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Some new species and combinations of Brazilian lichenized fungi

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Abstract: Six species of Brazilian lichenized fungi are described as new, viz: *Parmotrema eitenii* Marcelli & Benatti, *P. fleigiae* Canêz & Marcelli, *P. pectinatum* Jungbluth & Marcelli, *Parmotrema lacteum* Marcelli & Spielmann, *Heterodermia kalbii* M. F. N. Martins & Marcelli, and *Leptogium kalbii* Marcelli & I. P. R. Cunha. In addition, the new combinations *Hypotrachyna crustacea* (Lynge) Marcelli & Jungbluth and *Parmotrema laongii* (Lynge) Marcelli & Jungbluth are proposed. Detailed descriptions and comments are provided for all species.

Key words: Taxonomy; new species; cerrado; littoral; São Paulo; Rio Grande do Sul

Introduction

For some years the Lichenology Study Group (GEL – Grupo de Estudos Liquenológicos) of Instituto de Botânica has been working on the foliose lichenized mycota of Southeast and South Brazil, and recently it has produced some Masters' dissertations, chiefly on Parmeliaceae (Benatti 2005, Canêz 2005, Spielmann 2005, Jungbluth 2006) and, more recently, on Physciaceae (Martins 2007) and Collemataceae (Cunha 2007). The geographic area encompassing these lichenological researches includes altitudes from sea level to almost 2000 m at tropical and subtropical latitudes, and a broad variation of climatic conditions, involving many Brazilian vegetation types: mangroves, restingas (Brazilian littoral sand forests), rocky shores, tropical pluvial forests, cerradoes (Brazilian savanna-like vegetation), cloud forests, *Araucaria* forests, open fields, rocky fields, and urban areas.

These researches gave us the opportunity to observe – for the first time in several taxa – the real variation related to exposure, hydric stress, competition and other natural and antropic factors. In addition, by carefully studying the development of isidia, soredia, pustulae and other thalline structures, it was possible to understand certain cases of morphological convergence of the fully developed structures responsible for the description of several synonymous taxa in the 20th century.

Of considerable interest is the fact that our results strongly suggest that several lichenologists of the 19th and early 20th centuries better understood some of the Brazilian species and their variation than most later specialists did. Apparently, those older lichenologists reached somewhat intuitively – or by their naturalistic

approach – a better comprehension of the South American and tropical species, whose evolutionary lines obviously followed adaptive ways modifying structures and morphologies in a way different to that in other taxa, as the northern and European species, for instance. Consequently, for South American taxa a character and its variation might be considered, understood and weighted from points of view different to those used for studying taxa from other regions, even within a single genus.

The present expectation is that many taxa of Vainio, Zahlbruckner and Lynge – and even some of Dodge – will be resurrected in the coming years, as fresh, well-developed material is collected, adequately studied and accurately described. Brako et al. (1985) found that 10% of the macrolichens collected in central Brazil at Pará State were new to science, and Marcelli (1998) stated that 15% of the Parmeliaceae and 20% of the Cladoniaceae found in Southeast Brazil were undescribed. The dissertations cited above found from 20 to 55% novelties (geographic and taxonomic), depending upon the region and taxonomic group involved, which agrees with the prediction by Aptroot (1997) that approximately 50% of tropical forest lichens remain still to be described. Some of the species recently recognized by GEL are presented below, and the comments under each one illustrate some of the points mentioned above.

Material and methods

Specimens were described using standard stereoscopic and light microscopic examination. Anatomical sections, especially of apothecia and pycnidia, were made with razor blades from hand. Measurements were recorded from water mounts. Spot tests were performed with potassium hydroxide (K), sodium hypochlorite (C), and para-phenylenediamine (P) for all specimens. All taxa were also examined under UV light. Thin-layer chromatography (TLC) was performed using established procedures in solvents A and C (Bungartz 2001), and lichen substances were identified by consulting Huneck & Yoshimura (1996) and Orange et al. (2001).

The Latin diagnosis refers exclusively to the holotype and the English descriptions to all of the material studied. The word *lacinia* is used exclusively for thallus branches that are longer than wide and have parallel sides. *Lacinulae* are secondary minor growths, marginally developed from laciniae, lobes or apothecia. Thalli producing laciniae are said to be *laciniate*, and a structure that develops lacinulae is referred to as *lacinulate*. Regarding the morphology of *Leptogium*, the term *stria* (and *striate*) describes minute groves present on some species, visible only at × 10 magnification, which give the surface the appearance of having been scratched by a thin-toothed comb, and the new term *corona* is introduced for the permanent or age-depending, continuous or interrupted, grayish-blue line present at the edge of the apothecial margin of certain species due to an agglomeration of cyanobacteria near to the apex of the thalline exciple.

Direct reproduction structures in the sense of Marcelli (2006) are any propagules formed from both fungi and photobionts which directly develop into a new thallus (soredia, isidia, phyllidia, etc.), in opposition to *indirect reproduction*, made by means of a fungal structure alone (related or not to the sexual fungal reproduction) that needs to encounter a photobiont to reconstitute a lichen thallus.

The species

Hypotrachyna crustacea (Lynge) Marcelli & Jungbluth, comb. nova

Parmelia crustacea Lynge, Ark. Bot. 13(13): 108 (1914) – Type: Brazil. Mato Grosso State, Santa Anna da Chapada [called Chapada dos Guimarães since 1953, a municipality about 15° 27′ S 55° 45′ W, *c.*810 m a.s.l.], 'in margine silvae, ad corticem', 21. ii. 1894, Malme s.n. [S–lectotype].

Thallus white, laciniate, adnate, 4.0–4.5 cm broad; *laciniae* irregularly to dichotomously branched, from contiguous to laterally overlapping, 0.3–1.0 mm wide, apices truncate to subtruncate; *margin* smooth to crenate; *upper surface* reticulate, rugose; *lacinulae*, *maculae* and *cilia* absent. *Dactyli* laminal, concolorous with upper surface, simple, 0.1–0.7 × 0.2–0.6 mm, erect to procumbent, firm, the apices commonly pycnidiate; *pustulae*, *soredia* and *isidia* absent. *Medulla* partially bicolored, the upper part white and the lower brownish ochre (K + dark red). *Lower surface* black, sublustrous, rugose; *margin* dark brown, very narrow, sublustrous, attenuate, rugose, rhizinate to the edge; *rhizinae* black, dichotomously branched, 0.7–3.0 mm long, abundant, uniformly distributed.

Apothecia concave, 0.7–2.0 mm diam., sessile, laminal; *margin* crenate; *amphithecium* rugose; *disc* brown, imperforate. *Epithecium* 5 µm high; *hymenium* 50 µm high; *subhymenium* 50 µm high; *ascospores* spherical to ellipsoid, 8–11 × 6–8 µm, epispore 1.0 µm thick. *Pycnidia* chiefly on apices of dactyli, ostiole black; *conidia* bifusiform, 5–6 × *c.*1.0 µm.

Color reactions: Upper cortex K −, UV + golden yellow; white medulla K + brownish yellow (amber), C −, KC −, P + faint yellow, UV −.

Chemistry: Lichexanthone (upper cortex); protocetraric acid, unidentified substances and an unknown anthraquinone (medulla).

Remarks: *H. crustacea* is recognized by the apically pycnidiate dactyli, the brownish ochre lower part of the medulla and the UV + strong golden yellow upper cortex (lichexanthone) besides the presence of protocetraric acid and other substances of the *conformatum* complex (white medulla K + brownish yellow, P + faint yellow). Occasionally, the dactyli may have their apices eroded.

Hale (1975) placed this species under *H. silvatica* (Lynge) Hale, which grows at the same habitats in São Paulo State (Jungbluth 2006). The protologue of *Parmelia silvatica* (Lynge 1914) describes non-eroded crests or small rugae, and pycnidia located on the secondary laciniae, while that of *H. crustacea* states the presence of much greater, apically pycnidiate, eroded crests (dactyli) ('*verrucae fere semper conceptaculis pycnoconidiorum instructae*'). It is probable that Hale, based on the scanty material available to him, believed that the differences in pycnidia distribution and dactyli were just fortuitous. However, the new material from São Paulo State cerrado forest brings to light another case that demonstrates Lynge's good understanding of the Brazilian Parmeliaceae.

H. croceopustulata (Kurok.) Hale also has an ochraceous lower medulla, but produces structures resembling dactyli or pustulae that become apically opened and shed soredia. Moreover, its cortex produces atranorin instead of lichexanthone.

Ecology and distribution: In São Paulo State, *H. crustacea* is part of a small and not abundant group of *Hypotrachyna* species that grow on tree trunks inside well-preserved cerrado forests.

Specimens examined: **Brazil.** São Paulo State, Mogi-Guaçu Municipality, Biological Reserve of Mogi-Guaçu, Fazenda Campininha, 'cerrado denso' to 'cerradão' forest, along the trail between SPNP-1 (Non Perturbing Research Area) and SE (Teaching Sector) parcels, on tree trunk, 22° 22′ S 46° 56′ W, 590 m a.s.l, 3. iv. 1999, M. P. Marcelli & M. Falco no. 33207, 33248 [SP].

Parmotrema eitenii Marcelli & Benatti, sp. nova

Species nova cum thallo *Parmotremae tinctori* (Nyl.) Hale similis sed marginibus et pro parte rugis loborum solum sorediosis differt.

Type: Brazil. São Paulo State, Praia Grande Municipality, Bairro Cidade Ocean, urbane area, old trees along General Mallet Avenue near Itaipu Fortress, on tree trunk, 07° 06′ 30″ S 37° 36′ 35″ E, 1 m a.s.l, M. P. Marcelli & O. Yano no. 14345, 27. ix. 1992 [SP–holotype].

Etymology: This species is named in honor of Prof. Dr. George Eiten, who worked for many years at the Instituto de Botânica, in São Paulo city (presently professor at Universidade de Brasília), an eminent Brazilian Botanist and collector, whose excellent field data and lichen collections make a great contribution to the knowledge of Brazilian lichen (Marcelli 1998).

(Fig. 1)

Thallus up to 17 cm in width, subcoriaceous, corticolous, grayish green becoming dusky green in the herbarium, lobed to sublobed, attached to loosely attached; *lobes* 3.0–14.5 mm wide, irregularly branched, laterally overlapping, sometimes somewhat crowded at the center, weakly adnate to ascending, sometimes becoming folded and subcanaliculate, the apices concave to subconcave or less frequently subplane, rounded; *margin* smooth to subcrenate, slightly ascending and involute, at sorediate lobes sometimes very sinuous, subundulate to undulate, entire, eciliate; *lacinulae* absent, sometimes small adventitious lobules may grow from older parts, simple, plain to subconcave, 1.0–3.5 × 1.0–3.0 mm, rounded, underside concolorous with the lower margin; *upper surface* continuous, with a few cracks usually restricted to the older parts of the thallus, smooth to rugose; *maculae* absent to few, weak, linear, laminal; *cilia* absent. *Medulla* white, pigments absent. *Soralia* marginal, linear-interrupted to irregular; less frequently the soredia are formed on thallus ridges, spreading a little, and gradually coalescing into agglutinated structures of granular, pustular or isidioid aspect, which may become corticate; *pustulae* and true *isidia* absent. *Lower surface* black, shiny, smooth or subrugose, erhizinate at the margins and some central parts; *margin* shiny, brown to light brown, smooth to rugose, 3.0–11.0 mm wide, naked; *rhizinae* black, usually simple to rarely furcate or irregular, 0.20–0.70(–1.40) × 0.05–0.10 mm, few to frequent, grouped.

Apothecia and *pycnidia* not found.

Color reactions: Upper cortex K + yellow, UV −; medulla K −, C + red, KC + red, P −.

Chemistry: Atranorin (cortex, major) and lecanoric acid (medulla, major).

Remarks: *P. eitenii* is described here as being distinct from the sorediate forms of *P. tinctorum* (Nyl.) Hale. Since several authors (e.g. Hale 1965, Swinscow & Krog 1988, Brodo et al. 2001) mention the large variability of the vegetative propagules

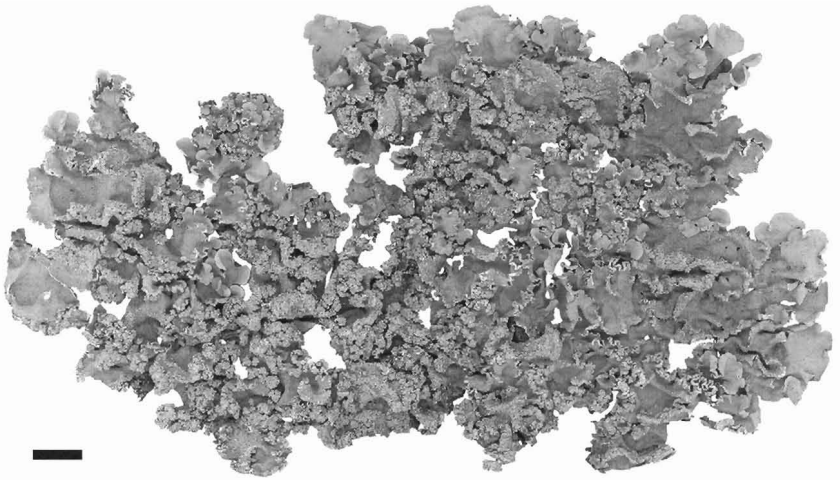

Fig. 1 Holotype of *Parmotrema eitenii*; scale bar = 1 cm.

of *P. tinctorum*, ranging from cylindrical isidia to the less common occurrence of soredia, *P. eitenii* might have frequently been mistaken for *P. tinctorum* by some collectors. When studying the material from São Paulo State previously called *P. tinctorum*, it became evident that this new taxon, abundant at state littoral, produced vegetative propagules that were structurally and ontogenetically very distinctive and easily recognizable even in the field. Furthermore, specimens of *P. tinctorum* have a more grayish thallus, larger rounded lobes and produce true cylindrical isidia that are virtually restricted to the proximal portions of the thallus, leaving uncovered the apices and distal portions of the lobes.

P. eitenii never produces isidia, but mainly marginal true soralia composed of granular soredia, which may develop into compact corticate agglutinations having a coarse, pustular or isidioid aspect. Secondarily, the soredia may develop on the lamina, but only on the crests of thalline folds and the very near surroundings.

P. austrosinense (Zahlbr.) Hale is the only other eciliate, marginally sorediate and lecanoric acid-producing species of *Parmotrema*; however, it has a more membranaceous thallus, thinner continuous linear soralia developed on very sinuous ascendant margins and producing farinose soredia that never become granular, agglutinated or corticate.

Although most sorediate species of *Parmotrema* have a differentiated very pale colored lower margin just below the soralia, usually white, cream or variegated, this does not occur in *P. eitenii*, whose lower margins are always entirely brown.

Ecology and distribution: This species is still recorded only from trees and palm trunks of coastal localities at São Paulo State, commonly facing the ocean, though it is believed to occur in a much broader area at least all over Southeast Brazil.

Additional specimens examined: Brazil. São Paulo State, Itanhaém Municipality, Bairro Santa Cruz, near Itanhaém and Peruíbe municipalities limit, low restinga forest *c.*500 m from the beach, vacant lots in allotment, 2 m a.s.l., on small tree trunk, 14. i. 2004, M. N. Benatti, I. P. R. Cunha,

M. P. Marcelli & P. Jungbluth no. 1729 [SP]. Praia Grande Municipality, Bairro Boqueirão, 2 m a.s.l., trees along General Mallet Avenue, near Itaipu Fortress, on tree trunk, 27. ix. 1992, M. P. Marcelli & O. Yano no. 14354, 14374 [SP]; idem, near the highway at the city entrance, restinga forest beside a natural stream, 3 m a.s.l., over tree trunk, 20. v. 1994, M. P. Marcelli no. 27196 [SP]. São Sebastião Municipality, Marine Biology Research Center CEBIMAR, on trunk of an isolated tree behind the boat's house *c.*30 m from the beach, 1 m a.s.l, 18. iii. 1988, M. P. Marcelli no. 2177 [SP]; idem, group of coconut palms 10 m from the beach, 1 m a.s.l., on coconut palm, 18. iii. 1988, M. P. Marcelli no. 2188 [SP].

Parmotrema fleigiae Canêz & Marcelli, sp. nova

Species nova *Parmotremae margaritati* (Hue) Hale similis sed thallo sorediis destituto at pustulas praesente differt.

TYPE: BRAZIL. Rio Grande do Sul State, Municipality of Vacaria, Fazenda da Estrela, open field, 28° 02′ 44.6″ S 51° 02′ 01.7″ W, 860 m a.s.l., on basaltic rock at left margin of Frade's River, shaded by a shrub, 11. i. 2004, L. S. Canêz & A. A. Spielmann no. 718a [SP–holotype; B–isotype].

Etymology: The epithet *fleigiae* is given to honor Prof. Dr. Mariana Fleig, recently retired from the Universidade Federal do Rio Grande do Sul, who passionately dedicated a greater part of her life to the study of lichens and who made significant contributions to Brazilian lichenology (MARCELLI 1998).

(Fig. 2)

Thallus whitish gray, lobate, 11 cm in width; *lobes* irregularly branched, 1.0–6.0 mm wide, adnate, contiguous to laterally overlapping, crowded in the center, the apices rounded, often pruinose; *margin* slightly undulate to crenate, slightly elevated, black marginal line very conspicuous; *surface* continuous to irregularly cracked, smooth; *lacinulae* and *maculae* absent; *cilia* black, simple, rarely furcate, slightly contorted, frequently turned down almost perpendicular to the margin, 0.25–1.00 × 0.05–0.08 mm, abundant to frequent, more frequent at the axils, but often also present all along the margin. *Pustuloid structures* submarginal or subapical, rounded, formed from thalline bulges that become solid swellings (i.e. not pustulae), which may develop into capitate to cerebroid structures in older parts of the thallus, often with a cracked to eroded cortex that sheds tiny plates (exposing the medulla or the upper side of the lower cortex) but never form soredia; *soralia* and *isidia* absent. *Medulla* white, pigment absent. *Lower surface* black, slightly shiny, rugose; *margin* reddish-brown or brown, shiny, naked, 0.6–2.0 mm wide, sharply delimited, smooth; *rhizinae* black, simple, rarely furcate, 0.20–1.00 × 0.05–0.08 mm, abundant, evenly distributed.

Apothecia and *pycnidia* absent.

Color reactions: Upper cortex K + yellow, UV −; medulla K + yellow → red, C −, KC −, P + orange.

Chemistry: Atranorin (cortical), salazinic and consalazinic acids (medulla).

Remarks: *P. fleigiae* is easily recognized by the pustuloid swellings developed at the proximal regions of the thallus, which never form soredia but may shed very small schizidia-like plates that may include all the medulla and thus expose the black lower cortex. The lobe margins with a very evident black line and the turned

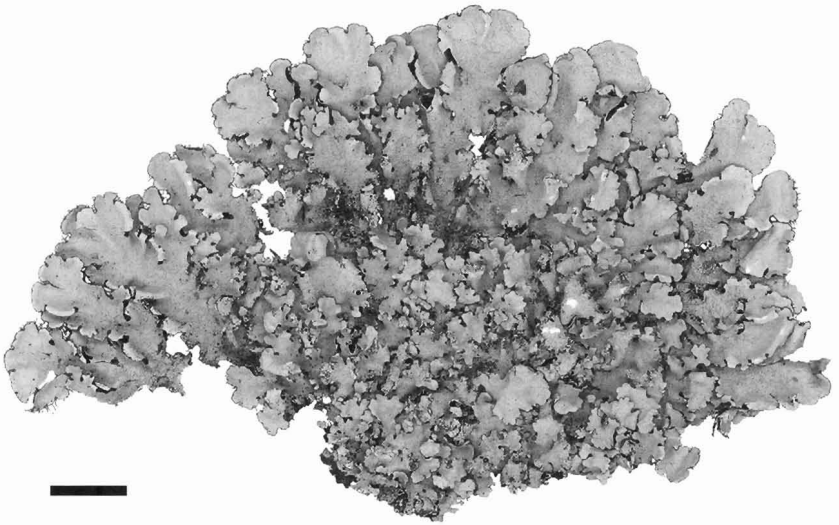

Fig. 2 Holotype of *Parmotrema fleigiae*; scale bar = 1 cm.

down cilia are characteristic. Its habitus is reminiscent of *P. margaritatum* (Hue) Hale, which has subapical soredia on the laciniae, an elevated margin and more or less erect cilia (Hale 1965).

P. ruptum (Lynge) Hale ex DePriest & Hale has a similar habit and chemistry, but does not produce any laminal structures and has a maculate upper surface (Lynge 1914).

Ecology and distribution: This species is known only from the type locality.

Additional specimens examined: Brazil. Rio Grande do Sul State, Vacaria Municipality, Fazenda da Estrela, open field, 28° 02′ 44.6″ S 51° 02′ 01.7″ W, 860 m a.s.l., on basaltic rock at the left margin of Frade's River, shaded by a shrub, 11. i. 2004, L. S. Canêz & A. A. Spielmann no. 677, 693, 718b [SP].

Parmotrema lacteum Marcelli & Spielmann, sp. nova

Species nova *Parmotremae subisidiosi* (Müll. Arg.) Hale similis sed thallo colore lacteo, cilia subsquarrosa et soredia isidiosa presente differt.

Type: Brazil. Rio Grande do Sul State, Boqueirão do Leão Municipality, Cascata do Gamelão, saxicolous on the rocky wall downstream from the cascades, inside the forest (shady), 29° 18′ 13.7″ S 52° 26′ 51.7″ E, 500 m a.s.l., 1. ii. 2004, A. A. Spielmann & M. A. Sulzbacher no. 1307 [SP–holotype].

Etymology: The epithet *lacteum* refers to the milk-white thallus color.

(Fig. 3)

Thallus saxicolous, milky pale gray, lobate, membranaceous, loosely adnate, 7.5–11.5 cm broad; *lobes* irregularly branched, laterally overlapping, 2.5–7.0 mm wide, plane to concave, with extended median axis and rounded apices; *margin* subundulate, often ascending, crenate to sublacinulate; lateral margin plane to ascending, lacinulate; *distal surface* smooth to slightly scrobiculate, opaque, reticulate-maculate,

becoming cracked in the center; *lacinulae* marginal, simple, furcate or irregularly branched, 0.2–2.5 × 0.2–2.0 mm, plane to canaliculate, with a rounded or acute apex, present over the entire thallus; *maculae* distinct, reticulate, laminal, developing into cracks; *cilia* black, simple to commonly subsquarrose, 0.20–2.00 × 0.02–0.05 mm, frequent, evenly distributed. *Pustulae* absent; *soredia* granular, produced mostly from subapical bulges of the lacinulae; true *isidia* absent; however, the soredia may pile up forming structures (isidioid soredia) which are ecorticate, terete, not ramified, with brown ciliate apex, 0.10–0.50 × 0.02–0.10 mm (including the cilia), often marginal, sometimes submarginal and reaching the lamina, rarely laminal, generally forming capitate sorediose clusters on the lacinulae. *Medulla* mostly white, but with an orange, K − pigment at the isidia clusters; K + purplish pigment absent. *Lower surface* black, shiny, smooth to slightly rugose; *margin* dark brown or sometimes beige, 1–2 mm wide, shiny, nude, rhizinate or papillate-rhizinate, with attenuate borders, smooth to slightly rugose; *rhizinae* black, simple to squarrose or irregularly branched, 0.10–3.00 × 0.02–0.05 mm, abundant, evenly distributed.

Apothecia and *pycnidia* unknown.

Color reactions: Upper cortex K −, UV −; medulla K + yellow → blood red, C −, KC −, P + yellow, UV −.

Chemistry: Atranorin (cortex), salazinic acid and consalazinic acid, unknown pigment (medulla).

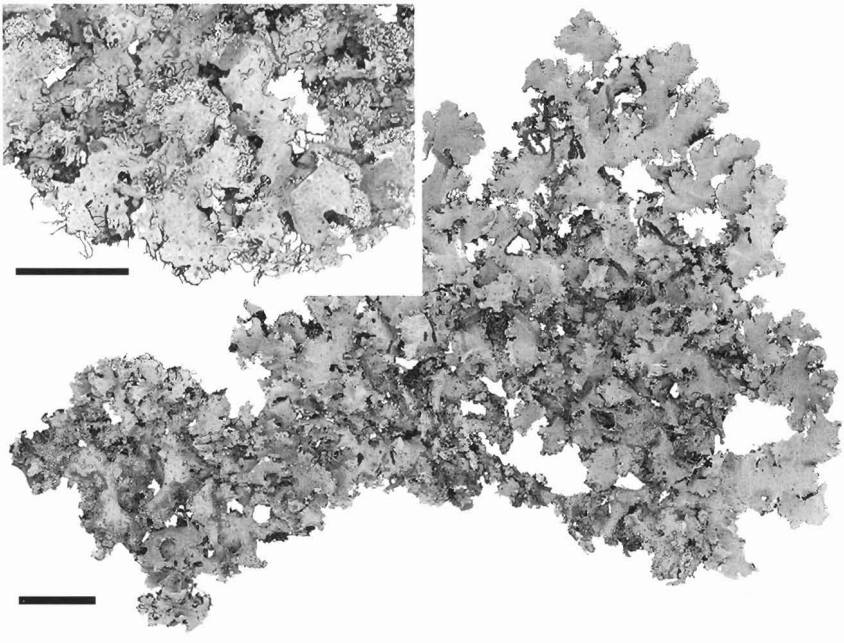

Fig. 3 Holotype of *Parmotrema lacteum*; scale bar = 1 cm.

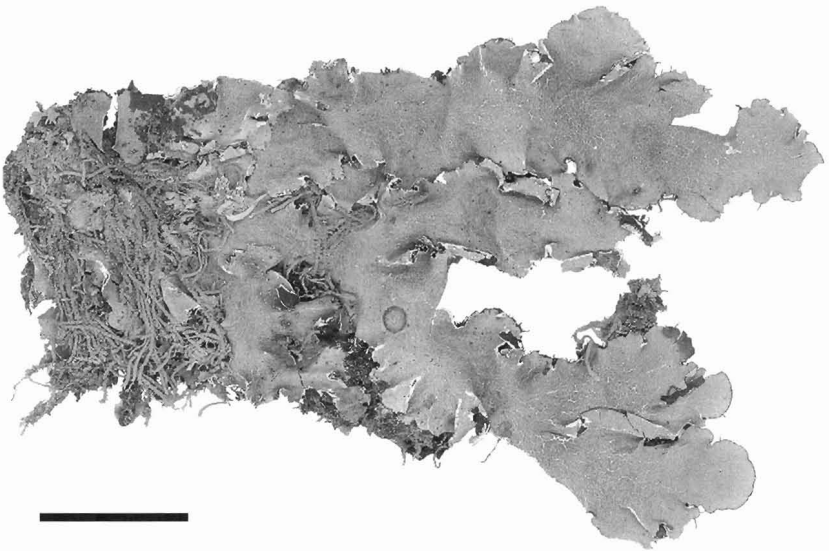

Fig. 4 Holotype of *Parmotrema subisidiosum* (Müll. Arg.) Hale [G]; scale bar = 1 cm.

Remarks: *P. lacteum* is recognized by the milk-white thallus coloration, the commonly subsquarrose cilia, the capitate sorediose clusters originating isidioid soredia, the orange pigment in the apices of the lacinulae, and the presence of salazinic and consalazinic acids.

Until recently, all the related species were treated under the genus *Rimelia* Hale & A. Fletcher that was proposed to be a synonym of *Parmotrema* A. Massal. by Blanco et al. (2005). Within this group of species with a sublaciniate and white reticulate maculate thallus, this is the third species producing isidioid structures.

P. subisidiosum (Müll. Arg.) Hale (G, holotype!) is distinguished by the shorter, simple cilia, and the formation of true marginal to laminal, simple to coralloid isidia, 0.1–0.2 × 0.05–0.15 mm, that remain entire or can form granules, but not soredia (fig. 4). *P. bonplandii* (Mata) O. Blanco, A. Crespo, Divakar, Elix & Lumbsch, produces norlobaridone and lichexanthone in the medulla (Mata García 1994). Finally, *P. clavuliferum* (Räsänen) Streimann (H, lectotype!), is somewhat similar in forming soredia on the lacinulae, but never produces isidioid structures.

Ecology and distribution: This species is known only from the type locality, where it grows on a high, steep, rocky slope near a small river in a shaded place inside a wood.

Additional specimens examined: **Brazil.** Rio Grande do Sul State, Boqueirão do Leão Municipality, Cascata do Gamelão, saxicolous on the rocky wall downstream from the cascades, inside the forest (shady), 29° 18′ 13.7″ S 52° 26′ 51.7″ E, 500 m a.s.l., 1. ii. 2004, A. A. Spielmann & M. A. Sulzbacher no. 748, 751 [SP].

***Parmotrema laongii* (Lynge) Marcelli & Jungbluth, comb. nova**

Parmelia laongii Lynge, Ark. Bot. 13 (13): 68 (1914) – Type: Brazil. Mato Grosso State, Santa Anna da Chapada [called Chapada dos Guimarães since 1953, a municipality about 15° 27′ S 55° 45′ W, *c.*810 m a.s.l.], 'in margine silvae, ad corticem', 21. ii. 1894, Malme no. 2392 [S–holotype].

(Fig. 5)

Thallus dark gray, lobate, loosely adnate, 3–8 cm broad; *lobes* irregularly branched, laterally overlapping to crowded, 6.0–10.0 mm wide, at the lobe base up to 6.0–11.0 mm maximum width, elevated to revolute, apices rounded; *margin* crenate; *upper surface* continuous, smooth to rugose; *lacinulae* and *maculae* absent; *cilia* black, simple to rarely furcate, 0.2–1.0 mm long, the longest in the crenate axils, abundant along the margin, K + purple pigment present. *Pustulae*, *soredia* and *isidia* absent. *Medulla* white, K + purple pigment present. *Lower surface* dark-brown to yellowish or golden-brown, slightly shiny, rugose and veined, erhizinate border 5.5–15.0 mm wide; *margin* golden-yellow or brownish-yellow, shiny, 4.0–10.0 mm wide, attenuate, rugose and veined; *rhizinae* black, simple, 0.2–0.5 mm long, scarce, in groups.

Apothecia cup-shaped, 0.2–0.8 mm in diam., stipitate to inflated-stipitate, laminal to submarginal; *margin* initially smooth, becoming dentate and short ciliate; *amphithecium* smooth to rugose; *disc* brown, imperforate. *Epithecium* 5–10 µm high; *hymenium* 40–45 µm high; *subhymenium* 30 µm high; *ascospores* ellipsoid, 15–17 × 7–8 µm, episporium 1.5 µm thick. *Pycnidia* submarginal and subapical, with black ostiole; *conidia* filiform, 6–10 × *c.*1 µm.

Color reactions: Upper cortex K + yellow, UV −; medulla K −, C −, KC + milky orange, P −, UV + pool-green.

Chemistry: Atranorin (cortex), alectoronic acid and two other unidentified substances (Rfs. 3 and 32 in solvent C, the last probably the K + purple substance present in the cilia) in the medulla.

Remarks: This species is characterized by the yellowish-brown to golden-yellow lower surface, with a darker brownish color restricted to the very central portions, as previously noted by Lynge (1914: '*subtus ad ambitum croceus vel aurantiaco-croceus*'). Given the UV + whitish green (pool green) medulla, the K + purple cilia, the ellipsoid ascospores, 15–17 × 7–8 µm, and the 6–10 µm long filiform conidia, it is a very distinctive species.

Hale (1965) synonymized *Parmelia laongii* and *P. subproboscidea* Lynge under *Parmelia* [*Parmotrema*] *argentina* Kremp., as did Fleig (1997). However, *P. argentinum* (Kremp.) Hale has a lower surface with a broad white border, K − cilia and somewhat larger ascospores, 19–24 × 10–14 µm (Hale 1965, Canêz 2005). Hale (1965) considered the K + purple ciliar pigment to be of no taxonomic value and the variation of the spore size too small to be significant. In addition, it is possible that he ignored the very characteristic golden-yellow coloration of the lower surface by attributing it to ageing of the herbarium material. However, fresh material collected in the northwest of São Paulo State, just some hundreds of kilometers distant from the type locality in the Mato Grosso State, had the precise golden tinge described by Lynge (1914).

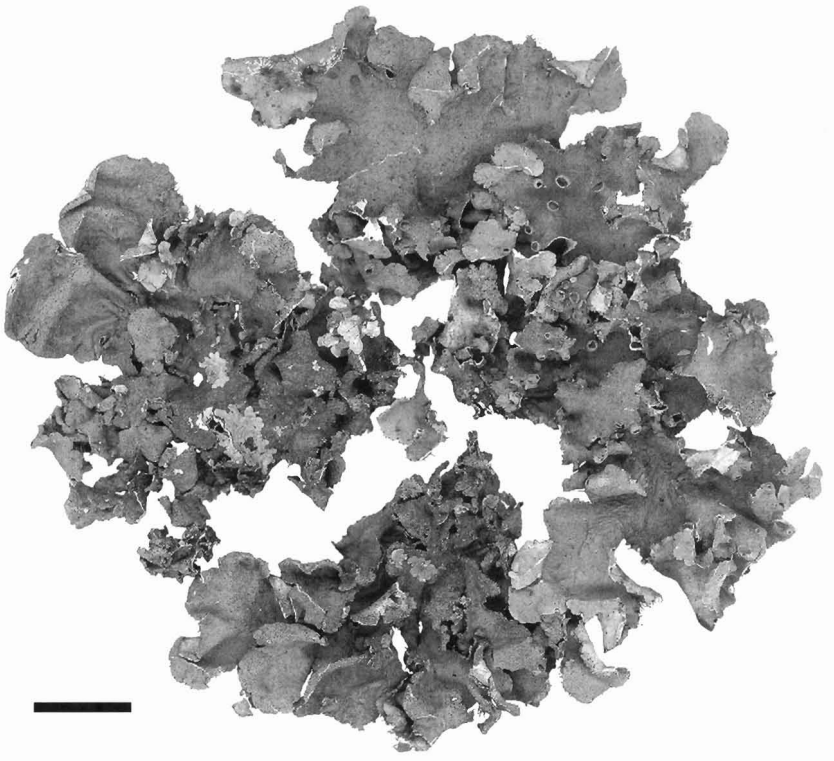

Fig. 5 *Parmotrema laongii*, Peralta no. 2326A; scale bar = 1 cm.

The first report of cilia reacting K + purple was made by LYNGE (1914) for *Parmelia laongii*. Since HALE's (1965) monograph, it has been common practice to consider this reaction of the cilia to be of no taxonomic value. In fact, it is quite common to find both K + and K − cilia in specimens of several species of *Parmotrema*. However, given that Hale's species concept was too broad (many species have been resurrected from his synonyms over the years), and the experience we have with Brazilian material, there are strong indications that the importance of such reactions of the cilia should be carefully reconsidered.

Ecology and distribution: This species is known from cerrado vegetation of central Brazil, in Mato Grosso (LYNGE 1914) and São Paulo states (JUNGBLUTH 2006).

Specimens examined: **Brazil.** São Paulo State, São José do Rio Preto Municipality, Fazenda São José, 20° 49′ S 49° 22′ W, 489 a.s.l., on palm trunk, 9. iv. 2004, D. F. Peralta no. 2326A [SP]; idem, São Paulo State University, São José do Rio Preto campus, on palm trunk, 9. iv. 2004, D. F. Peralta no. 2349 [SP].

Parmotrema pectinatum Jungbluth & Marcelli, sp. nova

Parmotremae nylanderi (Lynge) Hale affinis sed margine thallorum minute lacinulate differt.

Type: Brazil. São Paulo State, Itirapina Municipality, SP-225 Road, km 111, on a large rock of red arenite emergent above the cerrado forest canopy, in direct sunlight, 22° 15′ S 47° 49′ W, 770 m a.s.l., M. P. Marcelli, 16. vi. 1979, K. Kalb & A. E. Luchi no. 16077 [SP–holotype].

Etymology: The epithet *pectinatum* refers to the comb like aspect of the marginal lacinulae.

(Fig. 6)

Thallus yellowish green, sublobate to laciniate, adnate, 6–7 cm broad; *laciniae* irregularly to dichotomously branched, contiguous to slightly overlapping laterally, (0.5–)0.8–2.0(–3.0) mm wide at lobe base, (0.5–)0.8–3.0(–4.0) mm at maximum width, apices subrotund to subtruncate; *margin* sinuous to dentate (lacinulae primordia); *upper surface* continuous, smooth to slightly rugose in older parts; *lacinulae* marginal, simple to irregularly or dichotomously branched, mostly present at the center of the thallus, plane, apices truncate, 0.6–1.0 × 0.3–0.6 mm; *maculae* absent; *cilia* black, simple, 0.2–1.0(–2.0) mm long, abundant, more aggregated in axils. *Pustulae* absent; *soralia* concolorous with the upper cortex, subapical, rarely marginal, developed chiefly on the lacinulae, beginning as small orbicular protuberances that very early become sorediate; when subapically developed at the laciniae they may extend backwards, become confluent, and turn the apices involute; *soredia* granular; *isidia* absent. *Medulla* white, K + purple pigment absent. *Lower surface* black, shiny, smooth to rugulose, erhizinate border 0.3–3.0 mm wide; *margin* brown, shiny, 0.1–2.0 mm wide, sharply delimited, smooth to sparsely papillate; *rhizinae* black, simple or rarely irregularly branched, 0.2–1.0 mm long, frequent, uniformly distributed.

Apothecia absent. *Pycnidia* subapical on lacinulae, ostiole black; *conidia* absent.

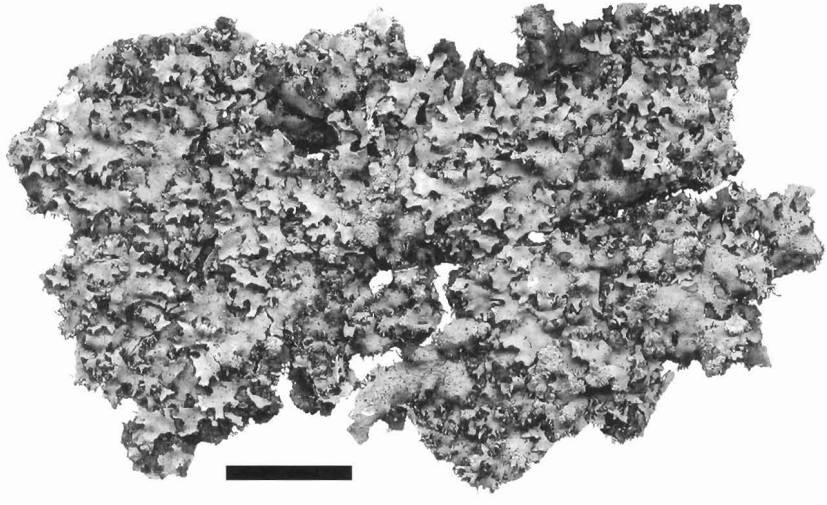

Fig. 6 Part of the holotype of *Parmotrema pectinatum*; scale bar = 1 cm.

Color reactions: Upper cortex K −, UV −; medulla K + yellow → red, C + orange rose, KC + orange rose, P + yellow, UV −.

Chemistry: Usnic acid (cortex), salazinic, consalazinic, and gyrophoric acids (medulla).

Remarks: *P. pectinatum* can be recognized by the sublaciniate, yellowish, saxicolous thallus producing soredia mainly on small plane marginal lacinulae, and the color reactions of the medulla corresponding to the presence of salazinic, consalazinic, and gyrophoric acids.

Despite some similarity, *P. nylanderi* (Lynge) Hale, sampled at the same site, has larger and more rounded lobes and produces marginal soredia that are evidently pustular in origin, and which can spread to the lobe surface. However, Lynge (1914) mentioned the presence of lacinulae (*lobuli*) in *P. nylanderi* in his description for the lobes margins ('*...anguste neque profunde sinuato-incisi*') and the photograph of the holotype indicates a lacerate or irregularly short lacinulate margin, very different of the true and abundant lacinulae of *P. pectinatum*.

Several species with a medullar chemistry similar to *P. pectinatum* occur in Southern Brazil: *P. mirandum* (Hale) Hale with larger lobes and shorter cilia (Hale 1965), *P. flavescens* (Kremp.) Hale with isidia, and *P. delicatulum* (Vain.) Hale, which does not produce any structures of direct reproduction.

The group of yellowish green *Parmotrema* species with cortical usnic acid is more diversified in Central and South America than elsewhere. Outside the Americas, only *P. xanthinum* (Müll. Arg.) Hale, an isidiate species, has been commonly reported; however, this name may have been misapplied for some African and Asian species. Indeed, according to our experience, even records from Brazil are doubtful.

Ecology and distribution: This species should have the same saxicolous habit as *P. nylanderi*, with which it grows intermixed at the type locality.

Additional specimens examined: Brazil. São Paulo State, Itirapina Municipality, SP-225 Road, km 111, on a big rock of red arenite emergent above the cerrado forest canopy, direct sunlight, 22° 15′ S 47° 49′ W, 770 m a.s.l., 16. vi. 1979, M. P. Marcelli, K. Kalb & A. E. Luchi no. 16075, 16079 [SP].

Heterodermia kalbii M. F. N. Martins & Marcelli, sp. nova

Species nova *Heterodermiae magellanicae* (Zahlbr.) Swinscow & Krog similis, sed rhizinis abundantissimis et ramosissimis, ascosporis majoribus et marginis apotheciorum lacinulis indivisis instructis differt.

Type: Brazil. São Paulo State, Campos do Jordão Municipality, 22° 43′ S 45° 31′ W, Campos do Jordão State Park, cloud forest along the road, on tree trunk, 1820 m a.s.l., 22. xi. 1994, M. P. Marcelli & A. E. Luchi no. 27341 [SP–holotype].

Etymology: The epithet *kalbii* is given in honour of Prof. Klaus Kalb, who, by supporting and advising the initial studies of M. P. Marcelli in several ways, bears the ultimate responsibility for the existence of the lichenological group study in São Paulo State.

(Fig. 7)

Thallus whitish gray, laciniate, adnate, up to 9.5 cm in width, 150–175 µm thick, upper cortex 35–70 µm thick, algal layer continuous, 10–30 µm thick, medulla 75–

100 µm thick, lower cortex lacking, the terminal portion of distal laciniae weakly ascending; *laciniae* with a sympodial primary axis and dichotomous ramifications, laterally to irregularly overlapping, 0.5–1.5(–2.2) × 0.7–1.6 mm, the distal branches appearing as layers separated by a thick matt of black rhizinae, axils mostly oval, apices mostly rounded to frequently truncate, margin smooth; *proximal* and *distal surfaces* plane to slightly concave or convex, from smooth to slightly undulate. *Lacinulae*, *maculae*, *cilia*, *phyllidia*, *isidia*, and *soredia* absent. *Medulla* white. *Lower surface* ecorticate, opaque, cortical border present; *proximal region* partially covered by rhizinae, compact, sordid white to brown; *distal region* subarachnoid to subcompact, white; *rhizinae* long 1.0–5.0 × *c.*0.1 mm, entirely black to black with a concolored base, simple when young, soon becoming narrow-squarrose and very regular in shape, extremely abundant, often with interwoven fibrils, forming a dense matt along the margins of the laciniae, projecting outwards and separating the thallus branches.

Apothecia cupulate, 0.5–4.0 mm diam., substipitate, laminal to submarginal; *margin* lacinulate, lacinulae ascending, in part involute when dry, apices rounded to truncate, 0.3–1.5 × 0.7–1.2 mm; *amphithecium* smooth to undulate; *disc* concave, epruinose, brown, slightly involute. *Epithecium* 10–15 µm high; *hymenium* 85–100 µm high; *subhymenium* 50–60 µm high, brown to concolorous with the epithecium; *ascospores* ellipsoid, (35–)36–39 × 16–19 µm, episporium *c.*1.0 µm, sporoblastidia 2 to 5, simple to ramificated. *Pycnidia* laminal, ostioles brown; conidia colorless, bacilliform, 2.5–4.0 × *c.*1.0 µm.

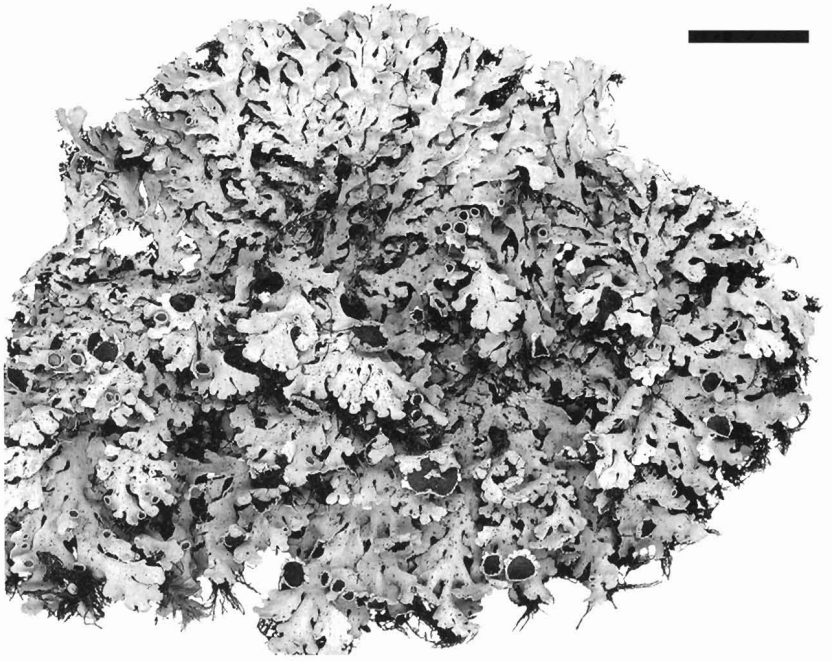

Fig. 7 Holotype of *Heterodermia kalbii*; scale bar = 1cm.

Color reactions: Medulla K + yellow, P–, UV –; lower surface UV – throughout.

Chemistry: Atranorin (cortex), zeorin and leucotylin (medulla).

Remarks: The laciniae of *H. kalbii* are characteristically ornate with long, very regular, narrow-squarrose and interwoven rhizinae that constitute a thick matt acting as a horizontal separator for the several layers of peripheral branches, and extending outwards the laciniae edges. Therefore, the distal parts of the thallus assume a lamellar aspect with superposed layers of rhizinae and branches.

Heterodermia kalbii is part of a species group (in preparation for publication elsewhere) whose specimens have been identified as *H. magellanica* (Zahlbr.) Swinscow & Krog throughout the tropics (e.g. Swinscow & Krog 1976), irrespective of differences in ascospore size, morphological details and chemical constitution.

The most closely related species is *H. magellanica*, described from the extreme south of the American continent (southern of Magellan Strait), which has the same chemistry but produces smaller ascospores and has the apothecial laciniae dorsiventrally split in two lamellae, which, in time, develops into a peculiar double whirl (Zahlbruckner 1917, Martins 2007). In *H. translucens* (Kurok.) D. Hawksw. (Kurokawa 1973) from New Guinea, the abundantly ramified matt-forming rhizinae are pale to translucent and the laciniae narrower (0.5–1.2 mm).

Leptogium kalbii Marcelli & I. P. R. Cunha, sp. nova

Thallus lobatus, 105–135 µm crassus, ambitu rotundatus, lobis planis, 2.0–5.5 mm latis, superne evidenter rugosus et striatus; isidiis destitutus; granulis subsphaericis vel peltatis, pro parte lobuliformis et convexissimis ad lamina dispositis. Apothecia margine thalli crebre disposita, subestipitata, c.1.2 mm diam.; ascosporae ellipsoideae, submurales vel murales, apices acutae, 26.5–32.5 (–34.0) × 11.0–12.5(–14.0) µm, 3–5 × 1–2 septatae. Paraplectenchyma subhymenialis nulla. Cortex apotheciorum 25–40 µm (5–8 cel.) crassus ad basis, 20–30 µm (3–5 cel.) ad lateris et 15 µm (2–3 cel.) ad apice.

Type: Brazil. São Paulo State, Peruíbe Municipality, left margin of Guaraú River, on tree trunk inside a shady but clear and humid restinga forest, 2 m a.s.l., 18. iv. 1995, M. P. Marcelli & C. H. Ribeiro no. 28458 [SP–holotype].

Etymology: The epithet honors Prof. Klaus Kalb, an exemplary teacher who has worked on Brazilian lichens for over 30 years, producing important contributions in tropical lichenology, and who sowed the seeds of modern lichenology in São Paulo State.

(Fig. 8)

Thallus corticolous, adnate, from greenish to brownish gray, 3.0–9.5 cm wide, lobate, 105–135 µm thick; *lobes* plane, 2.0–5.5 mm wide, mostly laterally overlapping, apices rounded; *margin* mostly smooth, sometimes with granules, sometimes slightly ascending; *upper surface* rugose and striate (not plicate), commonly weakly bullate in the distal portions; *rugae* irregular. *Isidia* absent; however, commonly subspherical laminal structures (called here '*granules*'), 0.10–0.25 mm diam., concolorous with the thallus, develop from the rugae; in some thalli the granules are rare, but in others they are densely crowded and cover significant portions of the thallus; in some cases, the granules can develop successively from older ones to form vertical structures *c.*0.40 mm high, appearing as elongated, irregular-oboval vesicles with a wilted aspect; in other cases, the granules may

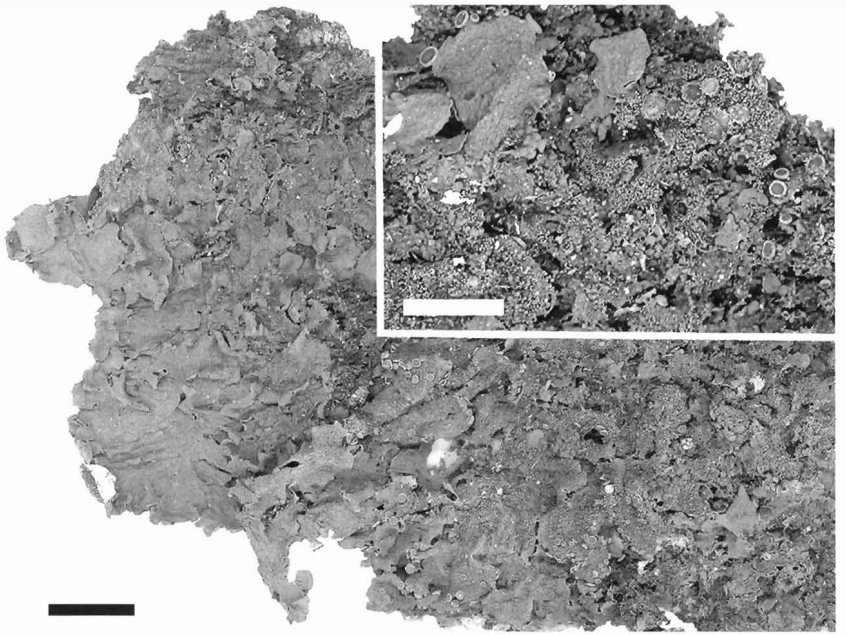

Fig. 8 Holotype of *Leptogium kalbii*; scale bars: black = 1 cm, white = 5 mm.

become somewhat flattened, acquiring a lobuloid aspect, but remaining thick, erect or commonly prostrate and convex; secondarily, the granules can grow at the margins of lobes (a few) or very old apothecia; true *lobulae* absent. *Lower surface* striate and lighter than the upper surface; *tomentum* absent; *attachment* by haptera. *Nostoc* cells 5.0–6.5 × 5.0–6.5 µm in size.

Apothecia mostly marginal, adnate to commonly substipitate, to 1.2 mm diam.; *amphithecium* smooth, grayish to concolored (the very young), changing to grayish brown when fully developed; *margin* normally smooth, sometimes granulate; *corona* more visible when the amphithecium becomes lighter on ageing, continuous to interrupted, occasionally producing granules on very old apothecia. *Apothecial cortex*: base 25–40 µm (5–8 cells) thick, side 20–30 µm (3–5 cells) thick, margin 15 µm (2–3 cells) thick; *subhymenial paraplectenchyma* absent. *Hymenium* hyaline to yellow, 100–130 µm high; *subhymenium* light brown, 35–55 µm high; *ascospores* submuriform to muriform, ellipsoid, with acute apices, 26.5–32.5(–34.0) × 11.0–12.5(–14.0) µm, with 3–5 transversal and 1–2 longitudinal septa.

Remarks: *L. kalbii* is easily recognized by the rugose thallus and the very characteristic laminal granule-like structures which, with difficultly, might be designated isidia, lobulae, or even granules.

According to its description, *L. victorianum* F. Wilson is somewhat similar to *L. kalbii*, though differing in producing cylindrical isidia and true lobulae (Verdon 1992). *Leptogium plicatile* (Ach.) Leight., which has striate lobes and sometimes develops spherical 'isidia', differs by the very small thallus, smaller ascospores (20–24 × 7–9 µm) and its saxicolous habit (Galloway 1999).

Leptogium brebissonii Mont. is also a species with a rugose thallus and granular isidia; however, it has poorly developed lobes and produces fusiform ascospores 20–37 × 10–17 µm (MALME 1924). *L. milligranum* Sierk may be tentatively compared because of its granular isidia and ascospore size, but it has a thicker thallus (150–800 µm) and the isidia are more marginal than laminal (SIERK 1964).

Additional specimens examined: Brazil. São Paulo State, Cananéia Municipality, Cardoso's Island, Vila Marujá's sandy restinga, post-dune restinga vegetation southward the island, 3 m a.s.l., on treelet trunk, 20. x. 1981, M. P. Marcelli no. 1307 [SP]; idem, Sambaqui-Mirim River, on tree trunk inside humid slope forest, 10 m a.s.l., 2. vi. 1982, M. P. Marcelli & V. L. R. Bononi no. 1383, 1384 [SP]; idem, right margin of Perequê River, extremely humid and tall restinga forest, 3 m a.s.l., on tree trunk, 2. iii. 1982, M. P. Marcelli no. 16325, 16326 [SP]. Peruíbe Municipality, left margin of Guaraú River, 2 m a.s.l., on tree trunk in the clear shade of the restinga forest, 18. iv. 1995, M. P. Marcelli & C. H. Ribeiro no. 28458, 28459 [SP].

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To my friend (and lichenological father) Klaus

Almost 30 years have vanished among life's twists and turns, since you were almost casually introduced to me, and to my lichenological vocation, in the old corridors of São Paulo University, in 1978. I was then a student trying to put forward my post-graduate project on lichen ecology, and completely lost and inexperienced in many aspects of life and lichen taxonomy. I remember clearly how you, immediately, offered your expertise and advice, opening your house's doors, books, and equipment to a completely unknown person. I remember how, for about three years, you spent a half-day (including the lunch with yours') patiently teaching me. I cannot forget our conversations and discussions about books, authors, taxonomy, etc., or the wonderful field trips, all paid by you. I cannot also forget the sense of ethics, commitment, and social responsibility I learnt from you. Do you remember when I asked you the reason for such a big investment in me, and you replied: 'I feel I owe this to Brazil'? Moreover, when you supported me because my grant failed to be paid: 'You will pay me by doing the same for a student of yours in the future'? Well, my friend, words like that have given me the correct moral orientation in many of life's aspects and important professional decisions since then. Under tropical Brazilian conditions, such seeds (spores?) may be delayed in germinating and need a precise combination of factors to growing up and produce healthy soredia, what happened only now. Therefore, I introduce you to the second generation of Kalbian Brazilians in this contribution: your lichenological grandchildren. They come from several parts of Brazil, and I hope you can be proud of them.

With a son's heart felt thanks
and the best hug of a true friend
Marcelo P. Marcelli

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