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# NEW SPECIES OF THE LICHEN GENUS *MENEGAZZIA* IN NEW GUINEA

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**Abstract:** Species of *Menegazzia* form a significant element of the lichen flora of the mountains of New Guinea. Several can occur together, and some appear to be widespread on the island. A preliminary taxonomic treatment is presented here. Most taxa produce atranorin and the stictic acid complex. There are several complexes with obvious species pairs or trios, indicating that the majority of the *Menegazzia* species in New Guinea are closely related and are the result of recent sympatric speciation. All taxa found are so far endemic to the island. The following are described as new: *Menegazzia digitiformis* P. James, Aptroot, Sérus. & Diederich, *M. dissoluta* P. James, Aptroot, Sérus. & Diederich, *M. efflorescens* P. James, Aptroot, Sérus. & Diederich, *M. isidiata* P. James, Aptroot, Sérus. & Diederich, *M. megathallina* P. James, Aptroot, Sérus. & Diederich, *M. pendula* P. James, Aptroot, Sérus. & Diederich, *M. saxicola* P. James & Aptroot, and *M. stellata* P. James, Aptroot, Sérus. & Diederich.

## Introduction

The genus *Menegazzia* (Lecanorales) forms a conspicuous and diverse element in temperate or montane habitats in much of the Southern Hemisphere. Only a single taxon, *M. terebrata* (Hoffm.) A. Massal. (the type species of the genus), is widespread in the Northern Hemisphere, although its distribution spreads into the Southern Hemisphere in Tanzania (KROG 1991) and Madagascar (DES ABBAYES 1961). Thus far, 54 species are accepted in the genus, mainly from temperate South America (SANTESSON 1942; ADLER & CALVELO 1996), New Zealand (JAMES 1985) and Australia (JAMES & GALLOWAY 1992), including Tasmania (KANTVILAS & JAMES 1987).

The genus is traditionally classified in the Parmeliaceae (e.g. SANTESSON 1942), but is sometimes separated, together with *Hypogymnia*, into the Hypogymniaceae (e.g. JAMES & GALLOWAY 1992). An alternative affinity with the Alectoriaceae has been suggested, based on similarities of the ascospores,

especially their dimensions and pigmentation (KÄRNEFELT & THELL 1992). However, the salient features of the excipulum of most of the Parmeliaceae *sens. lat.* are rather uniform, and the apparent similarity in ascospore pigmentation between *Menegazzia* and the Alectoriaceae is most probably polyphyletic in origin, as the type of pigment is different, being pale brown in the former as opposed to greyish black in the latter. Moreover, there are so few similarities in other (especially thalline) diagnostic structures between the two families, that *Menegazzia* is much more likely to be related to some foliose Parmeliaceae, even though the origin of the genus still remains a matter of conjecture.

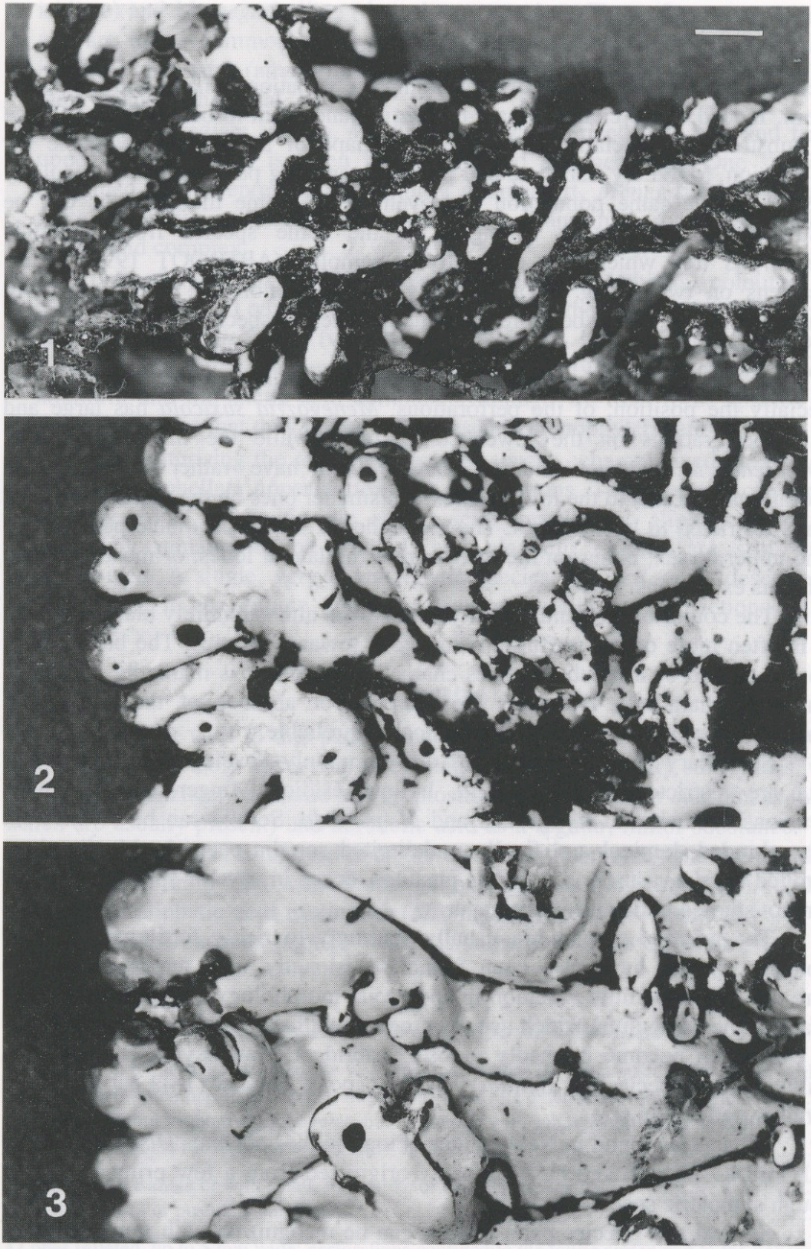
The lichen flora of New Guinea is relatively poorly known, although the number of species reported or described from this area has risen considerably in recent years, mainly as a result of several expeditions by the authors (APTROOT & SIPMAN 1991; APTROOT *et al.* 1995, 1997; APTROOT 1998). Species of *Menegazzia* form a conspicuous part of the lichen flora in the mountains of New Guinea, with a similar ecology to that of species of *Anzia* (YOSHIMURA *et al.* 1995; ELIX 1997). Often several taxa occur together, and some seem to be notably widespread on the island. During our expeditions, we observed what we thought might be undescribed species, and consequently paid particular attention to studying *Menegazzia* in the field, resulting in the adequate material now available for study. Prior to this account, only one species (*M. terebrata*) had been reported, albeit incorrectly, from the island (STREIMANN 1986).

Although the material now available is plentiful, it has been impossible to achieve a complete survey of the genus on the island. Unfortunately, the unsolved problems concern the most common sorediate and non-sorediate, non-isidiate, fertile species. The taxonomy of a complex of at least five species remains to be clarified; this will be studied later. Thus, while this paper is preliminary, it nevertheless describes several species as new to science and provides a key to the genus in New Guinea. It is dedicated to our friend and colleague Prof. John A. Elix on the occasion of his 60th birthday.

## Material and Methods

This study is based on all available herbarium specimens, gathered over the years during several expeditions, commencing with the collections of W. A. Weber & D. McVean (mostly in CANB and COLO, but with a few duplicates in other herbaria). Other important collections are those of H. Streimann (mostly in CANB, with a few duplicates in H and LAE) and P. W. Lambley (mostly in BM and UPNG). The majority of the available collections have, however, been gathered by the authors, who (together) examined all species in the field during four expeditions to Papua New Guinea, including the very successful 'Benelux Lichenological Expedition to Papua New Guinea 1992'. However, very few specimens are available from the western part of the island (Indonesia, Irian Jaya). The collections of A. Aptroot are in Herb. Aptroot, those of P. Diederich in Herb. Diederich, those of E. Sérusiaux in LG and those of H. J. M. Sipman in B. A total of about 250 specimens have been examined.

Most specimens have been checked for secondary products by TLC, using the solvents A, C and G (WHITE & JAMES 1985). The identity of all compounds has been checked by co-chromatography with species containing known substances as controls.




**Figs 1–3:** *Menegazzia* sp. [all specimens presumably belonging to the same undescribed species, and all from the same tree]. **Fig. 1.** Specimen on twigs (*A. Aptroot* 38006). **Fig. 2.** Specimen on branches (*A. Aptroot* 37928). **Fig. 3.** Specimen on trunk (*A. Aptroot* 37816). Scale for all specimens = 1 mm.

## Morphology and Phylogeny

Much effort has been given to understanding the variation in habit and branching pattern. Indeed, these characters are perplexing and seem to be partly due to age and substratum, especially the nature and shape of the surface available for colonization. Markedly flabellate and pinnate branching patterns can be regularly observed in the same population and even on the same thallus. This can be illustrated with specimens belonging to the same species from a single *Elaeocarpus* tree which was exhaustively sampled (APTROOT 1997). Thus, specimens on twigs (Fig. 1) are usually markedly elongate, specimens from branches (Fig. 2) tend to be more contiguous, whereas specimens from the trunk tend to be ± orbicular (Fig. 3).

A character that proved to be particularly valuable was the size, and especially the position, of the perforations. *Menegazzia saxicola* has large and gaping perforations on the lower cortex only, while the three species *M. efflorescens*, *M. isidiata* and *M. megathallina* have rather large, gaping perforations confined to the lower cortex and smaller ones on the upper cortex but always restricted to lateral lobes. The remainder of the species have perforations in the upper cortex, either on the main and/or the lateral lobes, or mostly present on thallus extensions.

The colour of the central cavity varies from almost entirely black to white, and is often more or less suffused ochraceous towards the tips. The basic cavity colour seems to be a reliable species character, because it is markedly correlated with other characters. However, the presence or absence of the ochraceous pigment is more variable and is taxonomically unreliable.

Secondary asexual propagules are commonly developed. Whereas true isidia are restricted to *M. isidiata*, hollow, isidioid, finger-like or clavate extensions occur in *M. digitiformis* and *M. pendula*. Soralia can be of different types: abraded, laminal and finally undelimited soredia occur in *M. dissoluta*; delimited soralia, usually starting as pustules, occur in several species, some of them not studied in detail for this paper.

The primary species are usually sparingly to richly fertile, but several secondary species have also been found occasionally with mature apothecia. There appears to be little variation in apothecial morphology except for the outer surface of the excipulum, which usually proceeds with a smooth, corticate surface, but which can become markedly rugose, scabrid or pseudocyphellate, or even papillate in one species (*M. stellata*). The ascospores number (1–)2 per ascus and are rather variable in size.

All species found in New Guinea belong to the subgenus *Dispora* R. Sant. (SANTESSON 1942) and have probably originated from a few primary species through sympatric speciation.

Several true species pairs or trios can be recognized, with four groups of species being distinguished as follows:

- A species trio of large taxa with swollen thalli characterized by lobe widths up to 5 mm and conspicuous, *c.* 4 mm wide perforations on the lower cortex with smaller ones on the upper cortex restricted to lateral lobes. All three species are newly described in this paper: *M. efflorescens* (sorediate), *M. isidiata* (truly

isidiate) and *M. megathallina* (the primary species). They often occur together and are rather common and widely distributed at high altitudes. They have identical chemistry (atranorin and the stictic acid complex) and differ only in their means of dispersal.

- The single sorediate species, *M. dissoluta*, characterized by a soft and fragile upper cortex, which is often finely wrinkled and perforate. One specimen examined could represent the primary counterpart. *Menegazzia dissoluta* is quite distinctive in its chemistry, producing atranorin, barbatic acid and the stictic acid complex.
- A group of relatively stout species from exposed habitats, coloured a ± suffused brown and perforated in the lower and/or the upper cortex. The group comprises *M. digitiformis* (with hollow, perforate, isidia-like extensions), *M. pendula* (with isidioid extensions) and *M. saxicola* (with soredia). All produce atranorin and the stictic acid complex. Although we treat these species as a group, we stress that they might not represent a monophyletic entity.
- A group comprising the remaining smaller species, characterized by a smooth or pseudocyphellate upper cortex with perforations. This group is chemically heterogeneous, producing the stictic acid complex or aliphatic acids. Its taxonomy remains to be studied, and clear-cut entities are still to be determined. A single, very characteristic species, *M. stellata*, is described in this paper. It has minute apothecia bearing papilla-like projections on the margin.

## Chemistry

All species dealt with in this paper produce atranorin in the upper cortex. Most species show a notably unvarying assemblage of other secondary substances, with stictic, menegazziaic, constictic and cryptostictic acids as major substances (all of which are usually present) and norstictic acid as a regular, minor substance. This combined set of acids is referred to as the 'stictic acid complex'. Barbatic acid has been detected in a few collections of one species (*M. dissoluta*), and an unidentified aliphatic acid in another (*M. megathallina*). No chemical basis was found for the ochraceous pigment which is sometimes observed towards the tips in the central cavity.

## Preliminary Key to *Menegazzia* in New Guinea

**1** Thallus with numerous to very sparse vegetative propagules (soredia, pustules, isidia) or with small, often perforate, ± erect, finger-like or clavate extensions; rarely fertile.....2
**1:** Thallus without vegetative propagules, but frequently with small lateral lobes or thallus extensions; usually at least sparingly fertile.....8

**2** Thallus truly isidiate or with small, finger-like or clavate extensions.....3
**2:** Thallus erose- or pustulate-sorediate.....5

**3** Lobes inflated, up to 5 mm wide; perforations confined to the lower cortex and to the upper cortex on lateral lobes or extensions; upper surface with patches of narrow, true, solid isidia which leave pits when shed.....***Menegazzia isidiata***
**3:** Lobes not inflated, not exceeding 2.5 mm wide; perforations present in the upper cortex; hollow, finger-like or clavate extensions present.....4

**4** Upper cortex often weakly striate-ridged to roughened; lobes often becoming pendulous, pale grey, often inspersed with black intrusions; finger-like extensions horizontal to pendulous ..... ***Menegazzia pendula***

**4:** Upper cortex smooth; lobes closely appressed, at least partly glossy brown, mottled with grey or black; finger-like or clavate extensions usually present, erect, typically perforate at the tips..... ***Menegazzia digitiformis***

**5** Upper cortex fragile, finely wrinkled, dissolving into ± effuse soredia; soralia laminal, becoming ± erose and confluent; usually containing barbatic acid, in addition to the stictic acid complex..... ***Menegazzia dissoluta***

**5:** Upper cortex firm, smooth or only faintly wrinkled, not dissolving into soredia; soralia or pustules delimited, often ± elevated; not containing barbatic acid; stictic acid complex present..... 6

**6** Lobes inflated, not or sparingly branched, up to 5 mm wide; perforations confined to the lower cortex and to the upper cortex on lateral lobes or extensions; soralia scattered, often marginal, labriform or erumpent with markedly uneven, lacerate margins ..... ***Menegazzia efflorescens***

**6:** Lobes not inflated, short or only somewhat elongate, often richly branched, up to 2.5 mm wide; upper cortex perforate; soralia or pustules sparse or abundant, usually formed on short, lateral lobe extensions..... 7

**7** Thallus closely appressed; lobes in part pale yellowish, suffused brown to nearly black; soralia capitate, confined to central parts of the thallus, originating from marginal lobules; saxicolous..... ***Menegazzia saxicola***

**7:** Thallus not closely appressed; lobes not brown; soralia not capitate; rarely saxicolous ..... **Species aggregate I**

**8** Lobes inflated, sparingly branched; perforations restricted to lateral lobes or extensions on the upper cortex, present or nearly absent on the lower cortex..... 9

**8:** Lobes not inflated, usually richly branched; perforations present only on the upper cortex..... 10

**9** Lobes sparingly irregularly branched, up to 5 mm wide; perforations confined to the lower cortex and to the upper cortex of lateral lobes or extensions; lobes greyish, rarely brown- or black-maculate; apothecia rather frequent; usually epiphytic; containing stictic acid complex..... ***Menegazzia megathallina***

**9:** Lobes loosely interwoven or separate, not exceeding 2.5 mm wide; perforations very rare and irregular; lobes at least partly glossy brown, grey- or black-maculate; apothecia absent; terricolous, saxicolous or epiphytic at high elevations; containing physodic, physodalic and alectoronic acids..... ***Hypogymnia lugubris*** var. ***lugubris***

**10** Thallus of numerous, intricately interwoven lobes up to 1.5 mm wide; apothecial margins with papilla-like projections..... ***Menegazzia stellata***

**10:** Thallus variable, short-lobed (to 3 mm wide) or with ± elongate, somewhat radiating lobes; apothecial margins never with papilla-like projections..... **Species aggregate II**

**Notes:**

**Species aggregate I**: varying in the shape of the lobes (ascending vs. appressed), the position of soredia (on terminal lobes or laminal on abraded pustules) and chemistry (with or without the stictic acid complex). This aggregate is widespread and abundant in the montane forests.

**Species aggregate II**: varying in the shape of perforations, the cortex (smooth and glossy vs. rather dull and almost pseudocyphellate) and chemistry (with or without the stictic acid complex). This aggregate is in part the primary counterpart of the former and is also widespread and abundant in the montane forests.

***Hypogymnia lugubris*** (Pers.) Krog var. ***lugubris***. The species is included in the key, because it might be confused with a genuine *Menegazzia*. It occurs at high elevations (3800–4200 m) on Mt

Edward and Mt Wilhelm where it can be quite common on the ground, rocks and small shrubs. It was first reported from New Guinea by ELIX (1979).

## The Species

### *Menegazzia digitiformis* P. James, Aptroot, Sérus. & Diederich, sp. nov.

Thallus valde adpressus, rosulatus, brunneus, lobulis marginibus digitiformibus vel clavatis, plus minusve erectis, usque 2 mm longis et 0.5 mm latis, plerumque ad apices minute perforatis. Soralia isidiaque destituta. Apothecia pycnidiaque ignota. Acida stictica aggr. continens.

*Typus*. PAPUA NEW GUINEA. *Simbu Province*: Mount Wilhelm, Pindaunde valley, near the hut on the S shore of Lake Piunde, alt. 3600 m, epiphytic in subalpine forest remnants on W slope of valley, 14.iii.1987, *H. Sipman 22139* [Holotype—B].

(Fig. 4)

*Thallus* closely appressed, ± rosette-forming, up to 10 cm wide. *Lobes* mostly dark brown, with main lobes sparingly grey in the median part, irregularly branched, convex, up to 2 mm wide, contiguous, becoming elongate with age; margins markedly black, developing marginal, usually ± erect, finger-like or clavate extensions up to 2 mm long and 0.5 mm wide; these extensions are commonly minutely perforate at the tips and simple to bifurcate; upper cortex smooth, typically glossy; lower cortex black, glossy; central cavity black. *Perforations* on main lobes scarce, up to 1 mm wide, ± impressed in the thallus surface, common on the marginal extensions, especially on the tips, and then up to 0.1 mm wide and elliptical. *Vegetative propagules* absent. *Apothecia and pycnidia* unknown.

*Chemistry*: Atranorin, stictic, constictic, cryptostictic and menegazziaic acids.

**Notes:** This new species does not seem to be related to any other species of *Menegazzia*. It is easily distinguished by the numerous, ± erect, apically perforate, finger-like or clavate extensions. The suffused brown colouration is probably a response to exposure in an open, sunny habitat.

**Distribution and habitat:** This is a rare endemic from New Guinea where it grows on exposed tree-trunks and branches in montane forest and alpine grassland at altitudes of 2900–3700 m.

**Additional specimens examined:** —PAPUA NEW GUINEA. *Enga Province*: 3 km N of Mount Leiwaro, 15 km ESE of Porgera, alt. 2900 m, epiphytic in alpine shrubbery, 22.viii.1985, *P. W. Lambley 275/85 p.p.* (BM). *Simbu Province*: Mount Wilhelm, Pindaunde valley, near the hut on the S shore of Lake Piunde, alt. 3500 m, epiphytic in subalpine grassland and scrub on bottom of the valley, 12.iii.1987, *H. Sipman 21999* (B); same locality, alt. 3700 m, epiphytic in subalpine forest remnants on W slope of valley, 6.viii.1992, *H. Sipman 35705* (B); same locality, alt. 3600 m, 5.viii.1992, *P. Diederich 10091* (Herb. P. Diederich).

***Menegazzia dissoluta* P. James, Aptroot, Sérus. & Diederich, sp. nov.**

Thallus valde adpressus, lobis glaucogriseis, ad apices luteolis, usque 4 mm latis, supra irregulariter corrugatis, fragilibus et diffluentibus, intra albis. Soralia plerumque diffusa, usque 5 mm lata, vulgo e cortice dirupta orta. Apothecia pycnidiaque ignota. Acida stictica aggr. et plerumque acidum barbaticum continens.

*Typus*. PAPUA NEW GUINEA. *Eastern Highlands Province*: Mount Gahavisuka Provincial Park, 11 km N of Goroka, alt. 2300 m, epiphytic on fallen *Castanopsis* tree in little-disturbed, mossy, montane forest, 5.xi.1995, *H. Sipman 39165* [Holotype—B].

(Fig. 5)

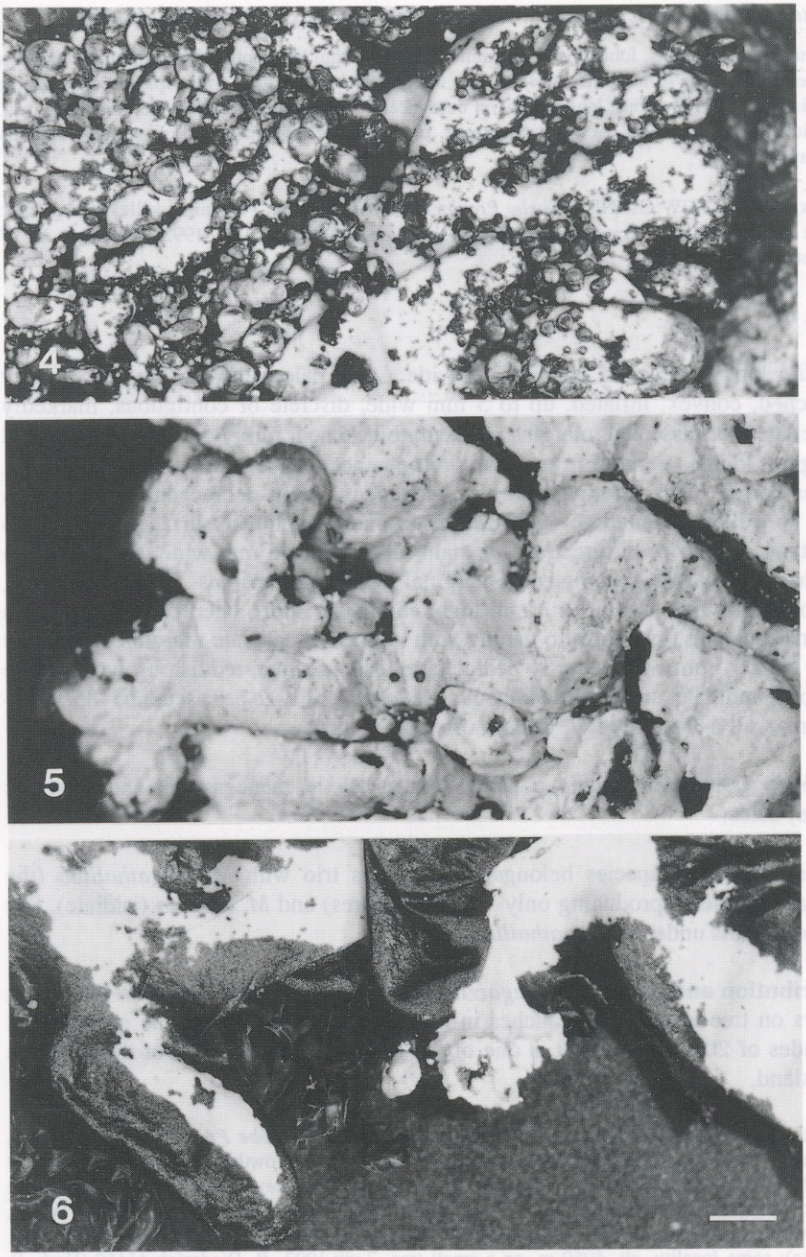
*Thallus* closely appressed, up to 10 cm wide. *Lobes* glaucous grey, becoming somewhat yellowish at apices, contiguous throughout, somewhat overlapping, irregularly branched, convex but uniform in thickness, up to 4 mm wide, not markedly elongate; margins sparingly black; young lobes at tips with a broad (up to 1 mm) brown margin; marginal lobules absent or very rarely developed; upper cortex usually irregularly wrinkled throughout, fragile, flaking off and dissolving; swollen and corticate protuberances sometimes present in eroded areas; lower cortex black except for a pale marginal zone, glossy; central cavity uniformly white. *Perforations* scarce, mostly on main lobes, up to 1 mm wide, level with the thallus surface. *Soralia* mostly diffuse, covering areas of up to 5 mm wide, usually forming after the breakdown of the upper cortex which dissolves into fragile flakes overlying the soredia which originate from the medulla. *Apothecia and pycnidia* unknown.

*Chemistry*: Atranorin, stictic, constictic, cryptostictic, menegazziaic and barbatic (not always detected) acids.

**Notes:** *Menegazzia dissoluta* is easily distinguished by the delicate and irregularly finely wrinkled upper surface that dissolves into soredia.

**Distribution and habitat:** This species is endemic to New Guinea where it grows on tree-trunks and branches in montane forest at altitudes of 2300–2500 m. It was found in only two localities, but is quite abundant at one of these; it has possibly been overlooked elsewhere.

**Additional specimens examined:** —PAPUA NEW GUINEA. *Eastern Highlands Province*: Mount Gahavisuka Provincial Park, 11 km N of Goroka, along trail to lookout, alt. 2300–2450 m, epiphytic in scarcely disturbed mossy montane forest, 3.viii.1992, *H. Sipman 35488* (part) (B); same locality, alt. 2500 m, 20.xi.1984, *P. W. Lambley 77/84b* (BM); same locality, alt. 2300 m, iii.1987, *A. Aptroot 18724 & 18812* (Herb. A. Aptroot); same locality, alt. 2300–2450 m, 11.viii.1992, *A. Aptroot 31257* (Herb. A. Aptroot). *Madang Province*: Huon Peninsula, Finisterre Range, Yupna valley, Teptep village, alt. 2300 m, epiphytic on *Cordyline* in hedges between gardens, 30–31.vii.1992, *A. Aptroot 32254* (Herb. A. Aptroot).




**Figs 4–6: Fig. 4:** *Menegazzia digitiformis* (holotype). **Fig. 5:** *Menegazzia dissoluta* (holotype). **Fig. 6:** *Menegazzia efflorescens* (holotype). Scale for all specimens = 1 mm.

## *Menegazzia efflorescens* P. James, Aptroot, Sérus. & Diederich, sp. nov.

Thallus laxe adhaerens, lobis convexis, tumidis, usque 5 mm latis, intra nigris, foraminibus infra frequentibus, usque 4 mm latis, supra lobulis marginalibus restrictis. Soralia sparsa, praecipue in lobulis lateralibus brevibus, labriformia vel cum laceratis marginibus discedentia. Apothecia rara. Pycnidia saepe numerosa. Acida stictica aggr. continens. *M. megathallinae* similis sed sorediis laceratis differt.

*Typus.* PAPUA NEW GUINEA. *Simbu Province*: Mount Wilhelm, Pindaunde valley, along track to the summit, alt. *c.* 4100 m, alpine grassland slope, on small shrub, 7.viii.1992, *H. Sipman 35774* [Holotype—B].

(Fig. 6)

*Thallus* loosely attached, up to 20 cm wide. *Lobes* pale yellowish grey, irregularly branched, convex, inflated, up to 5 mm wide, discrete or contiguous, markedly flabellate, not dissected; margins markedly blackened, rarely developing scattered marginal lobules derived from black protuberances; upper cortex smooth, glossy; lower cortex black, glossy; central cavity black, often ochraceous towards tips (due to yellow pigments). *Perforations* frequent on lower surface, rounded to elliptical, mostly on bifurcations of main lobes, up to 4 mm wide, depressed, on upper surface always restricted to marginal lobes or extensions. *Soralia* scattered, up to 7 mm wide and up to 3 mm high, chiefly on short, lateral lobes, rarely on laminal pustules, labriform to gaping with noticeably lacerate margins. *Apothecia* rare, up to 4 mm wide, shortly pedicellate; disc concave, reddish brown; exciple smooth, undulate, suffused ochraceous. *Ascospores* (1–)2 per ascus, 65–85 × 40–55 µm; wall 4–7 µm thick. *Pycnidia* often numerous.

*Chemistry*: Atranorin, stictic, constictic, cryptostictic, menegazziaic and norstictic (trace) acids.

**Notes:** This new species belongs in a species trio with *M. megathallina* (the primary species reproducing only with ascospores) and *M. isidiata* (isidiate). See further details under *M. megathallina*.

**Distribution and habitat:** *Menegazzia efflorescens* is endemic to New Guinea; it grows on tree-trunks and branches in montane forest and subalpine grassland at altitudes of 2000–3600 m. It is one of the most common species of the genus in the island.

**Selected specimens examined:** —PAPUA NEW GUINEA. *Morobe Province*: Mount Kaindi, Wau area, alt. 2360 m, *Nothofagus*-Cunnoniaceae-dominated regrowth on ridge, on dead treelet branches, 9.i.1983, *H. Streimann 17633* (CANB). *Simbu Province*: Mount Wilhelm, Pindaunde valley, alt. 3400–3800 m, epiphytic, 29.vi.1968, *W. A. Weber & D. McVean*, (W. A. Weber, *Lichenes Exsiccati* No. 384 as *M. pertusa*; B, U, Herb. A. Aptroot; the specimen in LG is *M. isidiata*); same locality, alt. 4050 m, on a small tree, 7.viii.1992, *P. Diederich 11150* (Herb. P. Diederich). *Eastern Highlands Province*: Mt Gahavisuka Provincial Park, 11 km N of Goroka, alt. 2300–2450 m, slightly disturbed, mossy, montane forest, 3.viii.1992, *H. Sipman 35480* (B). *Southern Highlands Province*: Mt Giluwe, alt. *c.* 3600 m, subalpine shrub, 31.viii.1987, *P. W. Lambley 1274* (BM).

***Menegazzia isidiata* P. James, Aptroot, Sérus. & Diederich, sp. nov.**

Thallus laxe adhaerens, lobis convexis, tumidis, usque 5 mm latis; intra niger; foramina infra frequentia et usque 4 mm lata, supra lobulis marginalibus restricta. Isidia sparsa, saepe aggregata, solida, simplicia vel raro bifurcata. Apothecia rara. Pycnidia ignota. Acida stictica aggr. continens. *M. megathallinae* similis sed isidiis solidis differt.

*Typus*. PAPUA NEW GUINEA. *Simbu Province*: Mount Wilhelm, Pindaunde valley, near the hut on the S shore of Lake Piunde, alt. 3500 m, epiphytic in subalpine grassland and scrub on bottom of valley, 12.iii.1987, *H. Sipman 22000* [Holotype—B].

(Figs 7 & 8)

*Thallus* loosely attached, up to 12 cm wide. *Lobes* pale yellowish grey, becoming suffused brownish at high elevations, irregularly branched, convex, inflated, up to 5 mm wide, discrete or contiguous, markedly flabellate, not dissected; margins markedly blackened, developing scattered marginal lobules derived from black protuberances; upper cortex smooth, glossy; lower cortex black, glossy; central cavity black, often ochraceous towards tips (due to yellow pigments). *Perforations* frequent on lower surface, rounded to elliptical, mostly on bifurcations of main lobes, up to 4 mm wide, depressed, on upper surface always restricted to marginal lobes or extensions. *Isidia* scattered, sometimes very rare, but often in dense groups, chiefly on main lobes, finger-like, solid, simple, rarely bifurcate, concolorous with the thallus, up to 1 mm long, uniformly 0.2 mm wide. *Apothecia* rare, up to 2 mm wide, pedicellate; disc concave, reddish brown; exciple smooth, becoming scabrid at the outer surface, suffused ochraceous. *Ascospores* (1–)2 per ascus, (60–)65–75(–80) × (35–)38–55(–57) µm; wall (3–)4–6 µm thick. *Pycnidia* unknown.

*Chemistry*: Atranorin, stictic, constictic, cryptostictic, menegazziaic and norstictic (trace) acids.

**Notes:** This is the only species of *Menegazzia* in New Guinea with true isidia; they are sometimes only sparingly present or concentrated on small areas of the older lobes. This new lichen clearly belongs in a species trio with *M. megathallina* (the primary species reproducing only by ascospores) and *M. efflorescens* (sorediate). See under *M. megathallina* for more details.

**Distribution and habitat:** This species is endemic to New Guinea, where it grows on tree-trunks and branches, occasionally on rock, in montane forest and alpine grassland at altitudes of 2100–3800 m. It is a rather common species, especially on Mt Wilhelm.

**Selected specimens examined:** —PAPUA NEW GUINEA. *Madang Province*: Huon Peninsula, Finisterre Range, Saidor, Mt Abilala, alt. 2800–3000 m, epiphytic in upper montane forest, 19.xi.1964, *A. C. Jermy 4326* (BM); Yupna valley, Teptep village, trail in NNW direction towards Bambu Airfield, alt. 2300–2750 m, epiphytic in montane forest, 30–31.vii.1992, *A. Aptroot 32024* (Herb. A. Aptroot). *Southern Highlands Province*: Mt Giluwe, summit area, alt. 3500 m, epiphytic on *Podocarpus* in alpine grassland, 1.vii.1985, *P. W. Lambley 159/85* (BM); Mt Wilhelm, Pindaunde valley, along track to the summit, alt. 3800 m, on granite rocks, 7.viii.1992, *E. Sérusiaux 14051* (LG). *Eastern Highlands Province*: Mount Gahavisuka Provincial Park, 11 km N

of Goroka, along trail to lookout, alt. 2300–2450 m, epiphytic in little-disturbed, mossy, montane forest, 3.viii.1992, *H. Sipman 35488* (part) (B).

### *Menegazzia megathallina* P. James, Aptroot, Sérus. & Diederich, sp. nov.

Thallus laxe adhaerens, lobis convexis, tumidis, usque 5 mm latis, intra nigris, foraminibus infra frequentibus, usque 7 mm latis, supra lobulis marginalibus restrictis. Propagula vegetativa destituta. Apothecia frequentia pedicellata. Pycnidia numerosa. Acida stictica aggr. continens.

*Typus.* PAPUA NEW GUINEA. *Eastern Highlands Province*: Mount Gahavisuka Provincial Park, 11 km N of Goroka, along trail to lookout, alt. 2300–2450 m, epiphytic in little-disturbed, mossy, montane forest, 3.viii.1992, *H. Sipman 35479* [Holotype—B].

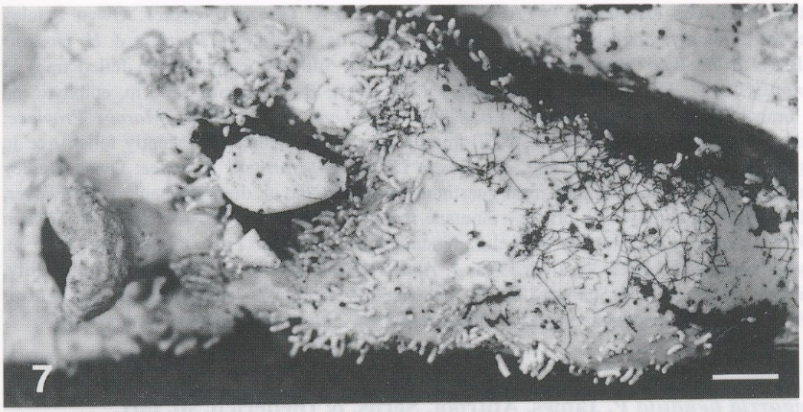
(Fig. 9)

*Thallus* loosely attached, up to 20 cm wide. *Lobes* pale yellowish grey, becoming suffused brownish at high elevations, sparingly irregularly branched, convex, swollen to inflated, up to 5 mm wide, discrete or contiguous, at least partly flabellate, not dissected; margins markedly blackened, developing scattered, marginal lobules derived from black protuberances, sometimes with many perforate lateral lobes, and in such cases markedly variable in lobe size; upper cortex smooth, glossy; lower cortex black, glossy; central cavity black, often ochraceous towards tips (due to yellow pigments). *Perforations* frequent on the lower surface, rounded to elliptical, mostly on bifurcations of main lobes, up to 7 mm wide, depressed, often shallow, gaping and totally revealing the central cavity, on upper surface always restricted to marginal lobes or extensions. *Vegetative propagules* absent. *Apothecia* frequent, up to 7 mm wide, pedicellate; stalk smooth or furrowed to wrinkled and sometimes ochraceous; disc concave, reddish brown; exciple smooth, becoming scabrid at the outer surface, suffused ochraceous. *Ascospores* (1–)2 per ascus, (65–)80–100(–118) × (30–)34–50(–53) µm; wall (4–)7–8(–10) µm thick. *Pycnidia* numerous; conidia bacillar, 4–7 × 0.5 µm.

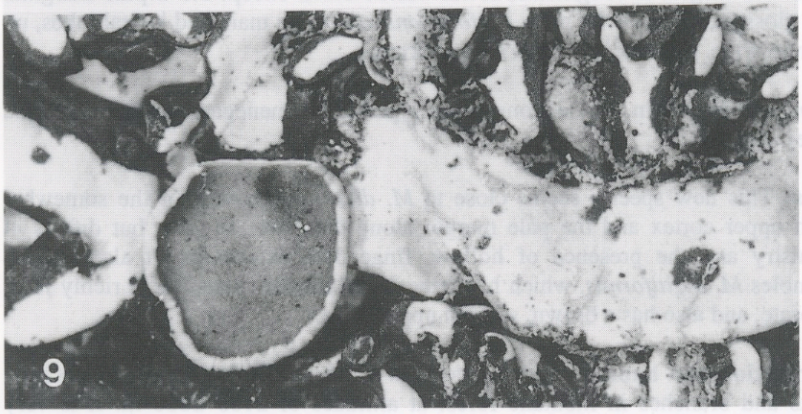
*Chemistry*: Atranorin, stictic, constictic, cryptostictic, menegazziaic and norstictic (trace) acids; sometimes in addition an unidentified aliphatic acid.

**Notes:** This species obviously belongs in a species trio with *M. isidiata* (isidiate) and *M. efflorescens* (sorediate). The elongate, inflated, little-branched lobes, and the perforations being confined to the lower cortex and to lateral lobes and extensions on the upper cortex are diagnostic for this species trio. The species is particularly variable in lobe width, with some specimens uniformly 5 mm wide and others with a great variation within one thallus, apparently in response to the habitat, substratum and age of the thallus. It has the largest known ascospores of the genus in New Guinea.

**Distribution and habitat:** Endemic to New Guinea, this lichen grows on tree-trunks and branches in montane forest and alpine grassland at altitudes of 1400–3800 m. It is a rather common species, with extensive populations of very spectacular specimens on Mt Wilhelm.








**Figs 7–9: Figs 7, 8:** *Menegazzia isidiata* (holotype). **Fig. 9:** *Menegazzia megathallina* (holotype). Scale for all specimens = 1 mm.

**Selected specimens examined:** —PAPUA NEW GUINEA. *Central Province*: Owen Stanley Range, Mt Scratchly, English Peaks, alt. 3600 m, epiphytic, xii.1986, *I. Burrows & H. Hopkins 910* (BM). *Milne Bay Province*: Mt Mon, Bonenau, alt. 1400 m, epiphytic on felled trees in *Castanopsis* forest, 16.ix.1987, *P. W. Lambley 1235* (BM); Bonenau, alt. 1600 m, epiphytic on fallen branch in *Castanopsis* forest, 14.ix.1986, *P. W. Lambley 781* (BM). *Morobe Province*: summit of Mt Kaindi, Wau area, alt. 2350 m, epiphytic on branchlets of recently felled tree in mossy *Nothofagus* forest, 9.viii.1981, *H. Sipman 15783* (B). *Northern Province*: Owen Stanley Range, Myola, 0–1 km along trail from guesthouse towards NE, on the right bank of Iora River, alt. 2100–2400 m, epiphytic in primary montane forest on montane slope, 15.x.1995, *H. Sipman 38250* (B). *Simbu Province*: Mt Wilhelm, Pindaunde valley, near Lake Piunde, alt. 3600 m, epiphytic in subalpine forest, 5–8.viii.1992, *A. Aptroot 31340* (Herb. A. Aptroot); same locality, alt. 3600 m, 14.iii.1987, *H. Sipman 2213* (B, LG, Herb. A. Aptroot). —INDONESIA. *Irian Jaya*: Star Mountains, Antares, epiphytic, 22.vii.1959, *B. O. van Zanten 672* (L, Herb. A. Aptroot).

## *Menegazzia pendula* P. James, Aptroot, Sérus. & Diederich, sp. nov.

Thallus laxe adhaerens, modice fragilis, lobis convexis, elongatis, plerumque tubulosis pendulisque, intra pallidi, cortice super leniter striato-porcato ad ruguloso. Apothecia et pycnidia ignota. Acida stictica aggr. continens.

*Typus*. PAPUA NEW GUINEA. *Madang Province*: Huon Peninsula, Finisterre Range, Saidor, Mt Abilala, alt. 3000 m, epiphytic, 16.xi.1964, *A. Eddy 1170* [Holotype—BM].

(Fig. 10)

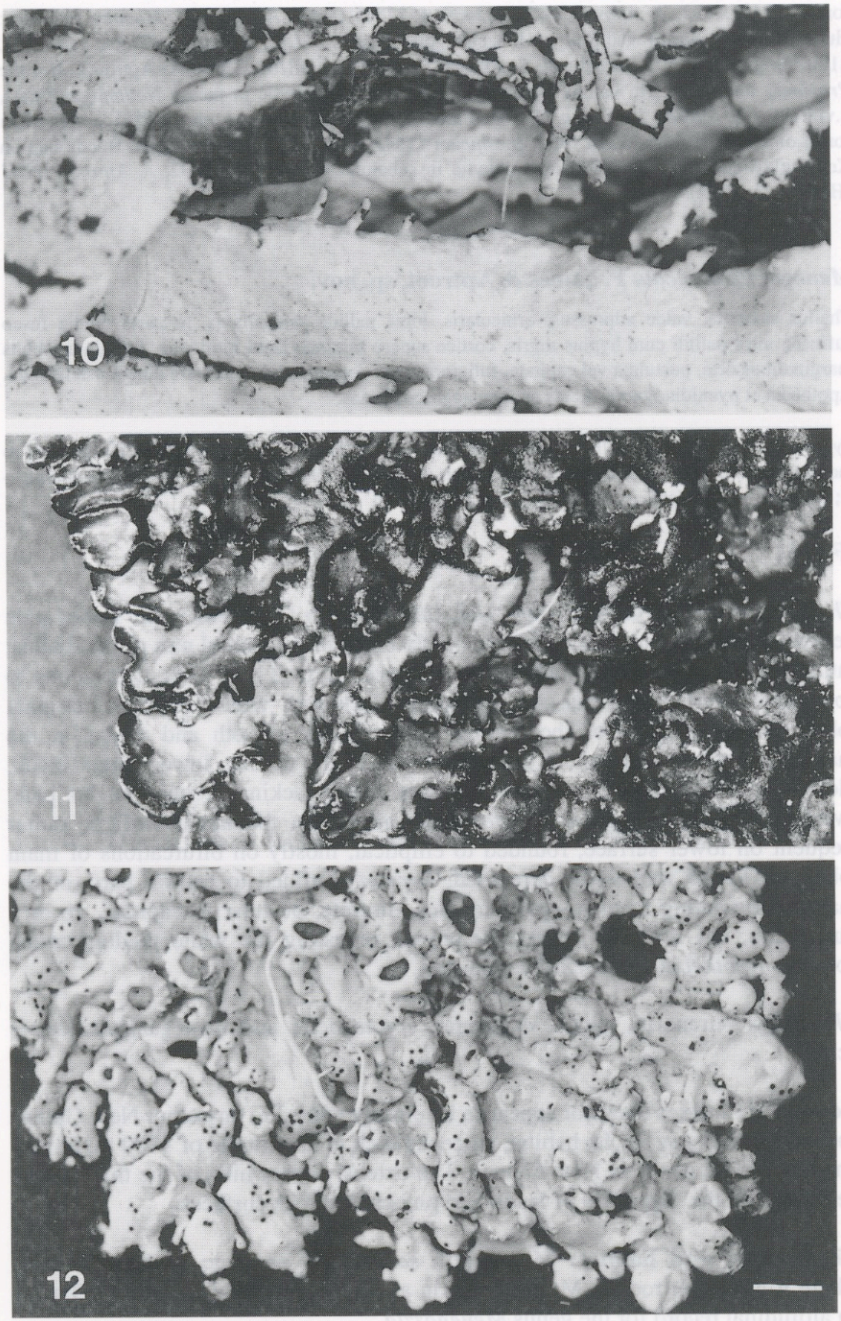
*Thallus* loosely attached to mosses, up to 20 cm wide, rather fragile. *Lobes* pale grey to yellowish grey, pale brown towards tips, irregularly branched, convex, up to 5 mm wide, becoming elongate, mostly tubular and pendulous; margins and older parts becoming partly blackened, developing short, horizontal to pendulous, lateral lobules derived from hollow, finger-like extensions; upper cortex weakly striate and ridged to roughened; lower cortex black except for a pale marginal area, glossy; central cavity pale. *Perforations* scarce, on main and lateral lobes, up to 4 mm wide. *Apothecia and pycnidia* unknown.

*Chemistry*: Atranorin, stictic, constictic, cryptostictic, menegazziaic and norstictic (trace) acids.

**Notes:** This new species seems close to *M. dissoluta* because of the somewhat rough upper cortex and the pale margin along the lower surface, but differs in chemistry and the presence of hollow, finger-like extensions. It also closely resembles *M. digitiformis*, which has rather similar extensions, but is richly fine-perforate, and also has a brown, smooth upper cortex.

**Distribution and habitat:** Endemic to New Guinea, this species grows on tree-trunks and branches in montane forest at altitudes of 2100–2800 m. It is very distinctive, but not particularly common.

**Additional specimens examined:** —PAPUA NEW GUINEA. *Eastern Highlands Province*: Mount Gahavisuka Provincial Park, 11 km N of Goroka, alt. 2300–2450 m, epiphytic in montane




**Figs 10–12: Fig. 10:** *Menegazzia pendula* (holotype). **Fig. 11:** *Menegazzia saxicola* (holotype). **Fig. 12:** *Menegazzia stellata* (holotype). Scale for all specimens = 1 mm.

forest, 11.viii.1992, *A. Aptroot 31222, 32436 & 32445* (Herb. A. Aptroot). *Madang Province*: Huon Peninsula, Saruwaged Range, Honzeukngon village S of Derim airstrip in Timbe valley, alt. 2100 m, epiphytic in mossy forest, 7–8.iii.1987, *A. Aptroot 18101* (Herb. A. Aptroot). *Morobe Province*: summit of Mt Kaindi, Wau area, alt. 2380 m, epiphytic in mossy *Nothofagus* forest, 8.viii.1981, *H. Sipman 15758 p.p.* (B); Wau area, along Edy Creek road, alt. 2100 m, epiphytic in forest on montane ridge, 5.viii.1981, *H. Sipman 15643* (part) (B). *Simbu Province*: Bundi Gap on Keglsugl–Bundi road, alt. 2800 m, epiphytic in subalpine forest, 4.viii.1992, *A. Aptroot 32551* (Herb. A. Aptroot).

### *Menegazzia saxicola* P. James & Aptroot, sp. nov.

Thallus saxicola, valde adpressus, orbicularis, lobis pallide griseoflavis, in parte media fusco suffusis, intra pallidi cum hyphis nigris, cortice supero margine laevi nitidoque. Soralia e lobulis marginalibus orta, pustulata vel capitata, fuliginosa, ubi abrumpentia medullam albam ostendentia. Apothecia et pycnidia ignota. Acida stictica aggr. continens.

*Typus*. PAPUA NEW GUINEA. *Simbu Province*: Mt Wilhelm, Pindaunde valley, along track to the summit, alt. 4200 m, saxicolous on siliceous rock, 7.viii.1992, *A. Aptroot 33134a* [Holotype—B; isotypes—BM, Herb. A. Aptroot].

(Fig. 11)

*Thallus* saxicolous, closely appressed, orbicular, up to 10 cm wide. *Lobes* pale yellowish grey, suffused brownish to nearly black in the central part of the thallus, rather regularly branched, flattened to concave, up to 2 mm wide, contiguous to somewhat overlapping; margins markedly blackened, with numerous marginal lobules in older parts of the thallus; upper cortex smooth and glossy at the margins, rugulose and dull in the central part of the thallus; lower cortex black, glossy, wrinkled, with hapters, sometimes partly lacking; central cavity pale, overlain with black hyphae. *Perforations* absent on the upper surface, rather frequent on lower surface, rounded to elliptical, mostly on bifurcations of main lobes, up to 0.5 mm wide, depressed. *Soralia* confined to central parts of the thallus, originating from marginal lobules, discrete, pustular to capitate, up to 1 mm diam., not confluent, chocolate-brown, revealing the white medulla when abraded. *Apothecia and pycnidia* unknown.

*Chemistry*: Atranorin, stictic, constictic, cryptostictic and menegazziaic (trace) acids.

**Notes:** This species does not appear to be closely related to any other New Guinea species of *Menegazzia*. Its habitat, siliceous rock at an altitude of 4200 m, is very unusual for the genus in New Guinea. The extensive browning of the thallus may be caused by the high level of insolation on exposed rock surfaces.

**Distribution and habitat:** *Menegazzia saxicola* is endemic to New Guinea, where it grows on rock at Mt Wilhelm, in an alpine grassland at 4200 m. This is an altitudinal record for the genus *Menegazzia*.

## *Menegazzia stellata* P. James, Aptroot, Sérus. & Diederich, sp. nov.

Thallus valde adpressus, usque 3 cm latus, lobis ad 1.5 mm latis, intricatis; intra albidi, hyphis nigris, propagula vegetativa destitutus. Apothecia numerosa, breviter pedicellata, excipulo projectionibus isidioideis stellatis, usque 0.5 mm longis et 0.2 mm latis praedito. Pycnidia numerosa. Acida stictica aggr. (sed sine acidum menegazziaicum) continens.

*Typus*. PAPUA NEW GUINEA. *Morobe Province*: Wau area, along Edy Creek road, alt. 2100 m, epiphytic on fallen branchlet from crown of isolated tall tree along road in mixed *Nothofagus* forest remnants on montane ridge, 9.viii.1981, *H. Sipman 15797b* [Holotype—B].

(Fig. 12)

*Thallus* closely appressed, up to 3 cm wide. *Lobes* cream-coloured, older parts suffused reddish, intricately interwoven, dissected, contiguous to overlapping, irregularly branched, convex, up to 1.5 mm wide, not elongate; margins sparingly blackened, developing numerous, short, nodular, marginal lobules; upper cortex smooth, glossy; lower cortex black, glossy; central cavity white, overlain with black hyphae. *Perforations* numerous, mostly median (in the middle of the lobes) on primary lobes and lobules, small and almost indistinct, up to 0.1 mm wide, slightly elevated above the thallus surface. *Vegetative propagules* absent. *Apothecia* numerous, up to 2.5 mm wide, shortly pedicellate; stalk furrowed; disc concave, reddish brown; exciple smooth, with isidia-like, corticate, papillate projections to 0.5 mm long and 0.2 mm wide. *Ascospores* (1–)2 per ascus, 65–85 × 35–50 µm; wall 4–7 µm thick. *Pycnidia* numerous; conidia bacillar, 5–7 × 0.5 µm.

*Chemistry*: Atranorin, stictic, constictic and cryptostictic acids; menegazziaic acid not detected.

**Notes:** This delicate species has isidia-like, papillate projections from the margins of the apothecia, thus giving them a stellate appearance which is unlike any other known *Menegazzia* species. It is among the smallest species of the genus, having lobes at most 1.5 mm wide and perforations 0.1 mm in diameter.

**Distribution and habitat:** This species is endemic to New Guinea. It grows on branches in mid-elevation montane forest at an altitude of 2100 m. A canopy species, it is known with certainty only from the type collection.

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