

The lichen genus *Erioderma* in Southeast Asia

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The lichen genus *Erioderma* has a centre of speciation in the islands of SE Asia. It is represented there by a total of ten species, seven of which are endemic. Four of the species are here described as new. All but two of the SE Asian species are closely related to South American species.

Key words: *Erioderma*, evolutionary centre, lichen, phytogeography, taxonomy

Jørgensen (2001b) has previously treated this genus in China and Japan where it is rather rare, only having four species. However, the *Erioderma* flora further south in East Asia, and particularly on the large islands north of Australia is richer. This area is a second centre of speciation (Jørgensen 2001a: 540), with several interesting taxa, four of which are described below as new.

Material and methods

The material has mostly been collected by the second author on his expeditions in the region, particularly New Guinea. In addition material from the cited herbaria has been included. The material was studied by traditional microscopic methods (Jørgensen 1978: 6–7). Thin layer chromatography (TLC) was performed accord-

ing to standard procedures (White & James 1985), and type specimens of new species kindly run by J. Elix, Canberra in HPLC (Feige *et al.* 1993).

The species

The species are normally easily recognized and best identified by the following key:

1. Thallus sorediate, very rarely fertile 2
1. Thallus usually fertile, never sorediate 3
2. Lower surface with distinct, raised veins; known only from Borneo *E. borneense*
2. Lower surface not veined; widespread *E. sorediatum*
3. Lower surface with distinct, raised veins; upper surface scrobiculate *E. tomentosum*
3. Lower surface not veined; upper surface smooth 4
4. Thallus perforated, net-like; Sulawesi ... *E. reticulatum*
4. Thallus entire; other islands 5

5. Lower surface orange yellow (K+ red); apothecial margin mostly with stiff black hairs *E. gloriosum*
5. Lower surface at most creamish white (K-); apothecial margin scabrous or softly white-haired 6
6. Thallus with convex, narrow (to 3 mm wide) lobes, bordered by a cushion of blackish brown rhizohyphae, apothecia terminal *E. phaeorhizum*
6. Thallus with flat, usually broader lobes (to 5 mm wide) with scattered fascicles of blackish rhizohyphae, mainly at lobe sinuoses; apothecia marginal or submarginal 7
7. Upper surface mostly naked (though downy towards the margins); lobes truncate with eriodermin; known only from Sri Lanka *E. unguigerum*
7. Upper surface hairy; lobes rounded with pannarin, argopsin and related substances or rarely of barbatic acid complex; widespread, but scattered 8
8. Thallus coriaceous, thick, with long (to 0.5 mm), partly soft hairs, PD+ faintly yellow (allorhizin and barbatic acid complex); known only from Mt. Albert Edward (New Guinea) *E. coriaceum*
8. Thallus softer, with shorter hairs, PD+ orange (argopsin/pannarin); widespread 9
9. Thallus with scattered stiff hairs and short, round lobes, containing argopsin *E. pellitum*
9. Thallus softly dense-haired with elongated lobes, containing pannarin *E. confusum*

***Erioderma borneense* P.M.Jørg. & Arv.**

Nova Hedwigia 73: 498 (2001). — TYPE: Malaysia. Sabah, Distr. Ranau, Kinabalu Park, S-slope of Mt. Kinabalu, along summit trail, 3200 m, 12.V.1989 *H. Sipman & B. Tan 31214* (B, holotype).

Thallus foliose, deeply lobed; lobes flabellate, to 5 mm wide with flat to sinuous margins, in parts involute and developing granular bluish soredia on labriform soralia. Upper surface smooth, greenish brown, arachnoid hairy, but naked centrally. Lower surface naked bluish with distinctly raised, cream-coloured veins, partly with pale to bluish black rhizohyphae, except in the marginal zone. In section 300–350 µm thick with irregularly celled upper cortex, 30–40 µm thick. Apothecia rare, only known as immature.

CHEMISTRY: PD+ orange, containing argopsin (major) and traces of norargopsin and vicanicin, as well as atranorin.

NOTES: Easily recognized species by the veined lower surface, the bluish soredia contrasting the greenish brown upper surface. For a comparison with the only other sorediate species in the region *see below* under *Erioderma sorediatum*.

HABITAT AND DISTRIBUTION: At present only known from a few collections in the cloud forests at high levels of the mountains in northern Borneo (Kinabalu, Mulu), and possibly a rather local taxon.

SPECIMENS EXAMINED: **Malaysia.** Sabah, Distr. Kota Belud, Kinabalu Park, S-slope of Mount Kinabalu, along summit trail, 3100 m, 1989 *H. Sipman & B. Tan 31095* (B); Sarawak, Gunong Mulu National Park, 4th Division, Baram Distr., Gunong Mulu, summit, 2375 m, 1978 *B. J. Coppins 5032* (E).

***Erioderma confusum* P.M.Jørg. & Sipm., sp. nova** (Fig. 1)

Eriodermati phaeorhizi similis, sed thallo hirsuto, lobiis latissimis, acidum pannaricum continens.

TYPE: Papua New Guinea. Morobe Prov., Huon Pen., Sarawaged Range, Honzeukngon village, S of Derim airstrip in Timbe valley, above village, 2100 m, 7.–8.III.1987 *H. Sipman 24. 418* (B, holotype).

Thallus 3–5 cm diam., deeply divided, elongated, hairy lobes to 5 mm broad and scattered marginal fascicles of blackish rhizohyphae; in section 200–250 µm thick with fairly regularly celled cortex, 25–30 µm wide. Upper surface brownish grey, short-haired, more or less glabrous centrally. Lower surface pale cream, naked except for marginal bundles of blackish rhizohyphae. Apothecia marginal, flat with brownish disc, to 3 mm diam., with coarsely warted margin; no ripe spores observed.

CHEMISTRY: PD+ orange (pannarin).

NOTES: As indicated by the epithet, this is a rather confusing taxon, seemingly combining characters of *Erioderma pellitum* and *E. phaeorhizum*, though distinct from both, and most certainly a species of the *E. divisum* complex. It has the same chemistry as the South American endemic *E. divisum* P.M.Jørg. & Arv. (Jørgensen & Arvidsson 2002), from which it differs in its hairier thallus, which has more elongated and narrower lobes than in *E. pellitum*. It normally lacks the marginal lining of dense brownish black rhizohyphae of *E. phaeorhizum*, which at most is arachnoid hairy on the upper surface, with different chemistry (*see below*). Two specimens which we include on the presence of pannarin, *Sipman & Tan 31284* and *Aptroot 17966*, deviate by their

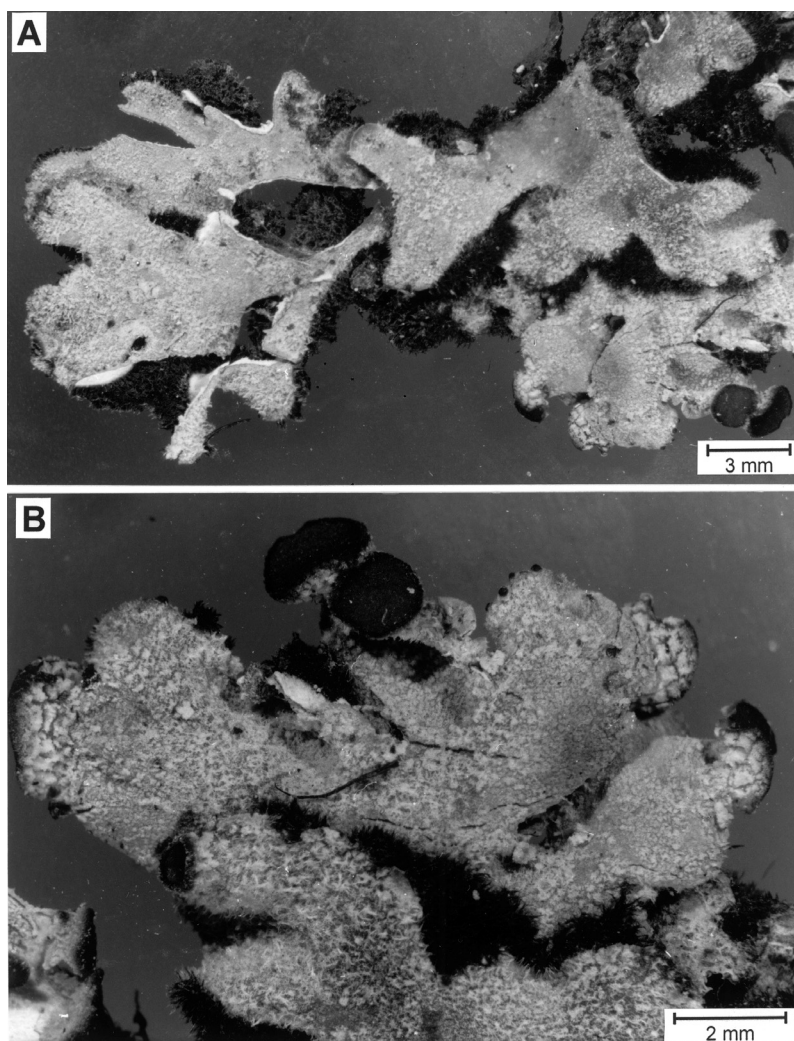


Fig. 1. *Erioderma confusum*. — **A:** Holotype. — **B:** Detail of fertile lobe.

quite elongate, slightly convex lobes with rather continuous marginal rhizohyphae.

HABITAT AND DISTRIBUTION: A species of upper montane forests, as yet only known from few collections from Borneo and the Huon Peninsula of New Guinea. Likely to show a wider distribution in the region as its habitat requirements are not specialized, and it occurs at lower altitudes than *Erioderma pellitum*.

SELECTED SPECIMENS EXAMINED (paratypes): **Malaysia.** Sabah, Distr. Kota Belud, Kinabalu Park, S slope of Mt. Kinabalu, along summit trail, on mountain ridge half way between Villosa shelter and Carson's camp, alt. 2800 m, 12.V.1989 *H. Sipman* & *B. Tan* 31284 (B). **Papua New Guinea.** Morobe distr., Huon Pen., Sarawaged Range, near Honzeukngon village, south of Derim airstrip in

Timbe valley, 1950 m, III.1987 *A. Aptroot* 17840, 17966 (Herb. Aptroot).

Erioderma coriaceum P.M.Jørg. & Sipm., *sp. nova* (Fig. 2)

Eriodermati leylandii similis sed thallo coriaceo, apotheciis et sporis magnis, et reactione chemico dilute luteo (ob acidum allorhizicum).

TYPE: Papua New Guinea. Central distr., Mt. Albert Edward, en route from tent site to summit, ca. 3000 m, 24.X.1975 *S. Kurokawa* 9384 (TNS, holotype).

Thallus 2–3 cm diam., coriaceous with margins rolled under. Upper surface brownish with

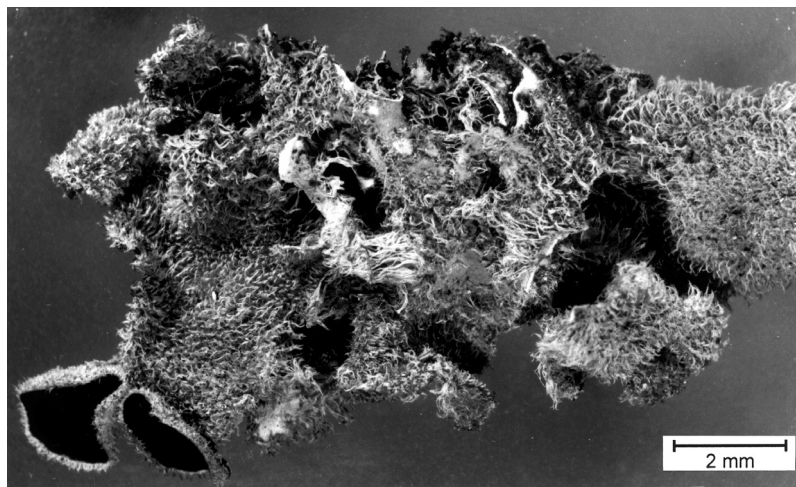


Fig. 2. *Erioderma coriaceum* (holotype).

long (to 0.5 mm), soft hairs. Lower surface naked, buff. In section 250–350 μm thick with irregularly celled upper cortex, 30–40 μm thick. Apothecia marginal, blackish brown, 5–7 mm wide, with long hairs on the margin, warty below. Ascospores simple, colourless, thick-walled, cuboid 10–12 \times 12–15 μm . Pycnidia rare, marginal, crescentiform, brown, to 2 mm wide, producing bacilliform conidia, 3–4 \times 1–2 μm .

CHEMISTRY: Thallus PD+ faintly yellow (barbatic-syndrome with methyl 5-chloro-4-*O*-demethylbarbatate and 5-chloro-4-*O*-demethyldiffractate (major), as well as methyl 4-*O*-demethylbarbatate (minor) and traces of allorhizin and isovicinin).

NOTES: This taxon is superficially very similar to the Andean *Erioderma barbellatum*, but has a more coriaceous thallus with larger apothecia and spores. It differs chemically in having both barbatic acid derivatives and depsidones, unlike in S. America where the two known chemotypes contain either of these chemosyndromes, as well as different substances from those found in New Guinea material (see Jørgensen & Arvidsson 2002). Since there are some morphological differences as well, we recognize the New Guinea material as a distinct species. *Erioderma coriaceum* is also superficially rather similar to *E. pellitum*, a related, rather common species in the high mountains of New Guinea (and Borneo). This differs chemically in having argopsin (giving a bright orange PD-reaction), but is best separated on the shorter, stouter hairs and non-coriaceous texture.

Both belong to the difficult *E. leylandii* complex.

HABITAT AND DISTRIBUTION: Found in the upper montane forests, 3000–3800 m, close to the tree limit. As yet only known from Mt. Albert Edward in southernmost New Guinea, and possibly a rather local taxon.

ADDITIONAL SPECIMEN EXAMINED (paratypes): **Papua New Guinea**. Central distr. Mt. Albert Edward, summit area, alt. 3700–3800 m, 26.X.1975 S. Kurokawa 9455 (TNS).

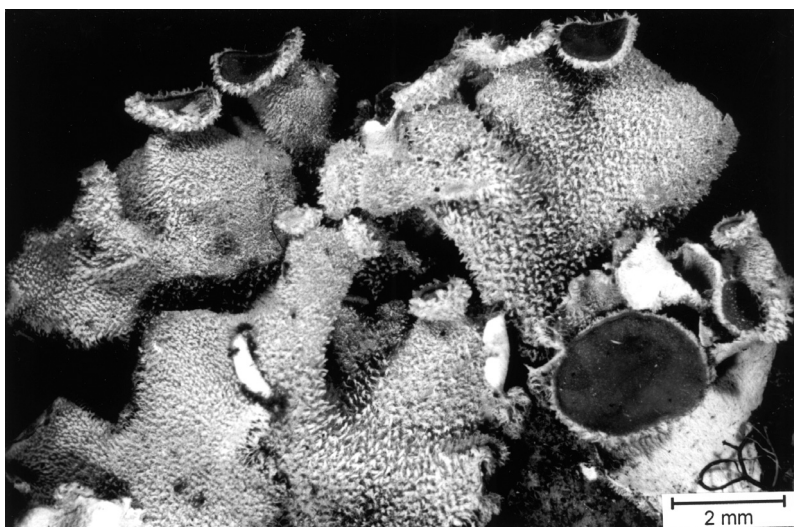
Erioderma gloriosum P.M.Jørg. & Arv.

Nordic Journ. Bot. 22 (2002). — TYPE: Ecuador. Azuay, road Cuenca–Loja, 15 km S of Cumbe, alt. 3500 m, 9.VII.1963 L. & A. Arvidsson 4301 (GB, holotype).

Thallus flat, irregularly spreading, to 3 cm diam. Lobes dichotomously divided, to 5 mm wide; margins ascending particularly apically. Upper surface brownish grey, short-haired, naked centrally; lower surface bright yellow-orange, K+ red, naked except for marginal bundles of blackish rhizohyphae. In section 250–300 μm wide with 30–40 μm cortex of rather irregular cells. Apothecia rather frequent, submarginal, shortly stipitate, up to 2–3 mm, flat, black, margins warty often with stiff black hairs on the margin; disc dark brown to black. Ascospores simple colourless, thick-walled, subglobose, 10–12 \times 8–9 μm . Pycnidia not observed in New Guinea material.

CHEMISTRY: PD+ orange (argopsin, minor), K+ red (3–4 unidentified quinons).

Fig. 3. *Erioderma pelltum* (holotype).



NOTE: A further species in the *Erioderma divisum* group, easily separated from the others on the spectacular orange-yellow lower surface and the black hairs on the apothecia. The paleo-tropical material matches that of the neotropics closely, except for the size of the apothecia which appears to be larger in the neotropics, 3–4 mm diam.

HABITAT AND DISTRIBUTION: Rare, only known from a few collections in high altitudes (about 3500 m) in subalpine scrub in the Mt. Wilhelm region of New Guinea. Otherwise known from similar habitats in the Andes, though there penetrating down into the rainforests (Jørgensen & Arvidsson 2002).

ADDITIONAL SPECIMENS EXAMINED (paratypes): **Papua New Guinea.** Simbu Province, Mt. Wilhelm, Pindaunde Valley, near the hut on S-shore of Lake Piunde, 3500 m, *H. Sipman* 21978 & 35757 *p. p.* (B); Mt. Wilhelm, en route from Piunde Lake to the summit, 3600 m, *H. Kashiwadani* (TNS); along track to the summit, 4100 m, III.1987 *A. Aptroot* 18620, 18305 and 5–8.VIII.1992 *Aptroot* 32695 (Herb. Aptroot). Eastern Highlands, Bismarck Range, on edges of subalpine groves at base of Bogonota Ridge, ca. 3500 m, *W. A. Weber* & *D. McVean* 51559 (COLO).

Erioderma pelltum P.M.Jørg. & Sipm., *sp. nova* (Fig. 3)

Eriodermati leylandii similis sed thallo minore, piliis curtis et crassis.

TYPE: Papua New Guinea. Simbu Prov., Pindaunde valley near Mt. Wilhelm, NE-facing slope along lake Piunde, 3550 m, 14.VIII.1981 *H. Sipman* 15884 (B, holotype; U, isotype).

Thallus orbicular, 2–3 cm wide, with rounded lobes, to 5 mm wide. Upper surface grey with short, stout, 100–200 μ m, hairs. Lower surface pale cream, naked except for marginal bundles of blackish rhizohyphae. In section 150–250 μ m with irregularly celled upper cortex, 25–35 μ m thick. Apothecia common, marginal to submarginal, 3–5 mm diam.; disc brown with hairy margin, often warted below. Spores simple, colourless, 10–12 \times 6–7 μ m. Pycnidia not observed.

CHEMISTRY: PD+ orange, containing argopsin (major) with minor quantities of norargopsin, the type also with methyl gyrophorate (a contamination?) and an unidentified pigment.

NOTES: This species is closely related to *Erioderma leylandii* ssp. *velligerum* (Tuck.) P.M.Jørg., but is generally smaller with different lobation and characteristic short, stout, fur-like (hence the epithet) hairs. *Erioderma pelltum* is rather variable in lobation and hairiness. It may in certain forms be difficult to distinguish from *E. coriaceum* which is larger and more coriaceous with longer, softer hairs and a different chemistry, being restricted to Mt. Albert Edward. Also the neotropical *E. barbellatum* P.M.Jørg. & Arv. is similar, but differs in being softer, more densely hairy with larger apothecia and partly different chemistry.

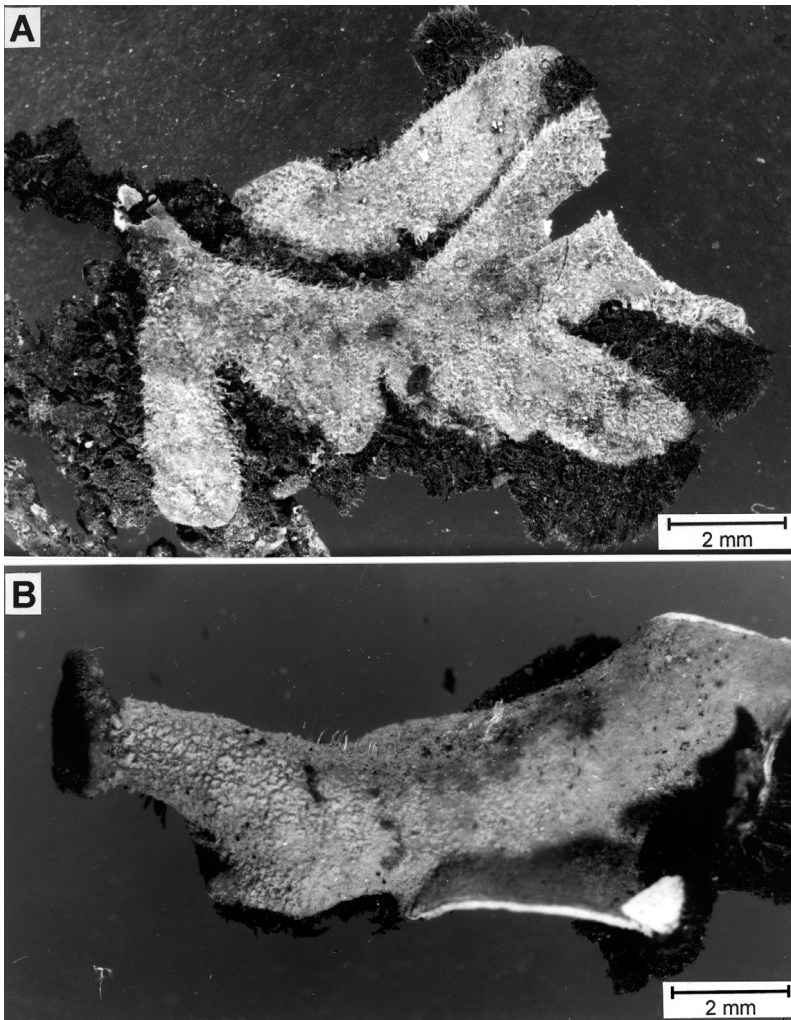


Fig. 4. *Erioderma phaeorhizum*. — **A:** Holotype. — **B:** Detail of fertile lobe showing terminal apothecium.

A specimen (*Aptroot 31549*) collected near the top of Mount Wilhelm is exceptionally thick and has ascending lobes which are blackish at the tips. Specimens from the lowest altitudes are thinner and approach *Erioderma confusum*, but do not contain pannarin.

HABITAT AND DISTRIBUTION: Confined to high-altitude scrub (2800–4100 m), mostly in the Mt. Wilhelm region where it apparently is rather common. Only one record from outside New Guinea, in northern Borneo, the only other region with similarly high mountains in SE Asia.

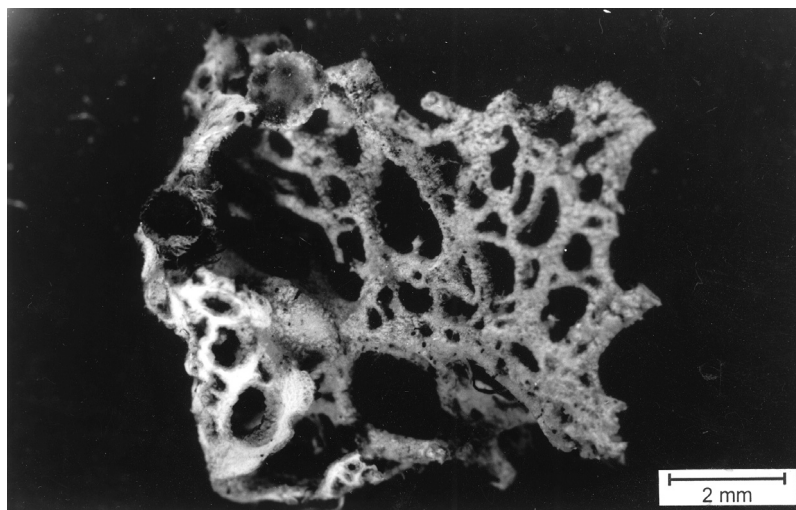
SELECTED SPECIMENS EXAMINED (paratypes): **Papua New Guinea.** Northern Prov., English Peaks, 3600 m, *P. W. Lambley 17332* (BM). Eastern Highlands Prov., Bismarck Ranges, Mt. Wilhelm, near Lake Aunde, ca. 3500 m, *W. A. Weber & B. McVean 51951* (COLO). Simbu

Prov., Mt. Wilhelm, en route from Pinaunde lake to the summit, 3600 m, *H. Kashiwadani 11365* (TNS); near the hut on S-shore of lake Piunde, 3600 m, *H. Sipman 22146* (B); Mt. Wilhelm area, ca. 11 km on new road under construction from Gembogl to Goroka, 2800 m, *H. Sipman 35850* (B); along track to summit, 4100 m, 7.VIII.1992 *A. Aptroot 31549* (herb. Aptroot); between Pinaunde valley and Keglsugl, 2600 m, 5–8.VIII.1992 *A. Aptroot 32600* (herb. Aptroot). **Malaysia.** Sabah, Ranau distr., Kinabalu Park, S-slope of Mt. Kinabalu, along summit trail, near Sayat Sayat hut, 3800 m, 11.V.1989 *H. Sipman & B. Tan 31163* (B).

Erioderma phaeorhizum Vain. (Fig. 4)

Ann. Acad. Sci. Fenn. ser. A, vol. 6: 6. 1921. — **TYPE:** Philippines. Mindanao, Davao, Mt. Apo, *E. O. Copeland 1090 p. p.* (TUR-V 12030, holotype).

Fig. 5. *Erioderma reticulatum* (holotype).



Thallus spreading, 3–5 cm diam with dichotomously divided lobes, 1–4 mm broad. Upper surface usually convex, greenish brown, scabrous to faintly tomentose, particularly in marginal/apical parts. Lower surface pale cream, naked with dense, marginal lining of blackish brown, repeatedly branched rhizohyphae. In section 250–300 μm with an irregularly celled cortex, 25–30 μm wide. Apothecia rare, terminal to 3 mm broad with brown disc and warted margin. Ascospores simple, colourless, 10–12 \times 7–9 μm . Pycnidia not observed.

CHEMISTRY: Usually PD– (vicanicin, major and norvicanicin) or more rarely PD+orange when containing traces of argopsin and related substances (Hamat *et al.* 1993).

NOTES: Contrary to Jørgensen's (2001a) suggestion of a relationship with *Erioderma tomentosum*, based on the minuscule type specimen, we do not hesitate to place this species in the *E. divisum* group with which it shares all general characters (Jørgensen & Arvidsson 2002): elongate, usually dichotomously divided, convex lobes with marginal rhizohyphae and small apothecia, which in *E. phaeorhizum* are terminal, rather than submarginal as in *E. divisum*, the latter containing pannarin rather than vicanicin.

Erioderma phaeorhizum is easily recognizable by the prominently developed marginal rhizohyphae, which form a continuous cushion along the margin, and when fertile by the terminal apothecia (Fig. 4B).

HABITAT AND DISTRIBUTION: A species of mon-

tane forests from 2000 m onwards, reaching 3600 m in New Guinea and there also found amongst bryophytes on the ground. Scattered and widespread (Fig. 6), certainly the most widespread taxon of the *Erioderma divisum* group in the region, though endemic to it.

SPECIMENS EXAMINED: **Malaysia.** Sabah, Distr. Kota Belud, Kinabalu Park, S slope of Mt. Kinabalu, along summit trail, 2900 m, *H. Sipman* & *B. Tan* 31026 (B). West Malaysia, Cameron Highlands, 2000 m, 1989, *M. Wahid Samsudin* (ANUC, BG, UKM). **Indonesia.** Sulawesi, Mt. Rantemario, 2800 m, *G. Kjellberg* 8L (S). Irian, S slope of Mt. Nettoti, along path Andjai-Saokorem, 100 km W of Manokwari, 1980 m, *P. van Royen* 3868 (L). **Papua New Guinea.** Morobe Prov., Wau area, summit of Mt. Kaindi, on N-summit, 2380 m, *H. Sipman* 15739b (U). Simbu Prov., Mt. Wilhelm, Pindaunde valley, near the hut on S. shore of lake Piunde, 3400 m, 1992 *H. Sipman* 35751 (B); near lake Piunde/Aunde, 3600 m, *P. W. Lambley* 16534/35 (BM); Mt. Wilhelm region, 11 km on new road under construction from Gembogi to Goroka, 2800 m, 1992 *H. Sipman* 35850 (B).

***Erioderma reticulatum* P.M.Jørg. & Arv., sp. nova (Fig. 5)**

Thallus foliatus, repetite perforatus, ordinationem reticulatum formans, acidum argopsicum continens. Apothecia marginalia, atra, ad 5 mm diam, margine hirsuto.

TYPE: Indonesia. Sulawesi, B. Rantemario, alt. 2800 m s. m., VI.1929 *G. Kjellberg* (S, holotype).

Thallus foliose, to 3 cm diam, repeatedly perforated, forming a reticulate pattern. Upper surface greyish green-brown, rugulose, irregularly hairy with involute, thickened margins. Lower surface whitish, fibrose with few marginal rhizohyphae, occasionally in blackish blue, penicillate fascicles. Apothecia marginal, pedicellate, to 5 mm broad, with brown-blackish disc and hairy margins; no mature ascospores observed. *Pycnidia* rare, marginal, papillate, blackish producing bacilliform conidia, $3-4 \times 1-2 \mu\text{m}$.

CHEMISTRY: PD+ orange, containing argopsin (major) and norargopsin (trace).

NOTES: A most unusual species, giving the impression of being abnormal, but producing normal apothecia and showing no signs of internal abnormalities. A perforated species of a foliose lichen, *Menegazzia myriotrema* (Müll. Arg.) P. James, is known previously (from Tasmania), so this may be an unusual growth-form engendered by the ecological conditions (in relation to the water economy). The general habitus and brittle texture of the type specimen suggest that it may be an extreme form of *Erioderma tomentosum*. However, its chemistry contradicts such an interpretation, though it may be a closely related, certainly independent taxon. The thallus is unique in the genus and the species is not likely to be confused with any other.

HABITAT AND DISTRIBUTION: *Erioderma reticulatum* is a species of the humid montane forests in Indonesia, as yet only known from the type collection in central Sulawesi, and is possibly a local endemic.

***Erioderma solediatum* P.M.Jørg. & D.J.Galloway**

Lichenologist 7: 139. 1975. — TYPE: New Zealand. Three Kings Isl., Great Isl., Tasman Valley, 21.XI.1970 D. J. Galloway (CHR, holotype).

Thallus foliose, broadly laciniately lobed, to 5 cm diam. with ascending margins, strongly involute when dry, exposing the bluish, limbiform soralia on the upturned lower surface. Upper surface grey, softly hairy. *Apothecia* unknown. For further details see Galloway and Jørgensen (1985).

CHEMISTRY: PD+ orange (eriodermin).

NOTES: An easily recognized species, by the

bluish soralia on the upturned lower surface. The only other sorediate species in the region, the rare *Erioderma borneense*, has partly hidden soralia and veins on the lower surface. However, in certain forms possible to confuse with *Leioderma solediatum* D.J.Galloway & P.M.Jørg., which is also present in the region. That species has an arachnoid hairy upper surface, lacks lateral bundles of rhizomorphs, and is always PD- (no substances present).

HABITAT AND DISTRIBUTION: The commonest and most widespread species of the genus, found scattered in the whole SE Asian region, mostly at low to middle altitudes (to 2500 m in Sri Lanka), also in mainland Asia (Thailand and Malaysia), as well as Japan and Australasia, rarely in the Americas, avoiding the Andes (Jørgensen 2001b).

SELECTED SPECIMENS EXAMINED: **Malaysia.** Sabah, Distr. Kota Belud, Kinabalu Park, S slope of Mt. Kinabalu, along summit trail, 2900 m, H. Sipman & B. Tan 31026 (B). West Malaysia, Cameron Highlands, 2000 m, 1989, M. Wahid Samsudin (ANUC, BG, UKM). **Indonesia.** Java, Mt. Gede, Tjibodas, 1450 m, 1939 P. Groenhart 4184 (L). **Papua New Guinea.** Eastern Highlands, Mt. Gahavisuka Prov. Park, 11 km N of Goroka, along trail to orchid house, 1992 H. Sipman (B). Prov. Madang, S side of Ramu valley, Bundi village, on slope towards Mt. Pizerata, 1300–1600 m, 1992 H. Sipman 39231 (B). Prov. Morobe, Huon Pen., Finisterre range, Yupna valley, Tep-tep village, 2300–2700 m, 1992 A. Aptroot 32059 (herb. Aptroot). Wau area, along Edie Creek road, on mountain ridge, 2100 m, 1981 H. Sipman 15793 (U). Southern Highlands, Lama sawmill, 6 km SE of Ialibu, 1860 m, 1982 J. A. Elix 12795 & H. Streimann (CBG). **Philippines.** Leyte, Leyte Prov., Lake Kadsuran near Barangay Liberty (Ormoc-City), F. Schumm 8740 (B); Luzon, Mountain Prov., hill above barrio of Mt. Datta, 2000 m, 1964 M. E. Hale & J. Banaag (US).

***Erioderma tomentosum* Hue**

Bull. Soc. Bot. Fr. 48: 49. 1902. — TYPE: New Caledonia. Mt. Mou, 1892, Balansa 2932 (G, lectotype, *vide* Jørgensen 2001a).

Thallus foliose, orbicular, 5–8 cm diam., with lobes broad, to 1.5 cm. Upper surface brownish green, scrobiculate, arachnoid tomentose, except in central parts. Lower surface whitish naked with distinct, elevated veins, partly beset with fascicles of yellowish brown (rare-

ly blackened) rhizohyphae, except in the marginal zone. In section 200–300 µm thick with upper cortex, 20–30 µm thick of irregular cells. Apothecia rare, marginal, 3–5 mm wide with brown disc and scabrous-tomentose margin; ascospores simple, colourless, $9\text{--}13 \times 6\text{--}8$ µm. Pycnidia scattered, marginal, black, conical, protruding, basally 150–200 µm wide, producing bacilliform conidia, $4\text{--}5 \times 1$ µm.

CHEMISTRY: Mainly PD– (type), containing vicanicin and norvicanicin (and trace of atranorin), occasionally with traces of argopsin and related substances giving a PD+ orange reaction (Hamat *et al.* 1993).

NOTES: An easily recognized *Peltigera*-like species with a brittle thallus which disintegrates easily when collected. When well developed it has the largest thallus of all species in the region, and is the only one with distinct, raised veins on the lower surface. Previously often confused, however, with the Southern Hemisphere *E. groenlandicum* Ach. (Jørgensen 2001a). It has a rather isolated position in the genus, and is possibly closest related to the tropical South American *E. wrightii* Tuck.

HABITAT AND DISTRIBUTION: A corticolous species of mossy or lower montane forests (not exceeding 3000 m) with its main distribution area in SE Asia, with only a few records outside it (Madagascar, Japan and Hawaii; Jørgensen 2001b), clearly a paleotropical species.

SELECTED SPECIMENS EXAMINED: **Sri Lanka.** Central Province, 2300 m, *G. H. K. Thwaites C. L. 26* (BM). West Malaysia, Cameron Highlands, *Laily Bin Din 3002* (ANUC, UKM). **Malaysia.** Sabah, Distr. Kota Belud, Kinabalu Park, in montane oak forest, 1630 m, *D. Hou 228* (herb. Aptroot); S slope of Mount Kinabalu, along summit trail, mountain ridge halfway between Villosa shelter and Carson's Camp, alt. ca. 2800 m, 1989 *H. Sipman & B. Tan 31283* (B); near Paka Cave, ca. 3000 m, 1989 *H. Sipman & B. Tan 31094*; Desa cattle farm, along Mesilau river from Kundersong, 1720 m, *I. Yoshimura & Y. Yamamoto 840149* (herb. Yoshimura). **Indonesia.** Java, Preanger, in Pangerongo mountains, garden Tjibodas, 1420 m, *V. Schiffner 3285* (M, W); Pasoeran (Pasuran) Reserve, G. Ardjoena (Mt. Ardiuna), Tretes-Ladlija-wa- track, upper rain-forest belt, 1000–1300 m, 1927 *G. E. Du Rietz 92:21* (UPS). Sumatra, Mt. Singalang, eastern slopes, 1280 m, *V. Schiffner 3402* (M, W); Dairien, 1600 m, *I. O. Surbeck 267* (L). **New Guinea.** Eastern Highland Prov., Daulo Pass, between Goroka and Chuave on south ridge, *W. A. Weber & D. McVean 51944* (COLO); Mt. Gahavisuka Prov. Park, 11 km N of Goroka,

along trail from parking place to orchid house, ca. 2300 m, 1992 *H. Sipman 35459* (B). Madang Prov., S. side of Ramu valley, Bundi village, on slope towards Mt. Pizetara, 1300–1600 m, 1995 *H. Sipman 39232* (B); Huon Pen., Finisterre range, Yupna village, Tep-tep valley, ca. 2300 m, 1992 *H. Sipman 35215* (B); Huon Pen., Sarawaged range, Honzeukngon village, S of Derim airstrip in Timbe valley, above the village, 2100 m, 1987 *H. Sipman 24.482* (B). Morobe Prov., old graveyard near Ogeranang airstrip, 1800 m, *P. W. Lambley 17632* (BM); Wau area, along Edie Creek road, 2100 m, *H. Sipman 15794* (B); Mt. Kaindi, vicinity of Wau, ca. 2100 m, *W. A. Weber & D. McVean 50226* (COLO); Manki Trig., Bulolo Watut Divide, 10 km SW of Bulolo, 1530 m, 1981 *H. Streimann & A. Bellamy 12793* (B, CNB, H, LAE, NICH). Northern Prov., Owen Stanley Range, Myola, surroundings of guesthouse, 2100 m, 1995 *H. Sipman 38083, 38220, 38493* (B); surroundings of Naduri village, 1600 m, 1995 *H. Sipman 38561* (B). Simbu Prov., Mt. Wilhelm area, Bundi Gap, on road Keglsugl–Bundi, 2800 m, 1992 *H. Sipman 35564* (B); ca. 11 km on new road under construction from Gembogl to Goroka, 2800 m, 1992 *H. Sipman 35849* (B). **Philippines.** Luzon, Benguet, Mt. Tonglon, *M. Ramos 5483* (TUR); Bontoc, *M. Vanoverberg 766, 1082, 1873* (TUR); Baguio, Mt. Sta Tomas, 2200 m, 1987 *A. Aptroot 20316* (herb. Apt.); Mindanao, Prov. Bukidnon, w. Malabalay, tropical forest on Mt. Kitanglad, 1870–2800 m, *F. Schumm 6306, 6355, 6360* (B).

Erioderma unguigerum (Bory) Nyl.

Mem. Soc. Sci. Nat. Cherbourg 5:10. 1871. — *Lichen unguigerus* Bory, Voyage de quatre îles d'Afrique I: 393. 1804. — **TYPE:** Ins. Bourbonia (Reunion), *J. Bory de Saint Vincent* (PC-Thuret, lectotype, *fide* Jørgensen 2001a).

Thallus flat, somewhat laciniate, 3–5 cm diam.; lobes to 5 mm wide, apically truncate with curved-sinuate axils; side-lobes often involute. Upper surface greenish grey, faintly tomentose towards the apices, glabrous/shiny centrally. Lower surface yellowish, naked except for marginal bundles of blackish rhizohyphae. In section 200–250 µm thick with rather regularly celled cortex, 25–30 µm thick. Apothecia rare, marginal or submarginal, pedicellate, 2–3 mm diam. with brown disc and tomentose-scabrous margin. Ascospores simple, colourless, ellipsoid, $12\text{--}15 \times 5\text{--}6$ µm. Pycnidia not observed in Lankese material.

CHEMISTRY: PD+ orange, containing eriodermin and traces of vicanicin.

NOTES: Previously confused with *Erioderma*

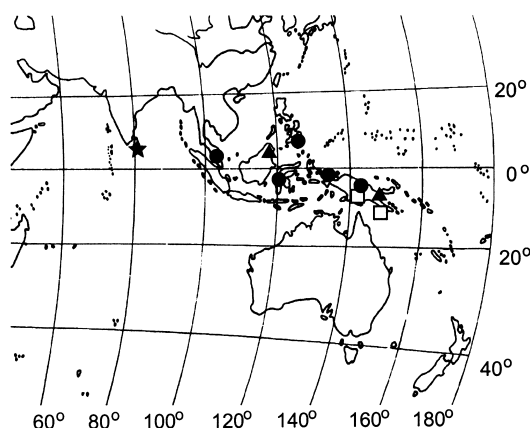


Fig. 6. Distribution map of the species in the *Erioderma divisum* group in SE Asia. ★ = *E. unguigerum*; ● = *E. phaeorhizum*; ▲ = *E. confusum*; □ = *E. gloriosum*.

leylandii from which it differs in the smooth, mostly glabrous upper surface, the greenish colour and lobation with truncate lobes and curved-sinuate axils, as well as chemistry. Closest related to *E. divisum*.

HABITAT AND DISTRIBUTION: Only known from montane forests in Sri Lanka in the region treated, in one old collection, otherwise quite widespread in the indo-pacific region, and also present in East-Africa and eastern South America, as well as in the Antilles (Jørgensen 2001a).

SPECIMEN EXAMINED: Sri Lanka. Central Region, G. H. K. Thwaites (BM).

Conclusion

The islands of SE Asia have more species of *Erioderma* than any other region, except South America, which is the evolutionary centre of the genus. Of the ten taxa present in the region, seven are endemic, two of which are quite widespread, *E. phaeorhizum* and *E. tomentosum*. The latter has an isolated position in the genus, and is a paleotropical species possibly originated in the tropical forests of SE Asia, as it occurs at lower altitudes than most of the other species, and only has a few records outside the

region (Madagascar, Japan and Hawaii). *Erioderma phaeorhizum*, however, is part of the *E. divisum* complex with four species (Fig. 6) in the region and six in South America (Jørgensen & Arvidsson 2002). They seem to have had a common Gondwanan ancestor, possibly *E. unguigerum* or a similar species, which apparently was present at the time when Australia was connected to South America, just as in the *E. leylandii* group. These groups of species proliferated in the montane forests and several distinctive taxa developed in SE Asia and South America.

Interestingly most of the species are shared between the two most species-rich regions or are closely related (with the exception of *Erioderma tomentosum*), indicating a common Gondwanan origin as suggested by Gressitt (1982) for some flowering plant genera. However, this cannot well explain the presence of *E. gloriosum* in New Guinea, a species otherwise only present in the northern Andes and most possibly having evolved there, much later. How it managed to cross the Pacific against the prevailing wind and current systems is difficult to understand, though Louwhoff (2001: 231) reports about three *Hypotrachyna* species with similar distributions, and we are unable to offer any reasonable explanation to this at the moment.

The other species (*Erioderma borneense*, *E. coriaceum*, *E. confusum*, *E. pellitum* and *E. reticulatum*) are rare and local, possibly neoenemics.

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References

- Feige, R. B., Lumbsch, T., Huneck, S. & Elix, J. A. 1993: Identification of lichen substances by a standardized high-performance liquid chromatographic method. — *J. Chromatography* 646: 417–437.
- Galloway, D. J. & Jørgensen, P. M. 1985: *Erioderma soreliatum*, a new lichen for New Zealand. — *Lichenologist* 7: 139–142.
- Gressitt, J. L. (ed.) 1982: *Biogeography and ecology of New Guinea*. Vol. 1. — Junk, Den Haag.
- Hamat, A. L. Bin, Din, L. Bin, Samsudin, M. W. Bin & Elix, J. A. 1993: Two new depsidones from the lichen *Erioderma phaeorhizum* Vainio *sensu lato*. — *Austral. J. Chemistry* 46: 153–156.
- Jørgensen, P. M. 1978: The lichen family Pannariaceae in Europe. — *Opera Bot.* 45:1–123.
- Jørgensen, P. M. 2001a: The present status of names applicable to species and intraspecific taxa in *Erioderma* (lichenised ascomycetes) included in Zahlbruckner's Catalogus. — *Taxon* 50: 525–542.
- Jørgensen, P. M. 2001b: The lichen genus *Erioderma* (Pannariaceae) in China and Japan. — *Ann. Bot. Fennici* 38: 259–264.
- Jørgensen, P. M. & Arvidsson, L. 2002: The lichen genus *Erioderma* Fée (Pannariaceae) in Ecuador and neighbouring countries. — *Nordic Journ. Bot.* 22. [In press].
- Louwhoff, S. H. J. J. 2001: Biogeography of *Hypotrachyna*, *Parmotrema* and allied genera (Parmeliaceae) in the Pacific islands. — *Biblioth. Lichenol.* 78: 223–246.
- White, F. J. & James, P. W. 1983: New guide to microchemical techniques for the identification of lichen substances. — *Bull. Brit. Lich. Soc.* 57 (Supplement): 1–41.