *N. cellulosum* except in the presence of isidia. The colour of the thallus varies from a slightly brownish-grey in the shade to a dark reddish brown in the sunlight. It evidently closely resembles *N. lepidophyllum* (Räs) Gyelnik, a South American species which has finer reticulate markings on the upper surface.

Nephroma helveticum Ach. var. **helveticum**

Nephroma helveticum Ach., *Lich. Univ.*, 523 (1810).
Gyelnik, *Ann. Musei Nat. Hung. Pars Bot.*, 11 (1935).
Du Rietz, *Archiv f. Bot., 22A*, No. 13, 5 (1929).
Nephromium helveticum Nyl., *Lich. N.Z.*, 43 (1888).
? *Nephroma resupinata* var. *papyracea* Ach. of Hook. *Fl. N.Z.* II, 272 (1855).
? *Nephroma resupinata* Mont. *apud* D'Urv., *Voy. de Decouv. Pôle sud Botanique* I, 192 (1842–5).

Thallus usually small, 1–5 cm dia., grey to livid-brown, thin, with subcylindrical more or less evenly distributed isidia above, and sometimes with more or less marginally distributed squamules about 1 mm wide; sometimes slightly pubescent above, particularly on the backs of the apothecia; tomentose below with tomentum of erect hyphae 0.1–1 mm long. Apothecia nearly round to reniform, with narrow, usually dentate thalline margin; hymenium 75–85μ high, hyaline except for pale brownish epithecium; hypothecium 30–40μ, light brownish, medulla and algal layer *ca* 180μ thick above apothecia, loosely woven centrally; cortex on backs of apothecia up to 40μ thick, slightly brownish; asci 52–60 x 12–14μ, 4–6 spored; spores light reddish-brown, 3-septate, 21–25 x 7½–9½μ, with end cells longer than central pair.

HABITAT. Tree trunks, rarely on damp rocks

DISTRIBUTION. Apparently in most parts of the North and South Temperate Zones. Otago: Huxley River, 1847; Routeburn Valley, 0813. Southland: Waikaia, Mr. 6913.

The species is frequently classed as a variety or form of *N. resupinatum* Ach., from which it differs in the constantly shorter tomentum, the absence of pseudocyphellae and probably the presence of isidia on the upper surface (cf. Du Rietz 1924; Gyelnik 1935, p. 11). Possibly this is the best treatment, but I have not seen enough foreign material to judge; true *N. resupinatum* does not seem to occur in New Zealand. *N. helveticum* appears to be variable as regards the presence or absence of marginal squamules so far as can be determined from the few specimens so far collected in New Zealand. The New Zealand specimens seem to agree with the type specimens of *N. helveticum* better than do the normal European plants, although Acharius' specimens were collected in Switzerland (Gyelnik, 1935). It is probable that *N. tropicum* (Müll. Arg.) Zahlbr. and *N. denticulatum* (Wain) Gyelnik are synonyms of *N. helveticum*, the former having the backs of the apothecia pubescent and the latter not. In the New Zealand specimens this feature is variable even within the same specimen, so cannot have any taxonomic significance. This pubescence is a microscopic feature, and is only visible macroscopically in a matt appearance of the surface.

Nephroma helveticum Ach. var. **rufum** (Bab.) Murray, comb. nov.

Nephroma resupinatum var. *rufa* Bab. in Hook., *Fl. N.Z.*, II, 272 (1855).
Nephromium laevigatum var. *rufum* Nyl., *Synops. Lich.* I, 321 (1860).
Nephromium laevigatum Hook., *Handb. N.Z. Fl.*, 566 (1867).
Kremph. *Reise der "Novara", Bot. I.*, 121 (1870).
Nephromium helveticum var. *rufum* Nyl. *apud* Hue, *Nouv. Archiv. du Museum*, ser. 3, Vol. II, 310 (1890).
Nephromium helveticum Hellbom, *Bihang. Kgl. Svensk. Vetensk. Akad. Handl., 21*, III (13), 27 (1896).

Thallus thin, 60-170μ thick, usually dark reddish-brown, mostly appressed to the substratum centrally, 1–10 cm dia., peripheral lobes 3–8 mm wide by 3–12 mm long, ascending, upper surface with scattered isidia singly or in groups; lower surface smooth or slightly wrinkled, shining or matt or microscopically pubescent. Isidia terete, 0.2 mm dia., by 0.5 mm high or subsquamulose, 1 mm dia. Upper cortex 12μ thick, slightly brownish and sometimes with minute pubescence of single hyphae 5–15μ high; algal layer 10–25μ thick, algae (?) *Nostoc* mostly $3\frac{1}{2}$ x $4\frac{1}{2}\mu$ oblong; medulla 15–100μ thick of rather loosely woven hyphae $2\frac{1}{2}\mu$ in dia.; lower cortex light brownish-red, $6\frac{1}{2}$–8μ thick, of 2 or 3 layers of cells about 4μ square, usually with a few protruding hyphae 5–25μ high. Apothecia subrotund to reniform, up to 3 x 5 mm with thin dentate margin, hymenium *ca* 65μ thick including the pale fuscous to brown epithecium, hypothecium 20–35μ, hyaline to pale brownish, cortex above apothecia obscurely wrinkled, 30–50μ thick of nearly cubic cells $7\frac{1}{2}\mu$ long, with some protruding hyphae; asci 45–55 x 8–13μ, somewhat clavate, (6–) 8-spored; spores nearly hyaline to pale reddish-brown, 3-septate, 15–20 x $5\frac{1}{2}$–$7\frac{1}{2}\mu$; paraphyses conglutinate, 2μ thick, aseptate, slightly thickened at tip. Pycnidia not seen.

HABITAT. Trees, damp rocks in shade.

DISTRIBUTION. ? Europe, New Zealand, Australia. North Island: Te Kotukutuku (Colenso 5097) WELT. Nelson: Aniseed Valley, Mr. 4171, Mr. 4172; (Knight) WELT (sub. *N. sublaevigatum*). Canterbury: Tekapo, Scott 160, Scott 165; Mt. Misery, Philipson 31. Otago: Lake Ohau, Mason 192; Routeburn Valley, 0830; Trotter's Gorge, 3820, 3875; Akatore, 1501, Mr. 574; Kaka Point, 0157, 0439. Southland: Doubtful Sound, 3952. Australia: Victoria, Seatoun Creek (F. Campbell 51 in Knight coll.) WELT sub *N. sublaevigatum*.

The variety differs from var. *helveticum* in the near absence of tomentum and the rather smaller spores. There is also, at least in the specimens so far examined, a difference in the number of spores in the asci. It appears close to European forms under the names *helveticum, subtomentellum, laevigatum*, etc., but European

specimens I have seen lack the characteristic isidia and are rather thicker and bluer than our plants. *N. laevigatum* appears to be a *nomen ambiguum* according to Gyelnik (1935), and the correct assignment of plants so identified is uncertain. *N. helveticum* var. *rufum* seems close to *N. sublaevigatum* Nyl. from Mexico, but I have seen no certain specimens of this. It is said to have a slightly reticulate-costate upper surface, a condition sometimes seen in specimens of var. *rufum*.

Nephroma lyallii Bab.

Nephroma lyallii Bab. *apud* Hook., *Fl. N.Z.*, II, 272 (1855), and plate 127a.
Nyl., *Synops. Lich.* I, 322 (1860).
Hook. *Handb. N.Z. Fl.* 566 (1867).
Nyl., *Lich. N.Z.* 42 (1888).
Hellbom, *Bihang Kgl. Svensk Akad. Handl. 21,* III (13), 27 (1896).
Nephroma javanicum Gyelnik, *Annal. Crypt. exot. 4,* 135 (1931), et *apud* Zahlbr. *Lich. N.Z.* 45 (1941).

Thallus blue or brown or variegated and smooth above, with lacerate to proliferate margins centrally, brownish and tomentose below centrally, pale and glabrous towards the periphery, 3–8 cm dia., with lobes 3–5 mm wide by (5–) 15 (–25) mm long. Apothecia very pale brown, 5–10 x 3–5 mm, more or less reniform with 1 mm wide entire thalline margin. Hymenium 50–55μ high, hyaline with thin, faintly coloured epithecium; hypothecium 15–25μ thick, nearly hyaline; medulla above hypothecium 60–70μ thick, of loosely woven thin-walled hyphae 2½μ dia.; algal layer here 8–15μ thick with *Nostoc* cells 4–7μ dia., pure blue or blue-green; cortex above apothecia 20–25μ thick of palisade-like cells *ca* 9 x 6μ. Paraphyses aseptate, 1μ thick, hardly thickened at the tips, asci 45–55 x 6–8 (–12)μ, 6–8 spored, thin-walled, cylindrical, with spores in two series; spores nearly hyaline to pale reddish-brown, 1-septate, 16–18 x (4½–) 5–6½μ, sometimes slightly constricted at the septum.

HABITAT. On small branches, usually in damp, shady places.

DISTRIBUTION. New Zealand and Java. North Island: Tiritea (G3, Zotov and Allan) CHR; Palmerston North (Zotov) CHR (all under *N. javanicum*); Hawke's Bay (Colenso) WELT. Westland: Franz Josef (C. K. Boey) 4165. Otago: Green Island, T 1956. Southland: Akatore, Mr. 576 (pr. p.); Forest Hill, 1011; Waihopai, Mr. 1305. Stewart Island: Oban, Mr. 708.

N. lyallii differs from most other *Nephroma* species in the uniseptate spores and the commonly blue algae. Gyelnik's brief description of *N. javanicum* makes no mention of the apothecial characters and is misleading in its reference to "superne . . . isidiatus" since he apparently means merely that the plant has lacerate margins. Gyelnik's description of *N. javanicum* (1931) is not clearly different from his redescription of the type specimen of *N. lyallii* (1938).

The Southland and Stewart Island specimens seem a little stouter and with less fragile margins than the North Island specimens identified as *N. javanicum* by Gyelnik, and have 8-spored asci, whereas (Zotov, Palmerston North) CHR has mostly 6-spored asci. Too few collections have yet been made to decide whether these differences are significant.

The identification of Allison 269 as *N. lyallii* in Zahlbruckner (1941) seems to be an error, since the two portions of the collection retained in New Zealand are clearly *N. australe*.

Nephroma lyallii Bab. f. **isidiatum** Murray, f. nov.

A typo differt isidiis squamiformibus ad margines et rimas thalli. Ceteres ut in specie.

DISTRIBUTION. Westland: Runanga, Mr. 6920. Otago: Leith Valley, 3544; Mihiwaka, T 630. Southland: Forest Hill, 0660 (Type); Wilmot Pass, 3935. No locality (Knight) WELT (sub. *N. schizocarpum*).

This form differs from the species in having subsquamulose isidia along the margins and cracks in the thallus. The isidia are mostly about 0.1 mm thick and 0.3 mm dia., and do not seem to be associated with damage by insects, etc. Some specimens grade into the "typical" form of the species.

Peltigera (Willd.) emend Rabenh.

Thallus foliose, grey-, blue-, yellow or brownish green, algae blue-green or bright green, ecorticate below and more or less whitish or brownish and more or less distinctly veined. Cortex large-celled, plectenchymatous. Apothecia sessile on margins of upper surface and often on ascending lobules; spores elongate, septate, hyaline to brownish.

The genus is represented in the temperate zones of both hemispheres and at high altitudes in the tropics. Although usually found on damp soil, logs or moss, specimens occur in exposed alpine situations where humidities are not too low.

The number of species recognized by different authorities varies from about 20 to over 80, and a multitude of varieties and forms have been proposed. It seems certain that many of the varieties and even species are no more than habitat or development forms.

I have recognised 9 species with 6 varieties for New Zealand, but an adequate study of the development of the group might reduce several of the latter to forms (cf. Thomson, 1950).

Key to New Zealand Peltigerae

1.	Algae, green. Subgen. *Peltidea*. Black cephalodia above and below, apothecia horizontal	*nigripunctata*
	Algae, blue-green. Subgen. *Peltigera*	2
2.	Thallus glabrous above	3
	Thallus tomentose or scabrid or scaly above, at least marginally	6
3.	Veins narrow, raised, rhizines mostly simple	*virescens*
	Veins broad (more than 1 mm), weakly raised	4
4.	Apothecia on horizontal lobules, spores 3-septate, less than 45μ long	*horizontalis*
	Apothecia on ± vertical lobules, spores 3–9-septate, over 45μ long	5
5.	Rhizines fasciculate, up to 5 mm long	*polydactyla*
	Rhizines simple, up to 10 mm long	*dolichorhiza*
6.	Lobes blue sorediate at margin, upper surface ± scabrid	*scutata*
	Lobes not marginally sorediate	7
7.	Upper surface with scales, edges and cracks isidiate	*praetextata*
	Upper surface tomentose, not isidiate	8
8.	Thallus rather soft, up to 1 mm thick, no veins beneath	*malacea*
	Thallus rather rigid, less than ½ mm thick, veins usually present beneath	*canina*

Key to Varieties

P. horizontalis.	Lobes narrow (½ cm wide), apothecia 2–5 mm dia., surface smooth	var. *muscorum*
	Upper surface white pruinose	var. *muscorum* f. *albido-pruinosa*
P. polydactyla		
1.	Interspaces beneath inconspicuous, small	var. *polydactyloides*
	Interspaces conspicuous	2
2.	Small, pusilloid (½ cm wide x 1 cm long)	var. *magyarica*
	Lobes more than ½ cm wide x 1½ cm	var. *polydactyla*
	Margins lacerate, f. *lophyra* (Ach.) Nyl.	
P. dolichorhiza		
1.	Thallus more than 220μ thick, greyish or brownish	2
	Thallus 100–200μ thick, reddish-green	var. *nana*.
2.	Lobes rather thick, crisp, about 8 mm wide x 15 mm long	var. *oceanica*
	Lobes mostly 1–2 cm wide, 1–5 cm long	var. *dolichorhiza*

P. canina

1. Lobes small, up to 1½ cm long, ± cochleate, ascending ..... var. *spuria*
   Lobes small, up to 1½ cm long, ± cochleate, with scattered soredia ..... var. *spuria* f. *sorediata*
   Lobes more than 2 cm. long, margins only ascending 2
2. Lobes less than 1½ cm wide, reddish brown, veins brown ..... var. *rufescens*
   Lobes more than 1½ cm wide ..... var. *canina.*

Peltigera nigripunctata Bitt.

Peltigera nigripunctata Bitt. *Berichte Deutsch. Bot. Ges., 27,* 194 (1909).
Peltigera nigripunctata Bitt. f. *farinosa* Gyeln., *Annal Cryptog. exot. 4,* 168 (1932), and *Rev. Bryol. et Lichen., 5,* 61, 69 (1932).

This is a Javan species which should be easily recognized by the characters given in the key. The form *farinosa* is based on a specimen collected by Berggren in 1874 in New Zealand (locality not stated) and now in the Uppsala Herbarium as "*P. venosa,* Berggren 39". It is not mentioned by Hellbom (1896) who described Berggren's New Zealand lichens. Gyelnik's form "differt thallo superne partim incuso" seems a trivial modification not worth retaining. *P. nigripunctata* apparently differs from *P. venosa* only in having cephalodia on the upper surface as well as the lower, but I have seen neither specimens nor a complete description.

Peltigera scutata (Dicks) Duby.

Peltigera scutata (Dicks) Duby, *Bot. Gallic.* II, 599 (1830).
Peltigera polydactyla var. *scutata* Müll. Arg., *J. Linn. Soc. Bot. 32,* 201 (1896).

Thallus medium sized, curled at edges, grey to brown, slightly scabrid to smooth, commonly pruinose at tips of lobes and with masses of grey soredia on the margins. Under surface without veins or with broad brownish veins and yellowish interspaces. Rhizines short and fasciculate. Apothecia up to 3 mm dia, horizontal or erect, hymenium up to 200μ thick, spores 3–7 septate, 30–70 x 3–5½μ. (Description abbreviated from Thomson, 1950.)

HABITAT. Logs, rocks.

DISTRIBUTION. Eurasia, North America, Peru, Chile, New Zealand.

Exsiceata SEEN. Lich. suecici (Du Rietz), Fl. suecica (Sandberg). The species is reported from Napier (Colenso, 1658) by Müller, but I have seen no New Zealand specimens, nor is it in the Colenso lichen collection in Wellington.

Peltigera virescens (Stnr.) Gyeln.

Peltigera rufescens var. *virescens* Steiner *apud* Zahlbr. et Zederb., *Annal. Naturhist. Hofmuseum Wien, 20,* 372 (1907).
Peltigera virescens Gyelnik, *Rev. Bryol. et Lich., 5,* 73 (1932).
et *apud* Zahlbr. *Lich. N.Z. 46* (1941).
Peltigera degeni f. *tasmaniae* Gyel., *Magy. Bot. Lapok, 28,* 61 (1929).
? = *Peltigera virescens* var. *tasmaniae* Gyelnik *apud* Zahlbruckner *Lich. N.Z., 46* (1941).
Peltigera tereziana Gyelnik, *Oesterr. Bot. Zeitschr., 77,* 220 (1928).
? *Peltigera pellucida* f. *dilacerata* Gyeln. *apud* Zahlbr. *Lich. N.Z., 46* (1941).

Thallus 3–10 cm dia., lobes 10–25 mm long, 3–10 wide, grey-green, smooth, glabrous, veins forming an anastomosing network, raised and narrow, rhizines usually tapering, simple but with some fasciculate and short (less than 3 mm long); interspaces between veins thinly tomentose. Cortex 25μ, algal layer about 40μ, medulla 200–300μ of fairly loosely woven hyphae 7½μ dia. Apothecia vertical on extended lobules, mostly about 3–5 x 2–4 mm; hymenium 100μ thick, including pale brown epithecium, hypothecium brown, 50μ thick; asci 65–95 x 15μ, apparently 6-spored; spores very pale yellow, 3–5 septate, straight or arcuate, 50–95 x 2½–3μ.

HABITAT. Logs, stones, moss in damp places.

DISTRIBUTION. North America, Europe, Australasia. North Island: Tiritea (G2 Zotov, pr.p.) CHR; (Chamberlain, sub *P. dolichorhiza*) CHR. Marlborough: Onamaluta, Mr. 4214 (pr.p.); Waihopai, Mr. 4211 (pr.p). Canterbury: Godley

River, 4,000ft, Sc 285. Westland: Franz Josef (C. K. Boey), 4166. Otago: Haast Pass (R. F. Smith), 1182; Trotter's Gorge, T 1400; Flagstaff, 1,000ft, T 732 (and as G21 in CHR sub *P. virescens* var. *tasmaniae*); Dunedin, T 1395, T 1071, T 1072; Taieri Mouth, 1423, 1676.

Exsiccata SEEN. Fl. Hung. (Filarszky, sub *P. pellucida*).

A specimen from Jamaica (Plitt) distributed as *P. virescens* from Gyelnik's Herb. Lich., has uniformly short fasciculate rhizines, and thus cannot be this species.

This species seems to be commonly known as *P. degeni* Gyelnik, but the name *virescens* clearly has priority if the species are truly identical. Gyelnik's variety *tasmaniae,* according to his description and the specimen in CHR (G21) is merely a rather short lobed fruiting form, such as may be found in several species. *P. pellucida* f. *dilacerata* Gyelnik according to the description is identical with *virescens,* although Thomson (1950) lists it as a synonym of *P. polydactyla. P. Lairdii* described by Dodge and Rudolph (1955) from Macquarie Id. is supposed to resemble *P. dilacerata* but is tomentose above, and must thus actually be in the *P. canina* group. I have not seen the original description of *P. dilacerata* which was founded on a specimen from Auckland. *P. Tereziana,* founded on a specimen from Wellington, is a pusilloid form of *virescens* according to the mention in Gyelnik (1931, 1932), although it is listed as a synonym of *P. canina* var. *spuria* by Thomson (1950), and is said to resemble *P. frigida* according to Santesson (1944).

It is possible that *P. virescens* might be best regarded as a variety of *dolichorhiza,* since the character of the thickness of the veins is the only clear distinction in non-fruiting specimens, and sometimes the veins are in part like those of the latter species. In one of my Otago specimens (1423) some of the lobes have traces of white tomentum at the edges, and this plant may belong in the *canina* group.

Peltigera horizontalis (Huds.) Baumg. var. **muscorum** (Schl.) Schaer.

Peltigera muscorum Schleich (1823) ? in sched.
Peltigera horizontalis var. *muscorum* Schaer., *Lich. Helvet. Spicil.,* (5) 265 (1833).
Peltigera horizontalis Hellbom, *Bihang Kgl. Svensk Vebensk. Akad. Handl., 21,* III (13), 29 (1896).

Thallus flat, to 8 cm dia., yellowish-green or brownish-green, lobes 1½–2 cm long by ½ cm wide, glabrous, somewhat shining; cortex 40–60μ thick, outer cells 13 x 8μ, algal layer 50–110μ thick, algae mostly 8 x 6μ, medulla 140μ thick, of septate hyphae 4–10½μ dia., lower surface with broad, flat anastomosing veins, rhizines sparse, dark, fasciculate and short. Apothecia on broad horizontal lobules, 2–5 mm dia., distinctly raised above thalline margin; hypothecium reddish-brown, 10–30μ; hymenium 70–95μ thick; paraphyses 2½μ thick, asci 6–8-spored; spores uniformly 3-septate, hyaline to light brownish, 26–32 (–38) x 5½–8μ, sometimes slightly constricted at middle septum.

HABITAT. On soil (in New Zealand).

DISTRIBUTION. North Temperate Zone, New Zealand. Marlborough: Avon Valley, Mr. 4245, Mr. 6918. Canterbury: Waipara (Allan); Godley Valley, 2,400ft, Sc 203; 4,300ft, Sc 202; Lake Tekapo, Mason, 43 and 54. Otago: Matukituki Valley (R. F. Smith) 0966; Lake Ohau, Mason, 177a.

Zahlbruckner in Cat. Lich. Univ. and Thomson (1950) both reduce the variety to formal rank, the latter stating that it is variable and inconstant and occurs throughout the range of the species. European forms of *horizontalis* which I have seen, however, are different from the New Zealand specimens, being much larger and thicker, with broad lobes (up to 3 cm) and considerably larger apothecia with distinctly longer spores (30–40μ). Consequently I have preferred to retain the variety. Hellbom's plant from Porter's Pass evidently also belongs here. *Peltigera frigida* Santesson (1944) from South America seems very close to the New Zealand specimens of *horizontalis* var. *muscorum,* but apparently differs in having radiating veins, thinner cortex and longer, narrower spores.

Peltigera horizontalis var. **muscorum** f. **albido-pruinosa** Murray, f. nov.

A varietate differt thallo superne dense albido-pruinoso; planta minima.

Thallus of more or less separate lobes, 3–8 mm long by 2–4 mm wide, mostly densely white pruinose above but with some patches of smooth surface; with broad pale brownish veins below; cortex 75–100μ high, hyaline of plectenchyma with cells up to 25 x 15μ and with thin irregular decomposed outer layer. Apothecia 3–4 mm dia., dark brown, epruinose; hypothecium brown, 25μ thick; hymenium 95μ high with pale, thin epithecium; spores broadly fusiform, 3-septate, 32 x 8μ, hyaline.

DISTRIBUTION. Otago: Matukituki Valley, 4,000ft (D. Scott), 4389 (on soil among scree).

The plant looks very like Santesson's illustration of *Peltigera frigida* (1944), from which it differs particularly in the pruina and thick cortex. The collection is quite distinct from other specimens of *P. horizontalis* but may be only an extreme habitat form.

Peltigera polydactyla (Neck.) Hoffm. var. **polydactyla**

Lichen polydactylon Neck., *Method. Muscor.* 85 (1771).

Peltigera polydactyla Hoffm., *Descript. et Adumbr. Plant Lich.*, 19 (1790), Bab. in *Hook. Fl. N.Z.* 271 (1855).
Hellb., *Bihang Kgl. Svensk Vetensk. Ada. Handl. 21*, III (13) 28 (1896).
Hook., *Handb. N.Z. Flora*, 566 (1867).
Buch., *Trans. N.Z. Inst., 6*, 231 (1873).
Kirk, *Trans. N.Z. Inst.* 4, 235 (1871).
Müller, *J. Linn. Soc. Bot., 32*, 201 (1896).

Peltigera polydactyla f. *minor* Krmph., *Reise Oesterr. Fregatt Novara, Bot.* Vol. II, 121 (1870).

? *Peltidea polydactyla*, Hook. *Fl. Antarctica, 1*, 197 (1844).

Thallus up to 20 cm dia., commonly of more or less detached lobes 3–8 cm long by about 1½ cm wide, grey, grey-green or brownish, smooth and glabrous above sometimes with somewhat impressed or undulating surface (corresponding to veins beneath) and usually ascending margins. Lower surface white to brown with veins ½–1½ mm wide and 0.2 mm high, carrying mostly short fasciculate rhizines or occasionally some simple ones. Cortex 30–35μ of about 4 cell rows, algal layer (10–) 30 (–65)μ, medulla (150–) 250–450μ of loosely woven hyphae 8–15μ dia., with cell walls 2½μ thick. Apothecia more or less round, 2–5 mm dia. with thin crenate margin; hymenium 100–150μ, including the pale brownish epithecium; hypothecium brown, 35–65 (–100)μ thick; asci 80–100 x 12–20μ; spores acicular (3–) 5–9 septate, light brownish, straight to slightly arcuate, 50–80 x 3–4μ.

HABITAT. In damp places on soil, logs, stones, etc.

DISTRIBUTION. Cosmopolitan. North Island: Orongaronga R. (Allan), CHR (pr.p); Wellington (KG11) CHR. Nelson: Hundalee, Mr. 1306. Marlborough: Pelorus Bridge, Mr. 4168. Canterbury: Craigieburn Range, 5,500ft (A. F. Mark), 4163. Westland: Greymouth, Mr. 5422; Styx River, 2,100ft, Scott, 141; Fox Glacier (J. M. Anderson), 0744. Otago: Dunedin, Mr. 5426; Mihiwaka, Mr. 706 (pr.p.); Mt. Cargill, Mr. 5423 (pr.p.); Mt. Flagstaff, 1,000ft, 1980; Taieri Mouth, 1261, 1464, 1666, 1667, 1672. Southland: Tautuky Bay, 1025. Stewart Island: Port Pegasus, Mr. 5424 (or *dolichorhiza* var. *nana*). Chatham Islands: (Colenso, 19) WELT.

Exsiccata SEEN. Swed. Lich. (Magnusson, 13788), Boros Lich. Fl. exsicc austro-hung. No. 41.

P. polydactyla has been frequently reported from New Zealand, and is probably not uncommon, although it is evidently less so than the closely related *P. dolichorhiza*. Probably many of the early reports actually refer to the latter species. Like most wide-ranging species it is variable, and it has been noted (e.g., by Nylander, 1860) that the New Zealand specimens are distinctly smaller lobed and thinner than the European forms and have a more impressed surface when dry. On this account our plants were distinguished as f. *minor* by Krempelhuber. Although this was reduced to synonymy with f. *microcarpa* (Ach.) Merat by Thomson (1950), the forms are

evidently different. The latter differs from the typical form in the narrower (but not necessarily thinner) lobes and small (2 mm dia.) apothecia, whereas f. *minor* has thinner lobes and small apothecia. A few of the specimens listed above have rather thin thalli with impressed upper surfaces, and presumably belong in f. *minor* Kremph. The dimensions of the cortex and algal layer are the same as in more typical specimens. Small apothecia which appear on many specimens are immature and are not clearly associated with thinner thalli. I have not thought it worth separating these as a distinct form.

Some New Zealand specimens have lacerate margins in part, and thus correspond to f. *lophyra* (Ach.) Nyl. This seems a trivial modification hardly worthy of recognition; the condition is sometimes seen on parts of otherwise normal plants. One specimen from Dunedin, Mr. 5426, has abundant 10 mm long black rhizines but is not otherwise different from normal.

There seems no doubt that *P. polydactyla* is endemic to New Zealand, both because of early reports which describe it as common, and because our specimens are usually distinguishable from European or American forms by their generally thinner thalli and narrower lobes.

Peltigera polydactyla var. **magyarica** (Gyelnik) Murray comb. nov.

Peltigera magyarica Gyelnik, *Ann. Musei Nat. Hung. Pars Bot., 31,* 46 (1937).

This is similar to the species but is usually thicker than the typical form in New Zealand and has smaller, more or less cochleate lobes and few rhizines below. It is often fruiting freely.

HABITAT. On clay banks.

DISTRIBUTION. Europe, New Zealand, North America. North Island: Mangarakau, T 2630; Huia, Auckland University Botany Department. Otago: Matukituki Valley, 1,700ft (D. Scott *et. al*) 4388; Dunedin, 1936; Taieri Mouth, 1385, 1502.

Distinguished by the above characters, this has the appearance of a habitat form, but two of the quoted specimens I found growing within a few centimetres of normal plants of *P. polydactyla* and *dolichorhiza*. It seems to be of rare occurrence and is perhaps not a good variety. It is not very different from small specimens of the following variety.

Peltigera polydactyla var. **polydactyloides** (Nyl.) Maas Gest. in sched?

Peltigera polydactyloides Nyl., *Flora, 46,* 265 (1863).
Peltigera crassoides Gyeln., *Magy. Bot. Lapok 29,* 51 (1930).
Peltigera polydactyla var. *hymenina* Auct. (non Ach.)
? *Peltigera pusilla* Zahlbr. *Lich. N.Z.,* 45 (1941).

Plants usually rather small with ascending or incurled edges, underside with a more or less continuous tomentum and the veins absent or very indistinct (except sometimes centrally); rhizines usually few but sometimes clustered in the centre; cortex 30μ, algal layer 25–50μ, medulla 350–450μ of loosely woven hyphae 8–10μ dia. Apothecia rare, hymenium ca 100μ thick; hypothecium brown, 50μ thick; spores 7–9 septate, 60μ or more long (ripe spores not seen).

HABITAT. On soil or logs, often in dry or alpine situations.

DISTRIBUTION. Apparently as for the species. Canterbury: Upper Godley Valley, 5,200ft, Scott 158. Otago: Merton, 3899; Dunedin, 1934, 3543; Ravensbourne, 1181, 1976; Sandymount, T 1773 (and in CHR as ZA 523 sub *P. pusilla*); Maungatua, 1,000ft, Mr. 925 (pr.p), 3,000ft, 0515; Waipori, T 196; Taieri Mouth, 1673, 1675. Southland: Manapouri (D. Hamilton), 0717; Riverton, T 797.

Exsiccata SEEN. No. 1944–29, ex Herb. R. D. Hoogland, in Auckland University Botany Department.

This does not seem to be a habitat form since specimens are sometimes growing with the typical form of the species and the difference between them is quite marked. It is not a growth form, since specimens 1181 and 1976 are collections from the

same plant taken five years apart. Possibly the variety is produced by an abnormally slow growing plant, since the veined surface in *Peltigera* is in large part due to separation of the lower surface by the more rapidly growing algal layer and cortex. Specimen 1976 had almost doubled in size in four years, which is about the usual lifetime for *Peltigera* species. The Sandymount specimen T 1773 certainly has the appearance of *P. pusilla* (*P. canina* var. *spuria*) but lacks any trace of tomentum; it could equally well be a small specimen of var. *magyarica*. The specimens under this variety name are not very homogenous, the size of the lobes varying from 15 mm in diameter to 3 mm. So far as I can discover Maas Geesteranus' combination has not been published.

Peltigera dolichorhiza Nyl. var. **dolichorhiza**

Peltigera polydactyla var. *dolichorhiza* Nyl., *Synops. Lich.* Vol. I, 327 (1860).
Müller, *J. Linn. Soc. Bot. 32*, 201 (1896).
Peltigera dolichorhiza Nyl., *Lich. N.Z.*, 43 (1888).
Hellb., *Bihang Kgl. Svensk Vetensk. Akad. Handl., 21*, III (13), 29 (1896).
Zahlbr., *Lich. N.Z.*, 46 (1941).
Peltigera dolichorhiza f. *javanica* Gyelnik, *Nyt Mag. Naturvidenskap, 68*, 269 (1930 et *apud* Zahlbr. *Lich. N.Z.* 46 (1941).

Thallus as for *P. polydactyla* f. *minor* except that the rhizines are up to 10 mm long, simple and tapering, usually dark coloured; cortex 25–30μ thick, algal layer 25–35μ, medulla 180–240μ of rather compact hyphae 8μ dia. Apothecia about 3 mm dia., hymenium 100–130μ high, hypothecium rather dark brown, 35–70μ thick; asci 4–6 spored, spores brownish when mature, (3–) 5–7 (–9) septate, 50–80 x 3–4μ.

HABITAT. In damp localities on soil, mosses, logs, rarely stones, etc.

DISTRIBUTION. New Zealand, North and Tropical America, Australia and probably elsewhere in the southern hemisphere. North Island: Whangarei (Given) CHR; (?) Volcanic Plateau (Attwood) CHR; Maungatawhiri (G20 Moore) CHR; Tiritea (G1 Chamberlain, 2 coll. and Allan) CHR; Pirongia (W12 Allan) CHR; Kaingaroa Plain, Allison 246; Wairarapa (Colenso 403) (Colenso 2591) WELT; Kahuraamake (Colenso 2904) WELT. Nelson: Korere (Allan) CHR; Hundalee, Mr. 1301. Marlborough: Pelorous Bridge, Mr. 1337. Westland: Greymouth, Mr. 6882. Canterbury: Waipara (G50, Moore sub *P. dolichorhiza* f. *javanica*) CHR; Hermitage, 3,000ft, Sc 291. Otago: Kaituna, T 1955; Haast Pass, 0954; Huxley River, 1848; Trotter's Gorge, T 1400 (pr.p); Leith Valley, Mr. 749, T 1740 (pr.p) and in CHR (G53); Abbott's Hill, T 936, T 949; Lee Stream, 0695; Flagstaff, 1,500ft, Mr. 1150 (pr.p.); Taieri Mouth, 1384, 1670, 1674. Southland: Mackinnon Pass, 3,000ft, T 2900 (unusually broad lobes); Doubtful Sound, T 2879, T 2885, 3945; Forest Hill, 0392; Riverton, T 793. Stewart Island: Oban, Mr. 78; Wilton's Bush, Mr. 5425.

Exsiccata SEEN. Gyelnik Herb. Lich. (Jamaica, Plitt) (Thallus thicker than in New Zealand specimens).

Nylander's original spelling of the species name with a single "r" was changed to "rr" in 1888. The difference between *polydactyla* and *dolichorhiza* is perhaps hardly enough to justify separation at the species level, but nevertheless is remarkably constant and I have not been in doubt about assigning more than a very few of the specimens to one or the other species. Since *dolichorhiza* was not segregated till 1860, and it is apparently the commonest member of the genus in New Zealand, it is more than likely that the early records of *P. polydactyla* refer in large part to *dolichorhiza*. The *polydactyla-dolichorhiza* complex is in need of controlled growth studies to ascertain the constancy of the taxa listed as varieties. It is a reasonable suspicion that they are not, in which case the best treatment may be to leave the latter as a variety of *polydactyla* and reduce the varieties to the rank of forms or to synonymy. It seems not without significance that parallel pusilloid, thinner or

obscurely-veined varieties are found in each of the species *virescens, polydactyla, dolichorhiza* and *canina*. Gylenik's f. *javanica* is merely a freely fruiting form.

Peltigera dolichorhiza var. **nana** (? Nyl.) Murray comb. nov.

Peltigera polydactyla var. *nana* Nyl., in sched. sec. Knight.
Peltigera nana Wainio, Philipp. J. Sci., *8*, 114 (1913) and Gyelnik, *Ann. Mus. Nat. Hung., 30,* 132 (1936).
Zahlbr. *Lich. N.Z.,* 45 (1941).
Peltigera nana f. *nervosa* Gyelnik *apud* Zahlbr., *Lich. N.Z.* 45 (1941).

Thallus thinner than for *dolichorhiza,* more or less shining, light reddish-brown or green above with reddish veins and rhizines below; cortex 30μ, algal layer 25–38μ thick, medulla 70–100μ thick of rather compact layers of hyphae 5μ in dia. Apothecia 3–5 mm dia., hymenium 90–110μ thick, hypothecium brown, 50μ thick, asci 4–6-spored, spores yellowish, 3–5 (–7) septate, mostly 65 x 4μ.

HABITAT. On mosses and plant debris in damp places.

DISTRIBUTION. Philippines, New Zealand, ? Jamaica. North Island: Little Barrier Island (G52, Hamilton, sub. *P. nana* f. *venosa*) CHR; Hen Islands (Moore) CHR; Mohikinui (Allan), CHR; Papataki, CHR; Awakino, CHR; Wellington (Allan), CHR; Totara Reserve, CHR; Wai-iti Stream, CHR; Hawke's Bay (Colenso, 1671), WELT; Plimmerton (Knight, sub. *P. polydactyla* var. *nana* Nyl.), WELT. Westland: Greymouth, Mr. 5430; Lake Kaniere, Mr. 1349. Otago: Waitati, T 1893 and in CHR (G55); Mihiwaka, Mr. 921. Southland: Freshwater Valley, T 3055; Doubtful Sound, T 2883; Waipai, Mr. 1304. Stewart Island: Port William, Mr. 707.

Exsiccata SEEN. Gyeln. Lichenotheca (Jamaica, Plitt) sub *P. nana* var. *meridiana* (doubtful).

I have not been able to find whether Nylander's name has been published, but it appears several times on specimens in the Knight collection. Gyelnik (1936) combined his species *P. meridiana* from Jamaica with Wainio's from the Philippines, listing the Jamaican plant as a variety and making Wainio's species *P. nana* var. *philippina* (an illegitimate new name). The New Zealand plant from Waitati (CHR, G55) he listed merely as the species; it agrees very well with Wainio's and Gyelnik's descriptions, whereas the Jamaican specimen distributed by Gyelnik does not. The differences from var. *dolichorhiza* are usually fairly clearly marked, although some specimens—e.g., T 2883, come close to var. *dolichorhiza,* so I have reduced the taxon in rank. The veins are usually of a light reddish colour not seen in var. *dolichorhiza.* Gyelnik's *nana* f. *venosa* according to the isotype specimen is scarcely distinguishable in venation from the more typical forms. Some North Island specimens are nearly as thick as var. *dolichorhiza* but have the other characteristic features of var. *nana.*

Gyelnik (1931b) describes a *Peltigera oceanica* apparently from the Pacific Islands which is evidently only a pusilloid variety of *dolichorhiza*—probably it may be found also in New Zealand, although I have seen no specimens which are clearly referable to this.

Peltigera malacea (Ach.) Funck

Peltidea malacea Ach., *Synops. Lich.,* 240 (1814).
Peltigera malacea Funck, *Crypt. Gewachse,* heft 33, 5 (1827).
Hellbom, *Bihang Kgl. Svensk Vetensk. Akad. Handl. 21,* III (13) 28 (1896).

Lobes up to 4 cm long by 2 cm wide, but usually considerably smaller, and lobes in alpine plants more or less pusilloid; tomentum sparse, mostly marginal and thallus shining in the centre. Tomentum on undersurface brown. Thallus rather soft; apothecia marginal, round, 4–8 mm dia.; spores 3–5-septate, 58–74 x 5–6μ. (Description adapted from Nylander (1860)).

HABITAT. On mosses, usually in alpine situations.

DISTRIBUTION. Europe, Himalayas, North America, Kerguelen, New Zealand.

The species is reported from the Bealey River (Canterbury) and Papakauri (Auckland) by Hellbom (1896). I have not seen New Zealand specimens, but it should not be difficult to recognise. The tomentum on the upper surface may be almost absent, as in a specimen from Europe distributed in Gyelnik's Lichenotheca (Timko).

Peltigera canina (L) Willd. var. **canina**

Lichen caninus L. *Sp. Pl.* 1149 (1753).

Peltigera canina Willd., Flora Berolinens. *Prodom.* 347 (1787).

Thallus usually large, up to 20 cm across, with lobes (2–) 5 (–10) cm long by (½–) 1–2 cm broad, grey-green sometimes turning yellowish or brownish-green in the herbarium. Upper surface dull, thinly tomentose particularly marginally, lower surface with white to brownish tomentum and rather narrow elevated veins bearing mostly simple rhizines, veins smooth to fibrillose. Cortex 25–30μ, algal layer 40–60μ, medulla (100–) 200–250μ of more or less parallel hyphae 5–8μ dia. Apothecia on extended lobules, *ca* 4 mm dia., with thin crenulate margins, hypothecium reddish-brown 50μ thick, hymenium 100μ thick; asci 6–8 spored, more or less cylindrical; spores acicular, hyaline or pale yellow, 3 (–5) septate, 45–70 x 3–4μ.

HABITAT. On soil, moss, logs, etc., in damp, shady places.

DISTRIBUTION. Cosmopolitan. North Island: ? Ruakura, Allan, CHR; New Plymouth, Moore, CHR (thin, apparently f. *membranacea*); Tahuna (Colenso, 5017) WELT. Otago: Dunedin, T 1740 (pr.p., and in CHR G53), 1187 (pr.p.), 1935, 1973; Maungatua, 1,500ft, 0392a, Mr. 925 (pr.p); Taieri Mouth, 1668, 1669. Southland: Eglinton, Rawlings CHR (KG10).

Exsiccata SEEN. Lich. Suecici (Vrang), Fl. v. Bayern (Royer), Swed. Lich. (Magnusson 7619), Herb. Schallert, Pl. reg. mag. (Dusen 260), Fl Hung. (Timkohy).

Peltigera canina has been variously split into forms, varieties and species on the basis of thallus thickness, character of tomentum, colour of veins and rhizines, size of lobes, presence of marginal lacerations, etc., until the list of synonyms includes at least 30 names. No doubt some of the published forms and varieties correspond to constant entities, but many certainly do not. Thomson (1950) divides the North American material into var. *albescens* with white veins and rhizines and var. *ulorrhiza* with brown veins, but European and New Zealand specimens appear to form a continuous series in this respect according to the few examples I have seen, and I have not used these names.

Thomson also separated North American specimens with thinner thalli and a penicillate appearance of the veins as *P. membranacea* Nyl., distinctions which also seem difficult to maintain (compare Lindahl, 1953). According to Thomson the thickness of the medulla in *P. canina* is 300–500μ and in *P. membranacea* is 70–110μ, but several of the above European specimens of *canina* come between these ranges and one (Magnusson 7619, *Swed. Lich.*) has both smooth and penicillate veins in the same specimen. New Zealand specimens of *canina* are distinguished from European by their generally thinner, narrower lobes, and closely resemble Schallert's and Dusen's American specimens. A penicillate appearance of veins and rhizines is sometimes shown by our specimens of var. *canina* and var. *rufescens*, but it is not constant even in the same specimen. Variations of this sort are similarly apparent in New Zealand specimens of *P. polydactyla*; I have seen no specimens in either of these species approaching the large size apparently common in Europe.

It has been noted in other cases that distinctions between certain lichen species or varieties may be clear-cut in one country but not in another, and this phenomenon may explain the different treatments of the *P. canina* complex in North America and in Europe. The fact that New Zealand specimens of *P. canina* do not match the European forms exactly favours the assumption that the species is truly indigenous.

A specimen from Doubtful Sound (3946) seems to belong to the *P. canina* complex, although it differs from all varieties or species of which I have seen descriptions. The lobes resemble those of *canina,* but have a few sorediate spots, while the undersurface has no distinct rhizines but caninaeform veins with a 2 mm thick mat of loose anastomosing hyphae. It is sterile, so I have preferred not to describe it as new in the meantime.

Peltigera canina var. **rufescens** (Weis.) Mudd

Lichen caninus var. *rufescens* Weis., *Plant. Cryptog. Flor. Goettigens,* 79 (1770).
Peltigera canina var. *rufescens* Mudd, *Manual Brit. Lich.* 82 (1861).
Peltigera rufescens Humb., *Fl. Friburg Specim.,* 2 (1793). Bab. in *Hook. Fl. N.Z.* Vol. II, 271 (1855).
Linds., *Trans. Linn. Soc. 25,* 521 (1866).
Nyl., *Synops. Lich.* Vol. 1, 325 (1860).
J. Linn. Soc. Bot. 9, 246 (1865).
Hellbom, *Bihang Kgl. Svensk Vetensk. Akad. Handl. 21,* III (13) 28 (1896).
Peltigera rufescens var. *spuria* Hooker, *Handb. N.Z. Fl.* 566 (1867).

Thallus 3–12 cm dia., with lobes 5–25 mm long by 5–12 mm wide, brownish or reddish-brown, veins dark-brown to nearly white but lighter near the periphery; other characters as in var. *canina,* but tips of lobes sometimes more scabrid than tomentose.

HABITAT. Mossy banks, rocks and logs, in more open situations than var. *canina.*

DISTRIBUTION. Probably cosmopolitan. North Island: Waitakere, 3456; Wellington, Allan (CHR, pr.p.). Marlborough: Waihopai, Mr. 4211 (pr.p.); Onamalutu, Mr. 4214 (pr.p.). Otago: Waikouaiti, T 2483; Dunedin and vicinity, T 733, T 2324 (and in CHR), Mr. 5421, 038, 0391, 1213, 1214, 1977; Mihiwaka, Mr. 706 (pr.p.); Mt. Cargill, 3782, 3783, Mr. 5423; Flagstaff, 1,500ft, Mr. 1137; Taieri Beach, 1424; Akatore, 1556. Campbell Island: Oliver (WELT 7) (uncertain).

Although the differences between var. *canina* and var. *rufescens* are difficult to express quantitatively, they are usually easily seen in both fresh and herbarium specimens, and most of the specimens in a moderate-sized collection can be placed in one or other variety without hesitation. Besides the generally smaller size of the lobes and the brittleness of var. *rufescens,* there is a definite habitat difference, although occasionally they can be found growing together. This is the case also in Europe according to Lindahl (1953). This is certainly the commonest form of *P. canina* in New Zealand, as it is also in North America. In alpine situations it has a thicker thallus with ascending or inrolled crisp margins and dark veins (e.g., Mr. 1137, from Flagstaff). In Europe it has evidently been confused with var. *canina,* and Central European specimens I have seen distributed as *P. rufescens* can mostly be referred to *P. canina* var. *canina* (e.g., *Flor. Hungarica* Nos. 75 and 227 and specimens from Budapest and Bucharest Museums).

The specimen from Campbell Island (WELT 7) does not exactly match any I have seen from the mainland; most of the lobes are longer than normal with relatively broad and little elevated veins, which have an appearance intermediate between those of *rufescens* and *dolichorhiza. Peltigera coloradoënsis* Gyelnik (1930) is a species like *rufescens* but with polydactylaeform veins and fasciculate rhizines (although Thomson (1950) treats it as synonymous with var. *rufescens*) and thus differs from the Campbell Id. specimen only in the nature of the rhizines. Pending further collections from Campbell Id. I have left this specimen under var. *rufescens.*

Specimens of *P. canina* var. *rufescens* are sometimes attacked by the fungus *Illosporium carneum* Fr. which forms small pink powdery spots on the upper surface; old specimens of the fungus can be mistaken for soredia.

Peltigera canina (L) Willd. var. **spuria** (Ach.) Schaer

Lichen spurius Ach., *Lichenogr. Suec. Prodom.* 159 (1798).
Peltigera canina var. *spuria* Schaer., *Lich. Helvet. Spicil.* (6), 265 (1833).
Peltigera pusilla Müller, *J. Linn. Soc. Bot. 32,* 201 (1896).
Peltigera rufescens Hook., *Handb. N.Z. Fl.* 566 (1867).
Peltigera canina var. *pusilla* Bab. in Hook., *Fl. N.Z.,* 271 (1855).
Peltigera rufescens var. *spuria,* Kirk. *Trans. N.Z. Inst.,* 4, 235 (1871).

Plant varying from single small cochleate lobes 3 mm in dia. to thalli 15–20 mm across, lobes ascending with incurled margins and small apothecia on short lobules; tomentum often restricted to margins.

HABITAT. Clay banks, alpine localities, usually in dry places.

DISTRIBUTION. Probably cosmopolitan. North Island: Napier (Colenso) WELT. Canterbury: Godley Valley, 6,200ft, Scott 156. Otago: Haast Pass (R. F. Smith) 0937; Ravensbourne, 0596.

Exsiccata SEEN. Fl. Suecica (Hülphers) (sub *P. spuria*).

Although commonly considered a separate species, this has every appearance of being a habitat form, although I have not seen specimens intermediate between this and var. *rufescens* or var. *canina.* The microscopic characters do not differ from those of var. *rufescens.*

Peltigera canina (L) Willd. var. **spuria** (Ach.) Schaer. f. **sorediata**

Schaer., *Enumer. Critic. Lich. Europ.* 20 (1850).

As for var. *spuria* but with small round spots of coarse greyish-blue or greyish-green soredia, like eroded places.

HABITAT and DISTRIBUTION. As for the variety. Canterbury: Lake Tekapo, Mason, 10. Otago: Maitland Valley, 1734; Flagstaff, 1,000ft, 0900; Taieri Mouth, 1671.

Exsiccata SEEN. Swed. Lich. (Magnusson, 13735) (sub *P. erumpens*).

Although there is a considerable number of synonyms at the species level for this form there now seems little doubt that it is no more than a growth form of the variety (cf. Thomson, 1950 and Dahl, 1950).

The earliest valid name for this form would seem to be *Peltigera canina* var. *sorediifera* Schaer, but I have not been able to see the relevant literature.

Peltigera praetextata (Flk.) Wain

Peltidea ulorrhiza var. *praetextata* Flk. *apud* Sommerf., *Suppl. Flor. Lappon.,* 123 (1826).
Peltigera praetextata Wain., *Termeszetr. Füzetek, 22,* 306 (1899).
(?) *Peltigera nitens* f. *zeelandica* Gyeln., *Bot. Lapok, 28,* 60 (1929).

Thallus about 8 cm dia., with lobes to 25 mm long by about 10 mm wide, brownish, with clusters of subsquamulose isidia along margins and imperfections on the upper surface and white scales near the tips of the lobes, which curl downwards; veins elevated (caninaeform), whitish to brown, obscure near the margin and with a fuzzy appearance due to projecting hyphae; rhizines simple to more or less fasciculate. Other and microscopic characters identical with those of *P. canina.*

HABITAT. On soil and damp rocks, etc.

DISTRIBUTION. Eurasia, North America, Japan. Otago: Flagstaff, 1,500ft, Mr. 1150 (pr.p.), Mr. 1152 (pr.p.).

Exsiccata SEEN. Fl. suecica (Hülphers), Swed. Lich. (Magnusson, 11650).

This species has been very variously treated by lichenologists recently. Thomson (1950) reduced it to a form of *canina* var. *rufescens,* remarking that it was merely a form of this variety with the edges regenerating after damage from " insect bites ", but Lindahl (1953) has shown from experiments on *P. canina* and *rufescens* that this is not so. Sometimes, apparently, particular plants do not develop isidia, in which case they are hardly distinguishable from var. *rufescens.* Although the species is usually described as " tomentose above ", Lindahl mentions the presence of scales, and the Otago plants are clearly scaly rather than tomentose under the microscope,

and are thus separable from most states of *canina* var. *rufescens*. The scales are formed by the growth of several adjacent cortical hyphae which fuse together to form a white mass 20–50μ square and about 30μ thick. The scales have rather the appearance of a decomposed areolate cortex. In specimens of *P. praetextata* var. *subcanina* distributed by Gyelnik the tips of the lobes are minutely tomentose, and these may be more nearly related to *P. canina*. Lindahl (1953) reduces *P. nitens* (Anders) Gyelnik to synonymy with *praetextata*, but it is clearly regarded by Gyelnik as smooth above and thus close to *P. virescens*. The Otago specimens like Gyelnik's *P. nitens* f. *zeelandica* have crisp margins, but I consider this appearance to be due to the plants growing in rather dry or alpine situations, particularly since similar forms are shown by all the *Peltigera* species under these conditions. *P. nitens* f. *zeelandica* was founded on one of Berggren's specimens (exact locality not stated) now in Stockholm; it is not impossible that it is a form of *praetextata* with the scales almost absent, as in some lobes of Mr. 1150.

Solorina Ach.

Thallus small foliose, corticate above, ecorticate below and with indistinct veins and scattered rhizines below. Algae commonly green and blue-green in the same thallus. Apothecia immarginate, scattered over the upper surface; spores brown, several celled.

The genus is predominantly Northern and African, and until now there has been only one record of it for New Zealand or Australia.

Solorina crocea (L) Ach.

Lichen croceus L., *Sp. Pl.*, 1149 (1753).
Solorina crocea Ach., *Lich. Univ.* 149 (1810).
Du Rietz, *Sv. bot. Tidskr. 20*, 300 (1926).
Ibid., Rept. *Austral Ass. Adv. Sci.* 628 (1928).

Thallus roundish, lobed, 1–10 cm dia., greenish brown above, copper-coloured below with indistinct subreticulate veins and a few rhizines; cortex 300–500μ thick, of vertical thick-walled hyaline hyphae about 4μ dia. and containing pyramidal or tooth-like sections containing mostly small algae (said to be *Dactylococcus*) which reach almost to the surface. Medulla and algal layer 300–600μ thick, of parallel, compactly layered hyphae 3–8μ dia. coated with orange granules, K + purple. Algal layer not clearly delimited, of small green algae mixed with scattered colonies and frequent more or less ovoid cephalodia containing *Nostoc*. Apothecia oblong to round, plane, dark brown, not depressed, to 1 cm dia.; hypothecium hyaline, 25μ thick; hymenium 125μ, hyaline with thin brownish epithecium; paraphyses simple, 2μ thick, conglutinate; asci 6–8-spored, spores 1-septate, hyaline becoming brownish, 26–34 x 8–10½μ, oblong-ellipsoid, sometimes slightly constricted at septum.

HABITAT. On soil in subalpine situations.

DISTRIBUTION. Eurasia, North America, Himalayas, New Zealand. Canterbury: Craigieburn Range, 5,500ft (A. F. Mark), 4162; Mount Peel, Allan (CHR); Godley River, 6,000ft, Sc 268, (D. Scott) 4164. Otago: Old Man Range, 5,000ft (D. Billings, NZL) 4160.

Exsiccata SEEN: Schaer. exsicc. no 24 (WELT), Metzger (WELT), Lich. scand. (Zetterstedt & Wickbom) (Otago Museum).

The New Zealand specimens are macroscopically indistinguishable from European *S. crocea*, although the spores are smaller and paler than reported for European plants (Nylander, 1860, gives the spores as 34–53 x 10–13μ). The occurrence of *S. crocea* in New Zealand is of considerable phytogeographical interest, since the nearest known report is from Java. It is curious that it was collected only once before 1959, despite the characteristic and striking appearance of the species. Although apparently not common, it is evidently widely distributed on the mountains of inland Otago and Canterbury, and can hardly have been introduced in recent times. If further collections sustain the spore differences seen (only one fruiting specimen, 4162, has been found), the New Zealand plants may prove to be taxonomically separable, and support a long isolation of the South Island lichen population.

There are, however, a few species in other groups which show a similar distribution to *Solorina crocea,* (e.g.) *Alectoria minuscula* (*Parmelia minuscula*), *Alectoria nigricans* and *Cornicularia aculeata* each from a few localities in Canterbury and Otago and *Cetraria islandica* var. *tenuifolia* from several South Island mountains. Probably the ranges of these species in New Zealand will be extended by further exploration, and other such cases found.

It seems likely that these species have reached New Zealand in earlier times by way of the high mountain ranges of the Himalayas, Indonesia and New Guinea; the latter area has not been explored for lichens and would clearly repay investigation. None of the three species mentioned has been reported from Australia. It is surprising that no lichens can be clearly shown to have been introduced to New Zealand, despite their seeming ready dispersal.

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