



A new non-isidiate *Leptogium* species with transverse septate ascospores from Southeastern Brazil

Kitaura MJ¹, Marcelli MP², Hora BR¹ and Jungbluth P¹

¹UNESP, Instituto de Biociências, Depto de Botânica, Distrito de Rubião Jr., Caixa Postal 510, Botucatu/SP, CEP 18618–970, Brazil

²Instituto de Botânica, Núcleo de Pesquisa em Micologia, Caixa Postal 68041, São Paulo/SP, CEP 04045–972, Brazil.

Kitaura MJ, Marcelli MP, Hora BR, Jungbluth P 2013 – A new non-isidiate *Leptogium* species with transverse septate ascospores from Southeastern Brazil. *Mycosphere* 4(5), 986–992, Doi 10.5943/mycosphere/4/5/11

Abstract

A non-isidiate *Leptogium* species with transverse septate ascospores is described as new. The species was collected in Serra da Mantiqueira and initially identified as *L. megapotamicum*, but the study of the type specimen demonstrated differences in the tissues of the apothecia, which supported the observed morphological variations of the thalli and apothecia found by our descriptive protocol.

Key words – amphithecia – columnar hyphae – section *Leptogiopsis* – subhymenial tissue

Introduction

The gelatinous foliose and corticate lichenized fungi with transverse septate ascospores were initially grouped in the genus *Leptogiopsis* by Muller Argoviensis (1882) and subsequently as a section of *Leptogium* by Vainio (1890). This group now has a total of 11 accepted species, most of them mentioned only by the authors that originally described them.

Leptogium chloromeloides Nyl. was described from Port Natal in South Africa (Nylander 1868); *L. thoroldii* C.W. Dodge was reported to northern Nigeria and Cameroon (Dodge 1964) and *L. ankolense* C.W. Dodge from Uganda (Dodge 1971).

In the Americas, *Leptogium megapotamicum* Malme was described from Brazil (Malme 1924), *L. reticulatum* Nyl. from French Guiana (Montagne 1841), *L. granadillae* (C.W. Dodge) Degel. from Costa Rica (Dodge 1933), *L. fusisporum* (Tuck.) C.W. Dodge from the USA, and *L. adpressum* Nyl. from Mexico, Florida (Sierk 1964) and Africa (Vainio 1901).

Leptogium pacificum Vain. is the only species known from the Philippines (Vainio 1920).

The best known species is *L. brebissonii* Mont., originally collected in the Canaries Islands (Montagne 1840). It has also been cited for Brazil (Malme 1924), southeast Africa (Swinscow & Krog 1988), the Iberian Peninsula (Aragon et al. 2005) and New Zealand (Feuerer 2011).

This study describes a new species of section *Leptogiopsis* sensu Vainio from southeastern Brazil and also provides a detailed description of the type of *Leptogium megapotamicum*, the nearest species and also from southern Brazil.

This work formed part of a PhD thesis that described *Leptogium* types from different morphological groups (Kitaura 2012).

Materials & Methods

The specimens were collected in the cities of Camanducaia, Campos do Jordão, Catas Altas, and Itamonte, all of them localized in the higher regions of the Mantiqueira's Range, a major mountain complex in southeastern Brazil.

A detailed revision of the type of *Leptogium megapotamicum* (S) was important in order to differentiate the new species.

All specimens were described by our protocol specially developed to analyze *Leptogium* species (Kitaura 2012, Kitaura & Marcelli 2012) and the tissues types were classified according Degelius (1954) and Kitaura & Marcelli (2013).

Leptogium thalli are usually attached by hapters whose presence may produce typical depressions on the upper surface. However, in this group such depressions were not found in all specimens and consequently this characteristic was not included in the descriptions.

Results and Discussion

Most species of sect. *Leptogiopsis* are in need of further study. The presence of paraplectenchymatous cortical cells is not a good characteristic for differentiating *Leptogium* from *Collema* species (Otálora et al. 2010) and recently *Collema* species of the *C. fasciculare* group, also with transverse septate ascospores, were transferred to *Arctomia* Th. Fr. Otálora & Wedin (2013) concluded that both have similar characteristics including ascospores, paraphyses, ascus types and hymenial reactions. Thus sect. *Leptogiopsis* species could also be included in *Arctomia*.

We have identified at least two *Leptogium* groups where the general morphology and some anatomical aspects correlate with the presence or absence of the columnar hyphae and with relief of thallus surface (Kitaura 2012). The species with surface weakly ridged to smooth have columnar hyphae and their apothecia have a thick amphithecial tissue, whereas that species with densely ridged surface lack columnar hyphae, but the apothecia have subhymenial paraplectenchymatous tissue and a one-celled layer of amphithecial tissue, as described below.

The apothecial anatomy was critical in establishing the precise circumscription of the species, but it is not fundamental in identification. To the naked eye the type of *L. megapotamicum* has a smooth to ridged upper surface, as well as inclined columnar hyphae, smooth to verruculose amphithecia and a thick cortex among the amphithecial verrucules, whereas *L. longisporum* has a weakly ridged upper surface to the naked eye, lacks columnar hyphae, has densely ridged, grey amphithecia and thick subhymenial paraplectenchymatous tissue.

***Leptogium megapotamicum* Malme, Arkiv för Botanik 19(8): 29. 1924.**

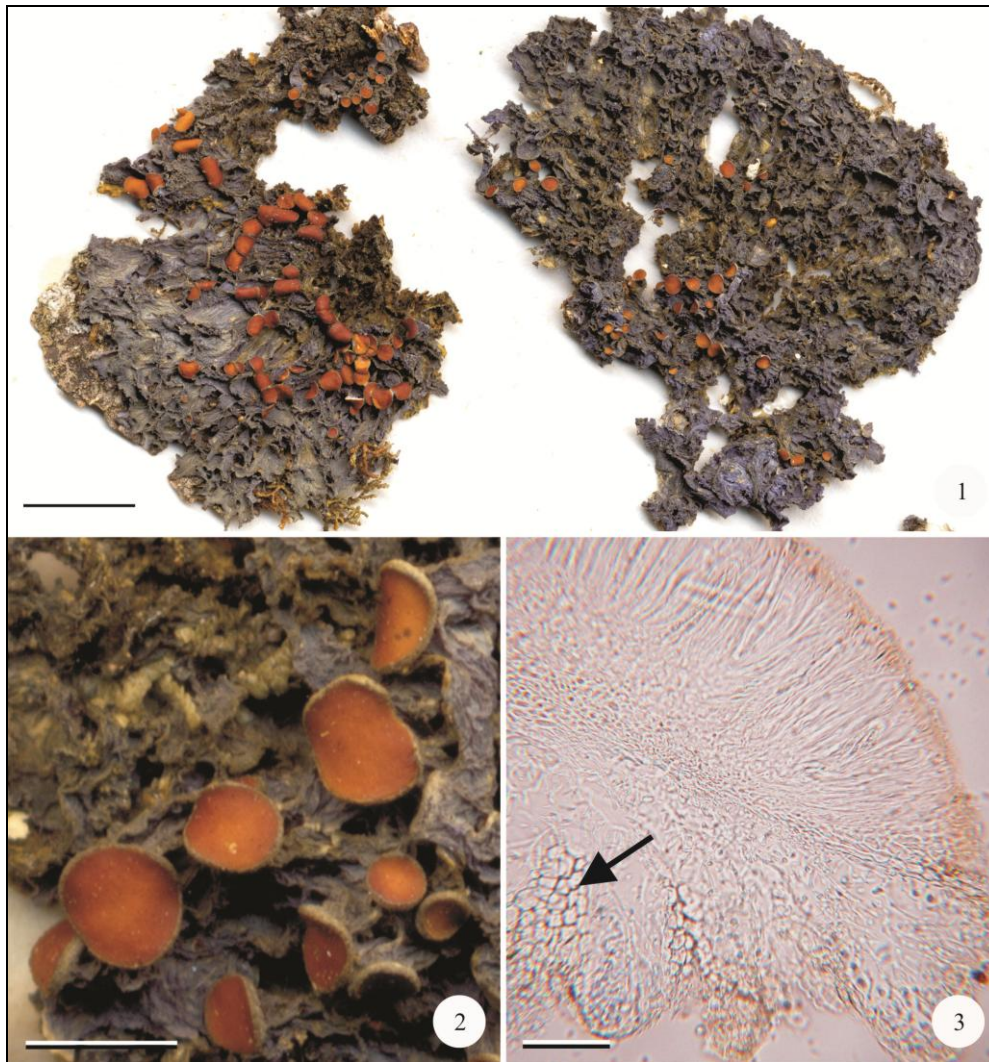
Figs 1–3

Holotype – Brazil, Rio Grande do Sul State, Municipality of Porto Alegre, Parthenon, corticola in ora Silva, leg. GO Malme 574 (S!).

Etymology – refers to Rio Grande do Sul State (Rio Grande = great river).

Description – Thallus ca. 5 cm broad, bluish gray under fluorescent light (naked eye), opaque, matt, bluish gray under the stereomicroscope. Branches lobuloid, 1.5–2.5 mm wide, contiguous, adpressed to attached in points, adnate, upper surface smooth to ridged to the naked eye, longitudinal or scattered ridges apparent under 20× magnification; apices rotund to irregular, revolute to ascending, smooth to crenulate; lateral margin smooth to irregular, ascending, sinuous; lower side bluish gray, ridged to the naked eye and under 20× magnification. Isidia and lobules absent. Thallus attached by hapters; hapters evenly distributed, frequent; rhizines and hairs absent. Apothecia up to 4 mm diam., marginal to submarginal, subpedicellate, disc cupuliform; margin gray, smooth, without ornamentation; amphithecia gray when young then white or yellowish, smooth and verruculose, verrucules gray; corona discontinuous, slightly evident, on older apothecia; pedicel as ridged as thallus, very short, without ornamentation.

Anatomy – Thallus 125 µm thick, 175 µm thick on the ridges; quadratic cells of cortices 5 µm wide, columnar hyphae inclined, simple, cell number not determined. Cyanobacteria blue, frequent to sparse, filament of spherical cells of undetermined number, 5 µm diam.; matrix gelatinous frequent, yellow near to the cortices and hyaline in the mid section. Apothecia with



Figs 1–3 – *Leptogium megapotamicum*. 1 Holotype. 2 Detail of apothecium. 3 Transverse section of apothecia (arrow = thick paraplectenchymatous tissue among the verrucules).– Bars: 1 = 10 mm, 2 = 2 mm, 3 = 50 μ m.

hymenia 100–115 μ m high, subhymenia 75 μ m thick, hyaline; hypothecia 20–25 μ m thick, prosoplectenchymatous cells, hyaline; subhymenial paraplectenchymatous tissue absent; parahymenial tissue continuous with hypothecium, as high as hymenium, 10–15 μ m (3–4 cells) thick at base; 35–40 μ m (4–7 cells) thick at apex, prosoplectenchymatous to euthyplectenchymatous cells; amphithecia 5 μ m (1 cell) at apex, 5–35 μ m (1–5 cells) at middle, 5–100 μ m (1–8 cells) at base, paraplectenchymatous cells, variable thickness by the presence of verrucules. Ascospores 60–75 \times 5 μ m, 9–12 \times 1 cells, apices acute, transversely septate. Pycnidia marginal, brown; conidia bifusiform to bacilliform, 3.75 \times 1.25 μ m.

Known distribution – only from the type locality.

Notes – *Leptogium megapotamicum* is characterized by the ridged upper surface (Fig. 1) and the white to yellowish amphithecia bearing gray verrucules (Fig. 2). The apothecia of *L. megapotamicum* have a prosoplectenchymatous hypothecium and the amphithecia with one to multiple paraplectenchymatous cell layers among the verrucules (Fig. 3).

Malme (1924) described the amphithecia of *L. megapotamicum* as composed by one layer of cells. However, they are multilayered between the verrucules and this characteristic is important in distinguishing this species.

Presently, *Leptogium megapotamicum* appears endemic to the southern-most Brazilian state (Rio Grande do Sul) and has not been found in southeastern Brazil.

Leptogium brebissonii is a somewhat similar species that has isidia and densely grouped ridges (Kitaura 2012), but *L. megapotamicum* has the upper surface with longitudinal or scattered ridges without isidia.

***Leptogium longisporum* Kitaura & Marcelli, sp. nov.**

Figs 4–6

MycoBank 804586

Holotype – Brazil, Minas Gerais State, Municipality of Itamonte, near to the road BR-485, on trunk, 22 Nov 2009, leg. M.J. Kitaura & M.P. Marcelli 1470 (SP).

Etymology – This species has the longest transverse septate ascospores in the genus.

Description – Thallus ca. 5 cm broad, gray under fluorescent light (naked eye), opaque, matt, gray under the stereomicroscope. Branches lacinioid, 0.7 mm wide, contiguous to slightly overlapping, attached in points, adnate to ascending, upper surface slightly ridged to the naked eye, densely ridged under 20× magnification; apices irregular, plane or ascending, ridged or with cerebriform structures; lateral margin usually plane or ascending, with ridged structures; lower side yellowish gray, wrinkled to the naked eye, irregularly ridged under 20× magnification. Isidia and lobules absent. Thallus attached by frequent, evenly distributed hapters; rhizines and hairs absent. Apothecia up to 4 mm diam., laminal, subpedicellate, disc usually plane; margin concolorous with the thallus; amphithecium gray, densely ridged (usually cerebriform contorted); corona absent; pedicel very short, densely ridged.

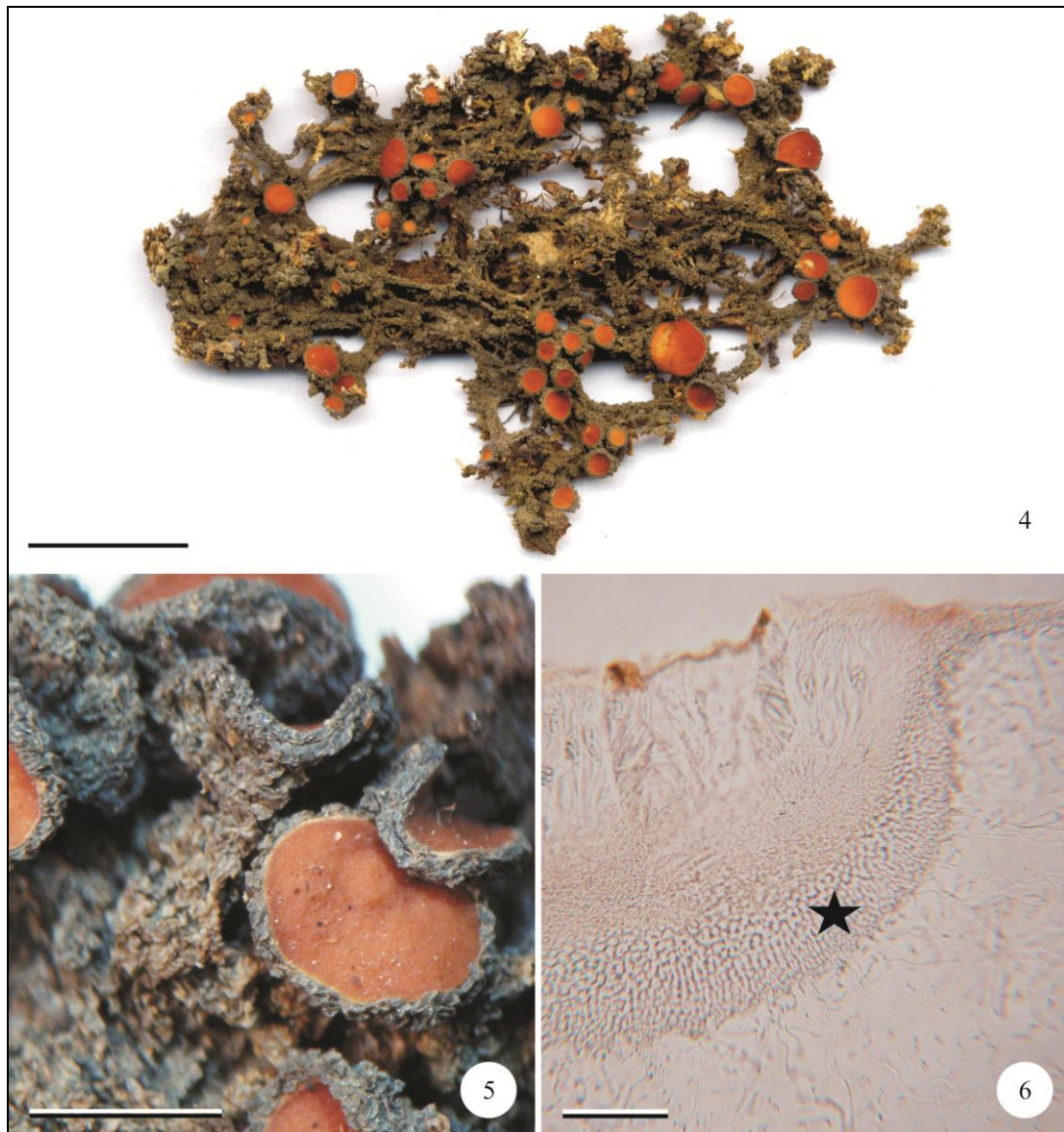
Anatomy – Thallus 150 µm thick, 350 µm thick at the ridges; quadratic cortical cells 5 µm wide, the outer wall thicker than the inner wall; columnar hyphae absent. Cyanobacteria green or bluish, frequent, filaments formed from up to 20 elliptical cells, 5.0 × 2.5 µm; gelatinous matrix frequent to abundant, hyaline. Apothecia with hymenia 125–150 µm high, subhymenia 25–65 µm thick, hyaline to yellow; hypothecia 25–35 µm thick, yellow, prosoplectenchymatous; subhymenial paraplectenchymatous tissue 75–110 µm (6–11 cells) thick; parahymenial tissue continuous with subhymenial tissue, coloplectenchymatous, 60–100 µm (9–11 cells) thick at base, 40–50 µm (7–10) cells thick at apex, up to 7/8 of hymenium height; amphithecia always 5 µm (1 cell) thick, the outer wall thicker; basal plectenchymatous tissue absent. Ascospores acicular, 55–90 × 5(–7) µm, 6–11 cells, transverse septate. Pycnidia absent.

Known distribution – Southeastern Brazil, mainly in Minas Gerais and São Paulo States.

Paratypes – Brazil, Minas Gerais State, Municipality of Itamonte, near to the road BR-485, trunk, 22 Nov 2009, leg. M.J. Kitaura & M.P. Marcelli 1503 (SP, topotype), 1522 (SP, topotype); idem, Municipality of Camanducaia, Vila de Monte Verde, 20 Nov 2008, leg. M.P. Kitaura & M.P. Marcelli 1092 (SP); idem, forest near to the parking area, Pedra Redonda trail, 22 Nov 2008, leg. M.J. Kitaura & M.P. Marcelli 1239 (SP); idem, Municipality of Lima Duarte, Parque Municipal do Ibitipoca, Serra do Ibitipoca, 1270 m alt., 19 Mar 1994, leg. M.P. Marcelli & C.H. Ribeiro 26776 (SP); idem, Catas Altas Municipality, Parque Natural do Caraça, Santuário do Caraça, trail to the Cascatinha, 1100 m alt., 06 Jul 1993, leg. M.P. Marcelli & O. Yano 25932 (SP); idem, São Paulo State, Municipality of Campos do Jordão, Parque Estadual do Jordão, Horto Florestal, trail of Cachoeirinha, 1400 m. alt., 19 Jun 1995, leg. M.P. Marcelli, A.E Luchi & A.M. Gugliotta 29091 (SP).

Notes –*Leptogium longisporum* is characterized by the lacinioid branches whose upper surface has dense ridges bearing cerebriform structures at the apices. The apothecia have a thick subhymenial paraplectenchymatous tissue and the acicular ascospores, 55–90 × 5(–7) µm, are the longest among the species with transverse septa.

Leptogium longisporum was collected in the Serra da Mantiqueira and initially identified as *L. megapotamicum* since the specimens agree well with the protologue (Malme 1924). However, a detailed morphological and anatomical study revealed several significant differences between these non-isidiate species.



Figs 4–6 – *Leptogium longisporum*. 4 Holotype. 5 Detail of apothecium. 6 Transverse section of apothecium (star = subhymenial paraplectenchymatous tissue). – Bars: 4 = 2 cm; 5 = 2 mm; 6 = 50 μm .

Subhymenial tissue composed of paraplectenchymatous cells was observed in several *Leptogium* species by Malme (1924), who mentioned it as “strato parenchymatico sub hypothecio”, and its presence or absence has been considered an important taxonomic characteristic for distinguishing *Leptogium* species (Swinscow & Krog 1988). However, Malme described *L. megapotamicum* as lacking such tissue but with amphithecia composed by a simple layer of cells.

The absence of a thick paraplectenchymatous tissue in the apothecia of *Leptogium* species is not common, and we initially believed that Malme may have been mistaken. However, sections of the apothecium of the type of *L. megapotamicum* were made and Malme’s observations confirmed.

The apothecia of *Leptogium longisporum* differs anatomically from both *L. megapotamicum* and *L. fusisporum*. *Leptogium longisporum* has a thick subhymenial paraplectenchymatous tissue and a one-layered amphithecium whereas *L. megapotamicum* and *L. fusisporum* lack subhymenial paraplectenchyma tissue, but have a paraplectenchymatous multilayered amphithecium instead.

The cerebroid structures present on the apices of the thallus ridges are somewhat similar to those found in *L. microcarpum*, but that species does not have transverse septate spores (Kitaura 2012).

Key to Brazilian species of *Leptogium* species with transverse septate ascospores

1. Isidia present.....*Leptogium brebissonii* Mont.
1. Isidia absent..... 2
2. Upper surface smooth to ridged to the naked eye, the ridge apices not ornamented; the amphithecia verruculose with thick paraplectenchymatous tissue between the verrucules; subhymenial paraplectenchymatous tissue absent *Leptogium megapotamicum* Malme
2. Upper surface slightly ridged to the naked eye; ridges ornamented with cerebroid structures; the amphithecia ridged and totally covered with a thin paraplectenchymatous tissue (one layer); a thick subhymenial paraplectenchymatous tissue present.....*Leptogium longisporum* Kitaura & Marcelli

Acknowledgements

The authors wish to thank Dr. Jack Elix for the revision of the English text, Dr. Arne Anderberg and Dr. Marianne Hamnede (S) for the loan of the type of *Leptogium megapotamicum*, and an unknown assessor for valuable suggestions. M.J. Kitaura wishes to thank the FAPESP (2008/51072-3) for a PhD grant and M.P. Marcelli, CNPq for a research grant.

References

- Aragón G, Otálora MAG, Martínez I. 2005 – New data on the genus *Leptogium* (lichenized ascomycetes) in the Iberian Peninsula. *Nova Hedwigia* 80(1–2), 199–226.
- Degelius G. 1954 – The lichen genus *Collema* in Europa. *Symbolae Botanicae Upsalienses* 13(2), 1–499.
- Dodge CW. 1933 – The foliose and fruticose lichens of Costa Rica I. *Annals of the Missouri Botanical Garden* 20, 373–467.
- Dodge CW. 1964 – Some lichens of Tropical Africa. *Nova Hedwigia* 12, 118–131.
- Dodge CW. 1971 – Some lichens of Tropical Africa. V. *Lecanoraceae* to *Physciaceae*. *Nova Hedwigia* 38, 1–225.
- Feuerer T. 2011 – Biodiversity of lichens and lichenicolous fungi [Internet]. Version 1 August 2011. Available: <http://webapp5.rz.uni-hamburg.de/lichens/formular.php> (accessed 2013 Feb 21).
- Kitaura MJ. 2012 – Estudos taxonômicos de *Leptogium* (Ach.) S.F. Gray (*Collemataceae*, fungos liquenizados) [thesis]. Instituto de Biociências, UNESP, Universidade Estadual Paulista, Botucatu. 249 p.
- Kitaura MJ, Marcelli MP. 2012 – The *Leptogium juressianum* complex in southeastern Brazil. *Mycotaxon* 120, 215–221.
- Kitaura MJ, Marcelli MP. 2013 – A revision of *Leptogium* species with spherical-celled hairs (section *Mallotium* p.p.). *The Bryologist* 116(1), 15–27.
- Malme GOA. 1924 – Die Collematazeen des Regnellischen Herbars. *Arkiv för Botanik* 19(8), 1–29.
- Montagne JFC. 1840 – Phytographia Canariensis, sectio ultima, Plantas cellulares sistens. In: Webb PB, Berthelot S, editors. *Histoire Naturelle des Canaries III*, Paris.
- Montagne JFC. 1841 – Seconde centurie de plantes cellulaires exotiques nouvelles, Décade IX. *Annales des Sciences Naturelles* 16, 108–128.
- Müller Argoviensis J. 1882 – Lichenologische Beiträge. *Flora oder Allgemeine Botanische Zeitung (Jena)* 65(19), 291–306.
- Nylander W. 1868 – Note sur les lichens de Port-Natal. *Bulletin de la Société Linneenne de Normandie* 3, 4–15.
- Otálora MAG, Aragón G, Molina MC, Martínez I, Lutzoni F. 2010 – Disentangling the *Collema-Leptogium* complex through a molecular phylogenetic study of the *Collemataceae* (*Peltigerales*, lichen-forming *Ascomycota*). *Mycologia* 102(2), 279–290.
- Otálora MAG, Wedin M. 2013 – *Collema fasciculare* belongs in *Arctomiaceae*. *The Lichenologist* 45(2), 1–10.

- Sierk HA. 1964 – The genus *Leptogium* in North America North of Mexico. *The Bryologist* 67(3), 245–317.
- Swinscow TDV, Krog H. 1988 – *Macrolichens of East Africa*, British Museum (Natural History). London.
- Vainio EA. 1890 – Étude sur la classification naturelle et la morphologie des lichens du Brésil. *Acta Societatis pro Fauna Flora Fennica* 7. Helsingfors.
- Vainio EA. 1901 – Lichenes; Catalogue of the African plants collected by Dr. Friedrich Welwitsch in 1853-61. Vol. II. Part II. pp. 396–493. *Cryptogamia*. London.
- Vainio EA. 1920 – Lichenes Insularum Philippinarum III. *Annales Academiae Scientiarum Fennicae* 15, 1–368.