

**Parmotrema s.l.** (Parmeliaceae, lichenized Ascomycota) from Serra Geral slopes in central Rio Grande do Sul State, Brazil

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**ABSTRACT** - (Parmotrema s.l. (Parmeliaceae, lichenized Ascomycota) from Serra Geral slopes in central Rio Grande do Sul State, Brazil). A survey of the parmotremoid lichens occurring in the central area of Rio Grande do Sul State (Brazil) revealed 31 species of Parmotrema A. Massal., distributed in three groups corresponding to the former genera Canomaculina Elix & Hale, Parmotrema s. str. and Rimelia Hale & Fletcher. All species are described, illustrated, commented and special notes compare similar species as an aid to identification.

Key words: Canomaculina, Parmotrema, Rimelia, Rio Grande do Sul

**RESUMO** - (Parmotrema s.l. (Parmeliaceae, lichenized Ascomycota) de escarpas da Serra Geral na região central do Rio Grande do Sul, Brasil). Em um levantamento das espécies de Parmotrema A. Massal. que ocorrem nos barrancos e perais de uma região central do Rio Grande do Sul, 31 espécies foram encontradas, as quais podem ser divididas em três grupos morfológicos, que correspondem a Canomaculina Elix & Hale, Parmotrema s. str. e Rimelia Hale & Fletcher. Descrições, ilustrações e comentários sobre espécies próximas são fornecidos, baseando-se no material encontrado.

Palavras-chave: Canomaculina, Parmotrema, Rimelia, Rio Grande do Sul

**Introduction**

Continuing the studies on the diversity of Parmeliaceae from Southern Brazil, focused on species found in roadsides and slopes in the central Rio Grande do Sul State (Spielmann 2005, Spielmann & Marcelli 2008), we are presenting here the most diverse group found: Parmotrema s.l.

Parmotrema was proposed a long time ago (Massalongo 1860) to delimit some species belonging to the genus Parmelia Ach., and Parmotrema perforatum (Wulfen) A. Massal. was chosen as the type. The name Parmotrema reports the perforate apothecia of this species, from the Greek pARMos = cup, and tREMA = perforation (Feige 1998). The genus was largely neglected by the contemporary workers, maybe with the exception of Krempelhuber (Hale 1984), and the species belonging to Parmotrema were dealt with in the large genus Parmelia Ach. by Zahlbruckner (1926a, 1930), Vainio (1890) assembled most species at present placed in Parmotrema in his Parmelia section Amphigymnia Vainio, and his delimitation was largely followed, sometimes with slight changes. Dodge (1959), for example, proposed Parmelia subgenus Amphigymnia (Vainio) Dodge, and with this name, the species were monographically treated by Hale (1965). In this meantime, some combinations in Parmotrema were proposed by M. Choisy, as can be seen in Lamb (1963). Later, Hale (1974a) recognized Parmotrema and placed in it the species studied in his monograph of Amphigymnia (Hale 1965). Therefore, Parmotrema began to be widely used. Nevertheless, some workers (e.g. Hawksworth, Dey, Krog, and Swinscow) do not accept this delimitation (Culberson 1991). Krog & Swinscow (1983) changed their mind, yet until recently (see Purvis et al. 1992) some Europeans still do not used Parmotrema (and no one of the genera proposed by Hale). Today the generic delimitation in Parmeliaceae is very controversial, but several Hale’s propositions are more widely used (see, e.g., Hawksworth et al. 2008).

The genus Canomaculina was proposed by Elix & Hale (1987) to accommodate three species previously classified within Parmelina Hale (Hale 1974b, 1976): C. consors (Nyl.) Elix & Hale, C. muelleri (Vainio) Elix & Hale and C. pilosa (Stiz.) Elix & Hale. Then the characteristic features of Canomaculina were adnate to strongly adnate thalli.

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(Hale 1976), typically narrow lobes, (1–) 2–4 (–5) mm, and dimorphic rhizines (Elix & Hale 1987).

Some years later, Kurokawa (1991a) proposed Rimeliella Kurok., to embrace several species formerly classified within Parmotrema, with adnate to loosely adnate thalli, wide lobes (5–15 mm) and dimorphic rhizines. Afterwards, Elix (1997) concluded that lobe’s width (narrow in Canomaculina, wide in Rimeliella) was not enough to distinguish the two genera, and since both have dimorphic rhizines, he synonymized Rimeliella under Canomaculina.

Rimelia was proposed by Hale & Fletcher (1990), based on Parmelia section Hypotrachyna *Irregularis* (Vainio 1890). It shares several features with Parmotrema, but differs by a combination of characters: upper surface reticulate cracked, cilia almost always present [lacking only in Rimelia ruminata (Zahlbr.) Hale & Fletcher], lower surface generally rhizinate to margins (with several exceptions), and rhizines often squarrose (Hale & Fletcher 1990). However, there are species of Parmotrema with reticular maculae (particularly those with salazinic acid) and rhizinate to the margin, as well as species of Rimelia with a wide bare zone on lobes undersurface, so that the distinction of the genera is, in many instances, difficult.

Canomaculina Elix & Hale, by their turn, has species with broad or narrow lobes, ciliate, upper surface with effigurate maculae, lower surface rhizinate to the margins and dimorphic rhizines (Elix 1997).

Previously we treated Canomaculina and Rimelia separately (Spielmann & Marcelli 2008), but here they are included under Parmotrema, following the proposed circumscription of Blanco *et al.* (2005). Although few Parmotrema s. str. were included in this paper, *P. perforatum*, the type of the genus, was shown to be closely related to the others representatives. Maybe future studies, based on a higher amount of species, mainly from South America, could change this picture.

Nowadays about 350 species of Parmotrema s.l. are known (Blanco *et al.* 2005), although much more remain to be discovered or correctly delimited, based on modern taxonomic features.

**Material and methods**

Detailed description and maps of the studied area, material and methods employed and considerations on general morphology can be found in Spielmann (2005) and Spielmann & Marcelli (2008). Spot tests were performed by the use of K (potassium hydroxide), C (sodium hypochlorite) and P (para-phenylenediamine). TLC analysis followed Huneck & Yoshimura (1996), Orange *et al.* (2001) and Bungartz (2001). Several specimens were collected “on the roadside”. So this information is not repeated in the Specimens examined. Just different data were kept. Brazilian States abbreviations follow Marcelli (1998).

**Results and Discussion**

In the following flora we tried to put in evidence old and modern generic concepts, both in the key and in the disposition of the species, to facilitate the identification. The figures, however, are arranged in alphabetical order.

Key to Parmotrema from Serra Geral slopes in central Rio Grande do Sul State, Brazil

1. Upper surface clearly maculate, underside rhizinate up to the margin or more rarely nude
2. Maculae effigurate, cilia generally short, tapered and thick, underside often brown throughout or black only in the center (formerly Canomaculina; Group I below)
3. Thallus with soredia
   4. Medulla K–, KC+ reddish, P– (norlobaridone) .................................................. *P. conferendum*  
   4. Medulla K+ yellow, KC+, P+ orange (stictic acid) ............................................. *P. muelleri*
3. Thallus without soredia
   6. Medulla K+ yellow → red (salazinic acid) ...................................................... *P. subcaperatum*  
6. Medulla K–
   7. Medulla KC+ rose (norlobaridone) .............................................................. *P. recipiendum*
7. Medulla KC– (fatty acids) .................................................................................. *P. consors*
2. Maculae reticulate, cilia long and thin, underside black (formerly Rimelia; Group III below)
8. Thallus with soredia or pustules
   9. Thallus with soredia raised from pustules and soralia; medulla UV+ yellow-orange
      (lichexanthone) .............................................................. P. diffractaicum
   9. Thallus with soredia raised only from soralia; medulla UV–
      10. Medulla K+ yellow → red (salazinic acid) ........................................ P. clavuliferum
      10. Medulla K–
         11. Medulla KC+ reddish rose (norlobaridone) .................................... P. commensuratum
         11. Medulla KC– (capertatic acid) ................................................ P. simulans

8. Thallus without soredia or pustules
   12. Medulla K+ yellow → red, KC– (salazinic acid) .................................... P. cetratum
   12. Medulla K–, KC+ rose or red (norlobaridone) .................................... P. homotomum

1. Upper surface emaculate (rarely inconspicuously maculate), underside with a distinct bare zone
   around the margins (Parmotrema s. str.; Group II below)

13. Thallus with soredia, isidia or pustules
   14. Thallus with isidia (occasionally disintegrating into soredia with the age)
      15. Lobes eciliate; medulla C+ red (lecanoric acid) .................................... P. tinctorum
      15. Lobes ciliate; medulla C–
         16. Medulla K+ yellow, KC+ reddish, UV– (stictic acid and norlobaridone) .... P. internexum
         16. Medulla K–, KC+ rose → quickly orange, UV+ greenish blue (alectoronic acid) .... P. mellissii

14. Thallus with pustules, soredia present or lacking
   17. Lobes eciliate ................................................................. P. alidactylatum
   17. Lobes ciliate
      18. Medulla yellowish to orange .......................................................... P. flavomedullosum
      18. Medulla white
         19. Medulla K+ yellow, UV– (stictic acid) ........................................ P. bangii
         19. Medulla K+ yellow → red (salazinic acid), UV+ yellow-orange
            (lichexanthone) .................................................. P. spinibarbe

17. Thallus without pustules, soredia always present
   21. Lobes eciliate
      22. Medulla C+ red (lecanoric acid) .................................................. P. austrosinense
      22. Medulla C–
         23. Medulla K+ yellow (atranorin) .................................................. P. mordenii
         23. Medulla K– ................................................................. P. praesorediosum

17. Thallus without vegetative propagules
   27. Soredia often rising from arbuscular structures like a cauliflower;
       with an orange medullar pigment K+ red (unknown anthraquinone)
       present at the soralia and lobe apices ........................................ P. hypomiltoides
   27. Soredia rising from marginal to submarginal soralia and usually linear;
       pigment orange K+ red (skyrin) present only in the older parts, next
       to the lower cortex .......................................................... P. rampoddense

28. Medulla K+ yellow or K+ yellow → red
29. Medulla K+ yellow → red (salazinic acid) ......................................................... P. mantiqueirensense
29. Medulla K+ yellow (stictic acid) ............................................................................. P. eciliatum
28. Medulla K–
30. Medulla KC–, UV– (protopraesorediosic acid) ..................................................... P. melanothrix
30. Medulla KC+ rose → quickly orange, UV+ greenish blue (alectoronic acid)

31. Lower surface with a white margin; conidia unciform 4.0–5.5 µm long ................
............................................................................................................................ P. subrugatum
31. Lower surface with a brown margin; conidia bacillar to filiform 6.0–12.5 µm
long ........................................................................................................ P. wainioi

Group I – Canomaculina-like lichens (species with dimorphic rhizines, effigurate or punctiform
maculae, and rhizinate up to the margin, belonging to Canomaculina sensu Elix 1997)

This group of species is distinguished by the
usually thickened, furcated and spiky cilia, maculate
effigurate upper cortex, lower surface often brown
and usually rhizinate up to the margin and the
presence of dimorphic rhizines, the later feature
being the more distinctive one.

To make easier the comparison between the
known species of canomaculinoid lichens, a table
(1) was created, with data obtained from literature:
Adler & Elix (1987), Canéz (2005), Chen et al.
(2003), Eliasaro (2001), Elix (1997), Ferraro & Elix
Marcelli & Ribeiro (2002), Mata García (1994),

Parmotrema conferendum Hale, Mycotaxon 5(2):
433. 1977 = Rimeliella conferenda (Hale) Kurok.,
Annals of the Tsukuba Botanical Garden 10: 4,
1991 = Canomaculina conferenda (Hale) Elix,
Mycotaxon 65: 476. 1997. Type: VENEZUELA,
ESTADO DE MÉRIDA: El Valle, on rocks along stream,
2,600 m alt., 8-II-1974, M.E. Hale 43291 (holotype

Figure 9

Thallus olivaceous gray, brownish in herbarium,
lobate, membranaceous to subcoriaceous, loosely
adnate, saxicolous, 6.5–13.5 cm broad. Lobes
irregularly branched, laterally overlapping to
contiguous, 5–15 mm wide, surface smooth to
irregular, lustrous, becoming rugose and scrobiculate
in the center; apical zone plane to subconcave,
margin plane to ascendant or revolute, crenate to
incise-crenate (sublacinulate); marginal zone plane
to ascendant or revolute, margin undulate, crenate to
lacinulate, sometimes involute. Lacinulessimple, 0.5–
1.0 × 0.5–2.0 mm, marginal, plane to canaliculated,
evenly distributed, apex rounded or truncate. Maculae
weak to distinct, punctiform, irregular or reticulate,
laminal. Cilia black, simple to furcated or sometimes
squarrose, 0.10–1.20 × 0.02–0.10 mm, frequent,
evenly distributed. Pustules and isidia absent. Soralia
dirty white, usually capitate, coalescing at maturity,
marginal to submarginal, turning the lateral margin
involute; soredia subgranular. Medulla white. Lower
surface pale brown, lustrous, sometimes strongly
veined and depressed, rugose; marginal zone pale
brown, sometimes white variegated, lustrous, 0.5–
1.0 mm wide, with short or immature rhizines, bare,
smooth, rugose or veined, without a sharp limit.
Rhizines black to dark brown, dimorphic, the short
ones simple, straight or curly, 0.10–0.50 × 0.01–
0.05 mm, abundant, evenly distributed, the long ones
usually simple, sometimes furcated or irregularly
branched, 0.50–3.00 × 0.05–0.20 mm, frequent, in
disperse groupings. Apothecia unknown. Pycnidia
submarginal, little conspicuous, without prominent
margin, ostiole black. Conidia filiform, straight or
arcuate, 10–16 × ca. 1 µm.

Color tests: cortex K+ yellow, UV–; medulla K–,
C– or C+ rose, KC+ reddish, P–, UV–.

TLC: atranorin, norlobaridone, loxodin and
unidentified fatty acids.

Distribution: Africa (Winnem 1975), North America
(Esslinger 2008) and South America (Hale 1977). In
South America it is known to Argentina (Hale 1977,
Calvelo & Liberatore 2002), Brazil (Marcelli 2004),
Uruguay (Osorio 2003) and Venezuela (Hale 1977).
In Brazil it was recorded to PR (Eliasaro & Donha
2003) and RS (Spielmann 2006).

Specimens examined: BRAZIL, RIO GRANDE DO SUL:
Sinimbu, Cava Funda, 29°27′41.8"S, 52°31′11.7"W,
500 m alt., 4-II-2003, A.A. Spielmann 24 (SP); idem, 29°27′33.4″S, 52°31′05.1″W, 520 m alt., with mosses, 5-1-2004, A.A. Spielmann & L.S. Canêz 668 (SP); idem, Linha Almeida, 29°23′20.2″S, 52°30′21.9″W, 5-1-2004, A.A. Spielmann & L.S. Canêz 1297 (SP).

*Parmotrema conferendum* is distinguished by the usually capitate, marginal to submarginal soralia, and medulla with norlobaridone and loxodin (K−, KC+ reddish). This species was placed as synonym (Hale 1977), reacting K+ yellow Hale produces salazinic acid and norlobaridone reacting K+ yellow subsumptum has salazinic and consalazinic acids, differ mostly in chemical constituents (table 1): *P. subsumptum* has salazinic acid and norlobaridone, *P. reitzii* Hale produces salazinic acid and norlobaridone (Hale 1977), reacting K+ yellow → blood red (Fleig 1997), and *P. reitzii* Hale produces salazinic acid and norlobaridone (Hale 1977), reacting K+ yellow → blood red and KC+ reddish. This species was placed as synonym of *Rimeliella conferenda* by Kurokawa (1991a), and as synonym of *Rimeliella subsumpta* by Fleig (1997). However, Elix (1997) accepted *P. reitzii* as distinct, an opinion kept here. *Parmotrema larensense* López-Figueiras has, in addition to norlobaridone, lichexanthone in the medulla (Mata García 1994), being UV+ yellow-orange.

The specimen A.A. Spielmann & L.S. Canêz 668 (SP) has the lower surface strongly veined and sometimes depressed, as well as a white variegated margin. All specimens were found growing on the roadsides, in open places.


Figure 10

Thallus greenish gray, lobate, adnate, corticicolous or saxicolous, 8–20 cm broad. Lobes irregularly branched, laterally overlapping, 2–15 mm wide, surface smooth to rugose and scrobiculate, usually pruinose, becoming strongly rugose in the center; margin smooth to incise-crenate (sublacinulate). Lacinules, pustules soredia and isidia absent. Maculae distinct, puntiform to irregular, laminar, Cilia black, simple to furcated or irregularly branched, spiked and robust or slender, 0.10–0.05–0.20 mm, usually turned downwards, abundant, evenly distributed. Medulla white. Lower surface black, lustrous, smooth to rugose; marginal zone brown, lustrous, 1–3 mm wide, rhizinate, with attenuate limit, smooth to papillate. Rhizines black, simple to irregularly branched, 0.20–3.00 × 0.02–0.30 mm, dimorphism not always evident, but when discernible the short rhizines abundant and evenly distributed, the larger ones frequent and assembled. Apothecia concave to urceolate, 1.5–9.0 mm in diameter, adnate to subcapitate, laminal, margin smooth to crenate, amphithecial smooth, disc brown, perforate at maturity; epithecium 3–8 µm; hymenium 35–60 µm; subhymenium 15–30 µm; ascosporas ellipsoid, 11.0–16.5 × 7.0–10.0 µm, episporium 1.0–1.5 µm. Pycnidia laminal to submarginal, conspicuous, usually with prominent margin, ostiole black; conidia bacillar to filiform, straight or curved, 7–15 × ca. 1 µm.

Color tests: cortex K+ yellow, UV−; medulla K−, C−, KC−, P−, UV−.

TLC: atranorin and an unidentified fatty acid.


Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20′02.2″S, 52°26′27.9″W, 440 m alt., in the stream’s margin and close to the street, in a little shaded place, 24-II-2004, A.A. Spielmann & L.S. Canêz 1288 (SP); idem, 29°18′81.1″S, 52°26′88.5″W, on the forest border, 7-IX-2000, L.S. Canêz & A.A. Spielmann 1384 (HCB); Herveiras, near to “Balneário Tio Juba”, shaded place, 6-II-2004, A.A. Spielmann & L.S. Canêz 690 (SP); Sinimbu, Cava Funda, 29°27′33.4″S, 52°31′05.1″W, 520 m alt., open place, 5-1-2004, A.A. Spielmann & L.S. Canêz 665 (SP), A.A. Spielmann & L.S. Canêz 666 (SP), A.A. Spielmann & L.S. Canêz 687 (SP), A.A. Spielmann & L.S. Canêz 1290 (SP), A.A. Spielmann & L.S. Canêz 1294 (SP), A.A. Spielmann & L.S. Canêz 1296 (SP), A.A. Spielmann & L.S. Canêz 1300 (SP), A.A. Spielmann & L.S. Canêz 1328 (SP).
Table 1. Reproductive structures and chemistry in *Canomaculina* sensu Elix (1997) [atranorin is always present in the cortex].

<table>
<thead>
<tr>
<th>SUBSTANCES</th>
<th>WITHOUT VEGETATIVE PROPAGULES</th>
<th>SOREDIAE</th>
<th>ISIDIAE</th>
<th>PUSTULATE</th>
<th>LOBULATE</th>
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<td>CHLOROATRANORIN</td>
<td><em>P. cristobaliae</em></td>
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<td><em>P. tandilensis</em></td>
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<td>USNIC ACID</td>
<td><em>P. laciniiellum</em> (trace)</td>
<td><em>P. subsumptum</em> (trace)</td>
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<td></td>
<td><em>P. lobuliferum</em> (trace)</td>
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<td><em>P. recipiendum</em> (trace)</td>
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<td><em>P. subcaperatum</em> (trace)</td>
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<td>WITHOUT SUBSTANCES</td>
<td><em>P. consors</em></td>
<td><em>P. pilosum</em></td>
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<td>SALAZINIC AND CONSALAZINIC ACIDS</td>
<td><em>P. cristobaliae</em></td>
<td><em>P. leucosemothetum</em></td>
<td><em>P. neotropicum</em></td>
<td><em>P. ventanicum</em></td>
<td><em>P. lobuliferum</em></td>
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<td><em>P. spinibarbe</em></td>
<td><em>P. subinctorium</em></td>
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<td><em>P. subcaperatum</em></td>
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<td><em>P. tandilensis</em></td>
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<td>PROTOCETRARIC ACID</td>
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<td><em>P. tandilensis</em> (trace)</td>
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<td>fumarprotocetraric acid</td>
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<td>stictic acid and allied</td>
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<td><em>P. maulleri</em></td>
<td><em>P. kwalense</em></td>
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<td>nostctic acid</td>
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<td><em>P. conferendum</em></td>
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<td><em>P. recipiendum</em></td>
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<td>NORLobaridine</td>
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<td><em>P. conferendum</em></td>
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<td><em>P. subsumptum</em> (trace)</td>
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<td>lecanoric acid</td>
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<td><em>P. lobuliferum</em> (trace)</td>
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<td>GYROPHORIC ACID</td>
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<td>lichexanthone</td>
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<td><em>P. spinibarbe</em></td>
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</table>
**Parmotrema consors** is characterized by the absence of vegetative propagules and medulla containing only an unidentified fatty acid (negative reactions). The similar *P.* *pilosum* (Stiz. & Krog) Krog & Swinscow produces soredia, being regarded the sorediate pair of *P. consors* (Hale 1976).

In the specimens here examined the rhizines range from abundant and covering the entire surface, to frequent, sometimes leaving some parts with few rhizines. As to the dimorphism, it ranges from sharply evident in some specimens to hardly distinguishable in others.


Figure 25

Thallus greenish gray to brownish in herbarium, lobate, adnate, subcoriaceous, corticicolous or saxicolous, 11.5–15.0 cm broad. Lobes irregularly branched, laterally overlapping, 1–11 mm wide, surface smooth to scrobiculate, becoming rugose and cracked in the center; margin smooth to sublacinulate. Maculae distinct, punctiform to irregularly laminal. Cilia black, simple to furcated or sublacinulate. Maculae distinct, punctiform to irregular, laminal. Cilia black, simple to furcated or irregularly branched, robust to spiky, 0.20–1.20 × 0.04–0.20 mm, usually downwards turned, frequent, present mainly on the crenae axils. Pustules and isidia absent. Soralia capitate, often coalescing, laminal or frequently reaching the margin; soredia conspicuous, usually with prominent margin, ostiole black; conidia filiform, 10–15 × ca. 1 µm.  

Color tests: cortex K+ yellow, UV−; medulla K+ yellow, C−, KC−, P+ orange, UV−.  

TLC: atranorin, stictic acid, cryptostictic acid, and an unidentified substance with Rf 48 in solvent C.  

Distribution: Asia (Awasthi 1976), North and South America (Hale 1976). In South America it is known to Argentina (Hale 1976, Calvelo & Liberatore 2002), Brazil (Zahlbruckner 1930, Hale 1976, Marcelli 2004), Peru (Hale 1976), Uruguay (Osorio 1992a) and Venezuela (Hale 1976). In Brazil it was recorded to MG (Hale 1976, Ribeiro 1998), MS (Osorio 1992b), PR (Osorio 1977a, Eliasaro 2001, Eliasaro & Adler 2000, Eliasaro & Donha 2003), RS (Spielmann 2006) and SP (Jungbluth 2006).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Herveiras, near to “Balneário Tio Juba”, shaded place, 6-II-2004, A.A. Spielmann & L.S. Canêz 685 (SP); Sinimbu, Cava Funda, 29°27'33.4"S, 52°31'05.1"W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 1298 (SP).

**Parmotrema muelleri** is recognizable by the capitate, laminal soralia and medulla with stictic acid (K+ yellow, P+ orange). The sorediate *P.* *pilosum* is destitute of demonstrable medullar substances (Hale 1976). Another similar canomaculinoid lichen is *P.* *kwalense* (Krog & Swinscow) Krog & Swinscow, but it has isidia and in addition to stictic acid, norstictic acid is present (Swinscow & Krog 1988).

In the specimen A.A. Spielmann & L.S. Canêz 1298 the rhizines apparently have different sizes, but they surely are stages of development of the same type of rhizines, i.e., they’re not dimorphic. This confirms the observations of Hale (1976).


Figure 29
Thallus pale grey or brownish in herbarium, lobate, subcoriaceous, loosely adnate, saxicolous, 8.5–14.0 cm broad. Lobes irregularly branched, laterally overlapping, 5–20 mm wide, surface smooth to scrobiculate, lustrous, becoming scrobiculate, rugose or cracked in the thallus center; apical zone plane to subconcave; lateral marginal zone undulate, plane to ascendant and revolute or involute, margin crenate to incise-crenate (sublacinulate). Lacinules, pustules, soredia and isidia absent. Maculae distinct, punctiform to irregular, laminal. Cilia black, usually simple, sometimes furcated, irregularly branched, 0.10–2.00 × 0.04–0.10 mm, abundant, evenly distributed. Medulla white. Lower surface dark brown, lustrous, smooth to rugose or papillate, sometimes veined; marginal zone brown to pale brown, sometimes white variegated, lustrous to sublustrous, rhizinate or with small rhizines in development, rarely nude (up to 0.5 mm wide), without a sharp limit, smooth, rugose or papillate. Rhizines usually black, sometimes dark brown, dimorphic, the short ones simple to squarrose or irregularly branched, raised or curly, 0.10–0.50 × 0.01–0.04 mm, abundant, evenly distributed, the larger ones simple to furcated or irregularly branched, 0.50–2.50 × 0.04–0.30 mm, frequent, dispersed in groups. Apothecia urceolate, 5–14 mm in diameter, stipitate, laminal to submarginal, margin smooth to crenate, or sometimes dentate or short-dentate, amphitheicum maculate, smooth, disc brown, epruinose, perforate; epithecium 7–10 μm; hymenium 55–65 μm; subhymenium 13–20 μm; ascospores ellipsoid to ovoid, 12.5–15.0 × 6.5–9.0 μm, episporium 0.5–1.0 μm. Pycnidia submarginal to laminal, conspicuous, usually with prominent margin, ostiole black; conidia filiform straight or arcuate, 10–16 × ca. 1 μm.

Color tests: cortex K+ yellow, UV–; medulla K–, C–, KC+ rose, P–, UV–.

TLC: atranorin, norlobaridone and loxodin.

Distribution: Oceania (Kurokawa 1991a, Elix 1994) and South America (Kurokawa 1991a). In South America it is known to Argentina (Hale 1965, Kurokawa 1991a, Calvelo & Liberatore 2002), Brazil (Marcelli 2004), Paraguay (Lynge 1914, as Parmelia annae Lynge; Hale 1965), Peru (Hale 1965, Kurokawa 1991a) and Uruguay (Osorio 1980). In Brazil it was recorded to MG (Hale 1965), MT (Lynge 1914, as Parmelia annae; Kurokawa 1991a), PR (Kurokawa 1991a, Eliasaro 2001, Eliasaro & Donha 2003), RJ (Kurokawa 1991a), RS (Spielmann 2006) and SP (Hale 1965, Junghbluth 2006). Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sinimbu, Cava Funda, 29°27’33.4”S, 52°31’05.1”W, 520 m alt., 5-1-2004, A.A. Spielmann & L.S. Canêz 696 (SP); Sobradinho, margin of highway RST-481, near the crossroads, 29°24’20.2”S, 53°01’25.9”W, 375 m alt., 17-VII-2003, A.A. Spielmann 352 (SP).

Parmotrema recipiendum is distinguished by the lack of vegetative propagules and the presence of norlobaridone and loxodin (medulla K–, KC+ reddish). Parmotrema subcaperatum (Kremp.) Hale is very similar morphologically, so much that the two species were already synonymous (Hale 1965). The last one, however, has salazinic and consalazinic acids (medulla K+ yellow → blood red). On the other hand, Parmotrema cristobalaei (Ferraro & Elix) Blanco, Crespo, Divakar, Elix & Lumbsch and P. erubescens (Stirton) Krog & Swinscow have in medulla both norlobaridone and loxodin as well as salazinic acid (Krog & Swinscow 1981, Ferraro & Elix 1993). Finally, Parmotrema conferendum has the same chemical pattern of P. recipienda, but is a sorediate species.

The specimen A.A. Spielmann 352 (SP) has fertile lobes with several submarginal, grouped apothecia (figure 29), very like the holotype photograph of P. recipienda (Kurokawa 1991a: figure 2). All specimens were collected on the roadsides in open places.


Figure 34

Thallus greenish gray to brownish in herbarium, lobate, subcoriaceous, loosely adnate, saxicolous, 6–12 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 4–20 mm wide, surface smooth to rugose and scrobiculate, lustrous, becoming
rugose and cracked in the center; apical zone plane to subconcave, margin plane to ascendant or revolute, regular to undulate, crenate to sublacinulate; lateral marginal zone usually ascendant, regular to undulate, sometimes involute, margin crenate to lacinulate. Lacinules simple to furcated or irregularly branched, 0.20–1.20 mm, simple to furcated or dichotomous, sometimes involute, 0.04–0.10 mm, abundant, evenly distributed. Pustules, soredia and isidia branched, 0.20–1.20 mm, with wide bare zone along the margins and rhizines from 0.10–1.0 mm, wide, with rhizines or rarely nude up to 1 mm wide, limit absent, smooth to rugose or sometimes veined. Rhizines black, dimorphic, the short ones 0.10–0.50 mm, straight or curly, simple, abundant, evenly distributed, the larger ones 0.40–3.00 mm, simple to furcated or irregularly branched, frequent. Apothecia urceolate, 1–7 mm in diameter, stipitate, laminal to submarginal, margin smooth to crenate or incise, amphithecium smooth, disc epruinose, perforate; epithecium 7–10 µm; hymenium 40–50 µm; subhymenium 13–20 µm; ascospores ellipsoid, 11–14 × 7.5–9.0 µm, episporium 0.5–1.0 µm. Pycnidia submarginal to laminal, conspicuous, usually with prominent margin, ostiole black; conidia bacilliform to filiform, straight or arcuate, 8.5–15.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow → red, C+ slowly yellowish, KC+ orange, P+ yellow → orange, UV–.

TLC: atranorin, salazinic and consalazinic acids.

Distribution: Oceania and South America (Kurokawa 1991a). In South America it is known to Argentina (Calvelo & Liberatore 2002), Brazil (Zahlbruckner 1930, Kurokawa 1991a, Marcelli 2004), Paraguay (Osorio 1970a), Uruguay (Osorio 1972) and Venezuela (Vareschi 1973). In Brazil it was recorded to MG (Kurokawa 1991a), MS (Osorio 1992b), PR (Osorio 1977b, Kurokawa 1991a), RJ (Kurokawa 1991a), RS (Spielmann 2006) and SP (Kurokawa 1991a).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sinimbu, Cava Funda, 29°27′41.8″S, 52°31′11.7″W, 500 m alt., open place, 4-II-2003, A.A. Spielmann 74 (SP); idem, 29°27′33.4″S, 52°31′05.1″W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 710 (SP), A.A. Spielmann & L.S. Canêz 976 (SP), A.A. Spielmann & L.S. Canêz 1295 (SP).

Parmotrema subcaperatum is distinguished by the absence of vegetative propagules, medulla with salazinic (K+ yellow → red) and the dark brown lower surface. The similar P. recipiendum presents just norlobaridone and loxodin (medulla K–, KC reddish) while P. reparatum (Stirton) Blanco, Crespo, Divakar, Elix & Lumbsch has a distinct black lower surface (Kurokawa 2001).

Kurokawa (1991a) and Fleig (1997) reported the presence of usnic acid in P. subcaperatum. This substance was not found in this study or by Eliasaro (2001) to specimens from Paraná State.

It’s interesting to note that both Hale (1965), Kurokawa (1991a) and Fleig (1997) regarded Parmelia imperforata Nyl. as synonym of P. subcaperatum. However, according to Zahlbruckner (1909), P. imperforata (as suggested by the name) has imperforate apothecia, and conidia 10–12 µm long, while P. subcaperatum has perforate apothecia slightly longer conidia, 8.5–15 µm long.

Actually P. subcaperatum is part of a complex of species, which is being studied through the types and will be published elsewhere (Spielmann & Marcelli, unpublished data).

Group II – Parmotrema-like lichens (Species without dimorphic rhizines and rarely maculate, with a broad naked rim below, belonging to Parmotrema s. str.)

Parmotrema s. str. is characterized by the generally broad and loosely adnate to adnate thalli, relatively wide lobes, lower surface often with a wide bare zone along the margins and rhizines from simple to furcated or irregularly branched, but never dimorphic (Elix 1993).

To facilitate the comparison among the species of Parmotrema s. str. found, the main morphological and chemical data were summarized in the table 2. In some species of Parmotrema the rhizines reach the margin, mainly in the form of “rhizal papillae” (Awasthi 1976) or “rhizines in development” (Fleig 1997). Of the species here dealt with, Parmotrema internexum shows this feature.

Table 2. Morphological and chemical features in the species of *Parmotrema* s. str. found (atranorin is full present in the cortex of all species).

<table>
<thead>
<tr>
<th>MEDULLAR SUBSTANCES</th>
<th>WITHOUT VEGETATIVE PROPAGULES</th>
<th>SOREDIA</th>
<th>ISIDIA</th>
<th>PUSTULIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATRANORIN</td>
<td><em>P. mordenii</em></td>
<td><em>P. alidactylatum</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALECTORONIC AND α-COLLATOLIC ACIDS</td>
<td><em>P. subrugatum</em></td>
<td><em>P. hypomiltoides</em></td>
<td><em>P. rampoddense</em></td>
<td><em>P. mellissii</em></td>
</tr>
<tr>
<td>SKYRIN</td>
<td><em>P. hypomiltoides</em></td>
<td><em>P. rampoddense</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ANTHRAQUINONE</td>
<td><em>P. hypomiltoides</em></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>CAPERATIC ACID</td>
<td><em>P. mordenii</em></td>
<td><em>P. praesorediosum</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRAESOREDISIOIC ACID</td>
<td><em>P. praesorediosum</em></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>PROTOPRAESOREDISIOIC</td>
<td><em>P. melanotrix</em></td>
<td><em>P. mordenii</em></td>
<td><em>P. alidactylatum</em></td>
<td></td>
</tr>
<tr>
<td>PROTOCOLICHESTERINIC ACID</td>
<td><em>P. mordenii</em></td>
<td><em>P. praesorediosum</em></td>
<td><em>P. alidactylatum</em></td>
<td></td>
</tr>
<tr>
<td>SALAZINIC AND CONSALAZINIC ACIDS</td>
<td><em>P. mantiqueirense</em></td>
<td><em>P. spinibarbe</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STICTIC ACID AND ALLIED</td>
<td><em>P. eciliatum</em></td>
<td><em>P. perlatum</em></td>
<td><em>P. internexum</em></td>
<td><em>P. bangii</em></td>
</tr>
<tr>
<td>NORLOBARIDONE</td>
<td><em>P. internexum</em></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LECANORIC ACID</td>
<td><em>P. austrosinense</em></td>
<td><em>P. tinctorum</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GYROPHORIC ACID</td>
<td><em>P. indicum</em></td>
<td><em>P. sancti-angeli</em></td>
<td></td>
<td><em>P. flavomedullosum</em></td>
</tr>
<tr>
<td>SECALONIC ACID A</td>
<td><em>P. flavomedullosum</em></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>LICHEXANTHONE</td>
<td><em>P. spinibarbe</em></td>
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<td></td>
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</tbody>
</table>
Parmotrema from central Rio Grande do Sul State, Brazil


Figure 1

Thallus pale gray, lobate, membranaceous, loosely adnate, saxicolous, 10 cm broad. Lobes irregularly branched, laterally overlapping, 3.5–8.0 mm wide, surface smooth to lightly rugose, opaque to sublustrous, becoming rugose and cracked; apical zone subconcave, margin undulate, entire to broadly crenate, plane or slightly involute; lateral marginal zone undulate, plane or ascendant and involute, margin entire to crenate. Lacinules, maculae, cilia and isidia absent. Pustules simple, short-claviform or irregular, marginal, submarginal or laminal, more abundant in the proximal areas, with a lax medulla, becoming sorediose or not, arising from wrinkles or from capitate structures, often starting as black points in the thallus. Soredia granular, coming from pustules. Medulla white. Lower surface black, lustrous, smooth or more often rugose; marginal zone pale brown or ochraceous, nude or with few rhizines, smooth to papillate or sometimes rugose, opaque to sublustrous, with a sharp limit, 2–4 mm wide. Rhizines black or concolor to the marginal zone, simple or branched, sometimes with the apex flattened or coalescing in the distal areas, 0.20–0.70 × 0.05–0.10 mm, dispersed in groups, frequent. Apothecia and pycnidia unknown.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow, C–, KC–, P–, UV–.

TLC: atranorin (cortex and medulla), protolichesterinic acid and protopraesorediosic acid.

Distribution: Argentina (Calvelo & Liberatore 2002).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20'02.2"S, 52°26’27.9”W, 440 m alt., left side of the stream, open place, 23-II-2004, A.A. Spielmann & L.S. Canêz 1205 (SP).

Parmotrema alidactylatum is characterized by the adnate and eciliate thallus with pustules, and the presence of atranorin in the medulla (K+ yellow). Parmotrema soredioaliphaticum Estrabou & Adler is very close, but its pustules become sorediose (Estrabou & Adler 1998). This subtle difference could place P. soredioaliphaticum in the synonymy of P. alidactylatum (a hypothesis admitted by Estrabou & Adler 1998). In fact, the only specimen described here show some sorediate pustules. Additional collections from Argentina and Brazil, together with the study of the types, could contribute to this question.

We are naming here the structures of this lichen as pustules, while in the original concept Estrabou & Adler (1998) called them dactyls. These terms are not clearly delimitated in the current literature, and in this respect, there are two other species morphologically close to P. alidactylatum: P. tsavoense (Krog & Swinscow) Krog & Swinscow and P. dactylosum Fleig. The first one has physodic acid (medulla KC+ purple), oxyphysodic acid, and filiform conidia with 18–20 µm long (Krog & Swinscow 1981, Swinscow & Krog 1988), while P. dactylosum produces caperatic acid and unidentified fatty acids, the conidia being sublageniform to almost bifusiform, 5.0–7.5 µm long (Fleig 1999).


Figure 2

Thallus pale greenish gray, lobate, loosely adnate, membranaceous to subcoriaceous in some places, saxicolous, 11 cm broad. Lobes irregularly branched, laterally overlapping, 3.0–7.5(–9.0) mm wide, surface smooth, opaque to sublustrous, becoming rugose and cracked in the center; apical zone plane to subconcave, margin little to strongly undulate, usually ascendant, smooth to crenate; lateral marginal zone little or strongly undulate, margin entire. Lacinules, pustules, isidia and cilia absent. Maculae weak. Soralia white or with black points, marginal, linear interrupted, lightly wider in the older parts; soredia farinose. Medulla white. Lower surface black, rugose; marginal zone brown or white variegated, lustrous, 2–10 mm wide, with weak to sharp limit, smooth to usually rugose. Rhizines black to concolor with the lower surface, usually simple, 0.2–0.5 × 0.1–0.3 mm, few, dispersed in groups. Apothecia absent [according with Hale (1965), substipitate, to 10 mm. in diameter, amphithecium maculate,
sparsely sorediate, disc perforate; hymenium 75 µm; ascospores 10–16 × 6–10 µm, episporium 1.5 µm. Pycnidia submarginal, conspicuous, with or without prominent margin, ostiole black; conidia filiform, (11.0–) 14.0–16.0 (–17.5) × ca. 0.5 µm.

Color tests: cortex K+ yellow, UV–; medulla K–, C+ red, KC+ red, P–, UV–.

TLC: atranorin, lecanoric acid.

Distribution: Oceania (Feuerer 2005), Australia (Hale 1965), Asia (Zahlbruckner 1932, Hale 1965), Europe (Hale 1965), Africa (Hale 1965, Swinscow & Krog 1988) and Americas (Hale 1965). In South America it is known to Argentina (Hale 1965, Calvelo & Liberatore 2002), Brazil (Marcelli 2004), Colombia (Hale 1965), Paraguay (Hale 1959), Uruguay (Hale 1965, Osorio 1992a) and Venezuela (Hale 1965, Vareschi 1973); in Brazil it was recorded to MG (Ribeiro 1998), MS (Osorio 1992b), PR (Eliasaro 2001) and SP (Marcelli 1991, Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sinimbu, Cava Funda, 29°27’41.8”S, 52°31’11.7”W, 500 m alt., 5-I-2004, A.A. Spielmann & L.S. Canêz 1088 (SP).

Parmotrema austrosinense is distinguished by the linear soralia, the lacking cilia, and the presence of lecanoric acid (medulla C+ red) and atranorin (cortex greenish gray, K+ yellow). The white variegated lower surface also seems to be a constant feature, agreeing with the literature (Hale 1965, Osorio 1992a) and Venezuela (Hale 1965, Vareschi 1973); in Brazil it was recorded to MG (Ribeiro 1998), MS (Osorio 1992b), PR (Eliasaro 2001), RS (Spielmann 2006) and SP (Marcelli 1991, Ribeiro 1998).

Parmotrema defectum (Hale) Hale share the above presented features, but has an adnate to strongly appressed thallus, and lightly shorter conidia, 10–12 µm long (Krog & Swinscow 1981) [yet Swinscow & Krog (1988) gave a different size: 16–20 (24) µm long]. It is the sorediate counterpart of P. soyauxii (Müll. Arg.) Hale, while P. austrosinense is the counterpart of P. andinum (Müll. Arg.) Hale (Hale 1965, Swinscow & Krog 1988).

Two other similar sorediate species, P. cooperi (Steiner & Zahlbr.) Sérus. and P. sancti-angeli (Lynge) Hale, can be easily identified by the presence of marginal cilia (Hale 1965).

The illustrations of P. austrosinense in Tavares (1945, as Parmelia meridionalis), Awasthi (1976), Hale (1979), Hale & Cole (1988) and Brodo et al. (2001) are very alike the specimen here studied. Notwithstanding, the picture from Swinscow & Krog (1988) seems to suggest the presence of capitate, sorediate structures.

It is interesting to note that Hale (1965) and Awasthi (1976) asserted that P. austrosinense has “widely perforated” apothecia, while Krog & Swinscow (1981), Elix (1994) and Nash & Elix (2002a) stated that the apothecia vary from perforate to imperforate, unfortunately not specifying if in the same thalli or not. Species pairs in which one counterpart has perforate apothecia and the other not are, as far as we are aware, unreported in Parmotrema. If both P. austrosinense and P. andinum present perforate apothecia, then the species pair is well defined. Nevertheless, if a “hidden” species, very similar to P. austrosinense, with imperfect apothecia, in fact exist, its counterpart would be another one, for example, some of the specimens reported by Awasthi (1976) as Parmelia andina, with apothecia imperforate or perforate in the center. Moreover, there are differences in the soralia and soredia between the authors that describe perforate and imperfect apothecia. Since there are several accepted synonyms in both P. austrosinense and P. andinum, only a revisionary work could solve this question, because more than one taxon seems to be implied.

The typification of this species is also a little confused. Firstly, Hale (1965) asserted that the lectotype is located in WU, and the “isotypes” in BPI and W. Elix (1994), Fleig (1997) and Eliasaro (2001) wrote “isolatectotypes” instead of isotypes. On the other hand, Fleig (1997) stated that the lectotype is in US, not BPI. As some authors (e.g. Elix 1994, Eliasaro 2001) used “fide Hale 1965”, and Hale (1965) sends back to his previous paper, we are here using the data from Hale (1959), who made the typification.

Ribeiro (1998) described the rhizines of Parmotrema austrosinense as “dimorphic, black, simple and dichotomous”. With this features, his lichen is more properly a Canomaculina, and deserves further confirmation.

Parmotrema bangii is characterized by the soredioid pustules and the granular soredia originated from the cortex disintegration, together with the presence of stictic acid (medulla K+ yellow, P+ slowly orange). Parmotrema perlatum is a similar sorediate species, also with stictic acid, but in this species the soralia are linear and marginal, never forming pustules. P. madylnae Fletcher has pustules, but instead of stictic acid, it has protocetraric acid (medulla K–) and shorter ascospores, 23–25 × 14–15 µm, episporium 2 µm (Hale 1986).

Unfortunately, we were unable to find pycnidia in our specimen. However, it must be noted that Krog & Swinscow (1981) reported the conidia as being bacillar to filiform, 8–10 µm long, so different from that described by Vainio (1909).

Parmotrema eciliatum (Nyl.) Hale, Phytologia 28(4):

Figures 13, 37
Thallus greenish gray, lobate, membranaceous to subcoriaceous, loosely adnate, saxicolous, 12 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 4.0–8.0 mm wide, median axis extended to subascendant, surface smooth to irregular, opaque to lustrous, becoming rugose and cracked in the center; apical zone subplane to concave, margin undulate, subplane or ascendent, sometimes involute, crenate to incise-crenate (sublacinulate); lateral marginal zone undulate, suberect to erect, subimbricate and involute. Lacinules, pustules, soredia and isidia absent. Maculae present only close to the apothecia. Cilia black, simple to furcated or sometimes irregularly branched, 0.50–3.00 × 0.02–0.10 mm, frequent, evenly distributed. Medulla white. Lower surface black, lustrous, rugose; marginal zone brown to beige, narrow (0.5–2.0 mm) or with large parts white variegated (1–6 mm), lustrous to opaque, nude, smooth to rugose, with a sharp limit. Rhizines black, simple to rarely irregularly branched, 0.20–0.50 × 0.02–0.10 mm, with an attenuate or sharp limit. Rhizines black, simple or rarely irregularly branched, 0.20–0.50 × 0.03–0.05 mm, frequent, evenly distributed. Apothecia absent [according to Vainio (1909), up to 5 mm in diameter, cupulate, subsessile, imperforate, excipulum smooth or with a few soredioid or isidioid granules, ascospores ellipsoid-oblong, 26–36 × 11–16 µm, and episporium 3–4 µm (Hale 1965)]. Pycnidia absent [according to Vainio (1909), conidia sub-bifusiform, 5 µm long].

Color tests: cortex K+ yellow, UV–; medulla K+ yellow, C–, KC–, P+ slowly orange, UV–.

TLC: atranorin, stictic acid, constictic acid, cryptocistidic acid, hypoconstictic acid, hypostictic acid, and an unidentified substance similar to rhizocarpic acid.

Distribution: Africa (Østhagen & Krog 1976, Krog & Swinscow 1981, Sérasiaux 1984, Swinscow & Krog 1988) and South America (Hale 1965). In South America it is known to Bolivia (Vainio 1909, Zahlbruckner 1930, Hale 1965, Feuerer et al. 1998), Brazil (Marcelli 2004), Colombia (Hale 1965) and Venezuela (Feuerer 2005).
slightly prostrate and entangled, abundant, more or less evenly distributed. Apothecia urceolate to patent, 1–13 mm in diameter, stipitate, laminal to submarginal, base constricted, rugose, margin smooth to dentate, eciliate, amphitheciurn maculate, strongly rugose, disc brown, imperforate, plane to involute, entire or split; ascospores ellipsoid to reniform, 22.5–29.0 (–31.5) × 12.5–16.5 (–19.0) µm, episporium 2.5–3.5 µm. Pycnidia submarginal to laminal, abundant, ostiole black; conidia bacillar to filiform, rarely with a brief apical thickening, 5–9 × ca. 1 µm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow, C–, KC–, P+ orange, UV–.

TLC: atranorin, stictic acid, constictic acid, cryptostictic acid and hypostictic acid.

Distribution: Asia (Kurokawa 1991b, Kurokawa & Lai 2001, Feuerer 2005), Oceania (Elix 1994), Africa (Hale 1965, Krog & Swinscow 1981, Swinscow & Krog 1988), North and Central America (Hale 1965, Feuerer 2005) and South America (Hale 1965). In South America, it is known to Argentina (Lynge 1914, Hale 1965, Adler 1992, Calvelo & Liberatore 2002), Brazil (Hale 1965, Marcelli 2004) and Uruguay (Osorio 1972, 1992a). In Brazil, it was recorded to PR (Eliasaro & Donha 2003), RJ (Hale 1965) and RS (Spielmann 2006).

Specimens examined: BRAZIL, RIO GRANDE DO SUL: Sobradinho, margin of highway RST-481, near the crossroads, 29°24′20.2″S, 53°01′25.9″W, 375 m alt., open place, 17-VII-2003, A.A. Spielmann 410 (SP).

Parmotrema eciliatum is distinguished by the ciliate lobes, presence of stictic acid (medulla K+ yellow, P+ orange), apothecia imperforate, and the absence of vegetative propagules. Parmotrema aldabrense (C.W. Dodge) Hale, reported to Africa, sometimes presents stictic acid as an accessory substance to the norstictic acid (Medulla K+ yellow → red), his main substance. However, it has perforate apothecia, maculae distinct, ascospores 13–18 × 5–7 µm (Hale 1965) and filiform conidia, 12–15 µm long (Swinscow & Krog 1988). Parmotrema preperforatum (W.L. Culb.) Hale, known in the United States, also has norstictic acid and stictic acid, together with perforate apothecia (Culberson 1973), but this is the only information we were able to find about this species, so that we don’t know more differences between P. aldabrense and P. preperforatum, except that one is recorded to Africa and the other to North America. Finally, P. blanchetianum (Müll. Arg.) Kalb, has similar morphology, but produces protocetraric acid instead stictic acid. In the course of the present work we noted that P. eciliatum could also be distinguished by the cilia, usually furcated or irregularly branched (figure 37).


Figures 14, 40

Thallus pale grey, lobate, membranaceous to subcoriaceous in some areas, loosely adnate, corticicolous or saxicolous, 15.0–18.5 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 4–20 mm wide, surface smooth, rugose or with the cortex disintegrating in patches, sublustrous to opaque, becoming rugose in the center; apical zone plane to concave or involute, often curled or apically straighten and, combining with the involution of the lateral margins, assuming the aspect of a “T” when the lobe is observed from the lower side (figure 40), margin entire to crenate; lateral marginal zone undulate, plane to ascendant and involute, margin entire to crenate or incise-crenate (sublacinulate). Lacinules, maculae and isidia absent. Cilia black, cylindrical or flattened, simple to dichotomous, 0.40–3.00 × 0.05–0.10 mm, few, present on the axillar crenae, more abundant in some areas than others. Pustules developed from wrinkles, laminal to marginal, present mainly in the apices and lobe margins, breaking up in soredia. Soralia capitate to extensive, marginal to submarginal, approaching the lamina, usually developed from pustules, or sometimes directly from the fragmentation of the surface, commonly causing the “T” aspect of the lobes; soredia from subgranular to granular, sometimes isidioid and coalescing. Medulla yellow to orange. Lower surface black, lustrous, smooth, rugose or rugose-reticulate; marginal zone brown to beige or chestnut, opaque to lustrous, 1.5–6.0 mm wide, nude, limit from sharp to attenuate, smooth, papillate, rugose to strongly rugose-reticulate or with veins, usually with cracks. Rhizines black or sometimes with a whitish apex, simple to furcated
Parmotrema flavomedullosum is recognizable by the ciliate lobes, pustules fragmenting in soredia and the yellow to orange medulla with gyrophoric acid and secalonic acids A and C (K+ yellow, C+ orange, KC+ yellow). Some other species of Parmotrema with yellow medulla can be distinguished as follow: P. araucariarum (Zahlbr.) Hale has eciliate lobes and the gyrophoric acid absent (Hale 1974c), P. endosulphureum (Hillm.) Hale has eciliate lobes and produces isidia instead of soredia (Hale 1974c).

Color tests: cortex K+ yellow, UV–; medulla K+ yellow, C+ orange, KC+ yellow, P– (fading the pigment yellow), UV–.

TLC: atranorin, gyrophoric acid, secalonic acid A and C and unidentified substance of Rf 51 in solvent C.

Distribution: Known only to South America, where it was reported to Argentina (Hale 1974c), Brazil (Marcelli 2004), Paraguay and Venezuela (Hale 1974c). In Brazil it was recorded to MG (Hale 1974c), MS (Osoir 1992b), PR (Hale 1974c, Eliasaro 2001), SC (Hale 1974c, Fleig 1997) and RS (Spielmann 2006).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Cascata do Gamelão, 29°18’13.7”S, 52°26’51.7”W, 500 m alt., on the steep slope near the waterfalls, shaded place (inside the forest), 1-II-2004, A.A. Spielmann & M.A. Sulzbacher 743 (SP); idem, in the right side of the stream, open place, 1-II-2004, A.A. Spielmann & M.A. Sulzbacher 1037 (SP).

Parmotrema flavomedullosum is recognizable by the ciliate lobes, pustules fragmenting in soredia and the yellow to orange medulla with gyrophoric acid and secalonic acids A and C (K+ yellow, C+ orange, KC+ yellow). Some other species of Parmotrema with yellow medulla can be distinguished as follow: P. araucariarum (Zahlbr.) Hale has eciliate lobes and the gyrophoric acid absent (Hale 1974c), P. endosulphureum (Hillm.) Hale has eciliate lobes and produces isidia instead of soredia (Hale 1974c). Finally, Parmelia elabens Kurok., described in 1974 based on specimens from Paraná State, is regarded a synonym of P. flavomedullosum by Fleig (1997), Hale & DePriest (1999) and Eliasaro (2001).


Figures 16-17

Thallus pale gray, lobate, membranaceous, loosely adnate, saxicolous, 7.5–11.0 cm broad. Lobes irregularly branched, laterally overlapping, 2–17 mm wide, median axis extended to subascendant, surface smooth to scrobiculate, becoming rugose and reticulate cracked in the old parts; apical zone rounded, subconcave, margin usually ascendant and involute, sometimes revolute, entire to crenate or incise-crenate (sublacinulate); lateral marginal zone undulate and usually involute over the median axis and turning the lobes convex and almost canalicate, margin crenate to sublacinulate. Lacinules, pustules and true isidia absent; maculae weak to distinct, punctiform, laminar. Cilia black, simple or rarely irregularly branched, 0.50–2.00 × 0.02–0.05 mm, from few to frequent, evenly distributed. Soralia concolor to the thallus, capitate or irregular, usually marginal and in the sublacinules apices, sometimes laminar, often forming arbuscular structures with sorediate apices (like a cauliflower); soredia granular or sometimes isidioid. Medulla white with orange areas K+ red close to the soralia or in the older parts. Lower surface black, lustrous, smooth to slightly rugose or with veins, sometimes papillate; marginal zone brown to dark brown, often white or beige variegated, or completely black, opaque to lustrous, 2–6 mm wide, nude, with a sharp or attenuate limit, smooth to slightly rugose. Rhizines black, simple to irregularly branched, 0.20–3.00 × 0.02–0.05 mm, frequent, dispersed in groups. Apothecia absent [according to Fleig (1997), submarginal, imperforate, urceolate to patent and splitted when old, substipitate, with a wide base, rugose, amphithecium rugose, sorediate; ascospores 18.0–23.0 × 9.0–12.5 µm, episporium 1.5–2.5 µm]. Pycnidia absent [according to Fleig (1997), submarginal, sterile]; conidia unknown.

Color tests: cortex K+ yellow, UV–; medulla K–, C–, UV–. → TLC: atranorin, alecloronic acid, α-coillatolic acid, skyrin and unidentified anthraquinone of Rf 49 in solvent C.

Distribution: Oceania (Louwhoff & Elix 1999) and South America (Hale 1965). In South America it is known to Brazil (Zahlbruckner 1930, Marcelli 2004) and Venezuela (Feuerer 2005). In Brazil it was recorded to MG (Hale 1965), PE (Kurokawa & Moon 1998), RS (Spielmann 2006), SC (Fleig 1997) and SP (Hale 1965, Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Cascata do Gamelão,
Parmotrema hypomiltoides is distinguished by the production of soredia, often formed in arbuscular structures (like a cauliflower), the presence of alectoronic and α-collatolic acid (medulla KC+ rose → quickly orange, UV+ greenish blue) and the orange pigment K+ red (unidentified anthraquinone) close to the soralia and lobe apices. In P. rampoddense (Nyl.) Hale the soralia are usually marginal and linear, and the orange pigment K+ red (skyrin) is present only close to the lower cortex, in the old parts. Finally, P. mellissii (C.W. Dodge) Hale develops true isidia.

Fleig (1997) first proposed the new combination of Parmelia hypomiltoides in Parmotrema. At that time, the status of nomenclatural propositions in thesees were still somewhat obscure in the St. Louis Code (Greuter et al. 2003). Nevertheless, according to the Vienna Code (McNeill et al. 2007), Fleig’s thesis is not effectively published. So the following author proposes to propose the new combination, Kurokawa (1998, March) must be credited. Interesting to note that DePriest & Hale (1998, April-June) also proposed March) must be credited. Interesting to note that DePriest & Hale (1998, April-June) also proposed this new combination, since Hale already recognized this good species although not validly published. Later (Hale & DePriest 1999) they correctly used Kurokawa’s combination.


Figures 18, 39

Thallus greenish gray or mineral gray, lobate, loosely adnate, subcoriaceous, saxicolous, 20–28 cm broad. Lobes irregularly branched, laterally overlapping, 4–20 (–25) mm wide, surface smooth, opaque to lustrous, becoming rugose and cracked or reticulate cracked in the center; apical zone plane to subconcave, margin plane to undulate, often ascendant, entire to crenate; lateral marginal zone undulate to strongly undulate, subascendant to ascendant, involute in the older parts, sometimes revolute, margin entire to crenate. Lacinules, maculae, pustules and isidia absent. Cilia simple to branched, 0.50–3.50 (–4.50) × 0.05–0.15 mm, frequent to abundant, evenly distributed. Soralia marginal, rarely submarginal, linear-continuous or interrupted, slightly wider when dense, sometimes orbicular and laminal in the old parts; soredia granular, sometimes dense and coalescing, sometimes darkened in the central areas. Medulla white, in some points with orange patches K+ wine red near the lower cortex. Lower surface black, opaque or lustrous, papillate, smooth or rugose; marginal zone brown, sometimes ochraceous (especially in the older, sorediate parts), black or brown and black variegated, nude, lustrous, with an attenuate or sharp limit, smooth, papillate or rugose, (2–) 4–9 mm wide. Rhizines black, simple, 0.20–2.00 (–4.00) × 0.05–0.15 mm, frequent to abundant, dispersed in groups. Apothecia unknown. Pycnidia submarginal, ostiole black; conidia filiform, straight or arcuate, 8.0–12.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K–, C+ rose, KC+ rose, P–, UV–.

TLC: atranorin, gyrophoric acid.

Distribution: Africa (Krog & Swinscow 1981, as Parmelia indoafra; Swinscow & Krog 1988), Asia (Hale 1977), and South America, where it is known to Brazil (Marcelli 2004); in Brazil it was recorded to RS (Spielmann 2006).

Specimens examined: BRAZIL, RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Peru da Nega, 29°20’02.2”S, 52°26’27.9”W, 440 m alt., left margin of a stream, shaded by a shrub and grasses, 23-II-2004, A.A. Spielmann & L.S. Canêz 931 (SP); Sinimbu, Cava Funda, 29°27’41.8”S, 52°31’11.7”W, 500 m alt., open place, 12-II-2003, A.A. Spielmann 61 (SP).

Parmotrema indicum is characterized by the robust thallus with ciliate lobes, marginal, linear soralia, the presence of gyrophoric acid (medulla C+ rose, KC+ rose) and filiform conidia, 8.0–12.5 × ca. 1.0 µm. P. sancti-angeli (Lynge) Hale has sublageniform conidia, 5.0–7.5 × ca. 1.0 µm. P. permutatum (Stirton) Hale presents a yellow lower medulla (secalonic acid A) and P. rampoddense produces alectoronic acid (medulla UV+ greenish blue).

However, usually the thalli are not pycnidiate, and so the conidia type is useless in the distinction of P. indicum and P. sancti-angeli. During the present
study, we realized other accessory differences between these species. *P. indicum* often has furcated or more branched cilia, also slightly thickened (0.05–0.15 mm wide), reminding the cilia from *Canomaculina* (figure 39), wide marginal soralia, together with orbicular and laminal ones in the older lobes, and a robust, usually coriaceous and adnate thallus. In *P. sancti-angeli*, the cilia are usually simple (rarely furcated) and thinner (0.05–0.10 mm). the marginal soralia are narrow and the orbicular, laminar ones absent. The thallus is usually membranaceous, with ascendant lobes.

There is also the option to verify if the medulla of one specimen has norlobaridone, present only in *P. indicum* (Hale 1977, Krog & Swinscow 1981, Swinscow & Krog 1998). Yet this substance was not found in our specimens.

Although Fleig (1997) stated that *P. indicum* occurs in North America, we were unable to confirm this.


Figure 19

Thallus greenish gray, lobate, adnate, membranaceous, saxicolous, 7–10 cm broad. Lobes irregularly branched, laterally overlapping, 2.5–7.0 mm wide, surface smooth to lightly scrobiculate, opaque to lustrous, becoming rugose and cracked in the center; apical zone plane to lightly concave or convex, plane to undulate; margin crenate or sometimes dentate; lateral marginal zone plane and imbricate to ascendant and involute, usually curling in the axils, undulate, margin entire to crenate. Lacinules, pustules and soralia absent, and maculae absent (but sometimes with irregular white patches). Cilia black, simple, few or rare, evenly distributed yet more abundant in the lobe axes, narrow, 0.20–0.80 × 0.02–0.10 mm. Isidia concolor to the thallus or with black or brown apices, cylindrical, simple, granular, branched or coralloid, erect, firm, more dense in the ascendant areas, eciliate, laminal to marginal, 0.05–0.40 × 0.05–0.20 mm. Medulla white. Lower surface black, lustrous, rugose; marginal zone brown or sometimes white variegated, nude or with young rhizines, lustrous, with an attenuate limit, smooth to subrugose or sometimes with veins, 0.7–3.5 mm wide. Rhizines black, simple or branched, dense and abundant, widely dispersed, 0.10–1.00 × 0.02–0.05 mm. Apothecia absent [according to Fleig (1997), laminar, imperforate, 3–4 mm in diameter, urceolate, substipitate, entire or split, amphitheicum isidiate, eciliate; ascospores 19.0–31.0 × 9.5–15.0 μm, episporium 3 μm]. Pycnidia rare, submarginal, with black ostiole; conidia bacillar to slightly sublageniform, 5.0–7.0 × ca. 1.0 μm.

Color tests: cortex K+ yellow, UV–; medulla K+ yellow, C–, KC+ rose-orange, P+ slowly orange, UV–.

TLC: atranorin, norlobaridone, stictic acid, constictic acid, cryptostictic acid and hypocryptstic acid.

Distribution: Africa (Dodge 1959, as *Parmelia meiosperma*), North America (Hale 1979, Esslinger 2008) and South America, where it is known to Brazil (Zahlbruckner 1930, Marcelli 2004). In Brazil it was recorded to MG (Ribeiro 1998), PR (Fleig 1997, Eliasaro 2001, Eliasaro & Donha 2003), RS (Spielmann 2006), SC (Fleig 1997) and SP (Marcelli 1991, 1992, Fleig 1997).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuinh, Perau da Nega, 29°20′02.2″S, 52°26′27.9″W, 440 m alt., close to a stream, 24-II-2004, A.A. Spielmann & L.S. Canêz 1252 (SP); Sinimbu, Cava Funda, 29°27′1.6″S, 52°31′02.9″W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 1167 (SP).

*Parmotrema internexum* is characterized by the laminal isidia, ciliate lobes and the presence of norlobaridone (medulla KC+ rose-orange) and stictic acid (medulla K+ yellow, P+ slowly orange). *Parmotrema crinitum* (Ach.) M. Choisy, has a robust thallus (8-25 cm broad), wider lobes (6–12 mm), often ciliate isidia, and norlobaridone lacking (Hale 1965).

In solvent C, the norlobaridone was “masked” inside the dot of stictic acid, but in solvent A the two dots were sharply distinct. However, the presence of this substance seems not universal, since it was not detected by Eliasaro (2001) and, according to Fleig (1997) and Eliasaro & Donha (2003), it was present only in some specimens.

The synonymy of this species is unclear. Hale (1974d) placed *Parmelia internexa f. meiosperma* Hue in *Pseudoparmelia* Lyng. Fleig (1997) listed...
Parmelia internea var. meiosperma Hue, P. meiosperma (Hue) C.W. Dodge and P. catharinensis Müll. Arg. f. isidiosa Müll. Arg. as synonyms of Parmotrema interneum. However, in Hale & DePriest (1999) the first two names are synonyms of Hypotrachyna bogotensis (Vainio) Hale and the last one of Parmotrema crinitum (Ach.) M. Choisy.


Figure 20
Thallus pale gray, lobate, subcoriaceous, fragile, loosely adnate, saxicolous, ca. 20 cm broad. Lobes irregularly branched, laterally overlapping, 7.0–27.0 mm wide, surface smooth, lustrous, reticulate cracked and slightly rugose in the older parts, usually with several scars; apical zone subconcave, undulate, ascendant, to involute, margin sublacinulate, margin crenate; lateral marginal zone undulate, plane to ascendant, subimbricate, margin entire to sublacinulate. Lacinules and maculae absent. Cilia black, usually simple, sometimes furcated, usually thickened and spiky, 0.50–3.50 × 0.05–0.10 mm, abundant, evenly distributed. Pustules, soredia and isidia absent. Medulla white. Lower surface black, lustrous, veined; with scars or cracks; marginal zone dark brown or sometimes black, 2.0–9.0 mm wide, nude, lustrous, smooth or papillate, having a wide area with young rhizines, with a sharp limit. Rhizines black, simple or sometimes furcated, rarely square, narrow to thickened, 0.30–3.00 × 0.02–0.10 mm, abundant, dispersed in groups. Apothecia absent [according to Eliasaro (2001), laminal, adnate, disc dark brown, imperforate, 2.5–5 mm in diameter; ascospores 13–18 × 6–10 µm]. Pycnidia submarginal to rarely marginal, ostiole black; conidia bacillar to filiform, 6.5–11.0 × ca. 1.0 µm.

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

TLC: atranorin, salazinic and consalazinic acids.

Distribution: known only to South America, where it was reported to Brazil (Hale 1990, Marcelli 2004). In Brazil it was recorded to MG (Hale 1990, Fleig 1997, Ribeiro 1998), PR (Fleig 1997, Eliasaro 2001) and RS (Spielmann 2006).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Barros Cassal, Nascente do Rio Pardo, 28°57’38.7”S, 52°38’53.9”W, 700 m alt., open place, close to a stream, 27-I-2004, A.A. Spielmann et al. 938 (SP).

Parmotrema mantiqueirense is distinguished by the wide lobes (7–27 mm), emaculate upper surface, the presence of salazinic acid (medulla K+ yellow → blood red, P+ yellow → orange) and the absence of vegetative propagules. P. eurysacum (Hue) Hale has subpalmate lacinules, often branched and longer cilia (1.5–5.0 mm) and perforate apothecia.

Although Fleig (1997) asserted that P. mantiqueirense occurs in North America, we were unable to confirm this information.


Figure 21
Thallus olivaceous gray, lobate, subcoriaceous, loosely adnate, saxicolous, 7.5 cm broad. Lobes irregularly branched, laterally overlapping, (3.0–) 5.0–10.0 mm wide, median axis plane to subascendant, surface smooth, lustrous, becoming slightly rugose towards the center; apical zone plane to undulate, margin crenate; lateral marginal zone undulate, plane to ascendant, subimbricate, margin entire. Lacinules, pustules, soredia and isidia absent. Maculae distinct, punctiform, laminal. Cilia black or cupreous (then K+ purplish), simple or rarely furcated, 1.00–4.00 × 0.05–0.10 mm, abundant, evenly distributed. Medulla white. Lower surface black, lustrous, veined; marginal zone beige or white variegated, usually with brown patches, sometimes with purplish patches, 4.0–8.0 (–15.0) mm, nude, lustrous, smooth to rugose, with a sharp limit. Rhizines black or brown, simple to irregularly branched, narrow to thickened, 0.10–0.30 × 0.10–0.20 mm, frequent, dispersed in groups, sometimes reaching the margin. Apothecia urceolate, laminal, 1.0–2.0 mm in diameter, stipitate, with a wide base, margin crenate, amphithecium strongly maculated, ciliate, disc concave, epruinose, imperforate or rarely perforate (one from seven apothecia seen), immature;
hymenium little developed and ascospores absent [according to Hale (1965), hymenium 80–100 µm; ascospores 20–26 × 10–16 µm, episporium 2–3 µm]. Pycnidia submarginal or touching the margin, conspicuous, without prominent margin, ostiole black; conidia bacillar to filiform, 6.5–10.0 × ca. 0.5 µm.

Color tests: cortex K+ yellow, UV−; medulla K−, C−, KC−, P−, UV−.

TLC: atranorin, protopraesorediosic acid.

Distribution: Oceania (Feuerer 2005), Africa (Réunion Island) and South America (Hale 1965). In South America it is known to Brazil (Marcelli 2004), Peru (Feuerer 2005) and Venezuela (Vareschi 1962). In Brazil it was recorded to MA (Hale 1965), MG (Lynge 1914, Hale 1965, Ribeiro 1998), MS (Osorio 1992b), MT (Lynge 1914, Fleig 1997, Ribeiro 1998), PR (Hale 1965, Fleig 1997, Eliasaro 2001), RJ (Hale 1965), RS (Spielmann 2006), SC (Fleig 1997) and SP (Hale 1965; Marcelli 1991, 1992, Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20'02.2"S, 52°26'27.9"W, 440 m alt., close to a stream, slightly shaded, 24-II-2004, A.A. Spielmann & L.S. Canêz 1033 (SP).

Parmotrema melanothrix is distinguished by the long, abundant cilia (1–4 mm), maculate upper cortex, conidia bacillar to filiform, 6.5–10.0 µm long, just protopraesorediosic acid in the medulla (spot tests negative) and the absence of vegetative propagules. P. catarinae Hale has gyrophoric acid (Hale 1986). P. glaucocarpoides (Zahlbr.) Hale has sublageniform conidia 5–6 µm long and protolichesterinic acid (Krog & Swinscow (1981).

According to Hale (1965), Fleig (1997), Ribeiro (1998) and Eliasaro (2001), the medullar substance typical of P. melanothrix is protolichesterinic acid, yet in the specimen here studied just protopraesorediosic acid was found.


Figures 22-23, 41
Parmotrema mellissii is characterized by the isidiate thallus with alectoronic acid (medulla KC+ rose → quickly orange, UV+ greenish blue). The similar P. hypomiltoides do not form isidia, but soredia, often in arbuscular structures. The cilia are simple to irregularly branched (figure 41). Parmotrema mordenii (Hale) Hale, Phytologia 28(4): 337. 1974 = Parmelia mordenii Hale, Smithsonian Contributions to Botany 4: 19. 1971. Type: DOMINICA. North of Coulibistri, ca. 30 m alt. M.E. Hale 35649 (holotype US, isotypes BM, UPS), fide Hale (1971b).

Figure 24

Thallus greenish gray or with some gray patches, especially in the lobe apices, lobate, membranaceous, adnate, saxicolous, 15 cm broad. Lobes irregularly branched, laterally overlapping, 2–10 mm wide, surface smooth or sometimes cracked, opaque to sublustrous, becoming rugose and cracked in the old parts; apical zone plane to subconcave, undulate, often involute, margin entire to crenate; lateral marginal zone undulate, imbricate to ascendant, or frequently sinuose; soredia subgranular. Medulla white. Lower surface black, lustrous, rugose; marginal zone brown, lustrous, 2.0–6.0 mm wide, nude, smooth, rugose or papillate, with attenuate limit. Rhizines concolor to the lower surface, simple although usually joined and forming disks of adherence to the substrate, 0.10–0.50 × 0.05–0.10 mm, frequent, dispersed in small groups. Apothecia unknown. Pycnidia laminal to submarginal, barely conspicuous, ostiole black; conidia sublageniform, 4.0–6.5 × 1.0 µm.

Color tests: cortex K+ yellow, UV−; medulla K+ yellow, C−, KC−, P+ slowly weak yellow, UV−.

TLC: atranorin (cortical and medullar), caperatic acid, protpraesorediosic acid and protolichesterinic acid.

Distribution: Africa (Winnem 1975), Central America (Hale 1971b), North America (Jackson & Hopkins 1980, Esslinger 2008) and South America (Feuerer 2005). In South America it is known to Brazil (Marcelli 1991) and Venezuela (Feuerer 2005). In Brazil it was recorded to SP (Marcelli 1991).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sinimbu, Cava Funda, 29°27'41.8"S, 52°31'11.7"W, 500 m alt., open place, 12-II-2003, A.A. Spielmann (SP).

Parmotrema mordenii is recognizable by the adnate thallus, eciliate lobes, presence of soralia and medulla with atranorin (K+ yellow, P+ slowly weak yellow). In P. praesorediosum the soralia are usually crescent-shaped and atranorin is lacking in the medulla. Although Sipman (2005) also treat these two species as distinct, Krog & Swinscow (1981) putted P. mordenii as synonym of P. praesorediosum.

In the protologue of P. mordenii, Hale (1971b) stated that the soralia could occasionally form coralloid subfatiscent structures. We found in the specimen collected some pustular, capitate soralia that remember this description, however, more material is necessary to prove if this is also a good feature to take this species apart from P. praesorediosum.


Figure 26

Thallus greenish gray or brownish in herbarium, lobate, membranaceous, loosely adnate, saxicolous, 7.0 cm broad. Lobes irregularly branched, laterally overlapping, 4.0–7.0 mm wide, surface continuous, smooth to subrugose, opaque to sublustrous, becoming reticulate cracked in the center; apical zone subconcave, undulate to plane, margin crenate; lateral marginal zone undulate, imbricate to ascendant and involute, margin crenate to incise-crenate (sublacinulate). Lacinules, maculae, pustules and isidia absent. Cilia black, simple, (0.20−) 0.50−1.00 × 0.02 (−0.10) mm, frequent, evenly distributed but
less common in the lobe apices. Soralia concolor to the thallus, linear, marginal, sometimes wide or subcontinuous, turning the margins undulate and involute, or orbicular to capititate in the sublacinules; soredia farinose to subgranular. Medulla white. Lower surface black, lustrous, rugose; marginal zone brown, 1.0–2.0 mm, lustrous, smooth to rugose, with a sharp limit. Rhizines black, simple, 0.30–1.00 × 0.01–0.02 mm, abundant, evenly distributed. Apothecia absent [according to Hale (1965), 3–5 mm in diameter, disc imperforate; hymenium 70–80 μm; ascospores 22–30 × 13-16 μm, episporium 3 μm]. Pycnidia absent [according to Maas-Gesteranus (1947, as Parmelia trichotera Hue), pycnidia with a black ostiole; conidia cylindrical, 5–7 × ca. 1 μm].

Color tests: cortex K+ yellow, UV−; medulla K+ yellow, C−, KC−, P+ orange, UV−.

TLC: atranorin, stictic acid, constictic acid, cryptostictic acid, hypoconstictic acid, hypostictic acid, menegazziaic acid and norstictic acid.

Distribution: Oceania (Elix 1994, Malcolm & Galloway 1997, Louwhoff & Elix 1999, Kantvilas et al. 2002), Asia (Hale 1965, Kurokawa 1991b, Kurokawa & Lai 2001), Europe (Hale 1965), Africa (Hale 1965, Swinscow & Krog 1988), North America (Hale 1965, Brodo et al. 2001, Nash & Elix 2002a), Central America (Hale 1965), and South America (Hale 1965). In South America it is known to Argentina (Adler 1992, Calvolo & Liberatore 2002), Bolivia (Feuerer 2005), Brazil (Marcelli 2004), Chile (Hale 1965), Uruguay (Osorio 1972) and Venezuela (Feuerer 2005). In Brazil it was recorded to MG (Hale 1965), Uruguay (Osorio 1972) and Venezuela (Hale 1965). In South America it is known to Central America (Hale 1965), and South America (Hale 1965). In South America it is known to Argentina (Adler 1992, Calvolo & Liberatore 2002), Bolivia (Feuerer 2005), Brazil (Marcelli 2004), Chile (Hale 1965), Uruguay (Osorio 1972) and Venezuela (Feuerer 2005). In Brazil it was recorded to MG (Ribeiro 1998), PR (Eliasaro 2001, Eliasaro & Donha 2003), RS (Spielmann 2006), SC (Feuerer 2005) and SP (Marcelli 1997).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sinimbu, Cava Funda, 29°27′41.8″S, 52°31′11.7″W, 500 m alt., open place, 4-II-2003, A.A. Spielmann 65 (SP).

**Parmotrema perlatum** (Nyl.) Hale there’s also a lower white margin (as *P. hypoleucinum*) but it has just norstictic acid, the medulla being K+ yellow → red (Brodo et al. 2001). Finally, *P. rampoddense*, although with a similar morphology, presents electroronic acid (medulla KC+ rose → quickly orange, UV+ greenish blue).

Some authors (Hale 1965, Swinscow & Krog 1988, Eliasaro 2001, Sipman 2005) described *P. perlatum* with revolute lobes, while Feuer (1997) called them involute and Hale & Cole (1988) as “revolute with the apex involute”. This last observation agrees with the specimen here seen. The presence of trace of norstictic acid in the solvent C, already reported by Elix (1994) and Brodo et al. (2001), was confirmed here too.


Figure 27

Thallus aluminium gray or slightly straw pinkish, lobate, adnate, membranaceous, saxicolous, 6.0–10.5 cm broad. Lobes irregularly branched, laterally overlapping, 3.0–10.0 mm wide, surface smooth, opaque to sublustrous, becoming rugose and cracked in the old parts; apical zone subplane to slightly concave, undulate, usually ascendant, margin entire to subcrenaee; lateral marginal zone undulate, imbricate to ascendant, margin entire to crenate. Lacinules, maculae, pustules, isidia and cilia absent. Soralia whitish or slightly grayish, usually crescent-shaped or more wide and dense, or orbicular to capititate, marginal to submarginal or laminal, turning the lateral margins ascendant and sometimes densely sinuous; soredia subgranular. Medulla white. Lower surface black, lustrous or opaque, smooth to rugose; marginal zone pale brown or sometimes black or white variegated, 3.0–7.0 mm wide, lustrous or opaque, with a sharp limit, smooth to reticulate rugose or with veins, sometimes papillate. Rhizines black or concolor to the lower surface, sometimes brown with white apices, usually...
simple, 0.20–0.80 × 0.05–0.10 mm, few to frequent, dispersed in small groups. Apothecia laminal, very immature (asci and ascospores not developed), rare [according to Hale (1965), apothecia 4–10 mm in diameter, with a short stipe, amphithecium rugose and sorediate, disc imperforate; hymenium 70–80 µm; ascospores 15–21 × 7–10 µm, episporem 1.2–2.0 µm]. Pycnidia submarginal to laminal, ostiole black; conidia sublageniform, 4.0–7.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV−; medulla K−, C−, KC−, P−, UV−.

TLC: atranorin, praesorediosic acid, caperatic acid, protolichesterinic acid and an unidentified substance of Rf 54 in solvent C.

Distribution: Oceania (Elix 1994, Louwhoff & Elix 1999), Africa (Hale 1965, Swinscow & Krog 1988), Asia (Hale 1965), North America (Hale 1965, Esslinger 2008), Central America (Hale 1965) and South America (Hale 1965). In South America it is known to Argentina (Hale 1965, Calvelo & Liberatore 2002), Brazil (Hale 1965, Marcelli 2004), Chile (Feuerer 2005), French Guiana, Paraguay (Hale 1965), Uruguay (Osorio 1992a) and Venezuela (Hale 1965, Vareschi 1973). In Brazil it was recorded to BA (Lynge 1914, as Parmelia capitata), MG (Hale 1965), MS (Fleig & Riquelme 1991), PA (Brako et al. 1985), RJ (Hale 1965), RS (Spielmann 2006), SC (Fleig 1997) and SP (Marcelli 1991, 1992).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Santa Cruz do Sul, margin from highway RST-287, km 102, 29°41'03.3"S, 52°25'33.6"W, 150 m alt., 28-VII-2003, A.A. Spielmann 386 (SP), A.A. Spielmann 399 (SP).

Parmotrema praesorediosum is characterized by the adnate thallus, eciliate lobos, crescent-shaped soralia and medulla with caperatic acid, praesorediosic acid and protolichesterinic acid and an unidentified substance of Rf 54 in solvent C.

Distribution: Oceania (Elix 1994, Louwhoff & Elix 1999), Africa (Hale 1965, Swinscow & Krog 1988), Asia (Hale 1965), North America (Hale 1965, Esslinger 2008), Central America (Hale 1965) and South America (Hale 1965). In South America it is known to Argentina (Hale 1965, Calvelo & Liberatore 2002), Brazil (Hale 1965, Marcelli 2004), Chile (Feuerer 2005), French Guiana, Paraguay (Hale 1965), Uruguay (Osorio 1992a) and Venezuela (Hale 1965, Vareschi 1973). In Brazil it was recorded to BA (Lynge 1914, as Parmelia capitata), MG (Hale 1965), MS (Fleig & Riquelme 1991), PA (Brako et al. 1985), RJ (Hale 1965), RS (Spielmann 2006), SC (Fleig 1997) and SP (Marcelli 1991, 1992).


Figure 28

Thallus greenish gray to pale gray, lobate, membranaceous to subcoriaceous, loosely adnate, corticicolous or saxicolous, 4.5–20.0 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 4.0–20.0 mm wide, surface smooth, rugose, irregular or scrobiculate, opaque to lustrous, becoming rugose and cracked towards the center; apical zone plane to concave, usually ascendant and sometimes revolute, undulate, margin entire to subcrenate or sublacinulate; lateral marginal zone undulate, plane, ascendant, subumbonate or involute, margin entire to subcrenate or sublacinulate to lacinulate. Lacinules simple, plane, 0.5–2.5 (−4.0) × 0.5–2.5 mm, evenly distributed or sometimes only in the center, apex truncate to rounded, lower surface black, rarely brown or white variegated; maculae absent. Cilia black or cupreous and then K+ purplish, simple, furcated or irregularly branched, 0.50–6.0 × 0.02–0.10 mm, frequent to abundant, evenly distributed. Pustules and isidia absent. Soralia whitish, marginal to submarginal, linear interrupted or wider (up to 2.5 mm) and approaching the lamina, turning the lateral margins involute, or capitate, laminal or in the lacinules apices; soredia farinose to grossly granular, coalescing in the older parts, sometimes developing small cilia. Medulla white, except by some orange parts K+ red in older parts, close to the lower cortex. Lower surface black, lustrous, smooth to rugose; marginal zone brown or sometimes black or with parts white or beige variegated close to the soralia, 1.0–4.0 mm wide, nude, sublustrous, lustrous or opaque, smooth to rugose or rugose-reticulate, rarely with veins, with an attenuate or sharp limit. Rhizines black, simple, furcated or irregularly branched, 0.20–3.50 × 0.02–0.05 (−0.10) mm, usually longer in the marginal zone than in the central lobe margins, frequent to abundant, dispersed in groups by almost all surface, sometimes some rhizines reaching the...
margin. Apothecia absent [according to Hale (1965), 3–10 mm in diameter, amphithecium sorediate, disc imperforate; hymenium 65–75 μm; ascospores 10–12 × 6–7 μm, episporium 1 μm]. Pycnidia submarginal to laminal, barely conspicuous, without prominent margin, ostiole black or brown; conidia bacillar to filiform, 5.0–9.0 × ca. 1.0 μm.

Color tests: cortex K+ yellow, UV−; medulla K−, C+ rose → quickly orange or C− (rarely C+ yellowish in some areas), KC+ rose → quickly orange, P−, UV+ greenish blue. Soredia sometimes UV+ slightly yellowish. The orange pigment (skyrin) is lacking in some specimens.

TLC: atranorin, alectoronic acid, α-collatolic acid and skyrin.

Distribution: Oceania (Hale 1965, Elix 1994, Louwhoff & Elix 1999); Asia (Hale 1965, Awasthi 1976, Kurokawa 1991b, Kurokawa & Lai 2001, Elix & Schumm 2001, Louwhoff & Elix 2002), Africa (Hale 1965, WinneM 1975), North America (Hale 1965, Brodo et al. 2001, Esslinger 2008), Central America (Hale 1965) and South America (Hale 1965). In South America it is known to Argentina (Calvelo & Liberatore 2001), Bolivia (Hale 1965), Brazil (Marcelli 2004), Chile (Feuerer 2005), Colombia (Hale 1965), Guyana (Feuerer 2005), Uruguay (Osorio 1992a) and Venezuela (Feuerer 2005). In Brazil it was recorded to MG (Hale 1965), PR (Eliasaro 2001, 2006), RS (Spelmam 2006) and SP (Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Paru da Nega, 29°20′02.2″S, 52°26′27.9″W, 440 m alt., slightly shaded place, 24–II–2004, A.A. Spelmam & L.S. Canez 1254 (SP); Herveiras, 29°25′53.7″S, 52°40′19.6″W, 570 m alt., open place, 20–I–2004, A.A. Spelmam & J. Putzke 1253 (SP); Sinimbu, Cava Funda, 29°27′41.8″S, 52°31′11.7″W, 500 m alt., open place, 4–II–2003, A.A. Spelmam 09 (SP), A.A. Spelmam 17 (SP), A.A. Spelmam 25 (SP); idem, 12–II–2003 A.A. Spelmam 94 (SP); idem, open place, 12–II–2003, A.A. Spelmam 106 (SP); idem, Linha Almeida, 29°23′20.2″S, 52°30′21.9″W, wrapping a wooden stub, close to ground, open place, 5–IV–2003, A.A. Spelmam 255 (SP); idem, Linha Almeida, 29°23′20.2″S, 52°30′21.9″W, on bark of Araucaria angustifolia, open place, 5–I–2004, A.A. Spelmam & L.S. Canez 1204 (SP); idem, Salto Rio Pardinho, 29°22′54.8″S, 52°32′33.2″W, 250 m alt., at river’s margin, shaded place, 2–II–2003, A.A. Spelmam & M.A. Sulzbacher 471 (SP).

Parmotrema rampoddense is recognizable by the ciliate lobes, marginal to submarginal soralia, the presence of alectoronic acid (medulla UV+ greenish blue), conidia bacillar to filiform, 5.0–9.0 × ca. 1.0 μm and the orange pigment K+ red (skyrin). In P. pooli (C.W. Dodge) Krog & Swinscow the conidia are sublageniform, 7–8 μm long (Krog & Swinscow 1981). Parmotrema hypomiltoides develops soredia in arbuscular structures, while P. mellissii has ciliate isidia and finally in P. exquisitum (Kurok.) DePriest & Hale, reported for Uruguay, the lobes are eciliate (Kurokawa 1987). Nevertheless, Fleig (1997) regarded this last species as synonym of P. rampoddense, stating that the type of P. exquisitum seems an old specimen that suffered weather conditions.

The K+ purplish reaction of some cilia was also observed in the type of P. rampoddense (Krog & Swinscow 1981).


Figure 30

Thallus greenish gray, lobate, membranaceous to subcoriaceous, loosely adnate, corticolous or saxicolous, 8.5–11.0 cm broad. Lobes irregularly branched, laterally overlapping, contiguous or crowded, 4.0–20.0(–25.0) mm wide, surface smooth or slightly rugose, opaque to sublustrous, becoming rugose and cracked in the center; apical zone plane to subconcave, undulate, margin crenate; lateral marginal zone undulate or strongly undulate towards the center, ascendant, sometimes involute, margin entire to crenate or sublacinulate. Lacinules, pustules, isidia and maculae absent. Cilia simple or less frequently furcated, (0.50–) 1.00–5.50 × 0.05–0.10 mm, usually ascendant, frequent to abundant, evenly distributed. Soralia white, linear, continuous or interrupted, wider in the thallus center, marginal; soredia farinose to subgranular. Medulla white. Lower surface black, lustrous, smooth to rugose; marginal zone pale brown, sometimes dark brown, white variegated or cream color, or still black, 3–15
mm wide, nude, lustrous, smooth to papillate or rugose, sometimes strongly veined, with a sharp or attenuate limit. Rhizines black, cream color, pale brown, whitish or brown with the apices whitish, or concolor to the margin, usually simple, sometimes furcated or rarely more branched, 0.50–2.50 × (0.02–) 0.05–0.15 (–0.20) mm, frequent to abundant, dispersed in groups. Apothecia absent [according to Hale (1965), adnate, disc imperforate; hymenium 65 µm; ascosporae 13–18 × 7–10 µm, episporium 1.0 µm, but see the Notes below]. Pycnidia submarginal, ostiole black; conidia sublageniform, 5.0–9.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV−; medulla K−, C+ rose or red, KC+ rose or red, P−, UV−.

TLC: atranorin, gyrophoric acid.


Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Perua da Nega, 29°20′02.2″S, 52°26′27.9″W, 440 m alt., in the stream’s margin and close to the street, in a little shaded place, 24-II-2004, A.A. Spielmann & L.S. Canêz 1061 (SP); idem, Cascata do Gamelão, 29°18′13.7″S, 52°26′51.7″W, 500 m alt., in the stream’s margin, slightly shaded, 31-I-2004, A.A. Spielmann & M.A. Sulzbacher 1110 (SP); Herveiras, 29°25′53.7″S, 52°40′19.6″W, 570 m alt., slightly shaded, 24-I-2004, A.A. Spielmann et al. 727 (SP); Sobradinho, margin from RST-481, next to the crossroads, 29°24′20.2″S, 53°01′25.9″W, 375 m alt., open place, 17-VII-2003, A.A. Spielmann 332 (SP).

Parmotrema sancti-angeli is distinguished by the ciliate lobes, marginal and linear soralia, the presence of gyrophoric acid (medulla C+ rose or red) and sublageniform conidia 5.0–9.0 × ca. 1.0 µm. In P. indicum the thallus is robust and the conidia filiform, 8.0–12.5 × ca. 1.0 µm (see also the Notes under this species), and P. permutatum (Stirton) Hale has the lower medulla yellow, because the presence of secalonic acid A (Fleig 1997).


Figure 32

Thallus aluminium gray, lobate, membranaceous, loosely adnate, saxicolous, 16.5 cm broad. Lobes irregularly branched, laterally overlapping, 4.0–11.0 mm wide, surface smooth, lustrous or opaque, becoming reticulate cracked in the center; apical zone plane to subconcave, usually ascendant, sometimes involute, undulate, margin strongly crenate; lateral marginal zone undulate, plane to ascendant, usually involute, margin crenate to incise-crenate (subclacinulate). Lacinules and isidia absent. Maculae weak, punctiform, laminar. Cilia black, simple or furcated, usually spiky, 0.20–2.00 × 0.02–0.15 mm, frequent, dense to spread, evenly distributed. Pustules capitate, marginal to submarginal, fragmenting in soredia. Soralia pustular, marginal to submarginal, at first narrow, then becoming wider and turning the margins thickened and involute, or subcapitate; soredia granular, sometimes isidioid, usually coalescing and somewhat stiff, forming a granular aggregate. Medulla white, sometimes with orange patches K+ yellow → blood red close to the lower cortex. Lower surface black, lustrous, smooth to rugose; marginal zone brown dark, 1.5–4.0 mm wide, nude, lustrous, smooth to rugose, with attenuate to sharp limit. Rhizines black, simple or irregularly branched, 0.20–2.00 × 0.02–0.15 mm, abundant, covering almost all the surface. Apothecia absent [according to Kurokawa (1974), stipitate, 3–10 mm in diameter, disc dark brown, perforate, splitted when mature; hymenium ca. 50 µm; ascosporae 12–14 × 7–10 µm]. Pycnidia submarginal, without prominent margin, ostiole black; conidia filiform, straight or slightly arcuate, 7.5–12.0 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV−; medulla K+ yellow → blood red, C− or C+ slowly yellowish,
KC+ orange, P+ yellow → orange, UV+ yellow-orange. Some orange patches are present, K+ yellow → blood red.

TLC: atranorin, salazinic acid, consalazinic acid, lichexanthone, and unidentified substance of Rf 49 in solvent C.

Distribution: Brazil (Marcelli 2004), where it was recorded to PR (Kurokawa 1974, Fleig 1997), RJ (Kurokawa 1974), RS (Spielmann 2006), SC (Fleig 1997) and SP (Fleig 1997, Ribeiro 1998).

Specimens examined: B (SP). 22-II-2004, A.A. Spielmann & L.S. Canêz 1161 (SP), A.A. Spielmann & L.S. Canêz 1162 (SP).

Parmotrema spinibarbe is distinguished by the ciliate lobes, sorediose pustules, presence of salazinic acid and lichexanthone (medulla K+ yellow → blood red, UV+ yellow-orange), and imperforate apotheca. Two other similar species share the same chemistry: P. ultralucens (Krog) Hale has isidia instead of soredia and longer ascospores, 15–17 × 2.5–4.0 µm; P. lichexanthonicum Eliasaro & Adler the vegetative propagules are lacking (Eliasaro & Adler 1997).

Eliasaro & Adler (1997) stated that P. lichexanthonicum could be the parental species of P. ultralucens. Yet, P. ultralucens has imperforate apothecia, while in P. lichexanthonicum they are perforate. According to Hale (1965), species pairs with these distinct features are not known. So maybe this is the first report.


Type: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Peru da Nega, 29°20’17.2” S, 52°26’33.6” W, 430 m alt., on the steep slope in the left side of the stream, partially shaded, 22-II-2004, A.A. Spielmann & L.S. Canêz 1161 (SP), A.A. Spielmann & L.S. Canêz 1162 (SP).

Parmotrema subrugatum is recognizable by the unciform conidia, the presence of alectoronic acid and α-collatolic acid. TLC: atranorin, alectoronic acid and α-collatolic acid.

Distribution: Oceania (Hale 1965, Elix 1994, Louwhoff & Elix 1999), Asia, Africa (Hale 1965, Kurokawa & Lai 2001) and Americas (Hale 1965). In South America it is known to Argentina (Hale 1965, Calvelo & Liberatore 2002), Brazil (Marcelli 2004) and Uruguay (Osorio 1972). In Brazil it was recorded to MG (Hale 1965, Fleig 1997, Ribeiro 1998), PA (Brako et al. 1985, as Parmotrema cf. subrugatum), PR (Osorio 1977a/b, Eliasaro 2001), RJ (Hale 1965), RS (Spielmann 2006) and SP (Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sobradinho, margin from RST-481, next to the crossroads, 29°24’20.2”S, 53°01’25.9” W, 375 m alt., open place, 17-VII-2003, A.A. Spielmann 360 (SP).
(medulla KC+ rose → quickly orange, UV+ greenish blue), apothecia imperforate, ascospores large (up to 34 µm), the lower ivory white margin and the absence of vegetative propagules. *Parmotrema wainioi* (A.L. Smith) Hale has a brown lower margin, bacillar to filiform conidia and smaller ascospores (up to 22 µm according to Vainio 1890). In *P. argentinum* (Kremp.) Hale, the conidia are bacillar (Fleig 1997), the apothecia often ciliate, ascospores with up to 22 µm (Hale 1965). *P. rigidum* (Lynge) Hale has filiform conidia and perforate apothecia. Finally, in *P. laciniatulum* Krog the conidia are sublageniform (Krog 1991).

Apparently *P. subrugatum* is the only known species of *Parmotrema* with unciform conidia. However, the literature about is very unclear. Vainio (1890) described the conidia as cylindrical 4–5 × 1 µm. Zahlbruckner (1926b) as bacillar, 3.8–6.5 × 0.5–0.7 µm. In this paper specimens from Brazil collected by Weddel revealed bacillar and slightly arcuate conidia, 2.5–5.0 × 0.6–0.7 µm. Based on the type of conidia found (cylindrical, arcuate and apical zone, 4–5 × 0.5 µm), Lynge (1914) proposed *Parmelia subrugata* var. *arcuata*. Hale (1965) stated that the conidia of *Parmelia subrugata* were not seen, although before (Hale 1960) he found that the holotype presented conidia more or less arcuate, identical to that described by Lynge (1914). Fleig (1997) found unciform conidia, 5–8 (–9) µm long. In Elix (1994) and Louwhoff & Elix (1999) they are bacillar, 4–5 × 1 µm. Finally, Eliasaro (2001) found cylindrical a sublageniform, straight or slightly curved conidia, 5–8 µm long.

The specimen studied here is very similar to the holotype picture published by Hale (1965), where the strongly rugose apothecia and lacinulate lobes are sharply distinct.


Figure 35

Thallus pale to mineral gray, lobate, membranaceous, subcoriaceous or coriaceous, loosely adnate, corticicolous or saxicolous, 6–28 cm broad. Lobes irregularly branched, laterally overlapping or slightly crowded, (3–) 4–22 (–25) mm wide, surface smooth, opaque to lustrous, becoming rugose and cracked in the center; apical zone plane to subconcave, undulate; margin entire to crenate; lateral marginal zone undulate, subascendant to ascendant, more or less imbricate, involute, margin entire to crenate. Lobules sometimes present, laminal or marginal, 0.20–4.00 × 0.20–4.00 mm. Lacinules, cilia, pustules and soralia absent. Maculae usually absent, when present weak or distinct, laminal. Isidia with base concolor to the thallus or rarely brownish, apex pale or dark brown, simple to branched or sometimes forming coralloid aggregates 1.0–1.5 mm in diameter, narrow, granular or coalescing and coarsely granular, sometimes becoming sorediose, or papillary at young, erect, firm or caducous, starting in the crests or fissures, then becoming laminal, usually more dense in the central areas, 0.05–0.50 × 0.05–0.30 mm. Medulla white. Lower surface black, opaque or lustrous, rugose; marginal zone brown, brown and black variegated or sometimes entirely black, nude, lustrous or rarely opaque, with a sharp or attenuate limit, smooth, rugose, papillate or veined, (2.5–) 4.0–12.0 mm wide. Rhizines black or rarely brown at the margin, simple or furcated, sometimes with as flattened apices, 0.10–3.00 × 0.05–0.20 mm, frequent to few, dispersed in small groups or almost evenly. Apothecia absent [according to Hale (1965), up to 20 mm in diameter, excipulum isidiate-dentate, amphithecium rugose, maculate, isidiate, disc imperforate; ascospores 13–15 × 7–10 µm, episporium 1.5 µm]. Pycnidia rare, submarginal, ostiole black; conidia filiform, straight or arcuate, (7.5–) 9.0–16.5 (–17.5) × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV–; medulla K–, C+ red, KC+ red, P–, UV–.

TLC: atranorin, lecanoric acid.

Parmotrema stuhlmanii (C.W. Dodge) Krog & C. Trentin

This was the more common species found in the studied area, so commonly reported (see Spielmann & Marcelli 2006) at the point to be called “weedy” (Hale 1965). A very wide morphological variation is admitted, from cylindrical or coralloid isidia to isidia becoming sorediose. Maybe more taxa are being wrongly named and a revision of this group would be very welcome.

Parmotrema tinctorum is often authored as “(Nyl.) Hale”, i.e., without Déspréaux. Here we agree with Lyng (1914), Krog & Swinscow (1981), Louwhoff & Elix (1999), Hale & DePriest (1999) and Hawksworth (2004), since Nylander (1872) admitted the Déspréaux as the author of this species (see also the Vienna Code Art. 46.4, in MacNeill et al. 2007).

The specimens Spielmann 113 and Spielmann 354 are maculate. This feature is rarely found in the literature (just Galloway 1985), as well as the presence of lobules, reported by Krog & Swinscow (1981) and also observed in our specimens.


Figures 36, 38

Thallus pale gray, lobate, membranaceous to subcoriaceous, loosely adnate, corticicolous or saxicolous, 8.0–11.5 cm broad. Lobes irregular, laterally overlapping to crowded, 3–20 mm wide, surface smooth to irregular or scrobiculate, opaque to lustrous, becoming rugose or reticulate cracked in the center; apical zone plane to subconcave, ascend, involute or revolute, undulate, margin entire to crenate or incise-crenate (sublacinulate); lateral marginal zone undulate, ascend to imbricate, margin irregular to crenate or sometimes lacinulate. Lacinules plane to subcanaliculate, simple or furcated, evenly distributed, with rounded, truncate or acute apex, 2–12 mm, lower surface black or brown; maculae absent. Cilia black or sometimes red pigmented (then K+ purplish), usually simple, rarely furcated or irregular-branched (figure 38), 0.20–3.00 × 0.05–0.10 mm, abundant, evenly distributed. Pustules, soredia and isidia absent. Medulla white. Lower surface black, lustrous, smooth to rugose; marginal zone brown to pale brown, lustrous, 1–6 mm wide, with a sharp or attenuate limit, smooth, rugose, papillate-rhizinate, scrobiculate, with veins or with small ridges (relatives to the foveolae from Dennis 1965, Hale 1965). In Brazil it was recorded to MG (Lynge 1914, Hale 1965, Fleig 1997, Ribeiro 1998), MS (Fleig & Riquelme 1991, Osorio 1992b), MT, RJ (Lynge 1914, Hale 1965, Fleig 1997), PA (Brako et al. 1985), PR (Osorio 1977a/b, Eliasaro 2001), RS (Spielmann 2006), SC (Fleig 1997) and SP (Hale 1965, Osorio 1989, Nagaoka & Marcelli 1989, Pereira & Marcelli 1989, Marcelli 1991, Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Linha Sinimbuzinho, Perau da Nega, 29°20’02.2”S, 52°26’27.9”W, 440 m alt., stream’s margin and close to the street, shaded place, 24-II-2004, A.A. Spielmann & L.S. Canêz 1257 (SP); Herveiras, 29°25’53.7”S, 52°40’19.6”W, 570 m alt., open place, 12-II-2003, A.A. Spielmann & J. Putzke 1260 (SP); idem, 24-I-2004, A.A. Spielmann, L.S. Canêz & C. Trentin 932 (SP), A.A. Spielmann et al. 970 (SP); Santa Cruz do Sul, margin from RST-287, Km 102, 29°41’03.3”S, 52°25’33.6”W, 150 m alt., open place, 28-VII-2003, A.A. Spielmann 384 (SP); idem, on Eucalyptus trunk, open place, 28-VII-2003, A.A. Spielmann 397 (SP); Sinimbu, Cava Funda, 29°27’41.8”S, 52°31’05.1”W, 500 m alt., open place, 12-II-2003, A.A. Spielmann 62 (SP), A.A. Spielmann 100 (SP); idem, open place, 12-II-2003, A.A. Spielmann 98 (SP); idem, open place, 12-II-2003, A.A. Spielmann 113 (SP); idem, 29°27’33.4”S, 52°31’05.1”W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 1255 (SP); idem, 29°27’33.4”S, 52°31’05.1”W, 520 m alt., with mosses, open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 1256 (SP); Sobradinho, margin from RST-481, next to the crossroads, 29°24’20.2”S, 53°01’25.9”W, 375 m alt., open place, 17-VII-2003, A.A. Spielmann 354 (SP); idem, 17-VII-2003, A.A. Spielmann 357 (SP).

Parmotrema tinctorum is distinguished by the isidiate thallus, broad (4–22 mm) and ehitiate, and the presence of lecanoric acid (medulla C+ red). The apothecia are rare and imperforate (Hale 1965). Parmotrema stuhlmanii (C.W. Dodge) Krog & Swinscow has narrower lobes (6–8 mm) and perforate apothecia (Krog & Swinscow 1981), while P. pseudotinctorum (Abbeyes) Hale has inflated isidia 0.5 × 0.2–0.3 mm (Hale 1965). In P. internexum (Nyl.) Fleig, the medulla presents norlobaridone and stictic acid (K+ yellow).

This was the more common species found in the studied area, so commonly reported (see Spielmann 1998).
the upper surface). Rhizines black, simple, furcated or irregularly branched, 0.20–2.50 × 0.02–0.10 mm, abundant, evenly distributed but more dense in some areas. Apothecia absent [according to Vainio (1890, as Parmelia proboscidea), 5–20 mm in diameter, cupulate, sessile to subtipitate, imperforate, margin entire or crenulated, excipulum reticulate-rugose, ascospores 14–22 × 9–12 μm]. Pycnidia submarginal to laminal, conspicuous, with prominent margin, ostiole black; conidia bacillar to filiform, straight or arcuate, 6.0–12.5 × ca. 1.0 μm.

Color tests: upper cortex K+ yellow, UV--; medulla K–, C–, KC+ rose → quickly orange, P–, UV+ greenish blue.

TLC: atranorin, α-alectoronic, α-collatolic and an unidentified substance of Rf 31 in solvent C.

Distribution: Oceania, Africa (Feuerer 2005) and South America (Hale 1965). In South America it is known to Brazil (Marcelli 2004), where it was recorded to MG (Vainio 1890, as Parmelia proboscidea) Taylor, Hale 1965, Fleig 1997, Ribeiro 1998), PR (Fleig 1997, Eliasaro 2001), RJ, GO? (Fleig 1997), RS (Spielmann 2006), SC (Fleig 1997) and SP (Ribeiro 1998).

Specimens examined: Brazyil, rio grande do sul: Herveiras, 29°25’53.7”S, 52°40’19.6”W, 570 m alt., on Eucalyptus trunk, open place, 24-1-2004, A.A. Spielmann & J. Putzke 728 (SP); Sinimbu, Cava Funda, 29°27’31.6”S, 52°31’02.9”W, 520 m alt., open place, 5-1-2004, A.A. Spielmann & L.S. Canéz 986 (SP).

Parmotrema wainioi is recognizable by the presence of alectoronic acid (medulla UV+ greenish blue), bacillar to filiform conidia and the absence of vegetative propagules. P. pseudobreviciliatum Adler, Elix & Hale has shorter cilia, up to 2.5 mm long (Adler 1989). And in P. subrugatum the conidia are unciform.

The epithet “wainii” is in disagreement with the recommendation 60C.1 of the Vienna Code (McNeill et al. 2007), since the end should be “oi”. Ribeiro (1998) proposed “vainioi”, since from 1919 Wainio changed his last name to Vainio (Alava 1998). Nevertheless, the article 60.1 asserts that “the original spelling of a name or epithet is to be retained”, and the article 60.11, together with the recommendation 60C.1, deal with just the ends of the epithets, the correct spelling therefore is “wainioi”.

Group III – Rimelia-like lichens (species with reticulate maculae and rhizines often reaching the margin, without dimorphic rhizines, belonging to Rimelia sensu Hale & Fletcher)


Figure 4

Thallus greenish gray, lobate, loosely adnate, corticicolous, saxicolous or muscicolous, 4.5–8.0 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 2.5–7.0 mm wide, median axis extended to subascendant, surface smooth to slightly rugose, usually undulate or subscrobiculate, opaque to slightly lustrous, becoming rugose and reticulate cracked towards de center; apical zone subconcave, plane to ascendant, undulate; margin entire to incise-crenate (sublacinulate); lateral marginal zone plane to more often ascendant, margin lacinulate. Lacinules furcated, dichotomous or irregularly branched, 2.0–20.0 × 0.5–3.5 mm, plane to canaliculated and usually revolute, apex acute or sometimes truncate, lower surface black with brown margin, evenly distributed; maculae distinct, reticular, laminal, forming cracks. Cilia black, simple to square, 0.20–2.00 × 0.02–0.05 mm, frequent to few, evenly distributed. Pustules, soredia and isidia absent. Medulla white. Lower surface black, lustrous, smooth, rugose or veined; marginal zone brown, 1.5–5.0 mm wide, lustrous, rhizinate, with attenuate limit, smooth to veined or scrobiculate. Rhizines black, usually simple, sometimes irregularly branched, 0.10–1.00 × 0.01–0.05 mm, abundant, evenly distributed. Apothecia urceolate, 2–15 mm in diameter, stipitate, submarginal, margin smooth or incise, amphithecium maculate-reticulate, smooth to slightly scrobiculate or rugose,
Table 3. Correspondence between morphological structures and the presence of medullar substances in Rimelia-like lichens.

<table>
<thead>
<tr>
<th>MEDULLAR SUBSTANCES</th>
<th>WITHOUT VEGETATIVE PROPAGULES</th>
<th>SOREDIAE</th>
<th>ISIDIATE</th>
<th>PUSTULATE</th>
<th>WITH SCHIZIDIA OR DACTYLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SALAZINIC AND CONSALAZINIC ACIDS</td>
<td>P. cetratum</td>
<td>P. albinata</td>
<td>P. lacteum</td>
<td>P. pustulatum</td>
<td>P. austroceptratum</td>
</tr>
<tr>
<td></td>
<td>P. ramescens</td>
<td>P. clavulifera</td>
<td>P. communis</td>
<td>P. subisidiosum</td>
<td>P. hawaiianensis</td>
</tr>
<tr>
<td></td>
<td>(±)</td>
<td>P. pontagrossensis</td>
<td>P. reticulatum</td>
<td>P. ruminatum</td>
<td></td>
</tr>
<tr>
<td>PROTOCETRARIC ACID</td>
<td>P. succinreticulatum</td>
<td>P. austroceptratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(± trace)</td>
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<td></td>
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<tr>
<td>FUMARPROTOCETRARIC ACID</td>
<td>P. succinreticulatum</td>
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<tr>
<td>STICTIC ACID AND ALLIED</td>
<td>P. sticticum</td>
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<tr>
<td>LOXODIN</td>
<td>P. homotomum</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>NORLOBARIDONE</td>
<td>P. homotomum</td>
<td>P. communis</td>
<td>P. bonplandii</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GYROPHORIC ACID</td>
<td>P. cetratum (accessory)</td>
<td>P. clavuliferum (accessory)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LICHEXANTHINE</td>
<td>P. diffractaicum</td>
<td>P. pontagrossensis</td>
<td>P. bonplandii</td>
<td></td>
<td></td>
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<tr>
<td>DIFFRACTAIC ACID</td>
<td>P. diffractaicum</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>LOBARIC ACID</td>
<td>P. albinatum (trace)</td>
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<tr>
<td>MENEGAZZIAIC ACID</td>
<td>P. sticticum</td>
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<tr>
<td>CAPERATIC ACID</td>
<td>P. macrocarpum</td>
<td>P. simulans</td>
<td></td>
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<tr>
<td>FAT ACIDS</td>
<td>P. clavuliferum</td>
<td>P. succinreticulatum</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

 disc brown, epruinose, perforate, usually involute and split; epithecium 5–10 µm; hymenium 40–55 µm; subhymenium 15–30 µm; ascospores ellipsoid, 8.5–15.0 × 5.0–10.0 µm, episporium ca. 1 µm. Pycnidia laminal to submarginal or sometimes reaching the margin, present mainly on the lacinules, conspicuous, usually with prominent margin, ostiole black; conidia filiform, 10.0–17.5 × ca. 1.0 µm.

Color tests: cortex K+ yellow, UV−; medulla K+ yellow → blood red, C+ slowly yellowish or orange, KC+ orange, P+ yellow → orange, UV−.

TLC: atranorin, salazinic and consalazinic acids.


Specimens examined: BRAZIL. RIO GRANDE DO SUL: Boqueirão do Leão, Cascata do Gamelão, 29°18’13.7”S, 52°26’51.7”W, 500 m alt., right side of...
the stream, open place, 31-I-2004, A.A. Spielmann & M.A. Sulzbacher 1289 (SP); Herveiras, 29°25’53.7”S, 52°40’19.6”W, 570 m alt., with mosses, open place, 21-I-2004, A.A. Spielmann et al. 697 (SP); idem, on Eucalyptus trunk, open place, 24-I-2004, A.A. Spielmann et al. 717 (SP); Siminbu, Cava Funda, 29°27’41.8”S, 52°31’11.7”W, 500 m alt., open place, 4-II-2003, A.A. Spielmann 63 (SP); idem, 29°27’33.4”S, 52°31’05.1”W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 752 (SP); idem, Linha Almeida, 29°23’20.2”S, 52°30’21.9”W, 5-I-2004, A.A. Spielmann & L.S. Canêz 1292 (SP).

Parmotrema cetratum is recognizable by the absence of vegetative propagules and the production of salazinic acid (medulla K+ yellow → blood red). Some similar species can be distinguished: P. austrocetratum Elix & Johnston is a lacinulate, develops schizidia and has filiform conidia up to 25 μm long (holotype CHR!); P. hawaiiensis (H. Magn.) Blanco, Crespo, Divakar, Elix & Lumbsch also bear schizidia, but the conidia are just up to 15 μm long and the lacinules lacking (holotype S!); P. homotomum presents norlobardone and loxodin → blood red, C+ slowly yellowish or C-, KC+ orange, -2.00 × 0.02-0.05 mm, frequent to abundant, but infrequent in the sorediate parts, evenly distributed. Pustules and isidia absent. Soralia labriform, capitate or orbicular, present in the lacinules apices or sometimes submarginal; soredia farinose to granular. Medulla white. Lower surface black, lustrous; margin, ostiole black; conidia bacillar to filiform, 7.5–12.5 × ca. 1.0 μm.

According to the current literature, P. cetratum shows a wide range of morphological variation, maybe a consequence of too broad species concepts, clearly seen by the long list of synonyms attributed to this species (see Hale & Fletcher 1990).

Galloway (1985) reported several morphological differences between specimens from coastal rocks and from wood or bark inland. Fleig (1997) recognized three distinct groups of species, based on thallus shape. Interestingly, Moon et al. (2001), studying material from Hawaii, also established three groups, adding features from cilia and substrate preferences, and that correspond to Fleig’s groups. These patterns may be indicative of specific variation, not just environmental modifications.


Figures 5-7

Thallus pale gray, lobate, membranaceous, loosely adnate, saxicolous or muscicolous, 6.5–22 cm broad. Lobes irregularly branched, laterally overlapping, subpalmate-lacinulate, 2–12 mm wide, surface smooth, opaque to sublustrous, usually pruinose, becoming reticulate cracked in the center; apical zone plane to subconcave, undulate, margin crenate to sublacinulate; lateral marginal zone usually undulate and ascendant, margin usually lacinulate. Lacinules simple to furcated, 0.5–2.0 × 0.2–1.5 mm, plane to canalculated, apex acute to truncate, evenly distributed, lower surface white variegated under the soralia; maculae distinctly, reticular, laminal, forming cracks. Cilia black, simple or sometimes squarrose, 0.50–2.00 × 0.02–0.05 mm, frequent to abundant, but infrequent in the sorediate parts, evenly distributed. Pustules and isidia absent. Soralia labriform, capitate or orbicular, present in the lacinules apices or sometimes submarginal; soredia farinose to granular. Medulla white. Lower surface black, lustrous; margin, ostiole black; conidia bacillar to filiform, 7.5–12.5 × ca. 1.0 μm.

Color tests: cortex K+ yellow, UV−; K+ yellow → blood red, C+ slowly yellowish or C-, KC+ orange, P+ yellow → orange, UV−.

TLC: atranorin, salazinic and consalazinic acids.

Distribution: Oceania (Lamb 1963, Feuerer 2005), Asia (Feuerer 2005), Hawaii (Moon et al. 2001) and Brazil (Barros & Xavier Filho 1972).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Barros Cassal, 29°07’05.4”S, 52°41’19.9”W, open place, 24-1-2004, A.A. Spielmann et al. 725 (SP); Boqueirão do Leão, Linha Sinimbuzinho, Peru da Nega, 29°20’17.2”S, 52°26’33.6”W, 430 m alt., open place, 23-II-2004, A.A. Spielmann & L.S. Canêz 1347 (SP), A.A. Spielmann & L.S. Canêz 1359 (SP); idem, 29°20’02.2”S, 52°26’27.9”W, 440 m alt., slightly shaded, 24-II-2004, A.A. Spielmann & L.S. Canêz 722 (SP); Herveiras, 29°25’53.7”S, 52°40’19.6”W, 570 m alt., muscicolous, open place, 24-1-2004, A.A. Spielmann et al. 683 (SP); idem, open place,
20-I-2004, A.A. Spielmann & J. Putzke 1303 (SP); Sinimbu, Cava Funda, 29°27’41.8"S, 52°31’11.7"W, 500 m alt., open place, 12-II-2003, A.A. Spielmann 36 (SP); idem, 29°27’33.4"S, 52°31’05.1"W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 688 (SP); idem, 5-I-2004, A.A. Spielmann & L.S. Canêz 745 (SP); idem, 5-I-2004, A.A. Spielmann & L.S. Canêz 1305 (SP).

*Parmotrema clavuliferum* is distinguished by the sorediate lacinules (figure 6), white variegated lower margin under the soralia (figure 7), filiform conidia 7.5–12.5 \( \mu \)m long and the presence of salazinic (K+ yellow \( \rightarrow \) blood red). In *P. reticulatum* the soralia are laminal to submarginal (Moon *et al.* 2001) and the conidia 12–16 \( \mu \)m (Hale & Fletcher 1990). *Parmotrema pseudoreticulatum* (Tavares) Hale has a nude and brown lower margin, 2–4 mm wide (Tavares 1945), *P. commensuratum* produces norlobaridone and loxodin (K–, KC+ rose \( \rightarrow \) reddish) and *P. simulans* only caperatic acid (negative reactions).


**Figure 8**

Thallus greenish gray, lobate, membranaceous, loosely adnate, corticicolous or saxicolous, 6.5–11.0 cm broad. Lobes irregularly branched, contiguous to crowded, 2–10 mm wide, surface smooth to scrobiculate, lustrous, sometimes pruinose, becoming reticulate cracked in the center; apical zone subconcave, margin ascendant to revolute, undulate, crenate to sublacinulate; lateral marginal zone undulate, ascendant, margin lacinulate. Lacinules simple to furcated, 0.5–3.5 \( \times \) 0.4–2.0 mm, plane to canaliculate, apical zone, truncate or sometimes acute, evenly distributed; maculae distinct, reticulat, laminal, forming cracks. Cilia black, usually simple, rarely furcated or irregularly branched, 0.20–1.50 \( \times \) 0.02–0.05 mm, few to frequent, evenly distributed. Pustules and isidia absent. Soralia orbicular to labriform, submarginal or in the lacinules apices, often approaching the lamina and turning the margins involute; soredia subgranular to granular. Medulla white. Lower surface black, lustrous, smooth to rugose; marginal zone brown, lustrous, 1.5–3.0 mm wide, usually densely rhizinate, with attenuate limit, smooth to papillate-rhizinate. Rhizines black, simple to squarrose, sometimes furcated or irregularly branched, 0.20–2.00 (–3.00) \( \times \) 0.02–0.05 mm, abundant, evenly distributed and covering almost the entire surface. Apothecia absent [according to Fleig (1997), urceolate, substipitate, submarginal, amphithecium sorediate]; ascospores unknown. Pycnidia submarginal, little conspicuous, rare, without prominent margin, ostiole black; conidia bacilliform to filiform, 7.5–10.0 \( \times \) ca. 1.0 \( \mu \)m.

Color tests: cortex K+ yellow, UV–; medulla K–, C–, KC+ rose \( \rightarrow \) reddish, P–, UV–.

TLC: atranorin, norlobaridone and loxodin.

Distribution: Africa (Hale & Fletcher 1990), North America (Hale 1971a, Dey 1974, Esslinger 2008), Central America (Hale 1971a), and South America (Feuerer 2005). In South America it is known to Brazil (Marcelli 2004), Colombia (Hale 1971a) and Venezuela (Feuerer 2005). In Brazil it was recorded to PR (Fleig 1997, Eliasaro 2001), RS (Spielmann 2006) and SC (Fleig 1997).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Sinimbu, Cava Funda, 29°27’41.8"S, 52°31’11.7"W, 500 m alt., open place, 4-II-2003, A.A. Spielmann 30 (SP); idem, 29°27’33.4"S, 52°31’05.1"W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 1283 (SP); idem, Linha Almeida, 29°23’20.2"S, 52°30’21.9"W, open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 1299 (SP).

*Parmotrema commensuratum* is characterized by the soralia submarginal and in the lacinules apices and the presence of norlobaridone (medulla K–, KC+ rose \( \rightarrow \) reddish). *Parmotrema simulans* (Hale) Hale has just caperatic acid (negative reactions) and *P. clavuliferum* presents salazinic acid (medulla K+ yellow \( \rightarrow \) blood red).

Figures 11-12

Thallus pale gray, lobate, membranaceous to subcoriaceous, loosely adnate, corticicolous or saxicolous, 7–15 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 3–11 mm wide, surface smooth, lustrous, becoming reticulate cracked in the center; apical zone subconcave, undulate, plane or more frequently ascendant, margin crenate to sublacinulate; lateral marginal zone undulate, usually ascendant, involute when sorediate. Lacinules and isidia absent. Maculae weak to distinct, irregular, laminal. Cilia simple, “V” branched, cespitose or sometimes irregularly branched, 0.50–2.50 × 0.02–0.05 mm, evenly distributed. Pustules capitulate, laminal, fragmenting in soredia. Soralia capitulate to extensive, marginal to submarginal, or forming sorediose laminar pustules; when dense turning lobe margins involute; soredia submarginal, or forming sorediose laminal pustules; in soredia. Soralia capitate to extensive, marginal to submarginal, or forming sorediose laminar pustules; when dense turning lobe margins involute; soredia granular. Medulla white. Lower surface black, lustrous, smooth to slightly rugose; marginal zone brown dark or rarely brown, lustrous, 1.5–4.5 mm wide, nude, with attenuate limit, smooth to papillulate, sometimes rugose or with veins. Rhizines black, simple, squarrose or irregularly branched, 0.20–4.00 × 0.02–0.10 mm, abundant, dispersed in groups dense. Apothecia and pycnidia unknown.

Color tests: cortex K+ yellow, UV-; medulla K-, C-, CK+, orange, P-, UV+ yellow-orange.

TLC: atranorin, lichexanthone and diffractaic acid.

Distribution: North America (Esslinger 1972, Hale & Fletcher 1990, Esslinger 2008) and South America, where it is known just to Brazil (Hale & Fletcher 1990, Marcelli 2004). In Brazil it was recorded to where it is known just to Brazil (Hale & Fletcher 1990, Esslinger 2008) and South America, Parmotrema diffractaicum (Marcelli & Canêz 2008).


Figure 15

Thallus greenish gray, lobate, membranaceous, loosely adnate, corticicolous or saxicolous, 8.0–10.5 cm broad. Lobes irregularly branched, laterally overlapping to crowded, 2.0–15.0 mm wide, surface smooth to slightly scrobiculate, opaque to lustrous, becoming reticulate cracked in the center; apical zone plane to subconcave, ascendant or revolute, undulate, margin crenate to sublacinulate; lateral marginal zone usually ascendant and revolute, undulate, margin sublacinulate to lacinulate. Lacinules simple, furcated or irregularly branched, 1.0–6.0 × 0.5–2.5 mm, evenly distributed, plane to canaliculated or concave, with rounded or acute apex; maculae weak to distinct, reticular, laminal, forming cracks. Cilia black, simple to squarrose or sometimes furcated, 0.20–1.50 × 0.02–0.06 mm, frequent to abundant, evenly distributed. Pustules, soredia and isidia absent. Medulla white. Lower surface black, lustrous, smooth to rugose or papillate; marginal zone brown to dark brown, lustrous, 0.5–5.0 mm wide, with rhizines, with attenuate limit, smooth. Rhizines black, simple, squarrose or irregularly branched, 0.10–3.00 × 0.01–0.06 mm, sometimes robust and slightly thickened (0.50–1.00 × 0.05–0.10 mm), dense and abundant, evenly distributed. Apothecia urceolate to slightly concave, usually laterally flatted, 1.5–9.5 mm in diameter, submarginal, stipitate, base constrict, margin smooth to dentate or short-dentate up to sublacinulate, amphithecium maculate-reticulate, smooth to rugose or scrobiculate, disc
brown, epruinose, perforate; epithecium 5.0–15.0 μm; hymenium 35–60 μm; subhymenium 15–35 μm; ascospores ellipsoid, 10.0–16.5 × 6.5–10.0 μm, episporium 0.7–1.2 μm. Pycnidia submarginal to laminal, conspicuous, usually with prominent margin, ostiole black; conidia bacillar to filiform, straight or slightly arcuate, 6.5–12.5 × 1.0 μm.

Color tests: cortex K+ yellow, UV–; medulla K–, C+ slowly yellowish or C–, KC+ rose or reddish, P–, UV–.

TLC: atranorin, norlobaridone and loxodin.

Distribution: Argentina (Fleig 1997) and Brazil (Zahlbruckner 1930, Marcelli 2004). In Brazil it was recorded to MG (Hale & Fletcher 1990, Fleig 1997), PR (Eliasaro 2001), RJ (Hale & Fletcher 1990), RS (Spielmann 2006), SC and SP (Fleig 1997).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Herveiras, 29°25’53.7”S, 52°40’19.6”W, 570 m alt., shaded place, 24-I-2004, A.A. Spielmann et al. 719 (SP); idem, on Eucalyptus trunk, open place, 24-I-2004, A.A. Spielmann et al. 735 (SP), A.A. Spielmann et al. 940 (SP); Santa Cruz do Sul, margin from RST-287, Km 102, 29°41’03.3”S, 52°25’33.6”W, 150 m alt., on Eucalyptus trunk, 28-VII-2003, A.A. Spielmann 390 (SP); Sinimbu, Cava Funda, 29°27’33.4”S, 52°31’05.1”W, 520 m alt., open place, 5-I-2004, A.A. Spielmann & L.S. Canêz 968 (SP), A.A. Spielmann & L.S. Canêz 971 (SP); idem, slightly shaded, 5-I-2004, A.A. Spielmann & L.S. Canêz 1291 (SP).

Parmotrema homotomum is distinguished by the absence of vegetative propagules and the presence of norlobaridone (medulla K–, KC+ rose or reddish). The similar Parmotrema simulans is recognizable by the presence of caperatic acid (negative reactions).


Figure 31

Thallus pale gray, lobate, membranaceous, loosely adnate, corticicolous, 15.5 cm broad. Lobes irregularly branched, contiguous to laterally overlapping, 2.5–10.0 mm wide, surface smooth, opaque to lustrous, sometimes pruinose, becoming reticulate cracked in the center, apical zone usually plane to slightly ascendant, rarely undulate, margin plane crenate to incise-crenate (sublaciniulate); lateral marginal zone usually ascendant, undulate, margin usually lacinulate. Lacinules simple to irregularly branched, 0.5–3.0 × 0.5–4.0 mm, plane to slightly canaliculate, apex acute or truncate, evenly distributed; maculae distinct, reticulate, laminal, forming cracks. Cilia black, simple to squarrose, 0.50–2.50 × 0.02–0.05 mm, few to abundant, evenly distributed, similar to the rhizines. Pustules and isidia absent. Soralia in the lacinules, capitately; soredia granular. Medulla white. Lower surface black, lustrous, smooth to rugose; marginal zone brown dark, lustrous, 1.5–2.5 mm wide, with rhizines, with attenuate limit. Rhizines black, simple, squarrose or irregularly branched, 0.50–2.50 × 0.01–0.05 mm, abundant, evenly distributed. Apothecia absent. Acreoleolate, in diameter, substipitate, base constrict, laminal, amphithecium sorediate, margin smooth, without cilia, disc perforate; ascospores 13.5–16.5 × 6.0–9.5 μm, episporium 1.0–1.3 μm. Pycnidia laminal, rare, ostiole brown; conidia unknown.

Color tests: cortex K+ yellow, UV–; medulla K–, C–, KC–, P–, UV–.

TLC: atranorin, caperatic acid.

Distribution: Africa (Hale 1971a, Krog & Swinscow 1981), North America (Hale 1971a, Nash & Elix 2002b, Esslinger 2008), Central America (Hale 1971a) and South America (Hale & Fletcher 1990). In South America it is known to Brazil (Marcelli 2004) and Venezuela (Feuerer 2005). In Brazil it was recorded to MG (Hale 1971a, Hale & Fletcher 1990, Ribeiro 1998), PR (Eliasaro 2001), RS (Spielmann 2006), SC (Fleig 1997) and SP (Ribeiro 1998).

Specimens examined: BRAZIL. RIO GRANDE DO SUL: Herveiras, 29°25’53.7”S, 52°40’19.6”W, 570 m alt., on Eucalyptus trunk, open place, 24-I-2004, A.A. Spielmann & J. Putzke 1306 (SP).

Parmotrema simulans is recognizable by the formation of capitate to extensive soralia in the lacinules and the presence of caperatic acid (negative
reactions). *Parmotrema clavuliferum* differs by the presence of salazinic acid (medulla K+ yellow → blood red), and *P. succinreticulatum*, as the name says, succinprotocetraric and protocetraric acids are present (medulla K+ weak yellow → orange, KC+ weak yellow (Eliasaro & Adler 1997).

**Literature cited**


