PATRÍCIA JUNGBLUTH

Estudos taxonômicos em *Physcia* (Schreb.) Michx. e *Pyxine* Fr. (*Physciaceae*, *Ascomycota*)

Tese apresentada ao Instituto de Botânica da Secretaria do Meio Ambiente, como parte dos requisitos exigidos para a obtenção do título de DOUTORA em BIODIVERSIDADE VEGETAL E MEIO AMBIENTE, na Área de Concentração de Plantas Avasculares e Fungos em Análises Ambientais.

SÃO PAULO 2010

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É essa uma maravilha que, a princípio,
não se impõe aos olhos do corpo, mas que,
após curta reflexão, fere os olhos da razão.

Charles Darwin,
Viagem de um Naturalista ao redor do Mundo (1871)

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RESUMO

Foram estudados detalhadamente os tipos de 29 táxons aceitos de *Physcia* (Schreb.) Michx. e 36 táxons de *Pyxine* Fr., bem como dos tipos de nomes atualmente aceitos em sinonímia, o que inclui todos os táxons de *Physcia* e *Pyxine* citados para o Brasil. Características de importância taxonômica foram reestudadas e discutidas. Além das descrições e comentários, são fornecidas chaves de identificação e ilustrações das espécies e suas variedades. A anatomia do córtex inferior de vários táxons de *Physcia*, uma das principais características de valor taxonômico ao nível de espécie no gênero, foi discutida para a maioria das espécies aceitas e seus sinônimos. Os sinônimos de *P. aipolia* (Humb.) Fürnr. foram revisados; *P. afra* Hue é proposta como sinônimo de *P. ochroleuca* (Müll. Arg.) Müll. Arg., enquanto *P. aipolia* f. *verruculosa* Vain. in Räsänen é combinada em *P. verruculosa* (Vain.) Jungbluth & Marcelli e considerada espécie válida. Um lectotipo para *P. alba* (Fée) Lynge var. *linearis* Lynge foi designado e esta variedade é sinônimo de *P. kalbii* Moberg. A presença de *P. adscendens* (Fr.) H. Olivier, *P. caesia* (Hoffm.) Fürnr., *P. dubia* e *P. stellaris* (L.) Nyl. na micota liquenizada brasileira é questionada. *Physcia obsessa* (Mont.) Nyl. permanece como *nomen dubium* e *P. lactea* Zahlbr. como *nomen inquerendum*. Quatro espécies de *Pyxine* são novas para a Ciência: *P. astipitata* Jungbluth & Marcelli, *P. exoalbida* Jungbluth & Marcelli, *P. jolyana* Jungbluth, Kalb & Marcelli e *P. mantiqueirensis* Marcelli & Jungbluth. *Pyxine heterospora* Vain. e *P. oceanica* Zahlbr., respectivamente consideradas sinônimos de *P. eschweileri* (Tuck.) Vain. e *Pyxine cocoës* (Sw.) Nyl., são propostas como espécies válidas. Também *P. microspora* Vain., *P. minuta* Vain. e *P. pyxinoides* (Müll. Arg.) Kalb são consideradas boas espécies, enquanto *P. nitidula* Müll. Arg. é proposta como sinônimo de *P. pyxinoides*. *Pyxine retirugella* var. *capitata* Zahlbr. é colocada como sinônimo de *P. fallax* (Zahlbr.) Kalb. *Pyxine caesiopruinosa* (Nyl.) Imshaug e *P. physciaeformis* (Malme) Imshaug são consideradas espécies distintas. O lectotipo de *P. meissneri* ssp. *connectens* Vain. foi escolhido. *Pyxine fallax* (Zahlbr.) Kalb e *P. katendei* Swinscow & Krog são novas citações para a América do Sul. No Brasil, *P. albovirens* (G. Mey.) Aptroot e *P. obscurascens* Malme são reportadas pela primeira vez para o estado de São Paulo, enquanto *P. caesiopruinosa* (Nyl.) Imshaug é nova para Minas Gerais, *P. coralligera* Malme para Goiás e *P. coccifera* (Fée) Nyl. para Maranhão e Tocantins.

Palavras-chave: fungos liquenizados, *Physciaceae*, *Physcia*, *Pyxine*, taxonomia, espécies novas.

ABSTRACT

Twenty-nine currently accepted taxa of *Physcia* (Schreb.) Michx. and thirty-six of *Pyxine* Fr. were studied in details, as well as their synonyms, wich includes all the taxa of *Physcia* and of *Pyxine* recorded to Brazil. Important taxonomic characters were restudied and discussed. Besides the descriptions and comments, keys and illustrations of the species and their varieties are given. The lower cortex type, an important character at level species in *Physcia*, was discussed to the majority of the accepted species and their synonyms. The synonyms of *Physcia aipolia* (Humb.) Fürnr. were revised; *P. afra* Hue is proposed as synonym of *P. ochroleuca* (Müll. Arg.) Müll. Arg., while *P. aipolia* f. *verruculosa* Vain. in Räsänen is combined to *P. verruculosa* (Vain.) Jungbluth & Marcelli and is considered a good species. A lectotype for *P. alba* (Fée) Lynge var. *linearis* Lynge is designated and this variety is placed under synonym of *P. kalbii* Moberg. *Physcia adscendens* (Fr.) H. Olivier, *P. caesia* (Hoffm.) Fürnr., *P. dubia*, and *P. stellaris* (L.) Nyl. are placed in doubt if are really present in Brazilian lichenized mycota. *Physcia obsessa* (Mont.) Nyl. remains a *nomen dubium* and *P. lactea* Zahlbr. as *nomen inquerendum*. Four *Pyxine* species are new to the Science: *P. astipitata* Jungbluth & Marcelli, *P. exoalbida* Jungbluth & Marcelli, *P. jolyana* Jungbluth, Kalb & Marcelli, and *P. mantiqueirensis* Marcelli & Jungbluth. *Pyxine heterospora* Vain. and *P. oceanica* Zahlbr., formerly considered synonyms of *P. eschweileri* (Tuck.) Vain. and *Pyxine cocoës* (Sw.) Nyl. respectively, are proposed as good species. *Pyxine microspora* Vain., *P. minuta* Vain. and *P. pyxinoides* (Müll. Arg.) Kalb are also treated as good species, while *P. nitidula* Müll. Arg. is considered synonym of *P. pyxinoides*. *Pyxine retirugella* var. *capitata* Zahlbr. is proposed as synonym of *P. fallax* (Zahlbr.) Kalb, and *P. caesiopruinosa* (Nyl.) Imshaug and *P. physciaeformis* (Malme) Imshaug are considered distinct species. The lectotype to *P. meissneri* ssp. *connectens* Vain. was chosen. *Pyxine fallax* (Zahlbr.) Kalb and *P. katendei* Swinscow & Krog are new records to South America. In Brazil, *P. albovirens* (G. Mey.) Aptroot and *P. obscurascens* Malme are reported for the first time to São Paulo State, while *P. caesiopruinosa* (Nyl.) Imshaug is new citation to Minas Gerais State, *P. coralligera* Malme to Goiás State and *P. coccifera* (Fée) Nyl. to Maranhão State and Tocantins State.

Key-words: lichenized fungi, *Physciaceae*, *Physcia*, *Pyxine*, taxonomy, new species

INTRODUÇÃO GERAL

Physciaceae Zahlbr. in Engler, Syllabus ed. 2:46. 1898, nom. cons. Tipo: *Physcia* (Schreb.) Michx.

= *Caliciaceae* Chevall., Fl. gen. env. Paris: 385. 1826, nom. rej. Tipo: *Calicium* Pers.

= *Pyxinaceae* (Fr.) Stizenb., Ber. Tat. St. Gall. Natunv. Ges. 1862: 156. 1862 (como "*Pyxineae*"), nom. rej. Basiônimo: "trib." *Pyxineae* Fr., Syst. Orb. Veg. 1: 266. 1825. Tipo: *Pyxine* Fr.

Physciaceae foi proposta por Zahlbruckner (1898) para abrigar três gêneros de fungos liquenizados de hábitos folioso e fruticoso, que produzem ascosporos marrons geralmente bicelulares e conídios curtos: *Anaptychia* Körb., *Physcia* (Ach.) Vain. e *Pyxine* Fr. Posteriormente, Zahlbruckner (1907) criou *Buelliaceae* para acomodar os gêneros com talos de hábito crostoso e ascósporos semelhantes, *Buellia* De Not. e *Rinodina* (A. Massal.) Stizenb.

A família chegou a ser uma das maiores em *Lecanorales*, com aproximadamente 860 espécies (Kirk *et al*. 2001) distribuídas em 34 gêneros (Eriksson 2006). Recentemente, estudos filogenéticos propuseram *Physciaceae* dentro de *Teloschistales* (Miądlikowska *et al*. 2007). Segundo Kirk *et al*. (2008), *Physciaceae* apresenta 512 espécies distribuídas em 17 gêneros.

Poelt (1973), a partir de estudos anatômicos, uniu *Physciaceae* e *Buelliaceae*, principalmente por apresentarem o mesmo tipo de asco.

A família *Pyxinaceae* (Fr.) Stizenb., proposta em 1862, é um nome mais antigo para *Physciaceae*. Porém, como o nome *Physciaceae* já havia sido amplamente utilizado no século passado, inclusive em obras consideradas clássicas para o grupo, foi aprovada a conservação do nome *Physciaceae* (Hawksworth & Eriksson 1988, Gams 1992).

Estudos moleculares (Wedin & Grube 2002, Wedin *et al*. 2000/2002) demonstraram que *Caliciaceae* Chevall. 1826 e *Physciaceae* formam um forte grupo monofilético, dividido em dois grupos informais: o "grupo *Physcia*" e o "grupo *Buellia*". O "grupo *Buellia*" é formado por representantes de *Buellia* (crostoso), *Amandinea* (crostoso), *Pyxine* (folioso) e *Caliciaceae*, inclusive a espécie-tipo desta família, *Calicium viride* Pers. Uma vez que *Caliciaceae* é o nome mais antigo, Wedin & Grube (2002) sugeriram novamente a conservação de *Physciaceae*, proposta sancionada em 2004 (Gams 2004).

Dados semelhantes foram obtidos por Helms *et al*. (2003), que também observaram dois clados onde membros de *Caliciaceae* ficavam juntos a representantes de *Buellia*, *Amandinea* e *Santessonia* (fruticoso), cujos dados moleculares são correlatos com o tipo de asco e com a pigmentação do hipotécio.

Porém, Helms *et al.* (2003) fizeram uma proposta diferente: ao invés de conservar o nome *Physciaceae*, propuseram emendar o conceito de *Caliciaceae* e *Physciaceae.* Segundo sua proposta, *Caliciaceae* englobaria táxons com ascos do tipo *Bacidia* ou protunicados, de hipotécio pigmentado e com ascosporos sem espessamentos, correspondente ao clado formado pelas espécies que antes pertenciam a *Caliciaceae*, mais os gêneros *Dirinaria*, *Pyxine* e *Buellia* s.l. Já *Physciaceae* ficaria caracterizada por táxons com asco tipo *Lecanora*, hipotécio hialino e ascosporos com espessamentos ou do tipo *Rinodinella*, acomodando os demais gêneros foliosos e fruticosos de *Physciaceae* e também *Rinodina* s.l.

Helms *et al.* (2003), ante a heterogeneidade de *Caliciaceae* emendada, ainda propõem a divisão desta família em três, ressuscitando *Pyxinaceae* (Fr.) Stizenb. 1862 e *Buelliaceae* Zahlbr. 1907.

Contudo, a proposta de Helms e seus colaboradores foi contestada por Bungartz (2004) em sua tese sobre um grupo de espécies de *Buellia*, uma vez que os caracteres usados por Helms *et al.* (2003) para redefinir os conceitos das duas famílias não correspondem perfeitamente às características de 11 das espécies apresentadas no cladograma. Inclusive, várias das *Buellia* estudadas por Bungartz (2004) consistiriam em exceções ao conceito emendado de *Caliciaceae*.

Kirk *et al.* (2008) consideraram as famílias separadamente no conceito de Helms *et al.* (2003). Somando os números por eles apresentados para *Physciaceae* e *Caliciaceae* se obtém 48 gêneros e 1246 espécies, já que *Caliciaceae* apresenta 31 gêneros e 731 espécies.

Aqui, como em Bungartz (2004), preferiu-se seguir Wedin & Grube (2002), considerando *Caliciaceae* sinônimo de *Physciaceae*, com *Physcia* e *Pyxine* pertencendo à mesma família.

No Brasil, *Physciaceae* é representada por 14 gêneros, dos quais seis são foliosos: *Dirinaria* (Tuck.) Clem., *Heterodermia* Trevis., *Hyperphyscia* Müll. Arg., *Phaeophyscia* Moberg, *Physcia* (Schreb.) Michx. e *Pyxine* Fr. (Marcelli 2009). As principais características destes gêneros são apresentadas na Tabela 1.

Em linhas gerais, *Dirinaria* pode ser facilmente separada dos demais gêneros de *Physciaceae* por não apresentar rizinas na superfície inferior e, assim como *Pyxine*, possui apotécios com hipotécio pigmentado e ascosporos do tipo *Dirinaria*. *Heterodermia* apresenta córtex superior prosoplectenquimático e em muitas espécies não existe córtex inferior.

Hyperphyscia pode não apresentar atranorina no córtex superior e não apresenta rizinas, além de ter conídios longos, filiformes. *Pyxine* freqüentemente apresenta liquexantona no córtex superior (K–, UV+ amarelo) e medula pigmentada, com epitécio sempre K+ púrpura.

Tabela 1: Gêneros foliosos de *Physciaceae* conhecidos para o Brasil, com suas principais características taxonômicas.
(para= córtex paraplectenquimático; proso= córtex prosoplectenquimático) (Moberg 1977, 1986, 1990, Aptroot 1987, Scutari 1995a/b).

Características Taxonômicas	***Dirinaria***	***Heterodermia***	***Hyperphyscia***	***Phaeophyscia***	***Physcia***	***Pyxine***
Córtex superior	para	proso	para	para	para	para
Córtex inferior	proso	quando presente, proso	proso, pouco diferenciável da medula	para ou proso	para, proso ou intermediário	proso
Atranorina no córtex superior	presente	presente	raramente presente	ausente	presente	presente
Cor da medula	branca ou pigmentada	branca	branca ou pigmentada	geralmente branca	branca	branca ou pigmentada
Máculas	presentes ou ausentes	presentes ou ausentes	presentes ou ausentes	presentes ou ausentes	presentes ou ausentes	presentes ou ausentes
Pruína	presente ou ausente	ausente	rara	ausente	presente ou ausente	presente ou ausente
Camada de algas no apotécio	persistente	persistente	persistente	persistente	persistente	não persistente
Epitécio	K–	K–	K–	K–	K–	K+ violeta
Hipotécio	castanho-escuro	branco a castanho-amarelado	branco a castanho-amarelado	branco a castanho-amarelado	incolor a amarelado	castanho-escuro
Ascosporos	tipo *Dirinaria*	tipo *Polyblastidium* ou *Pachysporaria*	tipo *Conradia* ou *Pachysporaria*	tipo *Physcia* ou *Pachysporaria*	tipo *Physcia* ou *Pachysporaria*	tipo *Dirinaria*
Forma dos conídios	de baciliformes a bifusiformes	de cilíndricos a bifusiformes	filiformes	elipsoidais	de baciliformes a bifusiformes	baciliformes, bifusiformes ou sublageniformes
Comprimento dos conídios	3–6 µm	2–5 µm	≥15 µm	4–5 µm	4–6 µm	3–4 µm

Physcia

Physcia (Schreb.) Michx., Flora boreali-americana, 2: 326. 1803.
Lichen sect. *Physcia* Schreb. in Linnaeus, Gen. Plant., vol. 2: 768. 1791., Acharius, K. Vet. Acad. Nya Handl.: 252. 1794. – *Lichen* trib. *Physcia* Ach., Lichenographiae Sveciae Prodromus: 170. 1798 (nom. invalid.).
TIPO: *Physcia tenella* (Scop.) DC., *fide* Thomson 1963.

A história do gênero *Physcia* começou na Europa e foi muito estudada por vários cientistas de origem escandinava. O histórico a seguir foi em parte baseado em Moberg (1977).

Physcia foi primeiramente tratada ao nível genérico por Michaux (1803), que apresentou a descrição fornecida por Acharius (1798) para a sua tribo *Physcia*, que estava abaixo do nível de gênero (Thomson 1963, Moberg 1977). Mas Acharius (1794 apud Moberg 1977) já havia tratado de *Physcia*, citando Schreber (1791). Portanto, o basiônimo do gênero é *Lichen* seção *Physcia* Schreb. A espécie-tipo do gênero viria a ser escolhida apenas cerca de 150 anos depois: Thomson (1963) escolheu *Physcia tenella* (Scop.) DC. a partir da lista que Michaux (1803) elaborou baseado nas espécies citadas por Acharius (1798).

As bases da circunscrição atualmente aceita de *Physcia* foram estabelecidas na tese de Vainio (1890), que dividiu o gênero nas seções *Euphyscia* (hipotécio incolor) e *Dirinaria* (hipotécio marrom-enegrecido). *Euphyscia*, por sua vez, era dividida em *Albida* (talo K+ amarelo) e *Sordulenta* (talo K–), sem informação de categoria infragenérica. *Sordulenta* foi ainda dividida em *Brachysperma* (conídios oblongos curtos) e *Macrosperma* (conídios filiformes).

Porém, Lynge (1916) não seguiu as subdivisões propostas por Vainio em seu estudo com as espécies norueguesas de *Physciaceae*. Foi Du Rietz (1925) o primeiro a adotar esses grupos, além de propor a separação de *Brachysperma* nas séries *Pulverulentae* e *Obscurae* (diferindo em tamanho de lacínias e pruinosidade).

Mais tarde, Lynge (1924) finalmente passou a seguir o sistema proposto por Vainio quando estudou as *Anaptychiae* and *Physciae* latino-americanas.

Alguns anos depois, Lynge (1935) elevou *Brachysperma* e *Macrosperma* ao nível subgenérico, dividindo-os em várias seções. *Macrosperma* seguiu a delimitação proposta por Vainio, porém *Brachysperma* correspondia a todas as demais *Euphyscia* no senso de Vainio, isto é, incluindo *Albida* e parte de *Sordulenta*.

Essa subdivisão proposta por Lynge foi então seguida por grandes nomes como Nádvornik (1947), em seu tratado das *Physciaceae* da Tchecoslováquia, Maas Geesteranus (1952) com as *Physciaceae* holandesas, e Thomson (1963), com as espécies norte-americanas (Moberg 1977).

Em 1950, Choisy propôs a elevação de *Macrosperma* de Vainio (1890) ao nível genérico, criando *Physciopsis*, que só foi reconhecido depois dos estudos de Poelt (1965). Neste mesmo trabalho, Poelt propôs *Physconia* (em parte *Brachysperma* Vain. e em parte *Pulverulenta* Lynge) a partir do tipo de ascósporo. Em 1979, Hafellner e colaboradores consideraram *Physciopsis* (ascosporos com 2 células) sinônimo de *Hyperphyscia* (ascosporos com 4 células). Estes dois gêneros apresentam o mesmo tipo de conídio (filiforme), e mais tarde Moberg (1987) observou que a ontogenia dos ascosporos é a mesma nas células com 2 ou 3 septos.

Num trabalho que estabeleceu a circunscrição do gênero *Physcia* atualmente aceita, Moberg (1977) propôs *Phaeophyscia*, que se diferencia de *Physcia* por não apresentar atranorina no córtex superior e diferencia-se de outros gêneros de *Physciaceae* de hábito folioso por apresentar conídios elipsóides.

Baseado em Lynge (1935), Moberg (1977) propôs as seguintes subdivisões do gênero *Physcia*:

- Seção *Physcia* (*Physcia* seção *Tenella* Lynge), caracterizada pela presença de cílios;
- Seção *Caesia* Lynge emend. Moberg, caracterizada pela superfície superior maculada, cílios ausentes e córtex superior e medula K+ amarelo (atranorina e zeorina);
- Seção *Fusisporae* Moberg, caracterizada pelos ascosporos estreitos distintamente ornamentados e a medula é K– (atranorina presente apenas no córtex superior, zeorina ausente);
- Seção *Stellaris* Lynge emend. Moberg, que não apresenta superfície superior maculada nem cílios e a medula é K– (atranorina presente apenas no córtex superior, zeorina ausente).

Posteriormente, Moberg (1986) apresentou uma nova seção:

- Seção *Atrae* Moberg, caracterizada pela superfície superior não fortemente maculada, córtex superior e medula K+ amarelo (atranorina e zeorina), cílios ausentes e superfície inferior negra.

Estabelecidas estas bases, vários trabalhos florísticos surgiram em regiões tropicais e subtropicais, até então pouco exploradas.

Moberg (1986), estudando *Physcia* s. str. no leste africano, encontrou 21 espécies e descreveu cinco novas. Anos depois, Moberg (2004) encontrou 15 espécies no sul do continente africano, inclusive uma citação nova para este continente. Swinscow & Krog (1988) também estudaram material do leste africano e relataram 21 espécies.

Aptroot (1987), na "Flora das Guianas" (Guiana, Guiana Francesa e Suriname), encontrou cinco espécies de *Physcia*.

Moberg (1990) então publicou um trabalho com 34 espécies da América Central e do Sul, das quais 11 eram inéditas para a Ciência, e Moberg (1997, 2002) estudou *Physcia* no Deserto de Sonora e áreas adjacentes, encontrando 25 espécies, das quais cinco eram novas.

Outras contribuições importantes para a América do Sul foram feitas por Scutari (1990a/b, 1992, 1995b, 1999), que enfocavam principalmente os táxons argentinos, mas com novidades e estudos taxonômicos com material de outros países, dentre estes o Brasil.

Moberg (2001) estudou material australiano e encontrou 17 espécies, uma nova para a Ciência e outras 10 novas citações para este continente, e Galloway & Moberg (2005) trataram de 14 espécies da Nova Zelândia, num trabalho extremamente minucioso em suas descrições. mais recentemente, Elix *et al.* (2009) descreveu três espécies do grupo *P. aipolia* para a Austrália.

São conhecidas 71 espécies de *Physcia* s. str. no mundo (Tabela 2). Segundo Moberg (1994), a América do Sul é o provável centro de diversidade deste grupo, com 34 espécies. Para o Brasil, há 27 registros na literatura.

Tabela 2: Cronologia das espécies de *Physcia* aceitas atualmente.

Basiônimo	Data	Obra	Nome atualmente aceito
Lichen stellaris L.	1753	*Spec. Plant.* 1144.	*Physcia stellaris* (L.) Nyl.
Lichen tenellus Scop.	1772	*Flora Carniolica* 394	*Physcia tenella* (Scop.) DC.
Lichen caesius Hoffm.	1784	*Enum. Lich*. 65.	*Physcia caesia* (Hoffm.) Fürnr.
Lichen semipinnatus Gmelin	1792	In Caroli a Linné, *Systema naturae* 2: 1372	*Physcia semipinnata* (Gmelin) Moberg
Lichen aipolius Ehrh. ex Humb.	1793	*Florae Fribergensis Berolini*: 19.	*Physcia aipolia* (Humb.) Fürnr.
Lobaria dubia Hoffm.	1796	*Deutsch. Flora*: 156.	*Physcia dubia* (Hoffm.) Lettau
Parmelia clementiana Ach.	1810	*Lich. Univer.*: 483.	*Physcia clementei* (Smith) Lynge
Lecanora tribacia Ach.	1810	*Lich. Univer.*: 415.	*Physcia tribacia* (Ach.) Nyl.
Parmelia albinea Ach.	1818	*Lich. Univer.*: 491.	*Physcia albinea* (Ach.) Malbr.
Parmelia alba Fée	1824	*Ess. Cryptog. Ecorc. Exot. Offic.*: 125.	*Physcia alba* (Fée) Müll. Arg.
Parmelia stellaris var. *adscendens* Fr.	1845	*Summa Veg. Scand.* sect. 1: 105.	*Physcia adscendens* (Fr.) Oliver
Parmelia albo-plumbea Tayl.	1847	in Hooker, *Lodon J. Bot*. 4: 161.	*Physcia albata* (F. Wils.) Hale
Parmelia phaea Tuck.	1853	in Darlington, *Flora Cestria*, 3rd ed.: 440	*Physcia phaea* (Tuck.) Thomson
Squamaria biziana A. Massal.	1856	*Miscell. Lich.*: 35	*Physcia biziana* (A. Massal.) Zahlbr.
Physcia crispa Nyl.	1860	*Syn. Meth. Lich.* 1(2): 423.	*Physcia crispa* Nyl.
Physcia dilatata Nyl.	1860	*Syn. Meth. Lich.* 1(2): 423.	*Physcia dilatata* Nyl.
Physcia integrata Nyl.	1860	*Syn. Meth. Lich.* 1(2): 424.	*Physcia integrata* Nyl.
Physcia dilatata ** *P. phaeocarpa* Nyl.	1860	*Syn. Meth. Lich*. 1(2): 424.	*Physcia phaeocarpa* (Nyl.) Hue
Physcia tribacoides Nyl.	1869	*Flora* 57: 322.	*Physcia tribacoides* Nyl.
Physcia dimidiata (Arnold) Nyl.	1881	*Flora* 64: 537.	*Physcia dimidiata* (Arnold) Nyl.
Pyxine ochroleuca Müll. Arg.	1881	*Flora* 64(32): 4.	*Physcia ochroleuca* Müll. Arg. (Müll. Arg.)
Physcia aipolia f. *alnophilla* Vain.	1881	*Adjumenta ad Lich. Lapp*. I(6): 136.	*Physcia alnophilla* (Vain.) Loht., Moberg, Myllis & Tehler
Physcia convexa Müll. Arg.	1888	*Rev. Mycol.* 10: 57.	*Physcia convexa* Müll. Arg.
Physcia pachyphylla Müll. Arg.	1888	*Rev. Mycol.* 10: 57.	*Physcia pachyphylla* Müll. Arg.
Physcia papyracea Müll. Arg.	1888	*Rev. Mycol.* 10: 58.	*Physcia papyracea* Müll. Arg.
Physcia paraguayana Müll. Arg.	1888	*Rev. Mycol.* 10: 57.	*Physcia paraguayana* Müll. Arg.
Parmelia albata F. Wilson	1889	*Vict. Naturalist* 6: 69.	*Physcia albata* (F. Wils.) Hale
Physcia integrata var. *sorediosa* Vain.	1890	*Acta Soc. Fauna Fl. Fenn*. 7: 142.	*Physcia sorediosa* (Vain.) Lynge
Physcia lacinulata Müll. Arg.	1891	*Bull. Soc. Botan. Belgique* 30: 54.	*Physcia lacinulata* Müll. Arg.

Physcia sublactea Zahlbr.	1909	*Denkschr. Kaiserl. Akad. der Wissensch.* 83: 198.	*Physcia sublactea* Zahlbr.
Physcia mexicana de Lesd.	1914	*Lich. du Mexique*: 8.	*Physcia mexicana* de Lesd.
Physcia poncinsii Hue	1917	*Bull. Soc. Bot. France* 63 (Mem. 28): 10.	*Physcia poncinsii* Hue
Physcia americana G.K. Merr.	1926	*Conn. Geol. Nat. Hist. Surv. Bull.* 37: 42.	*Physcia americana* G.K. Merr.
Physcia millegrana Degel.	1940	*Ark. f. Bot.* 30A, 1: 5.	*Physcia millegrana* Degel.
Physcia subtilis Degel.	1941	*Ark. f. Bot.* 30A, No. 3: 72.	*Physcia subtilis* Degel.
Physcia vitii Nádvar.	1947	*Stud. Bot. Cech*. 8: 94.	*Physcia vitii* Nádvar.
Physcia magnussonii Frey	1952	in *Ergebn. Wiss. Unters. Schweiz. Nationalparks*, III, 27: 480.	*Physcia magnussonii* Frey
Physcia pseudospeciosa Thomson	1963	*Beiheft Nova Hedwigia* 7: 91.	*Physcia pseudospeciosa* Thomson
Physcia halei Thomson	1963	*Beiheft Nova Hedwigia* 7: 57.	*Physcia halei* Thomson
Physcia abnuens Awasthi & S. Singh	1979	*Norw. J. Bot*. 26: 93.	*Physcia abnuens* Awasthi & S. Singh
Heterodermia desertorum Kalb	1984	*Lichenes Neotropici*, Fascicle 8: no. 324.	*Physcia nubila* Moberg
Physcia atrostriata Moberg	1986	*Nord. J. Bot*. 6(6): 853.	*Physcia atrostriata* Moberg
Physcia erumpens Moberg	1986	*Nord. J. Bot.* 6(6): 856.	*Physcia erumpens* Moberg
Physcia krogiae Moberg	1986	*Nord. J. Bot.* 6(6): 858.	*Physcia krogiae* Moberg
Physcia undulata Moberg	1986	*Nord. J. Bot*. 6(6): 861.	*Physcia undulata* Moberg
Physcia verrucosa Moberg	1986	*Nord. J. Bot*. 6(6): 862.	*Physcia verrucosa* Moberg
Physcia scopulorum (Lamb & Vezda) Poelt & Nimis	1987	*Studia Geobotanica* **7**(suppl. 1): 176.	*Physcia scopulorum* (Lamb & Vezda) Poelt & Nimis
Physcia convexella Moberg	1990	*Nord. J. Bot.* 10(3): 327.	*Physcia convexella* Moberg
Physcia coronifera Moberg	1990	*Nord. J. Bot.* 10(3): 328.	*Physcia coronifera* Moberg
Physcia decorticata Moberg	1990	*Nord. J. Bot.* 10(3): 329.	*Physcia decorticata* Moberg
Physcia kalbii Moberg	1990	*Nord. J. Bot.* 10(3): 331.	*Physcia kalbii* Moberg
Physcia lobulata Moberg	1990	*Nord. J. Bot.* 10(3): 333.	*Physcia lobulata* Moberg
Physcia lopezii Moberg	1990	*Nord. J. Bot.* 10(3): 333.	*Physcia lopezii* Moberg
Physcia manuelii Moberg	1990	*Nord. J. Bot.* 10(3): 334.	*Physcia manuelii* Moberg
Physcia neogaea R.C. Harris	1990	*Some Florida Lichens* (New York): 81.	*Physcia neogaea* Harris
Physcia pumilior R.C. Harris	1990	*Some Florida Lichens* (New York): 82.	*Physcia pumilior* R.C. Harris
Physcia rolfii Moberg	1990	*Nord. J. Bot.* 10(3): 337.	*Physcia rolfii* Moberg
Physcia sinuosa Moberg	1990	*Nord. J. Bot.* 10(3): 338.	*Physcia sinuosa* Moberg
Physcia tenuis Moberg	1990	*Nord. J. Bot.* 10(3): 340.	*Physcia tenuis* Moberg
Physcia vermifera Aptroot & Sipman	1991	*Willdenowia* 20(1-2): 245.	*Physcia vermifera* Aptroot & Sipman
Physcia solistella Essl. & Egan	1996	*Bryologist* 99(3): 331	*Physcia solistella* Essl. & Egan

Physcia nashii Moberg	1997	*Symb. Bot. Upsal.* 32: 174.	*Physcia nashii* Moberg
Physcia neglecta Moberg	1997	*Symb. Bot. Upsal.* 32: 176.	*Physcia neglecta* Moberg
Physcia tenellula Moberg	1997	*Symb. Bot. Upsal.* 32: 181.	*Physcia tenellula* Moberg
Physcia tretiachii Moberg	1997	*Symb. Bot. Upsal.* 32: 182.	*Physcia tretiachii* Moberg
Physcia villosula Moberg	1997	*Symb. Bot. Upsal.* 32: 185.	*Physcia villosula* Moberg
Physcia jackii Moberg	2001	*Biblioth. Lichenol.* 78: 298.	*Physcia jackii* Moberg
Physcia dakotensis Essl.	2004	*Mycotaxon* 90(2): 301.	*Physcia dakotensis* Essl.
Physcia austrostellaris Elix	2009	*Syst. Biodivers.* 7 (4): 482	*Physcia austrostellaris* Elix
Physcia littoralis Elix	2009	*Syst. Biodivers.* 7 (4): 484	*Physcia littoralis* Elix
Physcia tropica Elix	2009	*Syst. Biodivers.* 7 (4): 485	*Physcia tropica* Elix

Estudos de *Physcia* no Brasil

O primeiro a citar espécies de *Physcia* para o Brasil foi Eschweiler (1833) na "Flora Brasiliensis", onde *Parmelia stellaris* Eschw. e *Parmelia tenera* Eschw. foram apresentadas na seção *Physcia*. Não se sabe a quais táxons atualmente aceitos os espécimes assim por ele identificados podem corresponder.

Depois disso, Krempelhuber (1876) fez novas citações para o estado do Rio de Janeiro: *Physcia acromela* Nyl., *P. caesia* (Hoffm.) Fürnr., *P. candelaria* (Ach.) Nyl., *P. comosa* Nyl., *P. confluens* (Fr.) Nyl., *P. crispa* Nyl., *P. exilis* Michx., *P. flavicans* (Sw.) DC., *P. heppiana* Arn., *P. leucomela* (L.) Michx., *P. stellaris* (L.) Nyl. e variedades, das quais apenas *P. caesia*, *P. crispa* Nyl. e *P. stellaris* (L.) Nyl. continuam no gênero *Physcia* s. str., e mesmo assim, *P. caesia* e *P. stellaris* são de ocorrência duvidosa no Brasil, uma vez que são típicas de zonas temperadas e polares e/ou de altitude.

Müller Argoviensis (1881) descreveu *Pyxine ochroleuca* Müll. Arg., cujo tipo é do Estado de São Paulo, hoje *Physcia*, e citou *Physcia speciosa* Nyl. var. *granulifera* Müll. Arg., hoje uma *Heterodermia*. Poucos anos depois, Müller Argoviensis (1893) acrescentou *P. speciosa* Fr. var. *dactyliza* Nyl. para a micota de Minas Gerais, atualmente em *Heterodermia*.

Entretanto, foi o trabalho de Vainio (1890) que realmente marcou o início de estudos mais aprofundados do gênero. Dentro de *Physcia*, ele forneceu descrições detalhadas para 11 espécies e três variedades, das quais *Physcia alba* (Fée) Müll. Arg., *P. convexa* Müll. Arg., *P. crispa* Nyl. e *P. integrata* Nyl., da seção *Euphyscia*, permanecem em *Physcia* na circunscrição atual.

Zahlbruckner (1909) citou *P. alba* (Fée) Müll. Arg. e *P. aipolia* (Humb.) Fürnr. para o sudeste brasileiro e descreveu *P. sublactea* Zahlbr. para o estado de São Paulo.

Lynge (1924) estudou *Anaptychiae* e *Physciae* da América do Sul, apresentando descrições e chave para 13 espécies e três variedades e uma forma. Além daquelas espécies estudadas por Vainio que permanecem em *Physcia*, Lynge encontrou *P. sorediosa* (Vain.) Lynge.

Houve, após isso, uma fase em que pouco foi acrescentado ao conhecimento deste gênero, até que, a partir da década de 1980, inúmeros trabalhos surgiram. Estas publicações correspondiam principalmente a citações de espécies em artigos de cunho regional, como os

publicados por H.S. Osorio, M. Fleig e colaboradores (veja referências completas em Jungbluth & Marcelli 2010a).

Moberg (1990) então publicou um trabalho bem significativo, totalizando 34 espécies da América Central e do Sul, das quais 11 eram táxons novos. Destas 34 espécies, 18 foram encontradas no Brasil, aumentando consideravelmente o número de táxons brasileiros.

Depois deste trabalho, poucos outros surgiram, e consistiam novamente em listagens regionais. Destes, merece destaque Aptroot (2002), que acrescentou *P. lobulata* Moberg e *P. lopezii* Moberg para a micota paulista e reencontrou várias espécies citadas por Vainio (1890) e Moberg (1990).

Atualmente, são conhecidas 27 espécies de *Physcia* para o Brasil, que, segundo Moberg (1990), pertencem às seções *Atrae*, *Caesia* e *Stellaris*:

- Seção *Atrae* Moberg: medula K+ amarelo (atranorina e zeorina) e cílios ausentes, córtex inferior negro, proso ou paraplectenquimático;
- Seção *Caesia* Lynge emend. Moberg: medula K+ amarelo (atranorina e zeorina e cílios ausentes, córtex inferior claro, proso- ou paraplectenquimático;
- Seção *Stellaris* Lynge emend. Moberg: medula é K– (atranorina presente apenas no córtex superior, zeorina ausente), córtex inferior claro, proso- ou paraplectenquimático.

A Figura 1 mostra o número de espécies citadas na literatura por Estado brasileiro. Pode-se ver claramente que os Estados brasileiros historicamente com mais estudos liquenológicos

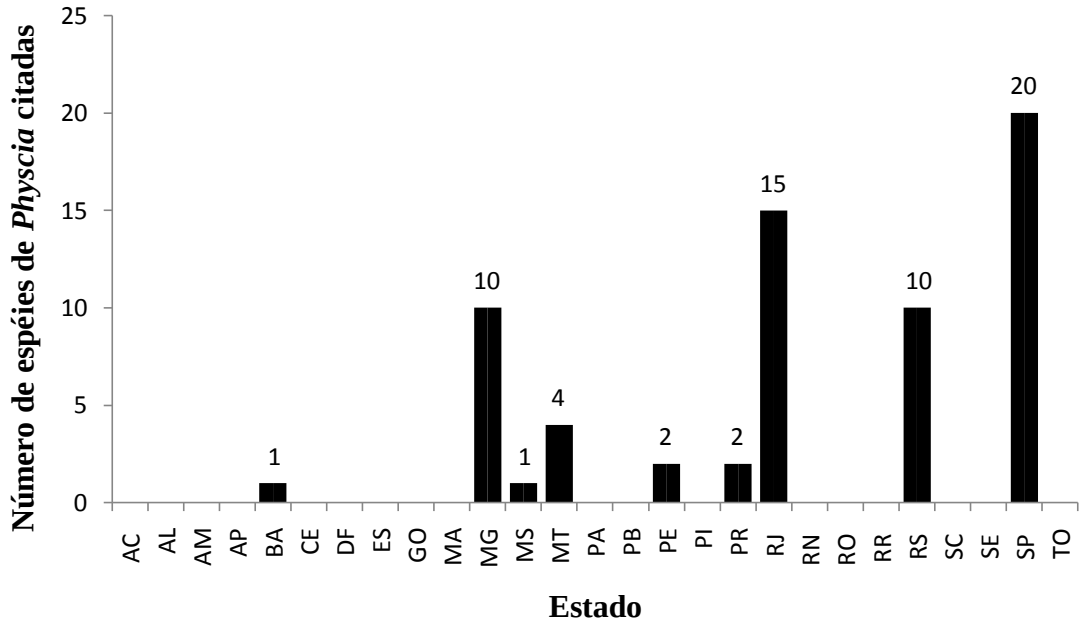

Figura 1: Número de espécies de *Physcia* citadas na literatura por Estado no Brasil.

são aqueles onde há mais citações de espécies: São Paulo (20 espécies citadas), seguido de Rio de Janeiro (15), Rio Grande do Sul (10) e Minas Gerais (10). Dezessete estados brasileiros, principalmente das regiões Norte, Nordeste e Centro-Oeste, permanecem sem citação do gênero, refletindo a falta de coletas e, principalmente, de pesquisadores.

Caracteres de importância taxonômica em *Physcia*

Na circunscrição proposta por Moberg (1977), *Physcia* s. str. possui talo folioso, mais ou menos adpresso ao substrato, superfície superior com ou sem máculas e pruína, córtex superior paraplectenquimático, com atranorina e freqüentemente também com zeorina, medula branca, com triterpenos, com ou sem atranorina e leucotilina. A superfície inferior é rizinada, clara a marrom ou negra, com córtex paraplectenquimático, prosoplectenquimático ou de tipo intermediário. Os apotécios são lecanorinos, laminais, sésseis a curto estipitados, com disco marrom a negro, às vezes pruinoso. Os ascos são cilíndricos e produzem ascosporos com um septo e paredes espessadas e marrons. Os conídios são subcilíndricos, levemente sublageniformes, com 4 a 6 µm de comprimento.

A **superfície superior** em *Physcia* pode ser cinza-clara, cinza-esverdeada ou azulada. A coloração não é muito útil na separação de espécies, mas *P. krogiae* Moberg apresenta cor azulada típica, que já foi utilizada em chaves para separar esta espécie de outras morfologicamente próximas (ver chave em Moberg 1986). O relevo da superfície superior pode variar de liso a rugoso ou verrugoso. *Physcia verrucosa* Moberg é um exemplo típico, com a superfície superior extremamente verrucosa (Moberg 1990).

Pruína pode ocorrer em quase todas as espécies conhecidas. Porém, seu valor taxonômico é questionado algumas vezes, pois talvez seja influenciado por fatores ambientais. Mas um grupo de espécies em especial apresenta a superfície superior, principalmente as partes distais, coberta por uma pruinosidade constante bem fina e homogênea: *P. atrostriata* Moberg, *P. krogiae* Moberg, *P. phaeocarpa* (Nyl.) Hue, *P. undulata* Moberg e *P. verrucosa* Moberg (Moberg 1990).

Máculas são características bem úteis na separação de algumas espécies. São nítidas em *P. aipolia* (Humb.) Fürnr. e *P. convexa* (Hoffm.) Fürnr. (Moberg 1986).

A largura e o formato das **lacínias** ou **lobos** também são importantes. Grande parte das espécies têm lacínias (ramificações longas, com largura pouco variável, freqüentemente convexas) com até 1 mm de largura. Já outras, como *P. dilatata* Nyl., apresenta lobos

(ramificações com base bem mais estreita que a largura dos ápices, arredondada e menos adnata ao substrato) que podem ultrapassar 4 mm de largura (Moberg 1986, 1990).

Isídios são estruturas raras em *Physcia*. *Physcia lopezii* Moberg é a única espécie isidiada citada para o Brasil (Aptroot 2002).

Igualmente as **pústulas** são raras, e na América do Sul surgem apenas em *P. decorticata* Moberg (Moberg 1990).

Sorais são muito mais freqüentes e diversificados neste grupo e, portanto, com maior valor taxonômico. Moberg (1977, 1986, 1990) classificou-os em:

- eumarginais: sorais marginais que se desenvolvem mais nas margens laterais e axilas das lacínias ou lobos;
- terminais labriformes: sorais marginais restritos aos ápices das lacínias ou lobos, que podem ter o formato de lábios conforme se desenvolve;
- em forma de capacete: um tipo de terminal-labriforme, mas ao invés de tornar reflexas as lacínias, faz com que a superfície superior distal fique inflada;
- marginais capitados: sorais marginais que se desenvolvem no ápice de lacínias (terminais) ou de lacínulas laterais;
- maculiformes: laminais pelo menos em origem, iniciam seu desenvolvimento como inchaços na superfície que depois se rompem;
- crateriformes: laminais, erumpentes, que rompem de maneira irregular o córtex superior, com base corticada e mais elevados que o tipo maculiforme;
- laminais capitados: às vezes difícil de ser separado do tipo anterior, mas não forma cratera depois que os sorédios foram liberados.

A **superfície inferior** pode variar na coloração e textura. Várias espécies apresentam superfície inferior clara, de bege a marrom-claro, como as do grupo *P. aipolia*, enquanto outras apresentam superfície inferior negra, exceto às vezes pelas margens acinzentadas ou marrons, como *P. integrata* Nyl. Um caso interessante é *P. atrostriata* Moberg, que apresenta as margens com borda ecorticada e dotada de veios escurecidos, principalmente próximo às margens, onde a superfície é mais clara.

Anatomicamente, o tipo de **córtex inferior** é importante na separação de espécies. As hifas podem apresentar distintas orientações, paredes finas ou engrossadas, células com diferentes formatos e tamanhos de lúmen, e distintos graus de pigmentação. De maneira geral,

os córtices inferiores podem ser paraplectenquimáticos, prosoplectenquimáticos ou intermediários, com células irregulares ou isodiamétricas com paredes claras ou pigmentadas.

Moberg (1986) classificou o córtex inferior em:

- paraplectenquimático com células claras e isodiamétricas;
- prosoplectenquimático com células claras longitudinalmente orientadas;
- intermediário entre paraplectenquimático e prosoplectenquimático, com células claras alongadas ou mais ou menos isodiamétricas;
- paraplectenquimático com células isodiamétricas marrons;
- intermediário entre paraplectenquimático e prosoplectenquimático com células marrons, cilíndricas a quadráticas;
- prosoplectenquimático com células marrons e longitudinalmente orientadas.

Hale (1983) distinguiu duas camadas de diferentes arranjos de córtex inferior: uma superior prosoplectenquimática formada de 2–3 camadas de células de paredes grossas, e outra inferior paraplectenquimática, de espessura variável. Este tipo está presente em *P. crispa* Nyl. e *P. sorediosa* (Vain.) Lynge (Hale 1983), mas não foi observado por Moberg (1986).

Apotécios em *Physcia* geralmente não ultrapassam 2 mm de diâmetro, e podem apresentar disco com ou sem pruína. *Physcia coronifera* Moberg e *P. tenuis* Moberg apresentam anfitécio ornamentado com pequenos cílios claros, discretos (Moberg 1990).

Os **ascosporos** podem ser divididos em dois tipos principais, o tipo *Pachysporaria*, com células arredondadas e paredes espessadas, e o tipo *Physcia*, com células de paredes espessadas principalmente nas extremidades e no septo central, cujos lúmens unidos parecem uma ampulheta (Moberg 1977).

O tamanho dos ascosporos não costuma variar muito e é considerado uma característica taxonômica de pouco valor. Mesmo assim, Moberg (1990) criou para eles três categorias: menores que 20 µm de comprimento, entre 21 e 26 µm, e maiores que 27 µm.

O tipo de **conídio** em *Physciaceae* tem valor ao nível genérico. Em *Physcia* s. str. eles são cilíndricos, levemente sublageniformes e com 4 a 6 µm de comprimento (Moberg 1990).

Pyxine

Pyxine Fr., Syst. Orb.Veg. 1: 267. 1825.

TIPO: *Pyxine sorediata* (Ach.) Mont. in Sagra, Hist. Phys. Cuba, Bot. Plant. Cell. 9: 188. 1842.

≡ *Lecidea sorediata* Ach., Syn. Meth. Lich. 54. 1814.

O seguinte histórico é em parte baseado em Kalb (1987).

Pouco tempo antes de Fries (1825) propor *Pyxine* como gênero, Fée (1824) havia criado o gênero *Circinaria*, com três espécies que hoje pertencem a *Pyxine*: *C. berteriana* [= *Pyxine berteriana* (Fée) Imshaug], *C. cocoës* [= *Pyxine cocoës* (Sw.) Nyl.] e *C. dissecta* [= *Pyxine cocoës* (Sw.) Nyl.]. Entretanto, Link (1809 apud Kalb 1987) já havia usado esse nome, o que torna *Circinaria* Fée um homônimo posterior.

Eschweiler (1833) e Nylander (1855) ainda trataram *Pyxine* como seção de *Lecidea*. Pouco depois, Nylander criou a tribo *Pyxinei* para acomodar o gênero *Pyxine* Fr., apresentando *Pyxine meissneri* (Tuck.) Nyl. [= *P. berteriana* (Fée) Imshaug], *P. coccifera* (Fée) Nyl., *P. cocoës* (Sw.) Nyl. e *P. retirugella* Nyl., coletadas em várias localidades, como Nova Caledônia, Java e América do Norte (Nylander 1863).

A pigmentação do hipotécio, presente tanto em *Pyxine* quanto em *Dirinaria*, chamou a atenção de Tuckerman (1882), que colocou *Dirinaria* como uma categoria infragenérica de *Pyxine* (Fr.) Tuck., separada de *Pyxine* Fr. por não ter os apotécios (pelo menos os mais velhos) com margens escurecidas. Tuckerman apresentou descrições e comentários para *Pyxine picta* (Sw.) Tuck. [= *Dirinaria picta* (Sw.) Schaer. ex Clem.], *P. frostii* Tuck. [= *D. frostii* (Tuck.) Awasthi], *P. cocoës* (Sw.) Nyl., *P. meissneri* Tuck. e *P. sorediata* Fr.

Anos depois, Vainio (1890) situou *Pyxine* Fr. na tribo *Buellieae*, juntamente a *Anaptychia* (Körb.) Vain., *Buellia* (de Not.) Vain., *Rinodina* (A. Massal.) Vain. e *Physcia* (Schreb.) Vain., e colocou as espécies com hipotécio pigmentado e margem sempre talina na seção *Dirinaria* (Tuck.) Vain., em *Physcia*.

Ainda no século 19, Stirton (1898) ampliou a circunscrição de *Pyxine*, reunindo o grupo de medula branca, margem talina e epitécio K– às espécies de medula pigmentada, margem enegrecida e epitécio K+ púrpura.

Mas o conceito genérico atualmente aceito de *Pyxine* foi estabelecido por Malme (1897), em sua monografia sobre as espécies brasileiras: *Pyxine* pode ou não apresentar margens talinas persistentes, mas sempre apresenta hipotécio pigmentado e epitécio K+ púrpura.

Passados 60 anos sem grandes avanços, Imshaug (1957), em seu estudo com material da América Central e do Norte, criou duas seções dentro de *Pyxine*:

- Seção *Pyxine*, com ascosporos bicelulares, "mischoblastiomorphic" (cada célula com um esporoblasto em forma de funil);
    - Subseção *Astipitatae* Imshaug, com estipe interno pouco desenvolvido e da mesma cor que o excípulo;
    - Subseção *Rubrostipitatae* Imshaug, com estipe bem desenvolvido e avermelhado;
- Seção *Phragmopyxine* (Clem.) Imshaug, com ascosporos tardiamente com 4 células, pouco "mischoblastiomorphic", sem estipe interno.

Embora estas seções não tenham sido historicamente adotadas, o trabalho de Imshaug, com explanações minuciosas sobre a anatomia do apotécio, demonstrou a importância do estipe interno na taxonomia do grupo.

O primeiro estudo químico do gênero com métodos modernos (cromatografia em camada delgada) foi efetuado por Swinscow & Krog (1975), em seu trabalho com *Pyxine* do leste africano.

Desde essa época, vários trabalhos regionais foram elaboradas para vários locais do planeta: Kashiwadani (1977a/b, Japão) e Kashiwadani (1977c, Papua Nova Guiné), Awasthi (1980, Índia), Moberg (1983, Europa, com poucas espécies, uma vez que o gênero é tipicamente tropical), Rogers (1986, Austrália, que, contra a tendência mundial, deu menor importância a compostos químicos e com isso sinonimizou espécies) e Aptroot (1987, Guianas e Suriname).

Numa ampla monografia do gênero para o Brasil, Kalb (1987) apresentou nova nomenclatura dos tipos de apotécios bem como uma nova estrutura morfológica, o polisidiângio (definição adiante).

Scutari, na Argentina, publicou uma série de trabalhos com idéias diferentes sobre a morfologia de algumas estruturas, como as máculas, além de apresentar descrições, ilustrações e novas citações (Scutari 1990a/b, 1992, 1995b).

Além desses, outros trabalhos merecem destaque por apresentarem novos táxons ou novidades geográficas: Kalb (1994), com *Pyxine* australianas, Kalb (2002), que tratou das

espécies da região do deserto de Sonora, na América do Norte, Gu & Chen (2003) com *Pyxine* chinesas, Moberg (2004), com as espécies do sul da África e, o mais recente, Elix (2009), com 26 espécies australianas.

Pyxine hoje conta com 64 espécies e duas variedades. A Tabela 3 apresenta o ano de publicação, obra e basiônimo das espécies aceitas.

Estudos de *Pyxine* no Brasil

O primeiro estudo que envolveu espécies de *Pyxine* para o Brasil foi o de Eschweiler (1833) na "Flora Brasiliensis". Ele apresentou *Lecidea sorediata* (Ach.) Eschw., encontrada na Bahia, e tratou *Circinaria berteroana* Fée como sinônimo. Porém, este material nunca foi encontrado e não se tem certeza a qual táxon pertenceria hoje.

Krempelhuber (1873) citou *P. cocoës* [*P. berteroana* (Fée) Imshaug, *fide* Kalb 1987], *P. cocoës* var. *sorediata* (*P. coralligera* Malme, *fide* Kalb 1987) e *P. meissneri* (*P. pungens* Zahlbr., *fide* Kalb 1987) para Minas Gerais. O mesmo autor, em 1976, publicou como *P. cocoës* uma coleta de Glaziou vinda do Rio de Janeiro. Kalb (1987) estudou este material e concluiu que se tratava de *P. rhizophorae* Kalb.

Vainio (1890) encontrou para Minas Gerais e Rio de Janeiro: *P. meissneri* Tuck. [= *P. berteroana* (Fée) Imshaug] e *P. meissneri* ssp. *connectens* Vain. [= *P. cocoës* (Sw.) Nyl.], mencionando ainda *P. retirugella* Nyl., *P. eschweileri* (Tuck.) Vain. e a nova espécie *P. minuta* Vain.

Müller Argoviensis (1891) também citou *P. meissneri* ssp. *connectens* (= *P. cocoës*) para o Rio de Janeiro.

Em 1897, Malme publicou espécies e variedades novas em uma monografia de *Pyxine* no Brasil: *P. coralligera* Malme, *P. obscurascens* Malme, *P. meissneri* var. *convexula* Malme [= *P. petricola* var. *convexula* (Malme) Kalb], e *P. meissneri* var. *physciaeformis* Malme [= *P. physciaeformis* (Malme) Imshaug].

Com o estudo das coletas de Schiffner em São Paulo, Zahlbruckner (1909) descreveu *P. rosacea* [= *P. eschweileri* (Tuck.) Vain., *fide* Kalb 1987].

Até Malme (1897), 11 espécies de *Pyxine* eram conhecidas para o Brasil. Kalb (1987) encontrou mais 15 táxons, dos quais sete eram espécies novas, somando 24 espécies e duas variedades conhecidas para este país.

Tabela 3: Cronologia das espécies e variedades de *Pyxine* aceitas atualmente.

Espécie	Data	Obra	Nome atualmente aceito
Lichen cocoës Sw.	1788	*Nov. Gen. Sp. Pl.*: 146.	*Pyxine cocoës* (Sw.) Nyl.
Lecidea sorediata Ach.	1814	*Syn. Meth. Lich.* 54.	*Pyxine sorediata* (Ach.) Mont. in Sagra
Lecidea albovirens G. Mey.	1818	*Prim. Fl. Esseq.*: 295.	*Pyxine albovirens* (G. Meyer) Aptroot
Circinaria berteriana Fée	1824	*Ess. Cryptog. Ecorc. Exot. Offic.*: 128.	*Pyxine berteriana* (Fée) Imshaug
Parmelia coccifera Fée	1824	*Ess. Cryptog. Ecorc. Exot. Offic.*: 126.	*Pyxine coccifera* (Fée) Nyl.
Pyxine retirugella Nyl.	1859	*Ann. Sci. nat.* (*Bot.*) Ser. 4, 11: 240.	*Pyxine retirugella* Nyl.
Physcia glaucovirescens Nyl.	1860	*Syn. Lich.* Vol. 1: 419.	*Pyxine glaucovirescens* (Nyl.) Aptroot
Pyxine cocoës var. *caesiopruinosa* Nyl.	1863	*Syn. Meth. Lich.* 2: 2.	*Pyxine caesiopruinosa* (Nyl.) Imshaug
Pyxine meissneriana Nyl.	1873	*Bull. Soc. Linn. Normandie*, Ser. 2, 7: 164.	*Pyxine meissneriana* Nyl.
Pyxine petricola Nyl. in Cromb.	1876	*Journ. Bot. Lond.* 14: 263.	*Pyxine petricola* Nyl. in Cromb.
Pyxine cocoës var. *eschweileri* Tuck.	1877	*Proc. Am. Acad. Arts Sci.* 12: 167	*Pyxine eschweileri* (Tuck.) Vain.
Pyxine cognata Stirton	1879	*Proc. Phil. Soc. Glasgow* 11: 311.	*Pyxine cognata* Stirton
Catolechia pyxinoides Müll. Arg.	1881	*Flora* 64: 509.	*Pyxine pyxinoides* (Müll. Arg.) Kalb
Pyxine endochrysina Nyl.	1890	*Lich. Jap.*: 34.	*Pyxine endochrysina* Nyl.
Pyxine minuta Vain.	1890	*Acta Soc. Faun. Fl. Fenn.* 7(2): 156.	*Pyxine minuta* Vain.
Pyxine cocoës var. *chrysantha* Müll. Arg.	1890	*Flora* 73: 341.	*Pyxine obscurascens* Malme
Pyxine limbulata Müll. Arg.	1891	*Flora* 74: 112	*Pyxine limbulata* Müll. Arg.
Pyxine cocoës var. *convexior* Müll. Arg.	1894	*Bot. Jb.* 20: 262.	*Pyxine convexior* (Müll. Arg.) Swinscow & Krog
Pyxine retirugella var. *endoxantha* f. *sorediosa* Müll. Arg.	1896	*Bull. Herb. Boiss.* 4: 91.	*Pyxine linearis* R.W. Rogers
Pyxine coralligera Malme	1897	*Bihang Kongl. svenka Vet.- Akad. Handl.* 23, afd. 3(13): 40.	*Pyxine coralligera* Malme
Pyxine obscurascens Malme	1897	*Bihang Kongl. svenka Vet.- Akad. Handl.* 23, afd 3(13): 42.	*Pyxine obscurascens* Malme
Pyxine meissneri var. *convexula* Malme	1897	*Bihang Kongl. svenka Vet.- Akad. Handl.* 23, afd. 3(13): 37.	*Pyxine petricola* var. *convexula* (Malme) Kalb
Pyxine meissneri var. *physciaeformis* Malme	1897	*Bihang Kongl. svenka Vet.- Akad. Handl.* 23, afd. 3(13): 36.	*Pyxine physciaeformis* (Malme) Imshaug
Pyxine subcinerea Stirton	1897	*Trans. New Zealand Inst.* 30: 397.	*Pyxine subcinerea* Stirt.
Pyxine rugulosa Stirton	1898	*Trans. Proc. N.Z. Inst.* 30: 396.	*Pyxine rugulosa* Stirt.
Physcia reticulata Vain. in Welwitsch	1901	*Cat. Afr. Pl. Welwitsch* 2 (2): 412.	*Pyxine reticulata* (Vain.) Vain.
Pyxine asiatica Vain.	1907	*Hedwigia* 46: 171.	*Pyxine asiatica* Vain.
Pyxine schmidtii Vain.	1907	*Hedwigia* 46: 170.	*Pyxine schmidtii* Vain.
Parmelia fallax Zahlbr.	1912	*Ann. Mycol. 10: 381.*	*Pyxine fallax* (Zahlbr.) Kalb
Pyxine consocians Vain.	1913	*Philipp. J. Sci.* 8: 109.	*Pyxine consocians* Vain.
Pyxine copelandii Vain.	1913	*Philipp. J. Sci.* 8: 110.	*Pyxine copelandii* Vain.
Pyxine philippina Vain.	1913	*Philipp. J. Sci.* Sect. C, 8 (2): 110.	*Pyxine philippina* Vain.
Pyxine pungens Zahlbr.	1928	*Ann. Crypt. exot.* 1(2): 210.	*Pyxine pungens* Zahlbr.

Pyxine rhodesiaca Vain. ex Lynge	1937	*Rev. bryol. lichènol.* 10 (N.S.): 90.	*Pyxine rhodesiaca* Vain. ex Lynge
Pyxine katendei Swinscow & Krog	1975	*Norw. J. Bot.* 22: 54.	*Pyxine katendei* Swinscow & Krog
Pyxine kibweziensis Swinscow & Krog	1975	*Norw. J. Bot.* 22: 54.	*Pyxine kibweziensis* Swinscow & Krog
Pyxine lilacina Swinscow & Krog	1975	*Norw. J. Bot.* 22: 56.	*Pyxine lilacina* Swinscow & Krog
Pyxine lyei Swinscow & Krog	1975	*Norw. J. Bot.* 22: 56.	*Pyxine lyei* Swinscow & Krog
Pyxine maculata Swinscow & Krog	1975	*Norw. J. Bot.* 22: 58.	*Pyxine maculata* Swinscow & Krog
Pyxine richardsii Swinscow & Krog	1975	*Norw. J. Bot.* 22: 127.	*Pyxine richardsii* Swinscow & Krog
Pyxine vermiformis Swinscow & Krog	1975	*Norw. J. Bot.* 22: 66.	*Pyxine vermiformis* Swinscow & Krog
Pyxine cylindrica Kashiw.	1977	*Bull. Natn. Sci. Mus.* Ser. B (Bot.) 3(2): 66.	*Pyxine cylindrica* Kashiw.
Pyxine farinosa Kashiw.	1977	*Bull. Natn. Sci. Mus.* Ser. B(Bot.) 3(2): 67.	*Pyxine farinosa* Kashiw.
Pyxine papuana Kashiw.	1977	*Bull. Natn. Sci.Mus.* Ser. B (Bot.) 3 (2): 68.	*Pyxine papuana* Kashiw.
Pyxine austroindica D.D. Awasthi	1980	*Phytomorphology* 30(4): 364.	*Pyxine austroindica* D.D. Awasthi
Pyxine keralensis D.D. Awasthi	1980	*Phytomorphology* 30 (4): 372.	*Pyxine keralensis* D.D. Awasthi
Pyxine palniensis D.D. Awasthi	1980	*Phytomorphology* 30 (4): 371.	*Pyxine palniensis* D.D. Awasthi
Pyxine himalayensis D.D. Awasthi	1980	*Phytomorphology* 30 (4): 371	*Pyxine himalayensis* D.D. Awasthi
Pyxine nilgiriensis D.D. Awasthi	1980	*Phytomorphology* 30(4): 374.	*Pyxine nilgiriensis* D.D. Awasthi
Pyxine daedalea Krog & R. Santesson	1986	*Thunbergia* 2: 7.	*Pyxine daedalea* Krog & R. Santesson
Pyxine isidiolenta R.W. Rogers	1986	*Aust. J. Bot.* 34(2): 142.	*Pyxine isidiolenta* R.W. Rogers
Pyxine africana Kalb	1987	*Bibl. Lichenol.*24: 78.	*Pyxine africana* Kalb
Pyxine astridiana Kalb	1987	*Bibl. Lichenol.*24: 33.	*Pyxine astridiana* Kalb
Pyxine cocoës var. *pallida* Kalb	1987	*Bibl. Lichenol.* 24: 43.	*Pyxine cocoës* var. *pallida* Kalb
Pyxine endocrocea Kalb	1987	*Bibl. Lichenol.*24: 80.	*Pyxine endocrocea* Kalb
Pyxine endolutea Kalb	1987	*Bibl. Lichenol.* 24: 49.	*Pyxine endolutea* Kalb
Pyxine nana Kalb	1987	*Bibl. Lichenol.*24: 49.	*Pyxine nana* Kalb
Pyxine primaria Kalb	1987	*Bibl. Lichenol.*24: 62.	*Pyxine primaria* Kalb
Pyxine rhizophorae Kalb	1987	*Bibl. Lichenol.*24: 68.	*Pyxine rhizophorae* Kalb
Pyxine schechingeri Kalb	1987	*Bibl. Lichenol.* 24: 71.	*Pyxine schechingeri* Kalb
Pyxine simulans Kalb	1987	*Bibl. Lichenol.* 24: 72.	*Pyxine simulans* Kalb
Pyxine australiensis Kalb	1994	*Herzogia* 10: 61.	*Pyxine australiensis* Kalb
Pyxine desudans Kalb	1994	*Herzogia* 10: 62.	*Pyxine desudans* Kalb
Pyxine elixii Kalb	1994	*Herzogia* 10: 64.	*Pyxine elixii* Kalb
Pyxine plumea Kalb	1994	*Herzogia* 10: 66.	*Pyxine plumea* Kalb
Pyxine mexicana Kalb	2002	In Nash III, T.H. *et al.* (eds), F. *Lichen Flora of the greater Sonoran Desert Region* 1: 439.	*Pyxine mexicana* Kalb

A partir dessa monografia, acréscimos na lista de espécies conhecidas se deram através de listas regionais de espécies, como Aptroot (2002) e Fleig, Osorio e colaboradores (veja referências completas em Jungbluth & Marcelli 2010a).

A Figura 2 mostra o número de espécies citadas na literatura por estado brasileiro. Aqui, vê-se que a região Centro-Oeste encontra-se melhor amostrada em números de espécies que *Physcia*, devido aos esforços de Malme (1897) e Kalb (1987). Os estados brasileiros com mais citações de espécies são: São Paulo (17 espécies citadas), seguido de Mato Grosso do Sul e Rio Grande do Sul (15 cada) e Minas Gerais e Mato Grosso (13 cada). *Pyxine* permanece desconhecido na região Norte e Nordeste.

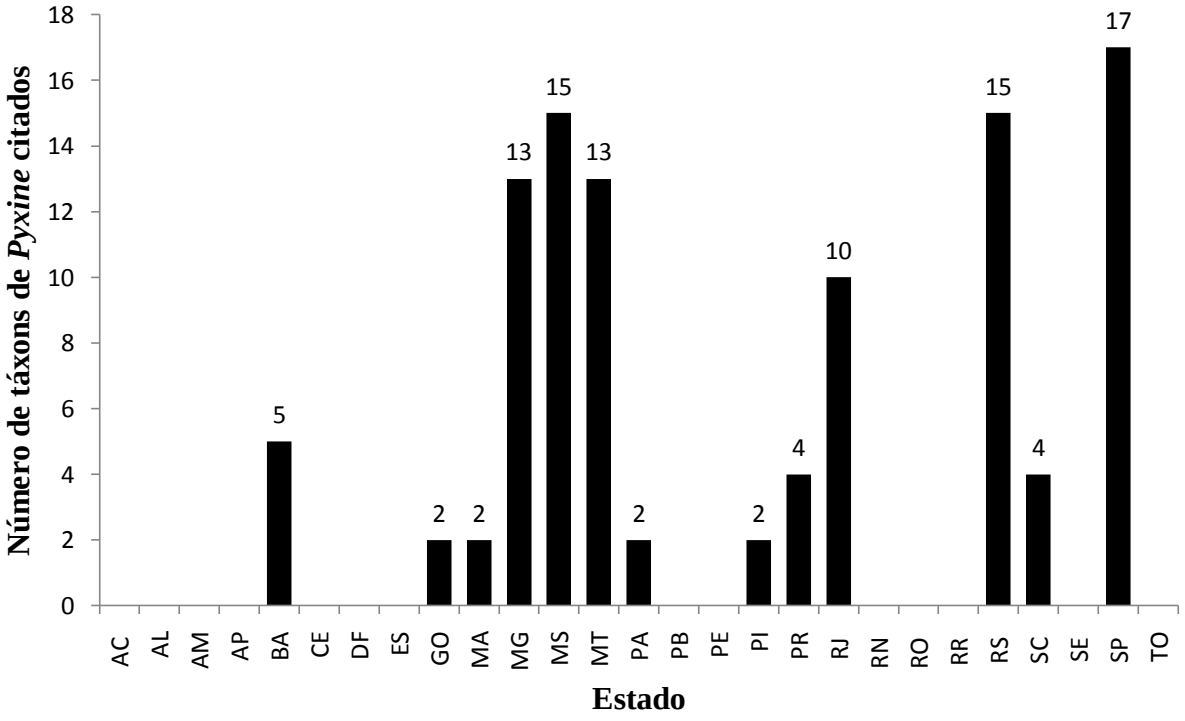

Figura 2: Número de táxons de *Pyxine* citados na literatura por Estado no Brasil.

Caracteres de importância taxonômica em *Pyxine*

Na circunscrição proposta por Kalb (1987), baseada em Malme (1897), *Pyxine* Fr. apresenta talo folioso mais ou menos adpresso ao substrato, superfície superior com ou sem pruína e máculas, córtex superior paraplectenquimático, com atranorina ou liquexantona, medula totalmente branca ou totalmente pigmentada ou, o que é mais comum, com duas camadas distintas, a superior pigmentada e a inferior branca, com triterpenos, com ou sem

testaceína; a superfície inferior é rizinada, negra, com córtex prosoplectenquimático; os apotécios são lecanorinos, do tipo *physciaeformis*, *cocoës* ou *obscurascens*, laminais sésseis a curto estipitados, com disco marrom a negro, raramente pruinoso; o hipotécio é pigmentado, o epitécio K+ púrpura; os ascos são cilíndricos e produzem ascosporos com um ou dois septos e paredes espessadas e marrons; os conídios são subcilíndricos, levemente sublageniformes, com 3 a 4 µm de comprimento.

A **superfície superior** é branca, cinza-esverdeada a cinza-claro ou marrom-acinzentado para esverdeado. Segundo Swinscow & Krog (1975), a coloração pode variar conforme as condições ambientais e não apresenta valor taxonômico.

O **córtex superior** de aproximadamente metade das espécies conhecidas apresenta atranorina (K+ amarelo, UV–); as demais apresentam liquexantona (K–, UV+ amarelo). Foram Culberson & Hale (1965) os primeiros a utilizar luz-ultravioleta para detectar liquexantona em *Pyxine*.

As **lacínias** são mais ou menos radiais, e podem variar de forma conforme a espécie: de planas no centro do talo a convexas ou côncavas nas partes distais. *Pyxine rhizophorae* Kalb apresenta lacínias planas a convexas nas partes proximais do talo, mas que ficam muito côncavas nas extremidades. Já espécies como *P. microspora* Vain. e *P. pyxinoides* (Müll. Arg.) Kalb, apresentam lacínias levemente planas no centro a bem convexas na periferia (Kalb 1987).

Pruína ocorre em várias espécies e pode ocorrer dispersa sobre a superfície ou formar pequenas aglutinações ou até mesmo placas, como em *P. petricola* Nyl. De acordo com Swinscow & Krog (1975), a presença ou ausência de pruína não parece ser uma boa característica distintiva, mas sua distribuição, se esparsa e subapical ou formando placas laminais, é em geral uma boa característica específica.

Segundo Malme (1897), Awasthi (1980) e Kalb (1987), **máculas** são vistas como estruturas esbranquiçadas pela falta da camada de algas logo abaixo do córtex superior. Swinscow & Krog (1975) e Rogers (1986) denominaram estas estruturas como pseudocifelas. Ocasionalmente, máculas em algumas espécies podem formar rachaduras no córtex superior, assemelhando-se realmente a pseudocifelas. Awasthi (1980) denominou as manchas máculas, só denominando-as pseudocifelas se elas produzissem rachaduras. Aqui, preferiu-se usar máculas, uma vez que raramente foram encontradas rachaduras nos espécimes estudados. Pseudocifelas, por sua vez, são consideradas estruturas que facilitam a troca de gases; em *Pyxine*, aparentemente, as rachaduras são o resultado de estresse hídrico/mecânico ou estão ligadas ao crescimento do talo.

Segundo Swinscow & Krog (1975), neste gênero ocorrem máculas irregularmente lineares a reticulares, mas não puntiformes, como em *Physcia*.

Isídios são projeções do talo, a partir do córtex superior, de base constrita e com o mesmo arranjo interno de um talo (com córtex, camada de algas e medula). Em *Pyxine*, isídios são estruturas raras, e não ocorrem nas espécies brasileiras (Kalb 1987).

Bem mais freqüentes são os **polisidiângios**. Kalb (1987) definiu estas estruturas como projeções do córtex superior, das quais estruturas verruciformes adicionais são produzidas: os polisídios. Os polisídios se quebram e expõem a medula. Em seqüencia, as cicatrizes resultantes destas quebras se regeneram em novos polisídios e/ou sorédios granulares. A estrutura resultante tem uma aparência disforme a coralóide. O desenvolvimento destas estruturas ainda não é bem compreendido em todas as espécies nas quais estão presentes. Segundo Kalb (1987), é possível que este nome tenha sido aplicado para estruturas similares que tenham diferentes processos de ontogenia.

Na literatura, estas estruturas já receberam as seguintes denominações: "isídios pustulados com grânulos soredióides" (Swinscow & Krog 1975), pústulas (Kashiwadani 1977c), "isídios crateriformes que produzem sorédios granulares" (Awasthi 1980), esquizídios (Brodo *et al.* 2001) ou dáctilos (Elix 2009).

Já as **pústulas**, no sentido de projeções ocas que podem estourar e liberar sorédios (Marcelli 2006), não ocorrem em *Pyxine*.

Sorais variam muito em cor, forma e localização, constituindo ótima característica na distinção de espécies. Sorais podem ser marginais ou laminais, orbiculares, maculiformes ou elipsóides. Sorais marginais maculiformes e de coloração vermelha ocorrem em *P. coccifera* (Fée) Nyl.; laminais, elipsóides e brancos em *P. katendei* Swinscow & Krog; laminais orbiculares amarelados em *P. subcinerea* Stirton (Swinscow & Krog 1975, Kalb 1987).

A **medula** é totalmente branca em algumas espécies, como em *P. cocoës* (Sw.) Nyl., ou totalmente pigmentada, como em *P. obscurascens* Malme e *P. schechingeri* Kalb; porém, mais freqüentemente apresenta uma camada superior pigmentada e uma inferior branca, bem fina, como em *P. berteriana* (Fée) Imshaug ou *P. physciaeformis* (Malme) Imshaug. A cor da medula pigmentada pode ser creme, amarelo para alaranjado, amarelo-cítrico, laranja-claro ou escuro, ocre ou rosa-salmão (Swinscow & Krog 1975, Kalb 1987).

A **química medular** é de grande importância na confirmação da identidade das espécies. A medula contém triterpenos, testaceína, pigmentos e ácido norstíctico (Rogers 1986), sendo este último ácido a única depsidona encontrada em *Pyxine* (Swinscow & Krog 1975) e foi

encontrado nos apotécios de *P. coccifera* e *P. schechingeri* (Kalb 1987). A ausência de outras depsidonas em *Pyxine* facilita a distinção com espécies pertencentes a *Dirinaria*.

Interpretar os terpenos que ocorrem em *Pyxine* não é tarefa fácil; o que se pode fazer é obter o perfil cromatográfico dos espécimes e compará-los para confirmar a identidade de um táxon a partir de material já identificado com segurança (Swinscow & Krog 1975).

A **superfície inferior** em *Pyxine* é negra no centro e um pouco mais clara próxima às margens (Swinscow & Krog 1975, Awasthi 1980, Kalb 1987, Rogers 1986, Elix 2009). As rizinas costumam variar de simples a dicotômicas ou irregularmente ramificadas. Provavelmente, o tipo de ramificação é característico da espécie, porém elas sempre foram pouco estudadas, talvez por serem de difícil visualização, uma vez que os talos costumam ser relativamente bem adpressos e freqüentemente coletados com o substrato.

Apotécios são estruturas interessantíssimas na taxonomia de *Pyxine*. Desde a criação do gênero até os trabalhos de Imshaug (1957), os apotécios deste gênero eram considerados caracteristicamente lecideínos. Um apotécio lecideíno apresenta um excípulo próprio do qual a camada de algas está ausente, enquanto nos apotécios lecanorinos o excípulo é de origem talina e, portanto, com uma camada de algas. Como apontado por Imshaug (1957), os apotécios em *Pyxine* são na verdade lecanorinos em origem, mas sofrem um processo de pigmentação e escurecimento (comumente denominado "carbonização") da margem talina. As hifas que sofreram pigmentação não parecem mais capazes de manter/estabelecer simbiose com as algas, que acabam morrendo, não proliferando mais.

Kalb (1987) dividiu os apotécios em três tipos:

- *physciaeformis*, com margem talina persistente, isto é, não sofre enegrecimento;
- *cocoës*, cuja margem talina vai gradativamente se carbonizando;
- *obscurascens*, cuja margem é carbonizada desde o início do desenvolvimento.

Partindo do himênio em direção ao talo e sustentando o apotécio, encontra-se o estipe interno. O estipe interno pode não se desenvolver ou ser pouco desenvolvido em algumas espécies, enquanto em outras pode ser extremamente bem desenvolvido, e às vezes pigmentado. Como a cor e a química do estipe interno variam, este caráter foi amplamente usado na separação de espécies (por exemplo, em *P. berteriana* o estipe é branco e K– mas em *P. caesiopruinosa* (Nyl.) Imshaug é amarelo a alaranjado e K+ púrpura) e variedades (*P. cocoës* tem estipe vermelho K+ púrpura, enquanto *P. cocoës* var. *pallida* Kalb tem estipe branco K–) (Imshaug 1957, Swinscow & Krog 1975, Kashiwadani 1977a/b/c, Awasthi 1980, Rogers 1986, Kalb 1987).

Os **ascosporos** em *Pyxine* são do tipo *Dirinaria*. Geralmente apresentam um septo (duas células), mas em *P. eschweileri* (Tuck.) Vain., apresenta três septos (quatro células). Eles variam de 10 a 25 µm de comprimento (Kalb 1987). Swinscow & Krog (1975) dividiram o comprimento dos ascosporos das espécies do leste africano em duas categorias: entre 10 e 15 µm e de 16 a 22 µm de comprimento.

Os **conídios** variam muito levemente de forma dentro do gênero, como mostrado pelas ilustrações em Kalb (1987), de bacilares a sublageniformes a bifusiformes, às vezes de difícil distinção, mesmo no maior aumento do microscópio óptico. Historicamente, não são usados na identificação das espécies, e seu comprimento, de 3 a 4 µm, não varia dentro do gênero (Kalb 1987, 2002, Elix 2009).

A Tabela 1 mostra os gêneros mais próximos de *Pyxine*; nenhum deles apresenta liquexantona no córtex superior ou epitécio K+.

Em linhas gerais, *Dirinaria*, o gênero cujo talo é morfologicamente mais semelhante, difere pela ausência de rizinas e apotécios com margem talina persistente. Os demais diferem, entre outras características, por terem ascosporos e/ou conídios de tipos e tamanhos diferentes. Além disso, *Heterodermia* tem córtex superior prosoplectenquimático e freqüentemente não apresenta córtex inferior. *Hyperphyscia* raramente apresenta atranorina no córtex superior e não apresenta rizinas. *Phaeophyscia* não apresenta atranorina ou liquexantona no córtex superior e geralmente tem rizinas que se projetam para fora das margens do talo. Finalizando, *Physcia* geralmente tem superfície superior clara, córtex superior com atranorina e medula sempre totalmente branca, e quando apresenta máculas, estas são puntiformes, enquanto que em *Pyxine* são irregularmente lineares a reticulares.

Pyxine tem distribuição pantropical a subtropical (Elix 2009). Apenas a distribuição de *P. sorediata* (Ach.) Mont. in Sagra e *P. subcinerea* se estende para regiões temperadas (Moberg 1983).

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OBJETIVOS

Esta tese tem por objetivo revisar a taxonomia, morfologia, anatomia e química dos materiais-tipo das espécies aceitas de *Physcia* (Schreb.) Michx. e *Pyxine* Fr. citadas para o Brasil, bem como de seus sinônimos.

ESTRUTURAÇÃO DA TESE

A tese está dividida em cinco capítulos:

Capítulo 1 – Checklist of *Physcia* (Schreb.) Michx. and *Pyxine* Fr. (*Physciaceae*, *Teloschistales*) from Brazil

Levantamento das espécies de *Physcia* e *Pyxine* citadas na literatura para o Brasil.

Capítulo 2 – Taxonomical studies in Brazilian species of *Physcia* (*Physciaceae*)

Estudo taxonômico das espécies aceitas de *Physcia* conhecidas para o Brasil e seus sinônimos.

Capítulo 3 – The *Pyxine pungens* complex (*Physciaceae*) in São Paulo State, Brazil

Este capítulo trata de um grupo de espécies morfologicamente próximas de *Pyxine* sem propágulos vegetativos, com medula pigmentada K+ púrpura e com atranorina no córtex superior.

Capítulo 4 – Studies in Brazilian *Pyxine* (*Physciaceae*) with vegetative propagules, with emphasis on species from São Paulo State

Este capítulo trata das espécies com sorais e polisidiângios que ocorrem no Brasil, com material adicional coletado principalmente no estado de São Paulo.

Capítulo 5 – Studies in *Pyxine* (*Physciaceae*) without vegetative propagules in Brazil

Este capítulo abrange as espécies de *Pyxine* sem propágulos vegetativos que ocorrem no Brasil.

Capítulo 1

Checklist of *Physcia* (Schreb.) Michx. and *Pyxine* Fr. (*Physciaceae*, *Teloschistales*) from Brazil

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Checklist of *Physcia* (Schreb.) Michx. and *Pyxine* Fr. (*Physciaceae*, *Teloschistales*) from Brazil

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Abstract: A literature-based checklist of Brazilian taxa of *Physcia* and *Pyxine* is presented. Twenty-seven species of *Physcia* and 26 species and two varieties of *Pyxine* are recorded to Brazil.

Key-words: lichens, lichenized fungi, checklist.

Introduction

This is a first effort to evaluate the knowledge status of two foliose genera of *Physciaceae* in Brazil: *Physcia* and *Pyxine*.

Although visually frequent in Brazilian landscapes (Marcelli 1998), studies including *Physciaceae* are few and concentrated mainly in South and Southeast regions of a country with continental dimensions and very high levels of biodiversity and endemism, believed to harbour the Earth's richest Flora (Myers *et al.* 2000).

The literature dealing with Brazilian *Physcia* and *Pyxine* can be divided in two main periods. The first, starting with Eschweiler (1833) in Martius' *Flora Brasiliensis*, finished with Lynge (1924), and is characterized by three main important works: Vainio (1890), Malme (1897) and Lynge (1924).

The next period started in the end of the 1970's with lists of species of South Brazilian localities mainly published by Osorio and Osorio *et al.* (1977 to 1997), ending in 2006. Important works with high number of taxonomic novelties in this phase were Kalb (1987) and Moberg (1990). However, after Moberg (1990), the progress of the studies embracing *Physciaceae* in general remained restrict to occasional citations of species on small localities.

The list below is based in the classic taxonomic and on regional literature. The general organization of this list is: under each taxon name, come the Brazilian's major Federation Units from where the taxon has been cited (see map in Marcelli 1998 for official

abbreviations of the States). Inside each State, the municipalities or localities are arranged alphabetically, followed by the respective bibliographic citation. When the name of the municipality or locality has been changed, the current name comes into brackets after the old one used in the original publication.

The numbered taxa correspond to the nowadays accepted species that presently occurs in Brazil, while the others are not accepted as *Physcia* or *Pyxine* any longer.

Results

Physcia

- ***Physcia acromela*** Nyl. is ***Teloschistes flavicans*** var. ***acromelas*** (Pers.) Norman *fide* Zahlbruckner (1931: 322) – **RJ**: municipality not cited (Krempelhuber 1876: 74, as *Physcia acromela* Nyl.)

1. ***Physcia adscendens*** (Fr.) H. Olivier – **RS**: Porto Alegre (Mazzitelli *et al*. 1999: 62)

- ***Physcia adglutinata*** (Flörke) Nyl. is ***Hyperphyscia adglutinata*** (Flörke) H. Mayrhofer & Poelt *fide* Hafellner *et al*. (1979: 62) – **RS**: Porto Alegre [Lynge (1924: 32), as *Physcia adglutinata* (Flörke) Nyl.]

- ***Physcia aegialita*** (Ach.) Nyl. is ***Dirinaria confusa*** D.D. Awasthi *fide* Awasthi (1975: 56) – **RJ**: municipality not cited [Krempelhuber 1876: 74, as *Physcia aegialita* (Ach.) Nyl.]; Rio de Janeiro (Zahlbruckner 1902: 412)

2. ***Physcia aipolia*** (Humb.) Fürnr. – **MG**/**RJ**: Itatiaia (Zahlbruckner 1909: 198); **MS**: Ponta Porá (Osorio 1992: 3); **MT**: municipality not cited (Moberg 1990: 323); **PE**: Jaqueira (Pereira *et al*. 2006: 117); **RS**: Bagé (Fleig 1995: 421), Eldorado do Sul (Osorio *et al*. 1997: 19), Guaíba (Osorio *et al*. 1982: 481), Montenegro (Osorio *et al*. 1980: 6; Osorio *et al*. 1997: 19), Portão (Osorio *et al*. 1997: 19); Porto Alegre (Osorio *et al*. 1997: 19; Mazzitelli *et al*. 1999: 62), Rio Grande (Osorio & Fleig 1985: 4), Santa Maria (Osorio & Fleig 1983: 139, 1990: 4, 1991: 5; Moberg 1990: 323), Santa Rita (Osorio *et al*. 1997: 19), São Francisco de Paula (Fleig & Grüninger 2000a: 73), São Leopoldo (Osorio *et al*. 1997: 19), Torres (Osorio & Fleig 1984a: 4), Triunfo (Osorio *et al*. 1997: 19), Casino (Moberg 1990: 323); **SP**: Ibiúna (Marcelli 1998: 43), Botucatu (Moberg 1990: 323), Monteiro Lobato (Moberg 1990: 323)

3. ***Physcia alba*** (Fée) Müll. Arg. – **MG/RJ**: Itatiaia (Zahlbruckner 1909: 198); **MG**: Carassa **[Caraça**, Catas Altas Municipality] (Vainio 1890: 139); **RJ**: Itatiaia (Moberg 1990: 324); **RS**: Canoas, Eldorado do Sul, Montenegro, Portão (Osorio *et al*. 1997: 19), Porto Alegre (Osorio *et al*. 1997: 19; Mazzitelli *et al*. 1999: 62), Santa Cruz do Sul (Wietzke-Beckenkamp & Pereira 1997: 85), Santa Rita (Osorio *et al*. 1997: 19), São Francisco de Paula (Fleig & Grüninger 2000a: 76), São Sebastião do Caí, Triunfo (Osorio *et al*. 1997: 19), Viamão (Osorio 1981: 74); **SP**: Campos do Jordão (Aptroot 2002: 40), Faxina [Itapeva] (Zahlbruckner 1909: 198), São Bento do Sapucaí (Moberg 1990: 324)

- ***Physcia alba*** (Fée) Lynge var. ***linearis*** Lynge is ***Physcia kalbii*** Moberg *fide* Jungbluth & Marcelli (2010: xx) – **MG**: São João d'el Rei (Lynge 1924: 24); **MS**: Corumbá (Lynge 1924: 24); **MT**: Santa Anna da Chapada (Lynge 1924: 24); **RJ**: Rio de Janeiro city (Lynge 1924: 24); **SP**: between Santos and Cananéia (Marcelli 1991: 157)

- ***Physcia alba*** (Fée) Lynge var. ***obsessa*** (Mont.) Lynge is ***Physcia obsessa*** sensu (Mont.) Nyl. (nomen dubium) *fide* Jungbluth & Marcelli (2010: xx) – **MG**: Caldas (Lynge 1924: 25), São João d'el Rei (Lynge 1924: 25); Carassa [Caraça, Catas Altas Municipality] (Vainio 1890: 141, as *Physcia integrata* Nyl. var. *obsessa* Vain.); **MS**: Corumbá (Lynge 1924: 25); **MT**: Cuiabá (Lynge 1924: 25), Santa Anna da Chapada (Lynge 1924: 25), between Santo Antonio and Cuiabá (Lynge 1924: 25); **PR**: Guarapuava, Porto Mendes, no municipality cited (Osorio 1977a/b); **RJ**: Rio de Janeiro (Lynge 1924: 25); Rio de Janeiro (Vainio 1890: 141, as *Physcia integrata* Nyl. var. *obsessa* Vain.; Zahlbruckner 1902: 412, as *Physcia integrata* Nyl. var. *obsessa* Vain.); **RS**: Cachoeira [do Sul] (Lynge 1924: 25); road to Encruzilhada (Osorio & Homrich 1978: 453); Cruz Alta (Lynge 1924: 25); Morro Pelado, Santo Angelo prope Cachoeira [Agudo], (Lynge 1924: 25); Parque Nacional [Estadual] do Turvo (Derrubadas municipality) (Osorio *et al*. 1981: 80); Porto Alegre (Lynge 1924: 25); Santa Maria da Bocca do Monte (Lynge 1924: 25); Serra dos Vallos [Valles, prope Cruz Alta] (Lynge 1924: 25); Torres (Osorio & Fleig 1984b: 277); Silveira Martinho [Silveira Martins] (Lynge 1924: 25); no municipality cited (Lynge 1924: 25); **SP**: coastal region between Santos and Cananéia (Marcelli 1991: 157), Santos (Lynge 1924: 25); inter Faxina et Apiahy [between Itapeva and Apiaí] (Vainio 1890: 141, as *Physcia integrata* Nyl. var. *obsessa* Vain.)

- ***Physcia albicans*** (Pers.) Nyl. is ***Heterodermia albicans*** (Pers.) Swinscow & Krog *fide* Swinscow & Krog 1976) – **SP**: Ibiúna (Marcelli 1998: 44), Paranapiacaba (Pereira & Marcelli 1989: 92), São Paulo (Marcelli 1998: 44)

- ***Physcia albicans*** f. ***hypomela*** (Tuckerman) J.W. Thomson is ***Heterodermia albicans*** (Pers.) Swinscow & Krog (1976) – **BA**: Rio Vermelho [Salvador] (Lynge 1924: 29, as *Physcia crispa* Nyl. var. *hypomela* Tuck.); **MG**: Sitio [Antônio Carlos] (Vainio 1890: 143, as *Physcia crispa* Nyl. var. *hypomela* Tuck.), municipality not cited (Lynge 1924: 29, as *Physcia crispa* Nyl. var. *hypomela* Tuck.); **MG/RJ/SP**: municipality not cited (Matos & Marcelli 1998: 159, as *Physcia crispa* Nyl. var. *hypomela* Tuck.); **RJ**: Rio de Janeiro (Vainio 1890: 143, as *Physcia crispa* Nyl. var. *hypomela* Tuck.); **SP**: between Santos and Cananéia (Marcelli 1991: 157)

4. ***Physcia atrostriata*** Moberg – **MG**: municipality not cited (Moberg 1990: 325); **MG/SP/RJ**: Serra da Mantiqueira, municipality not cited (Matos & Marcelli 1998: 159); **PE**: municipality not cited (Moberg 1990: 325); **SP**: Itanhaém, São Sebastião (Moberg 1990: 325)

- ***Physcia carassensis*** Vain. is ***Hyperphyscia carassensis*** (Vain.) Osorio *fide* Osorio (1985: 3) – **MG**: Carassa [Caraça, Catas Altas Municipality] (Vainio 1890: 147); **RS**: Pelotas (Lynge 1924: 31), Porto Alegre (Lynge 1924: 30)

- ***Physcia candelaria*** (Ach.) Nyl. is ***Candelaria concolor*** Arn. *fide* Zahlbruckner (1930: 4) – **RJ**: municipality not cited (Krempelhuber 1876: 73)

5. ***Physcia caesia*** (Hoffm.) Fürnr. – **RJ**: municipality not cited (Krempelhuber 1876: 73)

- ***Physcia comosa*** Nyl. is ***Heterodermia comosa*** (Eschw.) Follmann & Redón *fide* Follmann & Redón (1972: 446) – **RJ**: municipality not cited (Krempelhuber 1876: 73)

- ***Physcia confluens*** (Fr.) Nyl. is ***Dirinaria confluens*** (Fr.) D.D.Awasthi *fide* Awasthi (1975: 28) – **RJ**: municipality not cited (Krempelhuber 1876: 74)

6. ***Physcia convexa*** Müll. Arg. – **MG**: Carassa [Caraça, Catas Altas Municipality] (Vainio 1890: 140); **RS**: Bagé (Fleig 1995: 421), Porto Alegre (Lynge 1924: 27; Fleig 1990b: 44); **SP**: between Santos and Cananéia (Marcelli 1991: 158), São Sebastião (Moberg 1990: 327)

- ***Physcia coralloidea*** Lynge is ***Hyperphyscia coralloidea*** (Lynge) Scutari *fide* Scutari (1991: 21) – **RS**: Pelotas (Lynge 1924: 31)

7. ***Physcia crispa* Nyl**. – **MS**: municipality not cited (Osorio 1992); **RJ**: municipality not cited [Krempelhuber 1876: 74, as *Physcia crispa* (Pers.) Nyl.]; **RS**: Ponta Porã, Porto Alegre (Mazzitelli *et al*. 1999: 62), Rio Grande (Fleig 1988: 14), Santa Maria (Osorio & Fleig 1983: 139), Viamão (Osorio 1981: 74)

- ***Physcia crispa*** Nyl. var. ***hypomela*** Tuck. is ***Physcia albicans*** f. ***hypomela*** (Tuck.) Thomson *fide* Thomson (1963: 88) – **BA**: Rio Vermelho [Salvador] (Lynge 1924: 29); **MG**: Sitio [Antônio Carlos] (Vainio 1890: 143), municipality not cited (Lynge 1924: 29); **MG/RJ/SP**: municipality not cited, Serra da Mantiqueira (Matos & Marcelli 1998: 159); **RJ**: Rio de Janeiro (Vainio 1890: 143)

8. ***Physcia decorticata*** Moberg – **RJ**: Itatiaia (Moberg 1990: 329)

9. ***Physcia dubia*** (Hoffm.) Lett. – **RS**: Porto Alegre (Mazzitelli *et al*. 1999: 62)

10. ***Physcia erumpens*** Moberg – **RJ**: municipality not cited (Moberg 1990: 330); **RS**: São Francisco de Paula (Käffer & Mazzitelli 2005: 815); **SP**: municipality not cited (Moberg 1990: 330)

- ***Physcia exilis*** Michx. is ***Teloschistes flavicans*** Norman var. ***exilis*** Müll. Arg. *fide* Zahlbruckner (1931: 322) – **RJ**: municipality not cited (Krempelhuber 1876: 74)

- ***Physcia flavicans*** (Sw.) DC. is ***Teloschistes flavicans*** Norman *fide* Zahlbruckner (1931: 319) – **RJ**: municipality not cited (Krempelhuber 1876: 74)

- ***Physcia heppiana*** Arn. is ***Caloplaca aurantia*** Hellb. *fide* Zahlbruckner (1931: 212) – **RJ**: municipality not cited (Krempelhuber 1876: 73)

11. ***Physcia integrata*** Nyl. – **MG/RJ/SP**: municipality of São Paulo (Matos & Marcelli 1998: 159), Serra da Mantiqueira, municipality not cited (Matos & Marcelli 1998: 159); **MG**: Carassa [Caraça, Catas Altas Municipality] (Vainio 1890: 141); **RJ**: municipality not cited (Moberg 1990: 331); **SP**: municipality not cited (Moberg 1990: 331)

- ***Physcia integrata*** Nyl. var. ***obsessa*** Vain. is ***Physcia alba*** (Fée) Lynge var. ***obsessa*** (Mont.) Lynge *fide* Thomson (1963: 59) – **MG**: Carassa [Caraça, Catas Altas Municipality] (Vainio 1890: 141); **RJ**: Sepitiba [Baía de Sepitiba, Rio de Janeiro Municipality] (Vainio 1890: 141), "ad cortices laeves in horto botânico Janeirense" [Horto Botânico, Rio de Janeiro] (Zahlbruckner 1902: 412); **SP**: "inter Faxina et Apiahy" [between Itapeva and Apiaí] (Vainio 1890: 141)

- ***Physcia integrata*** Nyl. var. ***sorediosa*** Vain. is ***Physcia sorediosa*** (Vain.) Lynge *fide* Moberg (1990: 339) – **MG**: Sitio [Antônio Carlos] (Vainio 1890: 142, as ***Physcia integrata*** Nyl. var. ***sorediosa*** Vain.), Ouro Preto (Lisboa 1952: 8); **RJ**: Rio de Janeiro (Vainio 1890: 142, as ***Physcia integrata*** Nyl. var. ***sorediosa*** Vain.)

12. ***Physcia kalbii*** Moberg – **RJ**: Rio de Janeiro (Moberg 1990: 332), Itatiaia (Moberg 1990: 332); **RS**: São Francisco de Paula (Fleig & Grüninger 2000a: 73); **SP**: Canto Moreira at Maresias (holotype) (Moberg 1990: 332), Campos do Jordão (Moberg 1990: 332, Aptroot 2002: 16), Pico da Itapeva (Moberg 1990: 332)

13. ***Physcia krogie*** Moberg – **MG**: Carassa [Caraça, Catas Altas Municipality] (Aptroot 2002: 40), municipality not cited (Moberg 1990: 332); **RJ**: municipality not cited (Moberg 1990: 332); **SP**: municipality not cited (Moberg 1990: 332)

- ***Physcia leucomela*** (L.) Michx. is ***Heterodermia leucomela*** (Fée) Swinscow & Krog *fide* Swinscow & Krog (1976: 124) – **RJ**: municipality not cited [Krempelhuber 1876: 74, as *Physcia leucomela* (Michx.) Nyl.]

14. ***Physcia lobulata*** Moberg – **SP**: Campos do Jordão (Aptroot 2002: 28)

15. ***Physcia lopezii*** Moberg – **SP**: Campos do Jordão (Aptroot 2002: 29)

- ***Physcia obsessa*** Mont. [Nyl.], nomen dubium *fide* Jungbluth & Marcelli (2010: xx) – **RS**: Porto Alegre (Fleig 1990b: 45), Rio Grande (Fleig 1988: 14)

16. ***Physcia ochroleuca*** (Müll. Arg.) Müll. Arg. – **SP**: Apiahy [Apiaí] (Müller Argoviensis 1881: 4)

- ***Physcia minor*** (Fée) Vain. is ***Hyperphyscia minor*** (Fée) Kalb *fide* Kalb (1988: 9) – **RJ**: Rio de Janeiro (Vainio 1890: 149); **RS**: Porto Alegre (Lynge 1924: 37)

17. ***Physcia pachyphylla*** Müll. Arg. – **MT**: municipality not cited (Moberg 1990: 336); **SP**: municipality not cited (Moberg 1990: 336)

18. ***Physcia phaeocarpa*** (Nyl.) Hue – **MG**: municipality not cited (Moberg 1990: 336); **MT**: municipality not cited (Moberg 1990: 336); **PR**: municipality not cited (Moberg 1990: 336); **SP**: municipality not cited (Moberg 1990: 336)

- ***Physcia picta*** (Sw.) Nyl is ***Dirinaria picta*** (Sw.) Schaer. ex Clem. *fide* Clements & Shear 1931: 323 – **BA**: municipality not cited (Lynge 1924: 40); **MT**: Santa Anna da Chapada; **RJ**: Rio de Janeiro; **RS**: Porto Alegre, Rio Grande, Santa Maria (Lynge 1924: 40)

19. ***Physcia poncinsii*** Hue – **RS**: Bagé (Fleig 1995: 421), Canoas, Eldorado do Sul, Montenegro, Portão, Porto Alegre, Santa Rita, Rio Grande do Sul (Osorio *et al*. 1997: 19), São Francisco de Paula (Fleig & Grüninger 2000a: 73), São Leopoldo, São Sebastião do Caí, Triunfo (Osorio *et al*. 1997: 19); **SP**: municipality not cited (Moberg 1990: 337)

20. ***Physcia rolfii*** Moberg – **MT**: Estrada do Pantanal, a few km E from Coxim, in a cerrado along a tributary of Rio Taquari (Moberg 1990: 338); **RJ**: between Engenheiros Passos and Registro do Picu [between Engenheiros Passos and Itatiaia] (Moberg 1990: 338); **SP**: Rio Claro (Moberg 1990: 338), between Areiras and Silveiras (Moberg 1990: 338)

- ***Physcia setosa*** (Ach.) Nyl. is ***Phaeophyscia hispidula*** (Ach.) Moberg *fide* Moberg (1987: 305) – **MG**: Sitio [Antônio Carlos] (Vainio 1890: 146); Caldas (Lynge 1924: 29)

21. ***Physcia sinuosa*** Moberg – **BA**: "between Feira de Santana and Milagres, c. 10 km before Milagres, on caatinga" (holotype) (Moberg 1990: 338); **MG**: Carassa [Caraça, Catas Altas Municipality] (Aptroot 2002: 40); **SP**: between Pirapora do Bom Jesus and Cabreúva (Moberg 1990: 339)

22. ***Physcia sorediosa*** (Vain.) Lynge – **MG**: Sitio [Antônio Carlos] (Vainio 1890: 142, as ***Physcia integrata*** Nyl. var. ***sorediosa*** Vain.), municipality not cited (Lynge 1924: 28), Ouro Preto (Lisboa 1952: 8, as ***Physcia integrata*** Nyl. var. ***sorediosa*** Vain.), Catas Altas (Aptroot 2002: 40); **MS**: Corumbá (Lynge 1924: 28); **SP**: coastal region between Cananéia and Santos (Marcelli 1991: 158), Ibiúna (Marcelli 1998: 44), São Paulo (Pereira & Marcelli 1989: 92), São Paulo [Marcelli (1998: 44), municipality not cited (Moberg 1990: 339); **RS**: Porto Alegre (Fleig 1988: 14, Mazzitelli *et al*. 1999: 62), São Francisco de Paula (Fleig & Grüninger 2000a: 73, 2000b: 14); **RJ**: Rio de Janeiro (Vainio 1890: 142, as ***Physcia integrata*** Nyl. var. ***sorediosa*** Vain.); Rio de Janeiro (Lynge 1924: 28)

- ***Physcia speciosa*** Nyl. var. ***granulifera*** Müll. Arg. is ***Anaptychia granulifera*** *fide* Kurokawa (1962: 37) – **SP**: Apiahy [Apiaí] (Müller Argoviensis 1881: 3)

- ***Physcia speciosa*** Fr. var. ***dactyliza*** Nyl. is ***Heterodermia dactyliza*** (Nyl.) Swinscow & Krog *fide* Swinscow & Krog (1976: 117) – **MG**: Caraça [Caraça, Catas Altas Municipality] (Müller Argoviensis 1893: 28)

23. ***Physcia stellaris*** (L.) Nyl. – **RJ**: municipality not cited [Krempelhuber 1876: 74, as *Physcia stellaris* (L.) Fr.]; **RS**: Porto Alegre (Mazzitelli *et al*. 1999: 62);

- ***Physcia stellaris*** (L.) Fr. var. ***rosulata*** (Ach.) Nyl. is ***Physcia stellaris*** (L.) Nyl. *fide* (Moberg 1977: 71) – **RJ**: municipality not cited (Krempelhuber 1876: 74)
- ***Physcia syncolla*** Tuck. is ***Hyperphyscia syncolla*** (Tuck. ex Nyl.) Kalb *fide* Kalb (1983: no. 230) – **MS**: Corumbá (Lynge 1924: 35); **RJ**: Rio de Janeiro (Vainio 1890: 148); **RS**: Cruz Alta, Pelotas, Porto Alegre, Santa Maria da Bocca do Monte, Santo Angelo prope Cachoeira (Lynge 1924: 35); **SP**: Santos (Lynge 1924: 35)

24. ***Physcia sublactea*** Zahlbruckner – **SP**: prope Rio Grande ad "São Paulo Railway" [near São Paulo] (Zahlbruckner 1909: 198)
25. ***Physcia tenuis*** Moberg – **RJ**: Rio de Janeiro (Moberg 1990: 340); **SP**: Ilha de Santo Amaro [Guarujá] (holotype) (Moberg 1990: 340), Praia Grande (Moberg 1990: 340), Itanhaém (Moberg 1990: 340)
26. ***Physcia tribacia*** (Ach.) Nyl. – **RJ**: municipality not cited (Moberg 1990: 341)
27. ***Physcia tribacoides*** Nyl. – **RS**: Triunfo (Osorio *et al*. 1980: 7)

- ***Physcia tuckermannii*** Lynge is ***Hyperphyscia tuckermannii*** (Lynge) Moberg *fide* Moberg (1987: 752) – **RS**: Santo Angelo prope Cachoeira [Agudo], Serra Pelado (holotype) (Lynge 1924: 37)

28. ***Physcia undulata*** Moberg – **PR**: municipality not cited (Moberg 1990: 341); **SP**: municipality not cited (Moberg 1990: 341)

- ***Pseudophyscia speciosa*** var. ***dactyliza*** Müll. Arg. is ***Heterodermia dactyliza*** (Nyl.) Swinscow & Krog – **MG**: Carassa [Caraça, Catas Altas Municipality] (Müller Argoviensis 1895: 42)

Pyxine

1. ***Pyxine albovirens*** (G. M. Mey.) Aptroot – **MG**: Catas Altas (Aptroot 2002: 41); **RJ**: Itatiaia (Kalb 2004: 314); **RS**: Bagé (Fleig 1995: 422), Porto Alegre (Fleig 1990b: 45); **SC**: Ilha de Santa Catarina [Florianópolis] (Kalb 2004: 314)
2. ***Pyxine astridiana*** Kalb – **SP**: between Areias and Silveiras (holotype); West from Pedra do Baú, above São Bento do Sapucaí; Monteiro Lobato (Kalb 1987: 33-34)
3. ***Pyxine berteriana*** (Fée) Imsh. – **GO**: about 15 km southwestern from Goiania (Kalb 1987: 36); **MG**: Sitio [Antônio Carlos] (Vainio 1890: 153, as *Pyxine meissneri* Tuck.);

Lagoa Santa (Krempelhuber 1873, as *P. cocoës* (Kalb 1987: 36); **MG/RJ/SP**: Serra da Mantiqueira, municipality not cited (Matos & Marcelli 1998: 159); **MS**: Corumbá (Malme 1897: 36, as ***Pyxine meissneri*** Tuck. var. ***physciaeformis*** Malme *fide* Kalb 1987: 36), about 35 km southern from Campo Grande (Kalb 1987: 36), highway of Pantanal, few kilometer eastern from Coxim (Kalb 1987: 36), Ponta Porá (Osorio 1992: 4), Piraputanga (Fleig & Riquelme 1991: 9); **PR**: Guaíra (Kalb 1987: 36), Guarapuava, Porto Mendes (Osorio 1977b: 6); **RJ**: Petrópolis (Kalb 1987: 36); **RS**: Cachoeira do Sul (Osorio & Homrich 1978: 453), Santa Maria (Osorio & Fleig 1987: 6, 1989: 3); **SP**: Botucatu (Kalb 1987: 36), Ibiúna (Marcelli 1998: 43); Salto Grande do Rio Paranapanema [Salto Grande] (Zahlbruckner 1909: 197, as *Pyxine meissneri* Tuck.), between Mirassol and Votuporanga (Kalb 1987: 36), José Bonifácio (Kalb 1987: 36), between Osasco and Cabreúva (Kalb 1987: 36), Ruilândia (Kalb 1987: 36), Pardinho (Kalb 1987: 36), between São José do Barreiro and Bocaina da Serra (Kalb 1987: 36), São Bento do Sapucaí (Kalb 1987: 36), Campos do Jordão (Kalb 1987: 36), Monteiro Lobato (Kalb 1987: 36), São José do Barreiro (Kalb 1987: 36), between Socorro and Águas de Lindóia (Kalb 1987: 36)

- ***Pyxine berteriana*** var. ***subobscurascens*** **(**Malme) Imsh. is ***Pyxine pungens*** Zahlbr. *fide* Rogers (1986: 148) – **MT/PA**: municipalities not cited, Projeto Flora expedition to the Serra do Cachimbo, area along the Cuiabá-Santarém highway (BR-163), northcentral Brazil (Brako *et al*. 1985: 133)

4. ***Pyxine caesiopruinosa*** (Nyl.) Imsh. – **RJ**: Itatiaia (Kalb 1987: 38); **RS**: São Sebastião do Caí, Triunfo (Osorio *et al*. 1997: 19); **SC**: Florianópolis (Kalb 1987: 38); **SP**: Campos do Jordão, Ruilândia (Kalb 1987: 38), between Osasco and Cabreúva (Kalb 1987: 38)

5. ***Pyxine coccifera*** (Fée) Nyl. – **MS**: Pantanal Highway, few kilometer eastern from Coxim (Kalb 1987: 40), Piraputanga (Kalb 1987: 40), between Rio Verde do Mato Grosso and Coxim (Kalb 1987: 40), Piraputanga (Fleig & Riquelme 1991: 9); **MT**: Cuiabá (Malme 1897: 43), Cuiabá (Malme 1897: 43, 44), between Boa Vista and São Lourenço (Kalb 1987: 40), Santa Anna da Chapada (Lynge 1917: 3, as *Parmelia coccinea* Lynge; Malme 1897: 43), between Rondonópolis and Guiratinga (Kalb 1987: 40), between Cuiabá and Buriti (Kalb 1987: 40), Buriti (Kalb 1987: 40)

- ***Pyxine coccinea*** (Schaer.) Mont. et v.d. Bosch in Jungh. is ***Pyxine coccifera*** (Fée) Nyl. *fide* Kalb (1987: 39)

6. ***Pyxine cocoës*** (Swartz) Nyl. – **BA**: between Feira de Santana and Milagres (Kalb 1987: 42); **MG/RJ/SP**: Serra da Mantiqueira, municipality not cited (Matos & Marcelli 1998); **MG**: Carassa [Caraça, Catas Altas Municipality] (Aptroot 2002: 41); **MA/PI**: "ad confines provinc. Piauhy et Maranhão: ad Rio Paranahyba" (Zahlbruckner 1909: 197); **PR**: "in ripa sinistra fluminis Paranapanema ad cataratas Salto Grande" [Salto Grande] (Zahlbruckner 1909: 197); **RJ**: Rio de Janeiro (Krempelhuber 1876: 74, as *Pyxine cocoës* (Swartz) Tuckerm.; Vainio 1890: 154, as *Pyxine meissneri* ssp. *connectens* Vain.; Müller Argoviensis 1891: 230, as *Pyxine meissneri* ssp. *connectens* Vain.; Malme 1897: 39; Zahlbruckner 1902: 412); **RS**: Canôas, Porto Alegre (Malme 1897: 38); **SC**: Ilha de Santa Catarina [Florianópolis] (Kalb 1987: 42); **SP**: São Sebastião (Kalb 1987: 42); coastal region between Santos and Cananéia (Marcelli 1991: 158, as *Pyxine meissneri* ssp. *connectens* Vain.);

7. ***Pyxine cocoës*** (Swartz) Nyl. in Cromb. var. ***pallida*** Kalb – **MT**: Santo Antônio de Leverger (Kalb 1987: 42)

8. ***Pyxine cognata*** Stirt. – **GO**: between Jataí and Estância (Kalb 1987: 45), about 15 km southern from Goiania (Kalb 1987: 45); **MS**: Bandeirantes (Kalb 1987: 45), about 35 km northern from Campo Grande (Kalb 1987: 45); **MT**: between Rondonópolis and Guiratinga (Kalb 1987: 45); **RS**: Esmeralda (Fleig 1990a: 124); **SP**: Campos do Jordão, Cosmorama, Monteiro Lobato, São Bento do Sapucaí (Kalb 1987: 45)

9. ***Pyxine coralligera*** Malme – **MG**: Catas Altas (Aptroot 2002: 41); **MS**: between Rio Verde and Coxim (Kalb 1987: 47), Piraputanga (Fleig & Riquelme 1991: 9); **MT**: São Jerônimo [Cuiabá] (lectotype) (Malme 1897: 41); Butiti (Kalb 1987: 47), between Cuiabá und Buriti (Kalb 1987: 47), about 35 km southeast from Cuiabá (Kalb 1987: 47); **MT/PA**: municipalities not cited, Projeto Flora expedition to the Serra do Cachimbo, area along the Cuiabá-Santarém highway (BR-163), northcentral Brazil (Brako *et al*. 1985: 133); **PR**: Guaíra (Kalb 1987: 47); **RS**: Porto Alegre (Fleig 1990b: 45); **SP**: Itapecerica [Itapecerica da Serra] (Zahlbruckner 1909: 197, Kalb 1987: 46)

10. ***Pyxine daedalea*** Krog & R. Sant. – **MG**: Diamantina (Kalb 1987: 49); Lagoa Dourada (Kalb 1987: 49); São João del Rei (Kalb 1987: 49); **MT**: between Rondonópolis and Guiratinga (Kalb 1987: 49); Buriti (Kalb 1987: 49); about 10 km northeastern from Chapada dos Guimarães (Kalb 1987: 49); about 35 km southeast from Cuiabá (Kalb 1987: 49); between Boa Vista and São Lourenço (Kalb 1987: 49); **MS:** Aquidauana

(Fleig & Riquelme 1991: 9); **MA/PI**: Rio Paranahyba [Paranaíba] (Kalb 1987: 49); **PR**: Salto Grande do Rio Paranapanema [Salto Grande] (Zahlbruckner 1909 as *P. cocoës*); **RJ**: Itatiaia (Kalb 1987: 49); **RS**: Porto Alegre (Fleig 1990b: 45); **SP**: Luís Antônio (Kalb 1987: 49)

11. ***Pyxine endolutea*** Kalb – **BA**: Porto Seguro (Kalb 1987: 51); **MG**: undetermined municipality (Kalb 1987: 51)

- ***Pyxine endoleuca*** (Müll. Arg.) Vain. is ***Pyxine petricola*** Nyl. in Cromb. *fide* Kalb (1987: 58) – **RS**: Guaíba (Osorio *et al*. 1982: 482)

12. ***Pyxine eschweileri*** (Tuck.) Vain. – **MG**: Catas Altas (Aptroot 2002: 40), Monte Verde (Kalb 1987: 53), Sitio [Antônio Carlos] (Vainio 1890: 156); **MS**: Pantanal Highway, at Coxim (Kalb 1987: 53); Bandeirantes (Kalb 1987: 53), about 50 km southwestern from Campo Grande (Kalb 1987: 53), Aquidauana (Kalb 1987: 53), Corumbá (Malme 1897: 47); **MT**: **"**inter Coxipó (templum) et Santo Antonio" [Cuiabá] (Malme 1897: 47), Santa Anna da Chapada (Malme 1897: 47), between Rondonópolis and Guiratinga (Kalb 1987: 53), about 35 km southern from Cuiabá (Kalb 1987: 53); **SP**: Salto Grande do Rio Paranapanema [Salto Grande] (holotype) (Kalb 1987: 53); Salto Grande do Rio Paranapanema [Salto Grande] (Zahlbruckner 1909: 197, as *Pyxine rosacea* Zahlbr. *fide* Kalb (1987: 51); Botucatu, Canto Moreira, São Sebastião (Kalb 1987: 53)

- ***Pyxine meissneri*** Tuck. ex Nyl. is ***Pyxine berteroana*** (Fée) Imsh. *fide* Kalb (1987: 34) – **MG**: Sitio [Antônio Carlos] (Vainio 1890: 153); **SP**: Salto Grande do Rio Paranapanema [Salto Grande] (Zahlbruckner 1909: 197);

- ***Pyxine meissneri*** Tuck. var. ***physciaeformis*** Malme is ***Pyxine berteroana*** (Fée) Imsh. *fide* Kalb (1987: 36) – **MS**: Corumbá (Malme 1897: 36)

- ***Pyxine meissneri*** ssp. ***connectens*** Vain. is ***Pyxine cocoës*** (Swartz) Nyl. *fide* Kalb 1987: 41) – **RJ**: Rio de Janeiro (Vainio 1890: 154, Müller Argoviensis 1891: 230); **SP**: coastal region between Santos and Cananéia (Marcelli 1991: 158)

- ***Pyxine meissneri*** Tuck. var. ***convexula*** Malme is ***Pyxine petricola*** Nyl. in Cromb. var. ***convexula*** (Malme) Kalb *fide* Kalb (1987: 60) – **MS**: Corumbá (Malme 1897: 37)

- ***Pyxine meissneri*** Tuck. var. ***genuina*** Malme is ***Pyxine petricola*** Nyl. in Cromb. *fide* Kalb (1987: 58) – **MS**: Corumbá (Malme 1897: 37); **MT**: Cuiabá (Malme 1897: 37); **RJ**: Rio de Janeiro (Malme 1897: 36); **RS**: Porto Alegre, Santa Maria da Boca do Monte [Santa Maria], Santo Angelo prope Cachoeira [Agudo] (Malme 1897: 36)

- ***Pyxine meissneri*** Tuck. var. ***subobscurascens*** Malme is ***Pyxine pungens*** Zahlbr. *fide* Kalb (1987: 64) – **MG**: São João del Rei (Malme 1897: 38)

13. ***Pyxine microspora*** Vain. – **SC**: Ilha de Santa Catarina [Florianópolis] (Kalb 1987: 54); **RS**: Bagé (Fleig 1995: 422)

14. ***Pyxine minuta*** Vain. is ***Pyxine pyxinoides*** (Müll. Arg.) Kalb *fide* Kalb (1987: 66) – **MT**: Cuiabá (Malme 1897: 45); Morro Grande do Santo Antonio (Malme 1897: 45); **RJ**: Rio de Janeiro (holotype) (Vainio 1890: 156); **RS**: Porto Alegre (Malme 1897: 45)

15. ***Pyxine nana*** Kalb – **SP**: José Bonifácio (holotype) (Kalb 1987: 55); Botucatu (Kalb 1987: 56)

16. ***Pyxine obscurascens*** Malme – **BA**: between Mundo Novo and Morro do Chapéu (Kalb 1987: 58); **MG**: Diamantina (Kalb 1987: 57); **MS**: between Rio Verde do Mato Grosso and Coxim (Kalb 1987: 57), Piraputanga (Fleig & Riquelme 1991: 9); **MT**: Serra da Chapada prope São Jeronymo [Cuiabá] (Malme 1897: 43); between Rondonópolis and Guiratinga (Kalb 1987: 57); between Cuiabá and Buriti (Kalb 1987: 57)

- ***Pyxine ochroleuca*** Müll. Arg. – see *Physcia ochroleuca* (Müll. Arg.) Müll. Arg.

17. ***Pyxine petricola*** Nyl. in Cromb. – **MG**: Catas Altas (Aptroot 2002: 41), municipality undetermined (Kalb 1987: 59); **MG/RJ/SP**: Serra da Mantiqueira, municipality not cited (Matos & Marcelli 1998: 159); **MS**: Corumbá (Malme 1897: 36, as *Pyxine meissneri* Tuck. var. *genuina* Malme; Kalb 1987: 59]; **MT**: Cuiabá (Malme 1897: 36, as *Pyxine meissneri* Tuck. var. *genuina* Malme); **RJ**: Rio de Janeiro (Malme 1897: 36, as *Pyxine meissneri* Tuck. var. *genuina* Malme); **RS**: Bagé (Fleig 1995: 422); Porto Alegre; Santo Angelo pr. Cachoeira [Agudo]; Santa Maria da Boca do Monte [Santa Maria] (Malme 1897: 36, as *Pyxine meissneri* Tuck. var. *genuina* Malme); Cachoeira do Sul (Osorio & Homrich 1978: 453, as *Pyxine pringlei* Imshaug); Guaíba [Osorio *et al*. 1982: 482, as *Pyxine endoleuca* (Müll. Arg.) Vain.]; **SP**: Botucatu, Olímpia, Piracicaba, Rio Claro (Kalb 1987: 59); between Socorro and Águas de Lindóia (Kalb 1987: 59)

18. ***Pyxine petricola*** Nyl. in Cromb var. ***convexula*** (Malme) Kalb – **MG**: municipality not cited (Kalb 1987: 61); **MS**: Corumbá (Malme 1897: 37, as *Pyxine meissneri* Tuck. var. *convexula* Malme; Kalb 1987: 60); **RS**: Bagé (Fleig 1995: 422), Porto Alegre (Kalb 1987: 61)

19. ***Pyxine physciaeformis*** (Malme) Imsh. – **MS**: Corumbá (Malme 1897: 36, as *Pyxine meissneri* Tuck. var. *physciaeformis* Malme; Kalb 1987: 62); **RS**: Rio Grande (Fleig 1988: 14); **SP**: about 25 km northeastern from São José do Rio Preto (Kalb 1987: 62); Olímpia (Kalb 1987: 62)

20. ***Pyxine primaria*** Kalb – **MS**: Pantanal Highway, few kilometer eastern from Coxim (Kalb 1987: 64); **MT**: about 35 km southern from Cuiabá (Kalb 1987: 64)

- ***Pyxine pringlei*** Imshaug is ***Pyxine petricola*** Nyl. in Cromb. *fide* Kalb (1987: 58) – **RS**: Cachoeira do Sul (Osorio & Homrich 1978: 453)

21. ***Pyxine pungens*** Zahlbr. – **BA**: about 30 km western from Seabra (Kalb 1987: 65); **MG**: São João del Rei (Malme 1897: 38, as *Pyxine meissneri* Tuck. var. *subobscurascens* Malme); Diamantina, Catas Altas and surroundings, São João del Rei (Kalb 1987: 65), municipality undetermined (Krempelhuber 1873, as *P. meissneri fide* Kalb 1987); **MS**: about 50 km southern from Campo Grande (Kalb 1987: 65); between Rio Verde and Coxim (Kalb 1987: 65), Piraputanga (Fleig & Riquelme 1991: 9); **MT/PA**: municipalities not cited, Projeto Flora expedition to the Serra do Cachimbo, area along the Cuiabá-Santarém highway (BR-163), northcentral Brazil [Brako *et al*. 1985: 133, as *Pyxine berteriana* var. *subobscurascens* (Malme) Imsh.]; **SP**: about 25 km NE from São José do Rio Preto (Kalb 1987: 65); São Bento do Sapucaí (Kalb 1987: 65); "Fazenda Bela Vista, Santa Cruz ad flumen Rio Pardo et prope rubem Faxina" [Itapeva] (Zahlbruckner 1909: 196, as *Pyxine retirugella* Nyl. *fide* Kalb 1987: 65)

22. ***Pyxine pyxinoides*** (Müll. Arg.) Kalb – **MT**: between Cuiabá and Buriti (Kalb 1987: 66); Cuiabá (Malme 1897: 45, as ***Pyxine minuta*** Vain.); Morro Grande do Santo Antonio (Malme 1897: 45, as ***Pyxine minuta*** Vain.); Serra da Guia (Malme 1897: 45, as ***Pyxine minuta*** Vain.); **RJ**: Rio de Janeiro [Vainio (1890: 156), as *Pyxine minuta* Vain.]; **RS**: Porto Alegre (Malme 1897: 45, as *Pyxine minuta* Vain.); **SP**: Apiaí (holotype) (Kalb 1987: 66)

23. ***Pyxine retirugella*** Nyl. – **MG**: "supra rupem in Carassa in civ. Minarum" [Caraça, Catas Altas Municipality] (Vainio 1890: 155);

- ***Pyxine rosacea*** Zahlbr. is ***Pyxine eschweileri*** (Tuck.) Vain. *fide* Kalb (1987: 51) – **SP**: Salto Grande do Paranapanema [Salto Grande] (Zahlbruckner 1909: 197)

24. ***Pyxine rhizophorae*** Kalb – **RJ**: Rio de Janeiro (Krempelhuber 1876, as *P. cocoës fide* Kalb 1987: 23; Malme 1897: 40, as *P. cocoës fide* Kalb 1987: 69); **RS**: Canoas (Malme 1897: 39, as *Pyxine cocoës*; Kalb 1987: 69), Porto Alegre (Malme 1897: 39, as *Pyxine cocoës*); **SP**: Caraguatatuba (Kalb 1987: 69); coastal region between Santos and Cananéia (Marcelli 1991: 158); Cananéia (Kalb 1987: 69); Ilha Comprida (Kalb 1987: 69); Ilha de Santo Amaro (holotype) [Guarujá] (Kalb 1987: 69); Ilha do Cardoso [Cananéia] (Marcelli 1990)

25. ***Pyxine rhodesiaca*** Vain. ex Lynge – **MT**: about 30 km southern from Campo Grande (Kalb 1987: 71); **MS**: about 20 km northeastern from Chapada dos Guimarães (Kalb 1987: 71); Buriti (Kalb 1987: 71); **SP**: Rio Claro, Serra Negra (Kalb 1987: 71)

26. ***Pyxine schechingeri*** Kalb – **BA**: Roda Velha (Kalb 1987: 71)

27. ***Pyxine simulans*** Kalb – **MS**: about 50 km southwestern from Campo Grande (Kalb 1987: 72)

28. ***Pyxine subcinerea*** Stirton – **MG/RJ/SP**: Serra da Mantiqueira, municipality not cited (Matos & Marcelli 1998); **MG**: Catas Altas (Aptroot 2002: 41); **MS**: about 30 km southern from Campo Grande (Kalb 1987: 77); **RJ**: Itatiaia (Kalb 1987: 77); **RS**: Bagé (Fleig 1995: 422); Cachoeira do Sul (Osorio & Homrich 1978: 453); Eldorado do Sul, Esteio, Montenegro (Osorio *et al*. 1997: 19); Montenegro e Triunfo (Zanette *et al*. 1981: 112); Portão, Porto Alegre (Osorio *et al*. 1997: 19); Santa Cruz do Sul (Wietzke-Beckenkamp & Pereira 1997: 86); Santa Maria (Osorio & Fleig 1991: 6); Santa Rita, São Sebastião do Caí (Osorio *et al*. 1997: 19); Triunfo (Osorio *et al*. 1980: 7; Osorio *et al*. 1997: 19); **SP**: about 20 km eastern from Cruzeiro (Kalb 1987: 77); west from Pedra do Baú, near São Bento do Sapucaí (Kalb 1987: 77); between Monteiro Lobato and São Bento do Sapucaí (Kalb 1987: 77); Campos do Jordão (Kalb 1987: 77); Monteiro Lobato (Kalb 1987: 77); between Rio Claro and Ipeuna (Kalb 1987: 77); José Bonifácio (Kalb 1987: 77); near Ruilândia, about 20 km southwest from São José do Rio Preto (Kalb 1987: 77); Piracicaba (Kalb 1987: 77)

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Capítulo 2

Taxonomical studies in Brazilian species of *Physcia* (*Physciaceae*)

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Taxonomical studies in Brazilian species of *Physcia* (*Physciaceae*)

by

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Abstract: Twenty nine species of *Physcia* are known from Brazil. Key, descriptions and discussion are presented; their synonyms and additional species with taxonomic affinities are commented. The lower cortex type, an important character at species level, is discussed to the majority of the accepted species and their synonyms. The synonyms of *Physcia aipolia* (Humb.) Fürnr. are revised; *P. afra* Hue is proposed as synonym of *P. ochroleuca* (Müll. Arg.) Müll. Arg., while *P. aipolia* f. *verruculosa* Vain. in Räsänen is combined to *P. verruculosa* (Vain.) Jungbluth & Marcelli and is considered a good species. A lectotype for *P. alba* (Fée) Lynge var. *linearis* Lynge is designated and this variety is placed under synonym of *P. kalbii*. *Physcia adscendens* (Fr.) H. Olivier, *P. caesia* (Hoffm.) Fürnr., *P. dubia*, and *P. stellaris* (L.) Nyl. are placed in doubt if really are present in Brazilian lichenized mycota. *Physcia obsessa* sensu (Mont.) Nyl. remains a nomen dubium.

Key-words: lichenized fungi, new combinations, taxonomy

Introduction

Physcia (Schreb.) Michx. is a cosmopolite genus with about 70 species whose main area of speciation is South America (Moberg 1994, 2002a).

Acording to Moberg (1977), this genus is characterized by the foliose thallus with atranorine, paraplectenchymatous upper cortex, white medulla, two-celled brown *Pachysporaria*- or *Physcia*-type ascospores up to 30 µm in length, and conidia cylindrical to subcylindrical, 3 to 6 µm long.

Although most of the species have a shiny upper surface, Moberg (1986, 1990) recognized a group of species with pruina or a frosty coating on the lobes/laciniae margins: *P. atrostriata* Moberg, *P. krogiae* Moberg, *P. phaeocarpa* (Nyl.) Hue, *P. undulata* Moberg and *P. verrucosa* Moberg.

When present, maculae are very evident and distinguish species, giving a spotted appearance to the upper surface in *P. aipolia* (Humb.) Fürnr., *P. convexa* Müll. Arg. and others (Moberg 1986).

Soredia and lacinulae are the major vegetative propagules in *Physcia*. Isidia are present only in *P. lopezii* Moberg, while pustules characterize *P. decorticata* Moberg.

Soralia can be marginal or laminal, with different shapes and development. Moberg (1986) classified soralia into two main groups, marginal and laminal, wich he divided according to their development and shape.

Moberg (1986) recognized six different types of lower cortex, an important taxonomical character when separating species. Their hyphae can have distinct orientations and differs in cell-wall thickness, degree of pigmentation, and shape and size of the lumen. In general lines, the cortices can be divided into paraplectenchymatous, prosoplectenchymatous or intermediary, with irregular or isodiametric cells, pale or with strongly pigmented cell-walls.

There are two main types of ascospores in *Physcia*: the *Pachysporaria*-type, with thickened walls and rounded lumen, and the *Physcia*-type, using words from Moberg (1977), with walls thickened mainly at the extremities of the ascospores and at the septum, leaving a sandglass shaped lumen. These two types are illustrated in Poelt (1965) and Mayrhofer (1982).

The length of the ascospores is usually of minor importance (Moberg 1986) and not very useful to separate species. Nevertheless, Moberg (1990) created three categories (<20 µm, 21–26 µm, and >27 µm long) in his study on South American specimens.

Physcia (Moberg's 1977 sense) always has atranorine in upper cortex. Atranorine can be also present in the medulla, and it is detectable by the yellow colour-reaction with the KOH-test, being very useful to separate species. It is notable that, when atranorine is present in the medulla, zeorine is also present in the upper cortex (Moberg 1977, 1990). Besides, *Physcia* also has leucotyline and triterpenes, which despite having a secondary taxonomic importance, it is also interesting when considered with other characteristics.

Some morphologically similar genera of *Physciaceae* occur in Brazil: *Dirinaria* (Tuck.) Clem., *Pyxine* Fr., *Phaeophyscia* Moberg, and *Heterodermia* Trevis.

Dirinaria and *Pyxine* have a distinct brown hypothecium, dark lower surface and *Dirinaria*-type ascospores (see illustration in Mayrhofer 1982). *Dirinaria* also lacks true rhizines (Awasthi 1975) and several *Pyxine* have pigmented medulla and lichexanthone instead of atranorine in upper cortex.

Phaeophyscia has ellipsoid conidia and does not produce atranorine. So, a KOH-test in upper cortex distinguishes it easily from *Physcia*.

The upper cortex of *Heterodermia* is composed of longitudinally arranged thick-walled hyphae called prosoplectenchymatous by Moberg (2002b), very distinct from that found in *Physcia* and in the others foliose genera in *Physciaceae*. Also, the lower cortex is absent from several species of *Heterodermia* (Kurokawa 1962).

Historically, *Physcia* is well known in polar and temperate zones. In tropical regions, taxonomical or floristic works are recent and scarce.

Vainio (1890) produced the first work including *Physcia* in South America. He treated 15 taxa, of which only four are nowadays *Physcia* in Moberg's (1977) sense.

Lynge (1924) treated about 12 taxa, of which also four are still placed under *Physcia* nowadays.

In his work on South American taxa, Moberg (1990) cited 18 species to Brazil. Nowadays, 30 taxa (28 species and 2 varieties) are cited in the literature to this country (Jungbluth & Marcelli 2010).

The objective of the present work is to study the types of names and synonyms of the *Physcia* species cited to Brazil.

Materials and methods

The results obtained were based in the study of type-specimens of the names of the species cited to occur in Brazil, including their synonyms. These types were kindly lent by the curators of BM, G, H, PC, PRM, S, TUR and W or were studied in Herbarium Kalb and UPS. Photos were sent by LINN from the types asked.

Chemical analyses were performed using the traditional spot tests with potassium hydroxide (K) and *para*-phenylenediamine (P) as well examined under UV light.

Apothecia were sectioned by hand with steel razor blades when the information was necessary and sufficient material available. At least 10 ascospores and conidia measurements were taken.

Slides with transversal cuts of the laciniae or lobes were prepared from types representing almost all species here treated and were photographed.

Lacinia here is applied to ribbon-shaped ramifications, in which the width between the margins remains more or less constant, while lobes have variable width and are usually less adnate and more rounded at the apices. Two measures were taken from the lobes: the width at the basis of the ramification and at their larger portion.

A paraplectenchymatous cortex appears cellular and presents the cells looking more or less isodiametric and results from compacted hyphae without determined orientation. The prosoplectenchymatous cortex presents the hyphae in a periclinal or parallel arrangement (Hale 1983, Ryan et al. 2002). In *Physcia*, these hyphae are always periclinally oriented.

Results and discussion

Key to the Brazilian *Physcia* species

1a. Thalli with vegetative propagules..... 2
1b. Thalli without vegetative propagules 18

2a. (1) Isidia present; lacinulae, pustules and soredia absent ..... *P. lopezii*
2b. Isidia absent; lacinulae, pustules or soredia present 3

3a. (2) Lacinulae present ..... *P. lobulata*
3b. Lacinulae absent 4

4a. (3) Cilia present ..... *P. adscendens*
4b. Cilia absent 5

5a. (4) Pustules present, starting as laminal papilliform warts; upper cortex sometimes loosening ..... *P. decorticata*
5b. Pustules absent 6

6a. (5) Soralia laminal, sometimes secondarily marginal 7
6b. Soralia marginal, sometimes secondarily laminal 9

7a. (6) Lower surface white to pale brown ..... *P. poncinsii*
7b. Lower surface black, except near the tips 8

8a. (7) Laciniae up to 1.0 mm wide; soralia starting as cracks ..... *P. erumpens*
8b. Lobes up to 3.0 mm wide; soralia starting small and delimited ..... *P. krogiae*

9a. (6) Soralia mainly terminal at principal branches, labriform; medulla K– 10
9b. Soralia mainly marginal or at the tips of short lateral lacinulae, not labriform; medulla K+ yellow 11

10a. (9) Soredia produced at the upper surface; lower cortex prosoplectenchymatous .... *P. dubia*
10b. Soredia produced at the lower surface; lower cortex paraplectenchymatous .... *P. tribacia*

11a. (9) Soralia orbicular to capitate 12
11b. Soralia linear, semicircular or labriform 14

12a. (11) Lower surface black, except near the tips ..... *P. sorediosa*
12b. Lower surface white to pale brown or grey 13

13a. (12) Soralia marginal, not in the apices of lateral lacinulae; saxicolous ..... *P. caesia*
13b. Soralia mainly in the apices of lateral lacinulae; corticolous ..... *P. tribacoides*

14a. (11) Marginal lower surface striated and ecorticate next the tips,..... *P. atrostriata*
14b. Marginal lower surface not striated and corticated, ... 15

15a. (14) Lower cortex paraplectenchymatous ..... *P. crispa*
15b. Lower cortex prosoplectenchymatous to intermediary 16

16a. (15) Upper surface bluish, pruinose (or frosty coated) ..... *P. undulata*
16b. Upper surface grey or cream, rarely pruinose 17

17a. (16) Soralia sometimes originated from lateral lacinulae, orbicular to strongly lip-shape to helmet-shape ..... *P. rolfii*
17b. Soralia originated from small lateral warts, orbicular to crescent-shape, more frequent in the laciniae axils ..... *P. sinuosa*

18a. (1) Medulla K– ..... *P. stellaris*
18b. Medulla K+ yellow 19

19a. (18) Maculae absent or pale, not evidently spotted 20
19b. Maculae distinct and spotted 23

20a. (19) Upper surface pruinose; lower cortex paraplectenchymatous ..... *P. phaeocarpa*
20b. Upper surface epruinose; lower cortex prosoplectenchymatous to intermediary 21

21a. (20) Lower surface pale to grayish ..... *P. alba*
21b. Lower surface brown to black, except near the tips 22

22a. (21) Laciniae up to 1.5 mm; zeorine present ..... *P. kalbii*
22b. Laciniae up to 0.6 mm; zeorine absent ..... *P. tenuis*

23a. (19) Lower surface black, except near the tips ..... *P. integrata*
23b. Lower surface pale to dark brown 24

24a. (23) Upper surface strongly verrucose; apothecia undulate to irregular up to 5 mm diam. ..... *P. verruculosa*
24b. Upper surface smooth to slightly irregular or nodulose; apothecia smooth to very slightly crenulate up to 2 mm diam. 25

25a. (24) Lobulated; lobes up to 2.5–3.0 mm wide ..... *P. pachyphylla*
25b. Laciniate; lacinulae up to 2 mm wide 26

26a. (25) Saxicolous; lower surface white to pinkish ..... *P. convexa*
26b. Corticolous; lower surface white to grey to brown 27

27a. (26) Lower cortex prosoplectenchymatous to intermediary ..... *P. aipolia*
27b. Lower cortex paraplectenchymatous ..... *P. ochroleuca*

THE SPECIES

Physcia aipolia (Humb.) Fürnr., Naturhist. Topogr. Regensburg II: 249. 1839.

Lichen aipolius Ehrh. ex Humboldt, Fl. Friberg. Spec.: 19. 1793. TYPE: Germany, Hannover, Ehrh. *Pl. Crypt. Linn.* exs. n. 197 (lectotype: LINN, photo!).

= *Lichen athelinus* Ach., Lichenographiae suecicae prodromus: 111. 1798. *Physcia aipolia* f. *anthelina* (Ach.) Vain., Adjumenta ad Lich. Lapp. I(6): 135. 1881. TYPE: Sweden (lectotype: H-ACH n. 1435!).

= *Parmelia aipolia* α *acrita* Ach. Lich. Univ.: 477. 1810. TYPE: Sweden (lectotype: H-ACH 1378!).

= *Parmelia aipolia* β *cercida* Ach. Lich. Univ.: 478. 1810. TYPE: Sweden (lectotype: H-ACH 1434!).

= *Physcia stellaris* var. *angustata* Nyl. Syn. Meth. 1(2): 426. 1810. *Physcia aipolia* ssp. *angustata* (Nyl.) Lynge, Videnskapsselsk. Skrift I, Mat.-Naturv. Kl. 8: 35. 1916. TYPE: France Hospice de Luchon, Nylander (holotype: H-ACH 32232, fide Moberg 1977).

= *Physcia aipolia* f. *alnophila* Vain., Adjumenta ad Lich. Lapp. I(6): 136. 1881. *Physcia aipolia* var. *alnophila* (Vain.) Lynge, Videnskapsselsk. Skrift I, Mat.-Naturv. Kl. 8: 34. 1916. TYPE: Finland, Inari, Veskoniemi, 1878, Vainio (lectotype: TUR-V 8070!).

= *Physcia aipolia* f. *crenulata* Vain., Adjumenta ad Lich. Lapp. I(6): 136. 1881. TYPE: Finland, Kuusamo, 1861, Fellman (lectotype: H!).

= *Physcia aipolia* f. *decolorata* Vain., Adjumenta ad Lich. Lapp. I(6): 136. 1881. TYPE: USSR, Karelia pomorica occ., Repola, near Tuulijärvi, Vainio (lectotype: TUR-V 8079!). **(Fig.1 and 2)**

= *Physcia aipolia* ssp. *angustata* f. *pruinosa* Lynge, Videnskapsselsk. Skrift I, Mat.-Naturv. Kl. 8: 36. 1916. Coll. orig: Norway, Tromsö, Norman, fide Moberg (1977).

DESCRIPTION OF THE LECTOTYPE OF *LICHEN ATHELINUS* ACH.

THALLUS orbicular, corticolous, brownish grey, laciniate, 2.0–3.0 cm diam., adnate, 160–220 µm. PROXIMAL UPPER SURFACE continuous, smooth to slightly nodular, dull, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, dull, plane to slightly convex, without or with a narrow darker zone near the tips. UPPER CORTEX paraplectenchymatous, 15–40 µm. LACINIAE sublinear to linear, irregularly branched, contiguous, rarely overlapping laterally, 0.5–1.0 mm wide; apices subtruncate, flat to very slightly convex, adnate; lateral margin smooth; axils forming acute angles, rarely oval. PRUINA absent. MACULAE distinct, abundant, spotted, mainly laminal at the proximal parts of the thallus, originate small cracks. ISIDIA, PUSTULES AND SORALIA absent. ALGAL LAYER continuous, 10–30 µm. MEDULLA white, 50–90 µm. DISTAL LOWER SURFACE pale brown, slightly shiny, smooth to papillate (just a small part could be observed). PROXIMAL LOWER SURFACE dark brown, slightly shiny, smooth to papillate (just a small part could be observed). LOWER CORTEX prosoplectenchymatous to intermediary, 30–50 µm. RHIZINES darker than the lower cortex, mainly irregularly branched, abundant, aggregated or evenly distributed, up to 0.4 mm long. Apothecia frequent, mainly plane, sessile to shortly pedicellate, laminal, up to 2.0 mm diam.; margin smooth to very slightly crenulate; amphithecia maculate; disc dark brown, dull, with pruina, pruina white, dense. EPITHECIUM 10 µm high; hymenium 70–80 µm high; sub-hymenium 45–55 µm high. ASCOSPORES *Physcia* to *Pachysporaria*-type, ellipsoid, 20–22 × 8–11 µm. PYCNIDIA few, subapical. CONIDIA not found.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1990).

REMARKS. *Physcia aipolia* is recognized by the absence of vegetative propagules, the deeply maculate upper surface, the lower surface cream to brown and the prosoplectenchymatous to intermediary lower cortex.

The lectotype of *Lichen aipolius* could not be loaned, but many types of the species nowadays in its synonymy were studied, inclusively anatomically (Table 1). The variation in the laciniae shape and disposition is considerable. While the majority of the types have laciniae up to 1.0 mm wide, *P. aipolia* var. *decolorata* (Fig. 1) has laciniae up to 2.0 mm and *P. aipolia* var. *verruculosa* up to 1.5 mm. The lower surface varies from cream to dark brown, but in *P. aipolia* f. *crenulata* and *P. aipolia* var. *verruculosa*, the lower surface is cream, not becoming darker.

The anatomical study showed that all the types have a prosoplectenchymatous to slightly intermediate in some parts (see Fig. 2, showing the lower cortex of *P. aipolia* var. *decolorata*), except *P. aipolia* var. *verruculosa* and *P. afra* Hue, until now considered its synonyms (Moberg 1986, 1990).

Physcia aipolia var. *verruculosa* has an intermediate to paraplectenchymatous lower cortex with hyaline cells with very thick walls. However, the differential feature in this type is the upper surface relief, notably rugose, and the shape and margins of the apothecia. The apothecia are irregular in shape, up to 5.0 mm in diameter, while in the others types rarely they reach 2.0 mm, normally measuring about 0.5 mm. The margins in *P. aipolia* var. *verruculosa* are very crenulate, undulate and incised, characteristics absent from the others types analyzed. So, we consider that this variety has enough differences from the *P. aipolia* group to be considered a good species. As it has differences considered nowadays important at species level, we propose a new combination and new status to this variety (see below).

Moberg (1986) observed that the Scandinavian and North European material has distinctly separated hyphae in the lower cortex, while material from South Europe and East Africa has more or less conglutinated hyphae. Besides, he wrote that the African thalli have a lower cortex with affinities to a paraplectenchymatous-type, while the Nordic material has distinctly longitudinally arranged hyphae.

This is the case with the African *P. afra* Hue, the only taxa from a tropical zone that was up to now in the synonym of *P. aipolia*. *Physcia afra* (P!) has a paraplectenchymatous lower cortex similar to that found in the Brazilian *P. ochroleuca* (Müll. Arg.) Müll. Arg. (G!), an older species. See remarks under *P. ochroleuca*.

Table 1: Anatomical data (thickness in µm) from *P. aipolia* group, including also *P. afra* Hue and *P. ochroleuca* (Müll. Arg.) Müll. Arg.

	Thallus	**Upper cortex**	**Algal layer**	**Medulla**	**Lower cortex**	**Lower cortex type**
Lichen athelinus	160–220	15–40	10–30	50–90	30–50	Prosoplect. to intermediary
Parmelia aipolia* f. *acrita	150–200	30–50	20–50	60–90	40–50	Prosoplect. to intermediary
Parmelia aipolia* β *cercida	200–260	20–60	30–60	60–90	40–60	Prosoplect. to intermediary
Physcia aipolia* var. *alnophila	90–190	10–30	20–60	40–60	20–40	Prosoplect.
Physcia aipolia* f. *crenulata	150–215	10–25	50–60	40–75	20–40	Prosoplect. to intermediary
Physcia aipolia* f. *decolorata	170–230	30–60	30–50	40–100	40–60	Prosoplect.
Physcia aipolia* f. *verruculosa	240–380	20–70	30–60	120–180	50–80	Paraplect. to intermediary
Physcia afra	140–160	10–20	30–40	60–70	20–40	Paraplect. to intermediary
Physcia ochroleuca	160–240	20–30	20–50	80–160	20–40	Paraplect.

Physcia convexa Müll. Arg. (G!) is a typical saxicolous species with dark grey upper surface and paraplectenchymatous lower cortex (see remarks under this species).

Physcia pachyphylla Müll. Arg. (G!) is morphologically similar, differing in the wider laciniae up to 2.5 mm and not so evident maculae.

Physcia alba (Fée) Müll. Arg. differs from *P. aipolia* by its laciniae up to 0.5 mm wide and the absence of maculae.

Physcia alba (Fée) Müll. Arg., Rev. Mycol. 9: 136. 1887. **(Fig. 3 and 4)**

Parmelia alba Fée, Essai sur les cryptogames des écorces exotiques officinales 125. 1825. TYPE: Tab. XXX, Fig. 4a in Fée (1825), habitat in America meridionalis, ad Chinchonas (lectotype!).

DESCRIPTION OF THE PARATYPE IN G

THALLUS just few parts of lacinulae and a piece of apothecia left, corticolous, brownish grey, laciniate, adnate, 75−90 µm. UPPER SURFACE (only small distal parts) continuous, smooth, slightly shiny, plane. UPPER CORTEX paraplectenchymatous, 10−20 µm. LACINIAE sublinear, irregularly branched, up to 0.5 mm wide; apices absent; lateral margin perhaps smooth to

slightly irregular; axils forming acute angles to oval. PRUINA absent. MACULAE absent. ISIDIA, PUSTULES AND SORALIA absent. ALGAL LAYER continuous, 10−15 µm. Medulla white, 30−40 µm. Piece of DISTAL LOWER SURFACE cream to beige, dull, smooth. LOWER CORTEX prosoplectenchymatous to paraplectenchymatous, 10−15 µm. RHIZINES just two could be observed, concolored with the lower cortex, simple, up to 0.5 mm long. APOTHECIA just a piece of one present, plane, sessile; margin slightly crenulated; disc black, dull, epruinose.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, sometimes leucotyline, triterpenes (Moberg 1990, 2002).

REMARKS. *Physcia alba* is a laciniate species recognized by the absence of vegetative propagules, the pale lower surface and the paraplectenchymatous lower cortex.

There are fragments of the paratype deposited in Herbarium Müller Argoviensis in G (Fig. 3) with comments and illustrations from Müller Argoviensis, but as the material is in bad condition, Moberg (1990) decided to choose as lectotype the illustration in Fée (1825). Sadly, the description in Fée (1825) is very poor and the illustration provided do not give additional information. As the paratype in G give more information, it was analyzed and described above.

Based in the illustration and annotations by Müller Argoviensis in the paratype envelope in G, the ascospores are of *Pachysporaria*-type, 24–30 × 12–13 µm.

Physcia integrata Nyl. (H-NYL!) is morphologically similar, differing by the wider laciniae (up to 2.0 mm), the dark brown to black lower surface and the paraplectenchymatous lower surface.

Physcia stellaris (L.) Nyl., another related species, lacks zeorine and has a K– medulla (Moberg 1990).

DISTRIBUTION: North America (Thomson 1963, Moore 1968, Moberg 2002a), South America (Moberg 1990). In South America, it was cited to Argentina (Scutari 1992, in the key, 1995, Moberg 1990), Brazil, Costa Rica, Guatemala, Peru, Venezuela (Moberg 1990) and Uruguay (Moberg 1990, Osorio 1992). In Brazil, it was cited to occur between the States of Minas Gerais and Rio de Janeiro (Zahlbruckner 1909), to the States of Minas Gerais (Vainio 1890), Rio de Janeiro (Moberg 1990), Rio Grande do Sul (Osorio 1981, Osorio *et al*. 1997, Wietzke-Beckenkamp & Pereira 1997, Mazzitelli *et al*. 1999, Fleig & Grüninger 2000a) and São Paulo (Zahlbruckner 1909, Moberg 1990, Aptroot 2002).

Physcia atrostriata Moberg, Nord. J. Bot. 6(6): 853. 1986.

TYPE: Tanzania, Tanga Prov., Usambara Mts, Amani, in the surroundings of Forestry House, 5°07′S, 38°38'E, ca. 900 m, on *Spatodea* in a grassy SE exposed slope, 1971, R. Moberg 1495a (holotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, grayish white to brownish white, sublaciniate, 4–10 cm diam., loosely adnate, 150–180 µm. PROXIMAL UPPER SURFACE continuous, smooth, slightly shiny, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane to slightly concave, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 20 µm. SUBLACINIAE sublinear, irregularly to dichotomously branched, laterally superposed to overlapped, 0.6–1.2 mm wide at the basis of the branches, 1.0–2.0 maximum wide; apices rounded, flat to slightly concave, loosely adnate to slightly ascendant; lateral margin smooth and pulverulent to sorediate, slightly crenulated; axils acute, rarely oval. PRUINA absent, although pulverulent, mainly at the proximal parts. MACULAE absent. ISIDIA AND PUSTULES absent. SORALIA white, linear interrupted to crescent shape to sometimes labriform, mainly at the lateral margins, more abundant in proximal parts of the thallus, turning the margins strongly undulate and sinuous; soredia powdery. ALGAL LAYER continuous, 30–40 µm. MEDULLA white, 70–90 µm. DistAL LOWER SURFACE white, quite ecorticate next to the tips, dull, veined to smooth, veins sometimes darkened, ending in rhizines. PROXIMAL LOWER SURFACE dark brown to black, slightly shiny, veined to smooth. LOWER CORTEX prosoplectenchymatous, brown, 15–30 µm, absent from the marginal zone. RHIZINES concolored with the lower cortex or darker, simple to sometimes irregularly branched at the apices, frequent, evenly distributed, in distal parts, mainly in the veins, up to 0.7 mm long. APOTHECIA rare (just six, of which just two are in good conditions), plane to slightly concave, sessile, laminal, up to 2.0 mm diam.; margin smooth to sorediate; amphithecia sorediate; disc dark brown, slightly shiny, epruinose. ASCOSPORES *Pachysporaria*-type, ellipsoid, (21–) 23–26 (–29) × (8–) 10–12 (–13) µm (Moberg 1990). PYCNIDIA not found.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes.

REMARKS. *Physcia atrostriata* is a lobate species recognized by the slightly concave laciniae tips, presence of marginal linear interrupted to crescent shaped soralia, zeorine in the medulla

(K+ yellow) and lower cortex brown and prosoplectenchymatous; however, the most notable diagnostic character is the presence of black longitudinal veins on the white margins of the lower surface that gives a striate appearance to the lower surface.

Other interesting feature of this species, using the words from Moberg (1986, 1990), is the pruina or frosty coating on the lobe margins, as present in *P. krogiae* Moberg, *P. phaeocarpa* (Nyl.) Hue, *P. undulata* Moberg and *P. verrucosa* Moberg.

Physcia krogiae Moberg is morphologically similar, but the soralia are laminal and the lower cortex is paraplectenchymatous with rounded hyphae of very thin walls, without veins in the lower surface.

Physcia crispa Nyl. has marginal soralia, but the lower cortex is white to ivory and paraplectenchymatous with very thick hyphae walls.

Physcia sorediosa Moberg has marginal to laminal soralia and lower cortex paraplectenchymatous with brown thick walled hyphae.

DISTRIBUTION: Africa (Moberg 1986, Aptroot 1988, Swinscow & Krog 1988, Scutari 1995, Krog 2000, Aptroot 2001, Moberg 2004), Asia (Aptroot & Seaward 1999, Aptroot & Sipman 2001, Aptroot et al. 2007), Australia (Moberg 2001, McCarthy & Elix 2002), Central America (Moberg 1990, Esslinger & Egan 1995, Sipman & Wolf 1998, Tenorio et al. 2002), Europe (Moberg 1989, Scutari 1995, Llimona & Hladun 2001), New Zealand (Galloway & Moberg 2005), North America (Harris 1990, Esslinger & Egan 1995, Moberg 1997, Brodo et al. 2001, Hansen et al. 2008), South America (Moberg 1990). In South America, it was cited to Argentina (Scutari 1992, in the key; Scutari 1995; Calvelo & Liberatore 2002), Brazil (Moberg 1990), French Guiana, Guyanas (Aptroot 1987), Peru (Scutari 1995), Surinam (Aptroot 1987) and Venezuela (Marcano et al. 1996). In Brazil, it was cited to the States of Minas Gerais, Pernambuco and São Paulo (Moberg 1990).

Physcia convexa Müll. Arg., Rev. Mycol. 10: 57. 1888.

TYPE**:** Paraguay, saxicola in Cerro de Yaguaron, Balansa 4229, 17.VI.1879 (lectotype: G!; duplicates from the lectotype: PC!, UPS!).

DESCRIPTION OF THE DUPLICATE OF THE LECTOTYPE IN PC

THALLUS orbicular, saxicolous, brownish grey with rose tinge, laciniate, 1.0–2.5 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous, verruculose, dull, convex. DISTAL UPPER SURFACE continuous, verruculose to smooth, dull, convex to slightly convex, with a

pale rose zone near the tips. LACINIAE linear to sublinear, irregularly to subdichotomously branched, contiguous to slightly overlapping laterally, 0.7–1.0 mm wide; apices subtruncate to truncate, slightly convex to flat, adnate; lateral margin smooth; axils acute to oval. PRUINA absent. MACULAE distinct, abundant, spotted, laminal. ISIDIA, PUSTULES AND SOREDIA absent. MEDULLA white. LOWER SURFACE TOTALLY cream to beige, rarely parts with a rose tinge, dull, smooth, rarely with irregularities. RHIZINES concolored with the lower cortex (just few seen), simple, few, evenly distributed, up to 0.5 mm long. APOTHECIA frequent, plane to slightly concave, sessile, laminal, up to 1.2 mm diam.; margin mainly smooth; amphithecia maculate, with pale rose tinge; disc dark brown, dull, with scarce white pruina. EPITHECIUM 10 µm high; hymenium 80–90 µm high; sub-hymenium 60–80 µm high. ASCOSPORES 1-septate, *Physcia*-type, ellipsoid, 16–18 × 6–8 µm. PYCNIDIA few, laminal. CONIDIA bacillary, 3.5–4.0 × ca. 1.0 µm.

ANATOMICAL MEASURES FROM THE DUPLICATE OF THE LECTOTYPE IN PC

THALLUS 110−440 µm. UPPER CORTEX paraplectenchymatous to an intermediary type, 20–100 µm. ALGAL LAYER interrupted by projections of the upper cortex, 40–120 µm. MEDULLA white, strongly compact, 40–60 µm. LOWER CORTEX prosoplectenchymatous above, the lower layer with small rounded cells, paraplectenchymatous, pale brown, 30–40 µm.

COLOR TESTS FROM THE DUPLICATE OF THE ISOTYPE IN UPS: K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes.

REMARKS. *Physcia convexa* is a laciniate saxicolous species recognized by the convex laciniae, the distinct spotted maculae, the K+ yellow medulla and the pale paraplectenchymatous lower layer.

Müller Argoviensis (1888) found a major interval of ascospores length: 18–24 µm, while Scutari (1995) found ascospores 14.5–20.0 µm long.

Distinguish this species from *P. aipolia*, a morphologically and anatomically very variable species, is not easy. This species has a long list of synonyms. Some of them were forms or varieties in the past, with distinct intervals of laciniae width, different laciniae forms and lower cortex structure difficult to interpret (see remarks under this species). The lectotype (LINN, photo!) has laciniae up to 2.0 mm, slightly concave with the lateral margins irregular to sinuous. Nevertheless, the synonyms studied can have convex laciniae up to 1.0 mm and are not always so irregular in the lateral margins.

Some features usually used to distinguish *P. aipolia* from *P. convexa* are the substrate preference (*P. convexa* is saxicolous while *P. aipolia* is a corticolous species) (Moberg 1997), or the color of the lower surface, that is white to grey in *P. aipolia* and white to pinkish in *P. convexa*. Indeed, this pale rose tinge can be observed in parts of the lectotype and in its duplicate, inclusive in the upper surface, but in the descriptions of Vainio (1890), Lynge (1924) and Scutari (1995), there is no mention to this tinge.

Physcia cinerea Moberg (UPS!) can be distinguish from *P. convexa* by the typical dark grey color of the upper surface and the absence of the white spotted maculae and the strongly crenulated margins of the apothecia, which are smooth to very slightly crenulated in *P. convexa*.

Physcia phaea (Tuck.) J.W. Thomson has less convex laciniae, with crenulate and widening tips and prosoplectenchymatous lower cortex, as pointed by Moberg (1990, 1997).

Physcia convexella Moberg (UPS!) has K– medulla and prosoplectenchymatous lower cortex.

DISTRIBUTION: North America (Wetmore 1976) and South America (Moberg 1990). In South America, it was cited to Argentina (Osorio 1977; Scutari 1992, 1995; Calvelo & Liberatore 2002), Brazil (Moberg 1990), Chile (Galloway 1998), French Guiana, Guyana (Aptroot 1987), Paraguay (Müller Argoviensis 1888, protologue), Surinam (Aptroot 1987), and Uruguay (Osorio 1972, 1992). In Brazil, it was cited to the States of Minas Gerais (Vainio 1890), Rio Grande do Sul (Lynge 1924, Fleig 1990, Fleig 1995) and São Paulo (Moberg 1990, Marcelli 1991).

Physcia crispa Nyl., Syn. Meth. Lich. 1(2): 423. 1860.

TYPE**:** French Polynesia, Îles Marquises, Noukahova [Nuku Hiva], Vallée de Taio-ha, D. Jardin (lectotype: H-NYL 32199!).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, corticolous, cream, lobate, 1.5–3.0 cm diam., loosely adnate, 120–140 µm. PROXIMAL UPPER SURFACE continuous, smooth, dull, slightly convex. DISTAL UPPER SURFACE continuous, smooth, dull, slightly concave becoming convex, sometimes plane, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 15–20 µm. LOBES sublinear, irregularly branched, overlapping laterally, 0.6–1.0 mm wide at the basis of the branches, 1.0–2.0 maximum wide; apices rounded to subrounded, crispate and undulate,

mostly ascendant; lateral margin plane to elevated and sinuous, sometimes irregularly incised; axils oval or acute. PRUINA absent. MACULAE absent. ISIDIA AND PUSTULES absent. SORALIA white, linear interrupted to crescent shape, sinuous, marginal; soredia granular to heaped into isidia-like structures. ALGAL LAYER continuous or interrupted by projections of the upper cortex, 20–50 µm. MEDULLA white, 30–50 µm. DISTAL LOWER SURFACE white to ivory, dull, smooth to slightly veined. PROXIMAL LOWER SURFACE white to ivory, dull, smooth to slightly veined. LOWER CORTEX paraplectenchymatous, 20–30 µm. RHIZINES concolored with the lower cortex or slightly darker, simple to rarely irregularly, few, evenly distributed, up to 1.0 mm long. APOTHECIA frequent, slightly concave, adnate, laminal, up to 0.6 mm diam.; margin smooth becoming sorediate; amphithecia smooth becoming sorediate; disc dark brown, slightly shiny, without pruina. ASCOSPORES *Pachysporaria*-type, 20–27 × 8–11 µm [protologue]. PYCNIDIA rare, submarginal. CONIDIA not found.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, UV–. SECONDARY METABOLITES: atranorine, triterpenes.

REMARKS. *Physcia crispa* is a lobate species recognized by the marginal soralia, the pale lower surface and the paraplectenchymatous hyaline lower cortex with thick walled hyphae.

The ascospores of the lectotype were not measured, as different lichenologists had it made before. The ascospores were measured by Nylander (data in the protologue, see above); someone that left handwritings annotations in the lectotype's card [18–23 × 8–10 µm]; by Moberg (1986) [17.0–22.5 x 7.5–12.0 µm]; and by another anonymous person that left typewritten annotations in a piece of paper with dimensions and standard deviations in a Scandinavian language [18.3–24.2 × 8.1–12.9 µm].

During the studies with the lectotype, it was observed a K+ in reaction in the medulla. Just Vainio (1890) observed this same reaction (but did not studied the type), while Swinscow & Krog (1988), Moberg (1986, 1990, 1997, 2001) and Scutari (1995) described *P. crispa* as having medulla K– (only atranorine present). The lectotype needs to be chromatographed to confirm the absence of zeorine.

Physcia undulata Moberg (UPS!) differs from *P. crispa* by its prosoplectenchymatous lower cortex and the type of soralia. In *P. undulata*, the soralia are wider, starting short linear, becoming frequently crescent to lip-shaped, pushing the upper cortex backwards and exposing part of the medulla. In *P. crispa*, the soralia are more delicate, more continuous and turn the lateral margins crispate.

Physcia atrostriata Moberg (UPS!) has soralia morphologically very similar, but besides the prosoplectenchymatous lower cortex has striate lower surface ecorticate next to the margins.

Physcia rolfii (Moberg) has the same type of lower cortex as *P. crispa*, but the soralia are different, starting orbicular becoming strongly lip-shape to helmet-shape, never linear as the species above.

DISTRIBUTION: Africa (Müller Argoviensis 1894, Moberg 1986, Swinscow & Krog 1988), Australia (Moberg 1990), North America (Hale 1987, Harris 1990, Brodo et al. 2001), Central America (Müller Argoviensis 1891a/b, 1893a, Moberg 1990, Tenorio et al. 2002), South America (Moberg1990). In South America, it was cited to Argentina (Scutari 1992, in the key; 1995; Calvelo & Liberatore 2002), Brazil, Colombia (Moberg 1990, Aptroot 1989b), Paraguay (Müller Argoviensis 1888), Uruguay (Moberg 1990, Osorio 1992) and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Mato Grosso do Sul (Osorio 1992), Rio Grande do Sul (Osorio 1981, Osorio & Fleig 1983, Fleig 1988, Mazzitelli et al. 1999) and Rio de Janeiro [Krempelhuber 1876, as *Physcia crispa* (Pers.) Nyl.].

Physcia decorticata Moberg, Nord. J. Bot. 10: 329. 1990. **(Fig. 5 and 6)**

Type: Peru, Junin Dept. Tarma Prov., ca. 10 km (road distance) NNE of Palca, on open rocks at the bridge across Rio Palca, 2600 m alt., 11°18'S 75°32'W, 7-XI-1981, R. & B. Santesson & R. Moberg P 12:73 (holotype: S!; isotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, saxicolous, whitish grey, laciniate, 2.0–3.0 cm diam., closely adnate, 70–90 µm. PROXIMAL UPPER SURFACE continuous to cracked, smooth to rugose, some parts with warts, parts of the upper cortex released, dull, convex. DISTAL UPPER SURFACE continuous to cracked, smooth to rugose, dull, convex to plane, with a slightly darker zone near the tips. UPPER CORTEX paraplectenchymatous, 10 µm. LACINIAE sublinear, irregularly branched, contiguous to rarely overlapping laterally, 0.3–0.7 mm wide; apices subtruncate, flat, sometimes slightly concave, adnate; lateral margin smooth to irregular; axils acute to rarely oval. PRUINA absent. MACULAE absent. PUSTULIFORM STRUCTURES that starts as hollow warts that can spread out, releasing parts or small fragments of the upper cortex or latter becoming sorediate, marginal to submarginal; soredia granular. ALGAL LAYER continuous, 10–20 (–30) µm. MEDULLA white, 10 µm. LOWER SURFACE TOTALLY pale brown, dull, smooth to

papillate. LOWER CORTEX hyaline, prosoplectenchymatous to slightly paraplectenchymatous, 20–30 (–40) µm. RHIZINES concolored with the lower cortex, simple, frequent to scattered, evenly distributed, up to 0.4 mm long. APOTHECIA absent. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine and triterpenes.

REMARKS. *Physcia decorticata* is a laciniate species recognized by the fragile upper cortex, the peculiar marginal pustuliform structures and the cream to brown prosoplectenchymatous to slightly paraplectenchymatous lower cortex.

The two types do not have the vegetative propagules fully developed and also do not contemplate all the variations of ontogeny accepted nowadays to occur in this taxon. In the type-material, the upper cortex produces small warts that can break to expose the medulla and sometimes produce granular soredia. However, in different populations from distinct continents deposited in UPS, the soredia originated from the upper cortex eruptions are not granular (UPS 39665-Venezuela), while in others thalli the soredia are granular and form isidia-like heaps (UPS 36693-Venezuela, 36695, 36696, 39499- all from Australia).

The Australian material (UPS 56494, 56524, 55986) has better developed structures starting as papilliform warts that breaks and fall apart or remains and continues the development, becoming elevated. The hollow structure formed can break at the apice; these structures can liberate granular soredia and cover larger parts of the lamina of the distal parts of the upper surface. Sometimes, when very sorediate, one can have the impression that these structures are stalked soralia. Moberg (2001) affirms that these structures are indeed hollow isidia, but we prefer to call them pustules.

It is possible that the accepted circumscription of this species evolves two different taxa with distinct geographical distribution.

This species is also cited to Africa. Based in the description of Moberg (2004), the African population is morphologically more similar to the Australian specimens than to the South American populations studied.

Moberg (1990, 2001 and 2004) wrote that the closely related species is *P. clementei* (Sm.) Mass. Gest., which differs in having rounded laciniae, more distinct pustules, upper cortex relatively not so fragile and with leucotyline instead zeorine.

Physcia erumpens Moberg is morphologically similar to the South American population of *P. decorticata*, but it differs in having black lower surface of paraplectenchymatous type,

with very thick wall celled and pigmented cells. Besides, the development of the soralia is different (see under remarks of this species).

ADDITIONAL EXAMINED MATERIAL: AUSTRALIA, Queensland, Green Island, 27 km NE of Cairns, on tree along the foreshore, 26-VIII-1976, 1 m alt., leg. *J.A. Elix* 2581 (UPS no. 56494); idem, Great Barrier Reef, Green Island, on tree trunk, 05-III-1970, leg. *Gunnar Degelius* A-210 (UPS no. 56524); idem, 20 km NW of Cairns, Palm Cove, on bark of tree 26-X-1983, 16°45'S 145°46E, 5 m alt., leg. *Leif Tibell* A-14305 (UPS no. 55986). COSTA RICA, Puntarenas, Rio General, Brujo, tripocal moist forest zone, on tree trunk, 9°06'W 83°17W, 200 m alt., 02-I-1979, leg. *Leif Tibell* 8316 (UPS no. 36693). VENEZUELA, Falcon, inmediaciones del Rio Ricoa, Coro-Moron, en matorral espinoso a lo de la via, epifita, 25 m alt., 29-X-1979, leg. *M. Lopez-Figueiras* & *R. Wingfield* 21687 (UPS no. 39499); idem, Sierra Nevada de Merida, quebrada de Fafoy, cercanias de El Carrizal, saxicola, 1400 m alt., 4-IV-1979, leg. *M. Lopez-Figueiras* & *M. Hale* 20203 (UPS no. 36696); idem, Lara, serrania de Bobare, proximidades de Boca Ancha, carretera vieja, Barquisimeto-Carora, cercanias de la Encrucijada, zona arida, corticola, 750 m alt., 22-VII-1979, leg. *M. Lopez-Figueiras* & *M. Keogh* 21132c (UPS no. 39665).

DISTRIBUTION: Africa (Moberg 2004), Australia (Moberg 2001) Central America (Tenorio et al. 2002) and South America (Moberg 1990). In South America, it was cited to Brazil, Ecuador, Peru (Moberg 1990) and Venezuela (Moberg 1990). In Brazil, it was cited to Rio de Janeiro State (Moberg 1990).

Physcia erumpens Moberg, Nord. J. Bot. 6(6): 856. 1986. **(Fig. 7 and 8)**

TYPE**:** Kenya, Aberdare National Park, ca. 5 km W of Ruhuruini Park Gate, on the trunk of *Neoboutonia macrocalyx*, along the road, ca. 2550 m alt., 0°22'S, 36°47'E, 1979, R. Moberg 4419a (holotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, grayish white, laciniate, 2.0–4.0 cm diam., closely adnate, 100–150 µm. PROXIMAL UPPER SURFACE continuous, smooth with some concavities, shiny, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth with occasional concavities, shiny, plane to rarely slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 10–20 µm. LACINIAE sublinear, irregularly to dichotomously branched, contiguous to overlapping laterally, 0.5–1.0 mm wide; apices rounded, flat, rarely

with concavities, adnate; lateral margin smooth to sinuous; axils very closed to overlapping each other. PRUINA farinaceous, faint, subapical. MACULAE pale, very sparse, spotted, laminal. ISIDIA AND PUSTULES absent. SORALIA white, formed by cracks, crateriform, orbicular to slightly capitate to oblong, laminal; soredia powdery to granular. ALGAL LAYER continuous, 10–20 µm. MEDULLA white, 30–40 µm. LOWER SURFACE black, shiny, smooth, rarely with irregularities. LOWER CORTEX paraplectenchymatous, hyphae with very brown and thickened walls, 15–20 µm. RHIZINES concolored with the lower cortex, simple to rarely irregularly branched, frequent, evenly distributed, up to 0.7 mm long. APOTHECIA rare, plane, sessile, laminal, up to 1.2 mm diam.; margin smooth becoming sorediate; amphithecia smooth becoming sorediate; disc dark brown to black, slightly shiny, pruinose, pruina white, faint. ASCOSPORES *Pachysporaria*-type, ellipsoid, (18.5–) 21.5–27.0 × 8.5–11.0 µm (Moberg 1986, protologue). PYCNIDIA rare, laminal. CONIDIA not studied.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1986).

REMARKS. *Physcia erumpens* is a laciniate species recognized by its crateriform, orbicular to oblong laminal soralia, the black lower surface and the paraplectenchymatous lower cortex with dark brown hyphae with thickened walls.

Others species with the same lower cortex type are *P. integrata* Nyl. and *P. sorediosa*. *Physcia integrata* (H-NYL!) does not produce vegetative propagules and has laciniae up to 2 mm wide. *Physcia sorediosa* is morphologically very similar to *P. erumpens*, but has marginal orbicular soredia, neither laminal nor crateriform.

Physcia decorticata is another species that resembles this group of small sorediate species. However, it has narrow laciniae, pustuliform structures and the lower cortex is pale with another hyphal arrangement.

DISTRIBUTION: Africa (Aptroot 1988, Swinscow & Krog 1988, Moberg 2004), Europe (Moberg 1989, Nimis 1993), New Zealand (Galloway & Moberg 2005), North America (Moberg 1997) and Central and South America (Moberg 1990). In South America, it was cited to Argentina (Scutari 1990, 1995, Calvelo & Liberatore 2002), Brazil, Chile, Ecuador, Guiana, Venezuela (Moberg 1990, Marcano et al. 1996) and Uruguay (Osorio 1992). In Brazil, it was cited to the States of Rio de Janeiro, São Paulo (Moberg 1990) and Rio Grande do Sul (Käffer & Mazzitelli 2005).

Physcia integrata Nyl., Syn. Meth. Lich. 1(2): 424. 1860.

TYPE: Mexico, Orizaba, F. Müller (without data) (holotype: H-NYL no. 32211!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, brownish grey, lobate, 3.5–9.0 cm diam., adnate to closely adnate, 110−160 µm. PROXIMAL UPPER SURFACE continuous, smooth, sometimes with small concavities or elevations, slightly shiny, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane to slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 15−30 µm. LACINIAE sublinear, irregularly branched, overlapping laterally, 1.0–2.0 (–3.0) mm wide; apices subrounded, flat, rarely convex, adnate; lateral margin smooth to incised and sublacinulate; axils forming acute angles. PRUINA absent. MACULAE pale to distinct, abundant, spotted, laminal. ISIDIA, PUSTULES AND SOREDIA absent. ALGAL LAYER continuous, 20−30 µm. MEDULLA white, 40−80 µm. DISTAL LOWER SURFACE with a cream zone, dull, papillate. PROXIMAL LOWER SURFACE dark brown to black, slightly shiny, smooth to papillate. LOWER CORTEX paraplectenchymatous, 10−20 µm. RHIZINES concolored with the lower cortex, mainly simple, few rarely irregularly branched, but then the branches are very long and parallel with the main rhizines, abundant, evenly distributed, up to 1.0 mm long. APOTHECIA common, plane to slightly concave, adnate, laminal, up to 2.0 mm diam.; margin smooth; amphithecia maculate; disc dark brown, dull, without pruina. EPITHECIUM 10 µm high; hymenium 100–110 µm high; sub-hymenium 30–40 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, 22–26 × 10–14 µm. PYCNIDIA frequent, subapical. CONIDIA, 2.5–3.5 × ca. 1.0 µm. subcylindrical to sublageniform

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1986, Galloway & Moberg 2005), leucotyline (Moberg 1990, 2001).

REMARKS. *Physcia integrata* is recognized by the absence of vegetative propagules, the dark brown to black lower surface, the paraplectenchymatous lower cortex with thick walled cells and the ascospores 22–26 µm long.

Physcia aipolia (Humb.) Fürnr. is morphologically close, but it has a paler lower surface and a different lower cortex anatomy (see discussion in Moberg 1986 and under the remarks of this species above). There are some varieties of *P. aipolia* with a brown to dark brown, sometimes black, but just in parts of the lower cortex. Besides, a little experience with the

identification of these species is sufficient to distinguish the maculae, which are better developed in *P. aipolia* group.

Physcia ochroleuca (Müll. Arg.) Müll. Arg. can be easily distinguished by the pale lower surface and the paraplectenchymatous lower cortex with thin hyaline walled cells.

DISTRIBUTION: Africa (Müller Argoviensis 1885, 1894, Moberg 1986, 2004, Swinscow & Krog 1988), Asia (Müller Argoviensis 1893b, Aptroot & Seaward1999, Aptroot et al. 2007), Australia (Moberg 2001), Central America (Müller Argoviensis 1891b/1893a, Moberg 1990, Sipman & Wolf 1998), New Zealand (Galloway & Moberg 2005) and North America (Moberg 2002a). In South America, it was cited to Brazil, Colombia (Moberg 1990), French Guiana (Aptroot 1987, Hekking & Sipman 1988, Moberg 1990), Guyana (Aptroot 1987), Paraguay (Müller Argoviensis 1888), Venezuela (Müller Argoviensis 1895, Moberg 1990, Marcano et al. 1996). In Brazil, it was cited to the States of Minas Gerais, Rio de Janeiro e São Paulo (Moberg 1990).

Physcia kalbii Moberg, Nord. J. Bot. 10: 331. 1990. **(Fig. 9 and 10)**

TYPE: Brazil, São Paulo, Serra do Mar, Canto Moreira at Maresias, ca. 30 km W of São Sebastião, at house of Lauterbach family, on Avocado, 3 m alt., 18.II.1980, K. Kalb (holotype: Herb. Kalb!; isotype: UPS!).

= *Physcia alba* (Fée) Lynge var. *linearis* Lynge, Videnskapsselsk. Skrift I, Mat.-Naturv. Kl. 16: 24. 1924. TYPE: Brazil, Minas Gerais State, Sítio [nowadays Antônio Carlos], 1885, Vainio, Exsic. Wain. Lich. Bras. no. 790 (lectotype selected here: UPS).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, brownish grey, laciniate, 2.0–5.5 cm diam., adnate, 100–125 µm. PROXIMAL UPPER SURFACE continuous, smooth to slightly nodular, dull, plane. DISTAL UPPER SURFACE continuous, smooth to slightly nodular, dull, plane, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 17–25 µm. LACINIAE sublinear, irregularly branched, rarely subdichotomous, contiguous to overlapping laterally, 0.5–1.5 mm wide; apices subtruncate, flat to slightly convex, adnate; lateral margin sinuous to sublacinulate; axils acute. PRUINA absent. MACULAE absent. ISIDIA, PUSTULES AND SOREDIA absent. ALGAL LAYER continuous, 10–25 µm. MEDULLA white, 25–50 µm. LOWER SURFACE totally dark brown to black, dull, smooth or with irregularities. LOWER CORTEX prosoplectenchymatous, pale brown, 15–25 µm. RHIZINES concolored with the lower cortex,

simple to irregularly branched near the tips, frequent, evenly distributed, up to 0.5 mm long. APOTHECIA numerous, plane to slightly concave, sessile, laminal, up to1.5 mm diam.; margin smooth; amphithecia smooth; disc black, shiny, rarely with dense white pruina. EPITHECIUM 5–10 µm high; hymenium 130–150 µm high; sub-hymenium 100 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, 20–26 × 9–10 µm. PYCNIDIA few, laminal. CONIDIA not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1990).

REMARKS. *Physcia kalbii* is a laciniate species recognized by the absence of vegetative propagules, dark brown to black lower surface and prosoplectenchymatous lower cortex (Fig. 10) with pale brown to brown cells.

Physcia alba (Fée) Lynge var. *linearis* Lynge is a variety that fell into disuse. In Brazilian literature, this name was used just by Marcelli (1991). Using modern literature (Moberg 1990), specimens similar to the description of *P. alba* var. *linearis* keyed out in *P. kalbii*. Comparing *P. kalbii* with part of the specimens that Lynge used to described this variety (Exsic. Wain. Lich. Bras. no. 790 and 1313 in UPS, the other cited in the protologue were not found), we conclude that these taxa are the same. *Physcia alba* var. *linearis* is an older name, but as a name does not have priority outside the rank in which it is published (McNEILL et al. 2007, article 11.2), this variety is proposed here as synonym of *P. kalbii*. A lectotype for this variety was chosen from the material studied in UPS: Exsic. Wain. Lich. Bras. no. 790.

Physcia tenuis Moberg (Herb. Kalb!) has the same lower cortex, differing in the narrow laciniae (up to 0.6 mm wide), the absence of zeorine (Moberg 1990) and the eventual cilia in the margins of the apothecia.

Physcia coronifera Moberg (GB!) differs in having laciniae up to 0.8 mm and a white to cream lower surface.

DISTRIBUTION: Central and South America (Moberg 1990). In South America, it was cited to Brazil (Moberg 1990) and Chile (Elvebakk & Moberg 2002). In Brazil, it was cited to the States of Rio de Janeiro (Moberg 1990), Rio Grande do Sul (Fleig & Grüninger 2000a) and São Paulo (Moberg 1990, Aptroot 2002).

Physcia krogiae Moberg, Nord. J. Bot. 6(6): 858. 1986.

TYPE: Kenya, Central Provar. (K4), Fort Hall Distr., Thika, where the river Chanya joins River Thika, 1º03'S 34º05'E, alt. ca. 1500 m, on a giant Leguminosae tree, 1979, R. Moberg 4595 (holotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, bluish grey, lobate, 3.5–5.5 cm diam., loosely adnate, 120–180 µm. PROXIMAL UPPER SURFACE continuous, smooth, rarely with irregularities, dull, plane to slightly concave. DISTAL UPPER SURFACE continuous, smooth, dull, mainly plane, rarely slightly convex or concave, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 10–15 µm. LOBES linear, irregularly branched, contiguous to slightly overlapping laterally, 1.0–2.0 mm wide at the basis of the branches, 2.0–3.5 maximum wide; apices rounded, mainly flat, adnate to loosely adnate; lateral margin smooth to sinuous to irregular, slightly cottony; axils acute to oval. PRUINA absent, but upper surface covered with a very fine powder, mainly in distal parts. MACULAE pale to distinct, rare, shapeless to irregularly linear, laminal. ISIDIA AND PUSTULES absent. SORALIA white, orbicular becoming confluent, laminal, rarely becoming submarginal; soredia powdery to granular. ALGAL LAYER continuous, 20–30 µm. MEDULLA white, 90–100 µm. DISTAL LOWER SURFACE brownish grey, with a narrow white zone (about 1.0 mm), dull, smooth to veined. PROXIMAL LOWER SURFACE brownish grey to beige to dark brown, dull, smooth to irregular. LOWER CORTEX paraplectenchymatous, hyphae very pale brown, 10–15 µm. RHIZINES concolored with the lower cortex, simple, scattered to frequent, evenly distributed, up to 0.5 mm long. APOTHECIA absent. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1990).

REMARKS. *Physcia krogiae* is a lobate species recognized by the bluish upper surface, the laminal to submarginal orbicular to confluent soralia, the pale to dark brown lower surface and the paraplectenchymatous lower cortex.

This species has the same pruina covering the lobe margins as in *P. atrostriata* Moberg, *P. undulata* and in the non-sorediate *P. phaeocarpa* and *P. verrucosa*.

Physcia atrostriata is morphologically similar. Differs by the linear interrupted to crescent shaped marginal soralia, prosoplectenchymatous lower cortex and dark veins on the white margins of the lower surface.

Physcia crispa differs in having marginal soralia and white lower surface.

DISTRIBUTION: Africa (Moberg 1986, 2004, Aptroot 1988, 2001), Swinscow & Krog 1988) and South America (Moberg 1990). In South America, it was cited to Brazil (Moberg 1990), Guiana and Surinam (Aptroot 1988). In Brazil, it was cited to the States of Rio de Janeiro, São Paulo (Moberg 1990) and Minas Gerais (Moberg 1990, Aptroot 2002).

Physcia lobulata Moberg, Nord. J. Bot. 10: 333. 1990.

TYPE: Venezuela, Est. Trujillo, Bocono-Mosquey-Alto de San Antonio, ca. 1225-2400 m alt., epiphytic, 9-I-1976, M. Lopez-Figueiras & M. Keogh 11719 (holotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, cream to white, laciniate and lacinulate, 4.0–7.0 cm diam., adnate, 100–140 µm. PROXIMAL UPPER SURFACE continuous, smooth, slightly shiny, plane. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 14–20 µm. LACINIAE sublinear, irregularly to dichotomously branched, contiguous to overlapping laterally, 0.4–0.7 (–1.0) mm wide; apices rounded, flat to slightly convex, adnate; lateral margin crenate to lacinulate; axils oval. LACINULAE sublinear, simple to irregularly branched, procumbent, rarely erect, 0.5–1.0 mm wide, marginal. PRUINA absent. MACULAE absent. ISIDIA AND PUSTULES absent. SORALIA absent. ALGAL LAYER continuous, 20 µm. MEDULLA white, 20–70 µm. DISTAL LOWER SURFACE white to pale brown, slightly shiny, smooth to slightly rugose. PROXIMAL LOWER SURFACE brown to dark brown, slightly shiny, smooth to rugose. LOWER CORTEX paraplectenchymatous, 15–20 µm. RHIZINES concolored with the lower cortex, simple, few, evenly distributed, up to 0.2 mm long. APOTHECIA frequent, plane to slightly concave, sessile, laminal, up to 1.0 mm diam.; margin smooth to slightly crenulate; amphithecia maculate smooth; disc dark brown, shiny, epruinose. EPITHECIUM 10–15 µm high; hymenium 100–130 µm high; sub-hymenium 60–100 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, (25–) 30–32 × 12–14 µm. PYCNIDIA frequent, laminal. CONIDIA not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, leucotyline, triterpenes.

REMARKS. *Physcia lobulata* is recognized by the small simple to irregularly branched marginal lacinulae, the brown to dark brown lower surface and the paraplectenchymatous

lower cortex. Besides, this species has atypical large ascospores, reported by Moberg (1990) as up to 40 µm long.

Physcia manuelii Moberg (UPS!) differs by the very dissected to sublacinulate margins with granular soredia that forms isidia-like heaps. Moreover, the medulla is K–, the lower surface paler, from cream to pale brown, and the ascospores smaller (up to 24 µm).

Physcia lacinulata Moberg (G!) is another morphologically similar species, which differs in having laciniae up to 3 mm wide and upper surface white to grayish brown.

DISTRIBUTION: Central and South America. In South America, it was cited to Brazil, Ecuador and Venezuela (Moberg 1990). In Brazil, it was cited to São Paulo State (Aptroot 2002).

Physcia lopezii Moberg, Nord. J. Bot. 10: 333. 1990.

TYPE: Venezuela, Merida, finca "San Isidro", um sector de la Carbonera, via Mérida-La Azulita, alt. ca. 2200-2250 m, corticolous, 28-VI-1978, M. Lopez-Figueiras 16755 (holotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS irregular, corticolous, brownish white, laciniate, 3.0–8.0 cm diam., adnate, 80–90 µm. PROXIMAL UPPER SURFACE continuous, smooth to slightly nodular (isidia starting to grow), shiny, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, shiny, plane to slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 20–30 µm. LACINIAE sublinear, few linear, irregularly to dichotomously branched, contiguous, rarely overlapping laterally, 0.3–0.6 mm wide; apices rounded to slightly subtruncate, flat, adnate; lateral margin smooth to slightly sinuous; axils acute to oval angle. PRUINA absent. MACULAE absent, but where the isidia start to grow, the upper cortex seems slightly paler, what can be interpreted as pale, sparse, spotted and laminal maculae. ISIDIA cylindrical, simple to branched, rarely coralloid, erect to procumbent, apices when break can be sorediate, laminal to marginal, covering proximal parts of the thallus, soredia granular. PUSTULES absent. SORALIA absent. ALGAL LAYER continuous, 20–30 µm. MEDULLA white, 30–40 µm. DISTAL LOWER SURFACE white to pale grey, slightly shiny, smooth, rarely with irregularities. PROXIMAL LOWER SURFACE beige, slightly shiny, smooth, rarely with irregularities. LOWER CORTEX prosoplectenchymatous, 20–30 µm. RHIZINES

concolored with the lower cortex, the apices becoming blackened, simple, few, up to 0.4 mm long (just few found). APOTHECIA absent. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, leucotyline, triterpenes (Moberg 1990).

REMARKS. *Physcia lopezii* is recognized by the simple to branched cylindrical isidia, the white to beige and grey lower surface and the prosoplectenchymatous lower cortex.

This is the only species in the genus with true isidia in Brazil, which can produce soredia when injured.

Physcia decorticata has isidia-like structures formed by heaps of granular soredia or pustules (always hollow) that breaks at the apices.

DISTRIBUTION: South America, cited to Brazil (Aptroot 2002), Ecuador, French Guiana, Guyana, Venezuela and Chile (Moberg 1990). In Brazil, it was cited to São Paulo State (Aptroot 2002).

Physcia ochroleuca (Müll. Arg.) Müll. Arg., Verhand. zool. bot. Gesellsch. Wien. 43: 296. 1893c. **(Fig. 11 and 12)**

Pyxine ochroleuca Müll. Arg., *Flora* **64**(32): 507. 1881. TYPE: Brazil, São Paulo State, crescit corticola ut videtur in Brasiliae meridionalis districtu Apiahy [Apiaí], Puiggari n. 1384 pr. p. (holotype: G!).

= *Physcia afra* Hue, *Mém. Soc. Bot. France* 28: 11. 1916. TYPE: Kenya, Tika River southeast of Mt. Kenya at Blue Post, 45 km from Nairobi, on road to Fort Hall, 1500 m, corticole, 1912, Visc. de Poncins (holotype: PC!, syn. nov.).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, yellowish grey, laciniate, 2.5–3.0 cm diam., adnate, 160–240 µm. PROXIMAL UPPER SURFACE continuous to sometimes cracked, smooth to bullate, dull, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, dull, plane to slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 20–30 µm. LACINIAE sublinear, irregularly branched, overlapping laterally, 0.6–1.3 mm wide; apices subrounded, flat to slightly convex, adnate to convolute; lateral margin smooth to sinuous; axils forming acute angles or rarely. PRUINA absent or very sparse, farinaceous, subapical. MACULAE distinct, abundant, spotted, laminal. ISIDIA, PUSTULES AND SORALIA absent. ALGAL LAYER continuous 20–50 µm. MEDULLA white, 80–160 µm. DISTAL LOWER SURFACE cream,

dull, smooth to papillate and veined. PROXIMAL LOWER SURFACE cream to pale, dull, smooth to papillate. LOWER CORTEX paraplectenchymatous, 20–40 µm. RHIZINES concolored with the lower cortex or darker, simple, sometimes irregularly branched, frequent to numerous, evenly distributed, up to 0.5 mm long. APOTHECIA common, plane to slightly concave, adnate, laminal, up to 1.0 mm diam.; margin smooth or sinuous in old apothecia; amphithecia maculate; disc black, slightly shiny, epruinose. ASCOSPORES *Pachysporaria*-type, ellipsoid, 22–26 × 11–12 µm [19–22 × 10–12 µm (Müller Argoviensis 1881, protologue), 19–24 × 10–12 µm (annotations in handwriting, probably from Müller Argoviensis, left in the type-card)]. PYCNIDIA few, subapical. CONIDIA sublageniform, 3.0–4.0 × ca. 1.0 µm.

COLOR TESTS: upper cortex UV–; medulla UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes.

REMARKS. *Physcia ochroleuca* is recognized by the absence of vegetative propagules, the very pale lower surface, the paraplectenchymatous lower cortex and the *Pachysporaria*-type ascospores 19–26 µm long.

Pyxine ochroleuca is an old forgotten name, as the species was not cited since Müller Argoviensis (1893c) combined it into *Physcia*. This species belong to a complex group that involves *P. aipolia*, its numerous synonyms, *P. pachyphylla* Müll. Arg. and *P. integrata*.

The current circumscription of *P. aipolia* embraces taxa with different arrangements of the lower cortex hyphae and ascospores *Physcia*- to *Pachysporaria*-type, 19–28 µm length. Moberg (1986) observed that the Eastern African thalli have the lower cortex tending to be paraplectenchymatous, while the Scandinavian and North European material have distinctly longitudinally arranged hyphae (see remarks under *P. aipolia*).

During the studies with the synonyms of *P. aipolia*, we classified the Scandinavian and the European types as having prosoplectenchymatous or intermediate lower cortex, while *P. afra*, the unique synonym from tropical Africa, has a paraplectenchymatous lower cortex, similar to that found in the holotype of *P. ochroleuca* (Table 1).

Unfortunately, the holotype of *P. afra* is very small and consists of a fragmented thallus without entire laciniae. However, the protologue (Hue 1916) is very detailed and there is no reason to keep *P. afra* in the synonym of *P. aipolia* instead under *P. ochroleuca*.

Physcia integrata differs in having a black lower surface and paraplectenchymatous lower cortex with very thick walled cells.

Physcia pachyphylla (G!, PC!) differs in having wider laciniae up to 2.5 mm and a slightly different lower cortex.

DISTRIBUTION: Africa (Hue 1916, as *P. afra*, protologue) and South America, Brazil, cited to São Paulo State (Müller Argoviensis 1881, protologue).

Physcia pachyphylla Müll. Arg., Rev. Mycol. 10: 57. 1888.

TYPE: Paraguay, Assuncion, Villa Rica, Pl. du Paraguay, Balansa 4136 (lectotype: G!; duplicate of the lectotype: PC!).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular (probably just part of a specimen), saxicolous (?), brownish grey, laciniate, 2.0–4.0 cm diam., adnate, 210–280 µm. PROXIMAL UPPER SURFACE continuous, warty to rugose, dull, convex. DISTAL UPPER SURFACE continuous, slightly warty to irregular to smooth, dull, convex to plane, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 10–30 µm. LACINIAE sublinear, irregularly branched, overlapping laterally, 1.0–1.5 mm wide at the basis of the branches, 1.5–2.5 mm maximum wide; apices lacking, just few very damaged and without upper cortex; lateral margin smooth to slightly irregular; axils acute. PRUINA farinaceous, disperse, subapical. MACULAE pale to distinct, abundant, spotted to very short irregularly linear to subreticulate, laminal. ISIDIA, PUSTULES and SOREDIA absent. ALGAL LAYER continuous, 20–30 µm. MEDULLA white, 40–80 µm. DISTAL LOWER SURFACE beige, dull, rugose to irregular. PROXIMAL LOWER SURFACE pale brown, dull, rugose to irregular. LOWER CORTEX paraplectenchymatous below, intermediary above, 20–30 µm. RHIZINES concolored with the lower cortex or darker, irregularly branched, rarely simple, abundant, evenly distributed, up to 1.5 mm long. APOTHECIA numerous, mainly damaged, concave, sessile, laminal, up to 1.5 mm diam.; margin smooth to crenate; amphithecia maculate; disc black, absent in the majority of the apothecia, dull, with white dense pruina. EPITHECIUM 10–15 µm high; hymenium 80–100 µm high; sub-hymenium 40–50 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, 18–22 × 8–9 µm. PYCNIDIA frequent, subapical. CONIDIA not found.

COLOR TESTS FROM THE DUPLICATE OF THE LECTOTYPE IN PC: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes, sometimes leucotyline (Moberg 1990).

REMARKS. *Physcia pachyphylla* is a lobate species recognized by the absence of vegetative propagules, the beige to pale brown lower surface and the paraplectenchymatous to slightly intermediary lower cortex.

Physcia aipolia differs in having narrow and more convex laciniae rarely over 1.0 mm wide.

Physcia ochroleuca also has narrow laciniae, and the lower cortex is clearly paraplectenchymatous.

Physcia dilatata Nyl. differs from this group as it has wider not convex lobes up to 4.5 mm with rounded apices.

DISTRIBUTION: Central and South America (Moberg 1990). In South America, it was cited to Argentina, Brazil, Ecuador (Moberg 1990), Paraguay (Müller Argoviensis 1888), Peru (Moberg 1990), Uruguay (Osorio 1992) and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Mato Grosso do Sul and São Paulo State (Moberg 1990).

Physcia phaeocarpa (Nyl.) Hue, Nouvar. Arch. Mus. Hist. Nat., sér. 3, 2: 318. 1890.

Physcia dilatata ** *Physcia phaeocarpa* Nyl., Syn. Meth. Lich. 1(2): 424. 1860. TYPE: Brazil, Minas Gerais, Vauthier (lectotype: H-NYL 32181!).

DESCRIPTION OF THE LECTOTYPE

THALLUS irregular (consists of a fragment), corticolous, brownish white, laciniate, 1.5–2.5 cm diam., adnate, 210–270 µm. PROXIMAL UPPER SURFACE continuous, bullate, dull, plane to slightly convex. DISTAL UPPER SURFACE continuous, bullate to smooth, dull, plane to slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 15–20 µm. LACINIAE sublinear, irregularly branched, contiguous to slightly overlapping laterally, 0.5–1.0 mm wide; apices rounded, flat to somehow convex, adnate; lateral margin smooth to crenate to deeply incised or/and sublacinulate; axils acute. PRUINA or frosty coating on the laciniae margins. MACULAE absent or rare, pale, sparse, irregular, marginal. ISIDIA AND PUSTULES absent. SORALIA absent. ALGAL LAYER interrupted by projections of the upper cortex, 10–20 µm. MEDULLA white, 70–120 µm. DISTAL LOWER SURFACE pale brown to brown, slightly shiny, papillate to rugose. PROXIMAL LOWER SURFACE brown to dark brown, slightly shiny, papillate to rugose. LOWER CORTEX paraplectenchymatous, 20–30 µm. RHIZINES concolored with the lower cortex, simple, frequent, evenly distributed, up to 0.3 mm long. APOTHECIA frequent, plane to slightly concave, sessile, laminal, 1.5 mm diam.; margin smooth; amphithecia smooth; disc brown, shiny, epruinose. EPITHECIUM 10–15 µm high; hymenium 120–130 µm high; sub-hymenium 80–90 µm high. ASCOSPORES 1-septate,

Pachysporaria-type, ellipsoid, 28–31 × 10–11 μm (just two seen). PYCNIDIA frequent, submarginal. CONIDIA not found.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes, sometimes leucotyline (Moberg 1990).

REMARKS. *Physcia phaeocarpa* is a laciniate species recognized by the absence of vegetative propagules, brown to dark brown lower surface and paraplectenchymatous lower cortex.

This species has the same typical pruina (frosty coating, in the words of Moberg 1990) on the lobe margins present in *P. verrucosa* Moberg and the sorediate *P. atrostriata* Moberg, *P. krogiae* Moberg, and *P. undulata* Moberg.

Physcia verrucosa Moberg differs in having a white to cream lower surface, prosoplectenchymatous lower surface with a lower layer of cylindrical small rounded cells (1-2 layers).

Physcia pachyphylla is morphologically similar, differing by the presence of maculae and the wider laciniae, up to 2.5 mm.

Physcia aipolia and *P. ochroleuca* can be distinguished from *P. phaeocarpa* by the presence of maculae.

DISTRIBUTION: Australia (Moberg 2001) and South America (Moberg 1990). In South America, it was cited to Argentina (Moberg 1990, Scutari 1992, in the key), Brazil (Moberg 1990), Guyana (Aptroot 1987, as *P. verrucosa* fide Moberg 1990) and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Minas Gerais (Nylander 1860, lectotype local), Mato Grosso, Paraná and São Paulo (Moberg 1990).

Physcia poncinsii Hue, Bull. Soc. Bot. France 63 (28): 10. 1916.

TYPE**:** Kenya, Central Provar., Fort Hall Distr., "voisinage de la riviere Tika", alt. ca. 1500 m, 1912, Visc. de Poncins (lectotype: PC!).

THALLUS orbicular, corticolous, grayish white, laciniate, 1.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous, smooth, dull, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, dull, plane, without a darker zone near the tips. LACINIAE sublinear to linear, irregularly to dichotomously branched, contiguous, 0.4–1.0 mm wide; apices subtruncate to rounded, flat, adnate; lateral margin smooth, sometimes with sinuosities; axils acute. PRUINA dense, sometimes forming small spotted agglutinations, distributed over all the thallus surface, but more abundant in distal parts. MACULAE absent. Isidia and pustules

absent. SORALIA white, crateriform to orbicular, sometimes quite capitate, with marginal cortex elevating it, laminal to submarginal; soredia powdery. MEDULLA white. LOWER SURFACE cream, shiny, smooth. RHIZINES concolored with the lower cortex or paler, simple, few, evenly distributed, up to 0.2 mm long. APOTHECIA absent. PYCNIDIA absent.

ANATOMICAL MEASURES FROM SANTESSON P 2:1, IN UPS

THALLUS 110–140 µm. UPPER CORTEX paraplectenchymatous, 20–30 µm. ALGAL LAYER interrupted, but probably because the material is fragile, projections of the upper cortex absent, 20–40 µm. MEDULLA white, 30–50 µm. LOWER CORTEX prosoplectenchymatous above with a narrow lower layer paraplectenchymatous to intermediate, 10–30 µm.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes.

REMARKS. *Physcia poncinsii* is recognized by the laminal to submarginal crateriform to orbicular soralia, lower surface cream and an intermediate lower cortex.

Another species with crateriform soralia is *P. erumpens*, wich differs from *P. poncinsii* by the black lower surface and paraplectenchymatous lower cortex with brown and thickened walls cells.

Physcia caesia (Hoffm.) Fürnr., a species not yet known to Brazil (except for a doubtful citation from Krempelhuber 1876: 73), does not have crateriform soralia and the laciniae are very convex.

Physcia albata (Wils.) Hale (MEL!) is another morphologically similar species. Although with paraplectenchymatous lower cortex, the nature of the intermediary lower cortex of *P. poncinsii* might cause confusion; nevertheless, *P. albata* has lobes up to 8 mm of maximum width, soralia originate from the upper cortex swellings and a lower surface covered by rhizines, which are scarce in *P. poncinsii*.

Scutari (1995) found specimens with wide lobes, soralia laminal crateriform and intermediate lower cortex, and specimens with narrow lobes, orbicular laminal soralia and paraplectenchymatous lower cortex; she preferred to separate the species by the type of soralia, giving less importance to the type of lower cortex. Dodge (1953) described specimens with marginal to laminal soralia in Africa. Moberg (1990, 1997, 2002a, 2004) found specimens with predominant marginal soralia in African and North American populations: the North American specimens with an intermediate lower cortex and the African with a prosoplectenchymatous with the lowermost part short-celled and thick walled.

The anatomy of the lower cortex of the lectotype of *P. poncinsii* is in need to be determined and more investigations are necessary with different populations to delimit the real circumscription of this species and its related *P. albata*. In relation to the localization of the soralia, it seems that other taxa with marginal soralia can be involved in this group, as the type of *P. poncinsii* has only laminal soralia.

SPECIMENS EXAMINED: PERU, Cuzco Dept. Urubamba Provar., 13º12'S 72º18' W, 25.III.1981, leg. R. *Santesson, A. Tehler & G. Thor* P 2: 1 (UPS).

DISTRIBUTION: Australia (Moberg 2001), Africa (Dodge 1953, Moberg 1986, 2004; Swinscow & Krog 1988, Bock et al. 2007), New Zealand (Galloway & Moberg 2005), North and Central America (Harris 1995, Moberg 1990, 1997) and South America (Moberg 1990). In South America, it was cited to Argentina (Scutari 1990, 1995, Calvelo & Liberatore 2002), Brazil, Chile, Ecuador, French Guiana, Peru, Uruguay and Venezuela (Moberg 1990, Marcano et al. 1996). In Brazil, it was cited to the States of Rio Grande do Sul (Fleig 1995, Osorio *et al*. 1997) and São Paulo (Moberg 1990).

Physcia rolfii Moberg, Nord. J. Bot. 10: 337. 1990. **(Fig. 13 and 14)**

TYPE: Peru, Huanuco, valley of Rio Higueras, 17 km (road dist.) W of Huanuco, narrow ravine with scattered vegetation, on rocks, 09º55'S 76º22'W, 2300 m alt., R. Santesson & R. Moberg P48: 21, 1981 (holotype: S!; isotype: UPS!).

DESCRIPTION OF THE SAXICOLOUS THALLUS OF THE HOLOTYPE IN S

THALLUS irregular, saxicolous, brownish grey, laciniate, 1.5–2.0 cm diam., closely adnate to adnate, 110–180 µm. PROXIMAL UPPER SURFACE continuous, smooth, dull, plane to very slightly convex. DISTAL UPPER SURFACE continuous, smooth, dull, plane to very slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 20–30 µm. LACINIAE sublinear, irregularly branched, contiguous to overlapping laterally, 0.6–1.0 mm wide; apices rounded to subrounded, flat and adnate, sometimes concave and slightly ascendant; lateral margin smooth to irregular; axils acute, rarely oval. PRUINA farinaceous, sparse to abundant, subapical. MACULAE pale, abundant in distal parts, laminal. ISIDIA AND PUSTULES absent. SORALIA white, initially orbicular but soon becoming strongly lip-shape, sometimes helmet-shape or giving a stipitate appearance to the soralia, marginal; soredia farinaceous. ALGAL LAYER continuous, 20–30 µm. MEDULLA white, 60–80 µm. LOWER SURFACE totally cream to pale brown with a faint rose tinge, slightly shiny, smooth to slightly

veined and papillate. LOWER CORTEX prosoplectenchymatous to paraplectenchymatous in lower layers to, 20–30 µm. RHIZINES concolored with the lower cortex, simple, rarely irregularly branched, frequent, evenly distributed, up to 0.8 mm long. APOTHECIA frequent, plane, sessile, laminal, up to 1.0 mm diam.; margin smooth; amphithecia smooth; disc dark brown, dull, with dense white pruina. EPITHECIUM 10 µm high; hymenium 80–90 µm high; sub-hymenium 50–80 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, 14–16 × 6 µm (just few found). PYCNIDIA frequent, subapical. CONIDIA sublageniform, 3–4 × ca. 1.0 µm.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1990).

REMARKS. *Physcia rolfii* is recognized by the orbicular to strongly lip to helmet-shape, exclusively marginal soralia, the cream to pale brown lower surface and the intermediate lower cortex. The soralia has a stipitate appearance, as it grows sometimes from lateral lacinulae.

The type-material consists of a piece of rock with some thalli fixed on it with a mixture of loosen muscicolous and corticolous thalli in the herbarium envelop. There are mosses fixed on the rock. So, it is evident that the fragments of muscicolous thalli were once fixed on the rock. The corticolous were probably collected from a tree in the proximities. The isotype consists of muscicolous fragments of thalli and a specimen on a piece of thin twig. Moberg (1990) wrote that the type was collected from rocks. So, the corticolous thalli present in the holotype envelop and the thallus on twig found in the isotype were both disregarded as being type material. The description present above is based in the thallus that remains intact on the rock. Nevertheless, the loosen fragments of muscicolous and saxicolous thalli fit well with this description.

Moberg (1990, 1997, 2002a) and Scutari (1995) wrote that this species usually has maculae. Nevertheless, the lectotype is emaculate.

Physcia poncinsii is morphologically related, differing in the wider laciniae and laminal to submarginal crateriform soralia.

Physcia sinuosa Moberg is sometimes difficult to distinguish from *P. rolfii*. *Physcia sinuosa* has laciniae with truncate to subtruncate apices and the soralia are orbicular to crescent-shaped, more frequent in the laciniae angles and are originated from small lateral warts in the upper cortex.

Physcia undulata Moberg has wider laciniae (0.5–2.0 mm maximum wide) with lateral margins irregularly incised and the soralia starts as linear interrupted to long linear becoming crescent to lip-shaped.

DISTRIBUTION: North America (Moberg 1997, 2002) and South America (Moberg 1990). In South America, it was cited to Brazil, Ecuador, Peru (Moberg 1990), Uruguay (Osorio 1992, Moberg 1990) and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Mato Grosso, Rio de Janeiro and São Paulo (Moberg 1990).

Physcia sinuosa Moberg, Nord. J. Bot. 10: 338. 1990. **(Fig. 15 and 16)**

TYPE: Brazil, Estado da Bahia, zwischen Feira de Santana und Milagres, etwa 10 km vor Milagres, in einer Caatinga, 200 m alt., 21-VII-1980, K. Kalb 23043 (holotype: Herb. Kalb!; isotype: UPS!).

DESCRIPTION OF THE HOLOTYPE IN HERB. KALB

THALLUS rounded, corticolous, brownish grey, laciniate, 1.0–3.5 cm diam., closely adnate, 150–180 µm. PROXIMAL UPPER SURFACE continuous, smooth to slightly nodular, dull, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, rarely with an irregularity, dull, plane to slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 15–25 µm. LACINIAE sublinear, irregularly to dichotomously branched, contiguous to slightly overlapping laterally, 0.3–1.0 mm wide; apices subtruncate, flat, adnate but not attached to the substrate; lateral margin smooth to sinuous; axils acute to oval. PRUINA farinaceous, very faint, subapical. MACULAE absent in some parts, rare and pale in others, sparse, spotted to irregularly linear, laminal, rarely marginal. ISIDIA AND PUSTULES absent. SORALIA white, lip-shape to orbicular or crescent-shape, lateral marginal, more frequent in the lobes angles, originated from small lateral warts in the upper cortex; soredia powdery. ALGAL LAYER continuous, 15–25 µm. MEDULLA white, 50–65 µm. DISTAL LOWER SURFACE white to cream, dull, smooth, rarely with irregularities. PROXIMAL LOWER SURFACE cream to beige, dull, smooth rarely with irregularities. LOWER CORTEX prosoplectenchymatous (slightly paraplectenchymatous?), 20–25 µm. RHIZINES concolored with the lower cortex, simple, few, evenly distributed, up to 0.3 mm long. APOTHECIA common, plane to slightly concave, sessile, laminal, up to 0.5 mm diam.; margin smooth becoming sorediate; amphithecia smooth to sorediate; disc black, slightly shiny, rarely with

scarce white pruina. ASCOSPORES *Pachysporaria*-type, ellipsoid, 16–21 × 8–9 µm. PYCNIDIA few, laminal. CONIDIA not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1990).

REMARKS. *Physcia sinuosa* is recognized by the orbicular to crescent- or lip-shaped, lateral marginal soralia, the white to cream lower surface, and lower cortex that ranges from intermediate to prosoplectenchymatous type.

The soralia starts from small lateral warts in the upper cortex, forming crescents more frequent in the lobes angles.

The lower cortex has a tendency to be more prosoplectenchymatous than of the intermediate type.

Physcia rolfii is morphologically very similar, differing in the relatively more rounded laciniae apices and principally in the development of the soralia, initially orbicular but soon becoming strongly lip-shaped, sometimes helmet-shape and growing sometimes from lateral lacinulae.

Physcia undulata has wider laciniae and the soralia are initially linear and becomes crescent- to lip-shaped.

SPECIMENS EXAMINED. BRAZIL, Estado da Bahia, between Feira de Santana and Milagres, 10 km before Milagres, in Caatinga, 200 m alt., 21-VII-1980, leg. *K. Kalb* 19157.

DISTRIBUTION: North America (Moberg 1997, 2002a) and South America (Moberg 1990). In South America, it was cited to Argentina (Scutari 1992, 1995), Brazil and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Bahia (Moberg 1990), Minas Gerais (Aptroot 2002) and São Paulo (Moberg 1990).

Physcia sorediosa (Vain.) Lynge, Vid.-Selsk. Skrifter I. Mat.-Naturvar. kl. 16: 27. 1924. **(Fig. 17 and 18)**

Physcia integrata var. *sorediosa* Vain., Acta Soc. Fauna Fl. Fenn. 7: 142. 1890. TYPE: Brazil, Rio de Janeiro, 1885 Vainio, *Lich. Brasil. exs.* no. 155 (lectotype: TUR-V no. 8115!; duplicate from the lectotype: UPS!). **(Fig. 17)**

= *Physcia fragilenses* Zahlbr., Annals Cryptog. Exot. 1: 211. 1928. TYPE: Java, Provar. Batavia, in agro Buitenzorgensi, 1893/94, V. Schiffner 2892 (lectotype: W!). **(Fig. 18)**

DESCRIPTION OF THE LECTOTYPE

THALLUS irregular to orbicular (fragment), corticolous, brownish white, laciniate, 2.0–3.0 cm diam., adnate, 180–300 µm. PROXIMAL UPPER SURFACE continuous to cracked, smooth to very slightly bullate, slightly shiny, slightly convex. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane or convex or concave (just few seen), without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 30–50 µm. LACINIAE sublinear, irregularly branched, slightly overlapping laterally, 0.7–1.3 mm wide; apices subrounded, flat or convex or concave, adnate; lateral margin undulate to crenate; axils forming acute angles. PRUINA farinaceous, faint, disperse, laminal. MACULAE pale, rarely distinct, sometimes abundant in determinate limited proximal areas, spotted to subreticulate, laminal. ISIDIA AND PUSTULES absent. SORALIA concolored with the upper surface, orbicular to ellipsoid to confluent, marginal to submarginal; soredia farinaceous. ALGAL LAYER slightly interrupted by projections of the upper cortex, 20–60 µm. MEDULLA white, 60–100 µm. DISTAL LOWER SURFACE cream to pale brown, dull, papillate. PROXIMAL LOWER SURFACE brown to black, slightly shiny, smooth to rugose. LOWER CORTEX paraplectenchymatous, with brown thickened wall cells, 15–40 µm. RHIZINES concolored with the lower cortex, simple and sometimes with irregularities and apical thickness, frequent, evenly distributed, up to 0.5 mm long. APOTHECIA rare, plane to slightly concave, sessile, laminal, up to 1.5 mm diam.; margin smooth or sorediate, entire; amphithecia smooth; disc dark brown, dull, epruinose. EPIHYMENIUM 10–15 µm high; hymenium 80–90 µm high; sub-hymenium 60–70 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, 17–18 × 8–9 µm. PYCNIDIA few, subapical. CONIDIA sublageniform, 3.5–4.5 × ca. 1.0 µm.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1990, Brodo et al. 2001).

REMARKS. *Physcia sorediosa* is recognized by the orbicular to ellipsoid becoming confluent, marginal to submarginal soralia, the black lower surface and paraplectenchymatous lower cortex, with very thick wall and pigmented cells.

Studying East African *P. fragilescens* specimens, Moberg (1987) believed that there were differences between the South American *P. sorediosa* and the Asian *P. fragilescens*, but after studying more material (Moberg 1990), he was convinced that the two have the same morphological variation and considered *P. fragilescens* as synonym of *P. sorediosa*.

The lectotypes of these two species have differences in the granulation of the soredia: in *P. fragilescens* they occasionally form aggregates isidia-like erect structures, while in

P. sorediosa they are powdery. The ascospores found in the lectotype of *P. fragilescens* are (22–) 24–28 × 9–12 μm, while in the lectotype of *P. sorediosa* they are 17–18 × 8–9 μm. Vainio (1890) found ascospores 17–23 × 6–11 μm. These data indicates two possible distinct taxa.

Nevertheless, Moberg (1986, 1990, 2001, African, South American and Australian material, respectively) found the size interval of (17–) 18–28 × 9–12 μm to the ascospores; Aptroot (1987, South American material) 18–25 × 8–12 μm; Swinscow & Krog (1988, African) 21–28 × 9–12 μm; and finally Moberg (2002) found ascospores 20–26 × 9–11 μm in North American material. There is an evidently overlap. However, it is not excluded the possibility of two taxa with similar geographical distribution, of manner that more studies are recommended within this group.

Physcia erumpens is morphologically similar, but it has crateriform laminal soralia, sometimes submarginal.

DISTRIBUTION: Africa (Moberg 1986, Aptroot 1988 and Swinscow & Krog 1988, as *P. fragilescens*), Asia (Aptroot et al. 2002, Wolseley et al. 2002), Australia (Moberg 2001), Central America (Moberg 1990), North America (Moberg 1997, 2002, Brodo et al. 2001, Hansen et al. 2008), South America (Moberg 1990). In South America, it was cited to Argentina (Osorio 1977, Scutari 1992, in the key, Moberg 1990), Colombia (Aptroot 1989b, as *P. fragilescens*), Ecuador (Moberg 1990), French Guiana (Aptroot 1987, as *P. fragilescens*; Moberg 1990), Paraguay (Osorio 1970, Moberg 1990), Peru (Moberg 1990), Surinam (Aptroot 1987, as *P. fragilescens*) and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Minas Gerais (Vainio 1890, as *Physcia integrata* Nyl. var. *sorediosa* Vain.; Lynge 1924; Lisboa 1952, as *Physcia integrata* Nyl. var. *sorediosa* Vain.; Aptroot 2002), Mato Grosso (Lynge 1924), São Paulo (Marcelli 1991, 1998, Pereira & Marcelli 1989, Moberg 1990); Rio Grande do Sul (Fleig 1988, Mazzitelli *et al*. 1999, Fleig & Grüninger 2000a/b) and Rio de Janeiro (Vainio 1890, as *Physcia integrata* Nyl. var. *sorediosa* Vain.; Lynge 1924).

Physcia tenuis Moberg, Nord. J. Bot. 10: 340. 1990.

TYPE: Brazil, São Paulo, Ilha de Santo Amaro, just before Bertioga, ca. 20 km NE of Santos, on mangrove, 1 m alt., 21–X–1978, K. Kalb et G. Plöbst 23048 (holotype: Herb. Kalb!; isotypes: Herb. Kalb!, UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, grayish white, laciniate, 3.5–5.5 cm diam., adnate, 100–120 µm. PROXIMAL UPPER SURFACE continuous, rugose (the pycnidia in wrinkles), dull, plane. DISTAL UPPER SURFACE continuous, smooth, dull, plane, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 25–40 µm. LACINIAE sublinear, irregularly to subdichotomously branched, contiguous to slightly overlapping laterally, 0,3–0,6 mm wide; apices subtruncate, rarely rounded, flat to slightly convex, adnate; lateral margin smooth to sinuous; axils acute to oval. PRUINA absent. MACULAE pale, sparse, irregular, laminal. ISIDIA, PUSTULES AND SOREDIA absent. ALGAL LAYER continuous, 15–20 µm. MEDULLA white, 40–50 µm. DISTAL LOWER SURFACE white to cream, dull, smooth to slightly rugose. PROXIMAL LOWER SURFACE dark brown to black, dull, smooth to slightly rugose. LOWER CORTEX prosoplectenchymatous, 15–25 µm. RHIZINES concolored with the lower cortex or the marginal darker, simple, frequent, evenly distributed, up to 0.3 mm long. APOTHECIA few, plane to concave, sessile, laminal, up to 2.0 mm diam.; margin smooth to crenate to irregular; disc black, slightly shiny, epruinose. PYCNIDIA frequent, laminal. CONIDIA not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, triterpenes (Moberg 1990).

DESCRIPTION OF THE APOTHECIA FROM THE ISOTYPE IN UPS

APOTHECIA few, plane to concave, sessile, laminal, up to 2.0 mm diam.; margin smooth to crenate; amphithecia smooth, frequently with simple concolored or with darker base cilia; disc black, slightly shiny, epruinose. EPITHECIUM 10 µm high; hymenium 80–120 µm high; sub-hymenium 40–60 µm high. ASCOSPORES *Pachysporaria*-type, ellipsoid, 20–24 × 8–12 µm.

REMARKS. *Physcia tenuis* is a laciniate species recognized by the absence of vegetative propagules, the cream to brown to black lower surface and the prosoplectenchymatous lower cortex.

Physcia kalbii Moberg differs by the wider laciniae (up to 1.5 mm) and the presence of zeorine in the medulla.

Physcia coronifera Moberg (GB!) is another similar species that differs in having white to cream lower surface and cilia more frequent in the amphithecia.

DISTRIBUTION: Central America and South America (Moberg 1990). In South America, it was cited to Brazil, Peru and Venezuela (Moberg 1990). In Brazil, it was cited to the States of Rio de Janeiro and São Paulo (Moberg 1990).

Physcia tribacia (Ach.) Nyl., Flora 57: 307. 1874. **(Fig. 19 and 20)**

Lecanora tribacia Ach., Lich. Univ.: 415. 1810. TYPE: [Great Britain] Anglia (lectotype: H-Ach. 1115!, upper specimen).

= *Parmelia erosa* Borr., in Hook & Sowerby, Suppl. Engl. Bot. fig. 2807. 1837. – *Squamaria erosa* Borr. l.c., 2nd. ed. 11: 10 et fig. 2132. 1864. – *Physcia erosa* Leight. Lich. Flor. 152. 1871, fide Thomson (1963).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, corticolous, brownish white, laciniate and lacinulate, 1.5–3.0 cm diam., loosely adnate or scale-like, 120–180 µm. PROXIMAL UPPER SURFACE continuous, subscrobiculate, sometimes smooth, dull, slightly convex. DISTAL UPPER SURFACE continuous, smooth to subscrobiculate, dull, mainly concave, sometimes with a grey zone near the tips. UPPER CORTEX paraplectenchymatous, 20–30 µm. LACINIAE "sublinear", very irregularly branched, imbricate to crowded, 0.5–1.0 mm wide; apices irregular, deeply incised, convex to crispate, adnate to ascendant; lateral margin crenulate to irregular to deeply incised or sublacinulate; axils acute. PRUINA absent, but the upper surface is entire rough, giving the aspect of a farinaceous surface. MACULAE absent. ISIDIA AND PUSTULES absent. SORALIA absent, but there is a submarginal production of granules on the lower surface. ALGAL LAYER continuous, 40–50 µm. MEDULLA cream, 30–80 µm. DISTAL LOWER SURFACE cream to ivory, dull, smooth to papillate. PROXIMAL LOWER SURFACE cream to ivory, slightly shiny, smooth to papillate. LOWER CORTEX paraplectenchymatous, 20–30 µm. RHIZINES concolored with the lower cortex or darker, simple, rarely irregularly branched, few, evenly distributed, up to 0.5 mm long (just few seen). APOTHECIA absent. PYCNIDIA few, subapical. CONIDIA not found.

COLOR TESTS: upper cortex K+ yellow, P–, UV–; medulla K–, P–, UV–. SECONDARY METABOLITES: atranorine, triterpenes (Moberg 1986).

REMARKS. *Physcia tribacia* is recognized by the loosely adnate or scale-like habit, the production of granules on the cream to ivory lower surface, paraplectenchymatous lower cortex and the K– medulla.

Scutari (1990, 1995) described the vegetative propagules as marginal and laminal "paraisidios soredigeros" on the underside, with secondary soralia at the apices and in the underside of the laciniae. In the lectotype, these secondary soralia are not present.

The lectotype has not apothecia. However, some authors found fertile material. For example, Moberg (1986) and Swinscow & Krog (1988) found in the African material ascospores *Pachysporaria* to *Physcia*-type, 16–21 × 8–11 µm. Moberg (1990) related ascospores (17) 18–21 (23) x (8) 9–11 (12) µm to South American specimens.

Scutari (1995) placed *P. callosa* Nyl. (H-NYL 32163!) as synonym of *P. tribacia*. The type of *P. callosa* is almost fragmented, but it has more irregular upper surface (bullate to nodulate), does not produce granules on the lower surface, and has prosoplectenchymatous lower cortex. So, it cannot be synonym of *P. tribacia*, but of *P. phaea* (Tuck.) Thomson, as proposed by Moberg (1997).

Physcia dubia (Hoffm.) Lettau differs from *P. tribacia* by its not deeply incised or sublacinulate laciniae, the marginal soralia, mostly at the lobe tips and lip-shaped, not starting in the underside and the prosoplectenchymatous lower cortex.

Physcia tribacoides Nyl. has marginal orbicular soralia soon becoming elevated in the apices of lateral short laciniae and medulla K+ yellow.

DISTRIBUTION: Africa (Moberg 1986, 2004, Swinscow & Krog 1988), Australia (Moberg 2001), Europe (Lynge 1935, Poelt 1974, Nimis 1993, Llimona & Hladun 2001), North America (Thomson 1963, Esslinger & Egan1995, Moberg 1997, 2002), South America (Moberg 1990), New Zealand (Galloway & Moberg 2005). In South America, it was cited to Argentina (Scutari 1990, 1995, Calvelo & Liberatore 2001), Brazil, Chile, Ecuador (Moberg 1990), Venezuela (Moberg 1990, Marcano et al. 1996). In Brazil, it was cited to Rio de Janeiro (Moberg 1990).

Physcia tribacoides Nyl., Flora 57: 307. 1874.

TYPE: France, St Sauveur le Vicomte (Lenormand) (lectotype: H-NYL 32197!).

= *Physcia americana* Merrill in Evans, Conn. Geol. Nat. Hist. Surv. Bull. 37: 42. 1926 (*n.v.*).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, corticolous, light grey, laciniate to lobate, 4.0–6.0 cm diam., adnate, 120–170 µm. PROXIMAL UPPER SURFACE continuous, smooth to very slightly bullate, dull, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane to slightly

convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 10–30 µm. LOBES sublinear, irregularly branched, many times overlapping laterally, 0.5–1.0 mm wide at the basis of the branches, up to 2.5 maximum wide near the tips; apices subrounded, mainly flat, adnate, few slightly ascendant; lateral margin crenate to crenulated, sometimes deeply incised; axils acute, rarely auriculate. PRUINA absent. MACULAE present only in some regions on oldest parts of the centre of the thallus, pale, mainly sparse, spotted, laminal, originate very small cracks. ISIDIA AND PUSTULES absent. SORALIA white, beginning orbicular but soon becoming elevated in the apices of lateral short laciniae, capitate, marginal to occasionally sublaminal; soredia powdery. ALGAL LAYER continuous, 20–30 µm. MEDULLA white, 40–90 µm. DISTAL LOWER SURFACE cream to pale brown, slightly shiny, smooth to papillate. PROXIMAL LOWER SURFACE pale brown to grayish pale brown, slightly shiny, smooth to papillate. LOWER CORTEX paraplectenchymatous, 20–30 µm. RHIZINES concolored with the lower cortex or darker, pale cream to dark brown, simple to irregularly branched, frequent, evenly distributed, up to 0.5 mm long. APOTHECIA absent. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes (Moberg 1986).

REMARKS. *Physcia tribacoides* is recognized by the soralia in the apices of lateral short laciniae, first orbicular than becoming elevated, the cream to pale brown lower surface and the paraplectenchymatous upper cortex.

The lectotype does not have apothecia; Thomson (1963) found ascospores with 17–22 × 7.5–9.5 µm in North American populations, and Moberg (1986) reported 20–23 × 9–12 µm in African material.

Moberg (2004) noted that the lower cortex is not of the clearly defined paraplectenchymatous form and Galloway & Moberg (2005) wrote that the lower cortex is of an intermediary type. Indeed, there are some parts where the lower cortex seems of a typical paraplectenchymatous arrangement, but there are parts where is difficult to take a decision.

It was not possible to localize the type of *P. americana* Merrill *in* Evans, but Thomson (1963) placed it as synonym: "The type specimen of *P. americana* in the Yale University herbarium is undoubtedly this species". Nevertheless, Brodo et al. (2001) considered it a good species, however illustrating a thallus very similar to the lectotype of *P. tribacoides*. The only difference based in their description is that the soredia in *P. americana* are granular, while the lectotype of *P. tribacoides* has powdery soredia, a somewhat subjective difference.

At this time, we prefer to keep *P. americana* as synonym of *P. tribacoides*.

Jørgensen (1977) compared *P. tribacoides* to *P. sorediosa*. Nevertheless, *P. sorediosa* has clearly laminal soralia and a paraplectenchymatous lower cortex with brown thickened wall cells. In his key, Dey (1978) described the soralia of *P. tribacoides* as laminal. Indeed, however marginal in origin, sometimes the soralia have this appearance, as they grow and may cover part of the lamina.

Physcia dubia is morphologically similar, differing in the lip-shaped soralia mostly at the lobe tips and the medulla K–.

DISTRIBUTION: Africa (Moberg 1986, 2004, Swinscow & Krog 1988), Asia (Aptroot & Feijen 2002), Australia (Moberg 2001), Europe (Lynge 1935), New Zealand (Galloway & Moberg 2005), North America (Hale 1961, Thomson 1963, Dey 1978), South America (Osorio et al. 1980) and Tristan da Cunha (Jørgensen 1977). In South America, it was cited to Argentina (Calvelo & Liberatore 2002), Brazil (Osorio et al. 1980, cited to Rio Grande do Sul) and Uruguay (Osorio 1992).

Physcia undulata Moberg, Nord. J. Bot. 6: 861. 1986. **(Fig. 21 and 22)**

TYPE: Kenya, Rift Valley Provar. Kajiado Distr., Ngong Hills, south of the highest part, on shrubs, 1º26'–27'S 36º39'E, ca. 2170 m alt., 1971, R. Moberg 1406c (holotype: UPS!).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous (on twig), grey to ash-grey, lobate, 1.0–3.0 cm diam., loosely adnate, 90–110 µm. PROXIMAL UPPER SURFACE continuous, smooth, slightly shiny to dull, plane to very slightly irregular. DISTAL UPPER SURFACE continuous, smooth, slightly shiny to dull, plane to slightly irregular, mainly concave in the centre of the lobes, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 10–20 µm. LOBES sublinear, sometimes subspatulate, irregularly to subdichotomously branched, overlapping laterally to contiguous, 0.5–1.0 mm wide at the basis of the branches, 0.5–2.0 mm maximum wide; apices subtruncate to rounded, flat to slightly concave, loosely adnate, sometimes ascendant; lateral margin irregularly incised to sinuous and undulate; axils acute in not overlapped lobes. PRUINA or a very fine powder covering the upper surface, mainly in distal parts. MACULAE absent. ISIDIA AND PUSTULES absent. SORALIA white, marginal, short linear interrupted to long linear to frequently crescent to lip-shaped, the upper cortex pushed backwards and exposing the medulla; soredia powdery. ALGAL LAYER continuous, 30–40 µm. MEDULLA white, 30–50 µm. LOWER SURFACE totally white, dull, smooth, sometimes with few irregularities.

LOWER CORTEX prosoplectenchymatous to paraplectenchymatous, hyaline to pale brown, 15–20 µm. RHIZINES concolored with the lower cortex, simple, rare, evenly distributed, up to 0.3 mm long. APOTHECIA absent. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, zeorine, triterpenes, leucotyline (Moberg 1990).

REMARKS. *Physcia undulata* is recognized by usually ascending laciniae, the marginal lip-shape to linear marginal soralia, the white lower surface and an intermediate type of the lower cortex.

This species has a pruinose upper surface of the same type as present in *P. atrostriata*, *P. krogiae*, *P. phaeocarpa* and *P. verrucosa* Moberg.

Moberg (1990) found ascospores between *Physcia* and *Pachysporaria*-type in both African and South American specimens; the African 16–20 × 7–10 µm and the South American (15) 18–27(33) × (7) 8–11(13) µm. He pointed out this large variation size of the ascospores as an indication that more than one taxon can be involved, being necessary more field studies to explain the observed variation.

For differences between *P. undulata*, *P. rolfii* and *P. sinuosa*, see remarks under these species. See also remarks under *P. atrostriata*.

DISTRIBUTION: Africa (Moberg 1986, Swinscow & Krog 1988, Scutari 1995, Moberg 2004), Australia (Moberg 2001), Azores (Aptroot 1989a), Europe (Moberg 1989, Llimona & Hladun 2001), New Zealand (Galloway & Moberg 2005), North America (Harris 1995, Moberg 1997, 2002a) and South America (Moberg 1990). In South America, it was cited to Argentina (Moberg 1990, Scutari 1992, 1995, Calvelo & Liberatore 2002), Bolivia, Brazil, Chile, Colombia, Ecuador and Peru (Moberg 1990). In Brazil, it was cited to the States of Paraná and São Paulo (Moberg 1990).

Physcia verruculosa (Vain.) Jungbluth & Marcelli, comb. et stat. nov. **(Fig. 23 and 24)**

Physcia aipolia f. *verruculosa* Vain. in Räsänen, Medd. Soc. F. FI. Fenn. 46: 166. 1921. TYPE: Finland, Ostrobottnia austr., Lapua, Marielund, 1920, Räsänen (lectotype: TUR-V 8061!; duplicate from the lectotype: H!).

DESCRIPTION OF THE LECTOTYPE

THALLUS corticolous, brownish grey, laciniate, 1.5–3.5 cm diam., adnate? (could not be determined), 240–380 µm. PROXIMAL UPPER SURFACE continuous, rugose, dull, slightly convex. DISTAL UPPER SURFACE continuous, rugose to smooth, dull, slightly convex, without a darker zone near the tips. UPPER CORTEX paraplectenchymatous, 20–70 µm. LACINIAE sublinear, irregularly branched, overlapping laterally, 1.0–1.5 mm wide; apices subrounded, mainly convex, adnate; lateral margin crenate to irregular; axils acute. PRUINA absent. MACULAE distinct, abundant, spotted, laminal and marginal, originate elevations and warts. ISIDIA, PUSTULES AND SORALIA absent. ALGAL LAYER continuous, 30–60 µm. MEDULLA white, 120–180 µm. LOWER SURFACE cream, slightly shiny, smooth to slightly veined. Lower cortex intermediate to paraplectenchymatous, 50–80 µm. RHIZINES darker than the lower cortex, brown, irregularly branched or simple, contiguous (perhaps the rhizines once projected themselves beyond the margins, but it is not possible to observe in this specimen anymore), evenly distributed, up to 0.8 mm long. APOTHECIA common, plane to convex or irregular and undulated, shortly pedicellate, laminal to sub terminal, up to 5.0 mm diam.; margin smooth to crenulate; amphithecia maculate; disc dark brown, dull, with white dense pruina. EPITHECIUM 10 µm high; hymenium 80–90 µm high; sub-hymenium 60–70 µm high. ASCOSPORES *Physcia* to *Pachysporaria*-type, ellipsoid, 20–24 × 8–12 µm. PYCNIDIA few, laminal to subapical. CONIDIA not found.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow, P–, UV–. SECONDARY METABOLITES: atranorine, triterpenes.

REMARKS. *Physcia verruculosa* is recognized by the verrucose upper surface, the apothecia up to 5 mm, the cream lower surface and the intermediate to paraplectenchymatous lower cortex. See discussion under *P. aipolia*.

NOMEN INQUIRENDUM

Physcia sublactea Zahlbr., Denkschr. Kaiserl. Akad. der Wissensch. 83: 198. 1909.

TYPE: Brazil, São Paulo State, prope Rio Grande ad "São Paulo Railway", ca. 800m, s.m., corticolous, V. Schiffner (holotype: probably W).

DESCRIPTION BASED IN THE PROTOLOGUE

THALLUS corticolous, whitish to white, laciniate and lacinulate, adpressed, 13–15 µm. LACINIAE sub-imbricate to contiguous, 1–4 mm maximum wide, lacinulae in the centre smallest, contiguous to sub-imbricate; slightly convex, adpressed. PRUINA absent. MACULAE absent. ISIDIA, PUSTULES AND SOREDIA absent. ALGAL LAYER 18–20 µm. MEDULLA white. RHIZINES abundant, short. APOTHECIA frequent, concave to plane to convex, sessile, 0.9–1.3 mm diam.; margin thin, sub-crenate; disc dark brown to black with white pruina. HYMENIUM 120–122 µm high. ASCOSPORES 1-septate, ellipsoid, 21–26 × 9–11 µm. PYCNIDIA not seen.

COLOR TESTS: upper cortex K+ yellow; medulla K+ yellow.

REMARKS. Zahlbruckner (1909) compared this species with *Physcia alba*, a flatter species with narrow laciniae. Nevertheless, the available information does not allow many inferences. The type material is probably deposited in W, but there was no response from the herbarium about the localization of the specimen.

DOUBTFUL RECORDS FOR BRAZILIAN FLORA

Physcia adscendens (Fr.) H. Olivier, nom. cons., Flore analytique et dichotomique des lichens de l'Orne et départements circonvoisins I: 79. 1882.

Parmelia stellaris var. *adscendens* Fr., Summa vegetabilium Scandinaviae: 105. 1846. TYPE: Sweden, sine loco, E. Acharius (H-ACH 1428 – *type cons.*), fide Moberg (1977).
See Moberg (1977) for synonyms.

Earlier report (Mazzitelli et al. 1999) might be an error, since this species is typical from arctic, boreal and temperate zones, not from tropical and urbanized areas of low altitudes. In South America, *P. adscendens* was found at higher altitudes and cold climates in Argentina, Chile and Ecuador (Moberg 1990).

Physcia caesia (Hoffm.) Fürnr., Naturhist. Topogr. Regensburg II: 250. 1839.

Lichen caesius Hoffm., Enum. Lich. 65. 1784. TYPE: Austria, Steinach, 1957, Steiner, *Krypt. exs. Vind*. n. 4139 (neotype: UPS), fide Moberg (1977).
See Moberg (1977) for complete list of synonyms.

Earlier report (Krempelhuber 1876) might be an error, since this species is typical from arctic, boreal and temperate zones, not from Rio de Janeiro City. We saw a collection from Glaziou originate from Rio de Janeiro in UPS. We are not sure if was this material that Krempelhuber (1876) mentioned in his work, but it is not a sorediate specimen.

In South America, *P. caesia* was found at higher altitudes and cold climates in Argentina, Chile and Peru (Moberg 1990).

Physcia dubia (Hoffm.) Lettau, Hedwigia 54: 254. 1912.

Lobaria dubia Hoffm., Deutschl. Flora: 156. 1796. TYPE: Germany, Ehingen, 1897 Rieber, Arnold, *Lich. exs.* n. 1724 (neotype: UPS), fide Moberg (1977).
See Moberg (1977) for synonyms.

Earlier report (Mazzitelli et al. 1999) might be an error, since this species is typical from arctic, boreal and temperate zones, not tropical and urbanized areas of low altitudes.

In South America, *P. dubia* was found at higher altitudes and cold climates in Argentina and Chile (Moberg 1990).

Physcia stellaris (L.) Nyl., Actes Soc. Linn. Bordeaux 21: 307. 1857.

Lichen stellaris L., Species Plantarum: 1144. 1753. TYPE: ? (type: LINN), fide Moberg (1977).
See Moberg (1977) for synonyms.

Earlier reports (Krempelhuber 1876, Mazzitelli et al. 1999) might be an error, since this species is typical from arctic, boreal and temperate zones, not tropical and urbanized areas of low altitudes as the cities of Rio de Janeiro and Porto Alegre. Also, Krempelhuber (1876) studied Glaziou collections, and Glaziou is known to made suspect the data on very large number of his collections, data thus give erroneous amplification to the known-distribution of some species, as related by Wurdack (1970) to the *Melastomataceae*.

In South America, *P. stellaris* was found at higher altitudes and cold climates in Venezuela (Moberg 1990).

NOMEN DUBIUM

Physcia obsessa (Mont.) Nyl. [non *Parmelia obsessa* Ach.], in Triana & Planchon, Prodromus Florae Novo-Granatensis: 440. 1863.
Parmelia obsessa sensu Mont. (non *Parmelia obsessa* Ach.) in Sagra, Hist. Phys. Cuba, Bot. Pl. Cell.: 227. 1842.

During his studies on the lichens from Cuba, Montagne (1842: 227) erroneously identified a lichen as *Parmelia obsessa* Ach. and presented a good description of it that corresponds to a sorediate *Physciaceae* species, probably a *Physcia*. Nevertheless, the species proposed by Acharius (1814: 213) is a North American *Parmeliaceae*, nowadays *Myelochroa obsessa* (Ach.) Elix & Hale (Elix & Hale 1987).

Sometime later, Nylander (1855) proposed *Physcia obsessa* (Ach.) Nyl. based on that Cuban material and in Montagne's description, not in the type material of the name.

Shortly afterwards, Montagne (1856: 328) wrote "*P*. (*Physcia*) *obsessa* (Ach.?) Mont. – Cuba p. 227" (the initial "*P*." referring to *Parmelia*) and recognized that he did not know if that material he had identified was really the *Parmelia obsessa* proposed by Acharius (1814), claiming he never saw the type material of that name.

So, whatever Montagne called *P. obsessa* was obviously a *Physcia* species; the inclusion of those specimens in the genus *Physcia* was a simple case of mistake in genus identification, and Montagne never formally created nor intended to create a new taxon, neither in *Parmelia* nor in *Physcia*, as become obvious from his own writings. Indeed, initially he believed that the Acharius' *Parmelia obsessa* was truly the *Physcia* species that he was identifying.

Nylander (1855) proposed *Physcia obsessa* (Ach.) Nyl., induced by Montagne's description and probably induced by material from Cuba that he studied (there are exsiccates from UPS, with Nylander's handwriting indicating "*Parmelia obsessa* Mont. Cuba", see below). In 1860, Nylander attributed *Parmelia obsessa* to Montagne and placed it in a infra-species rank under *Physcia astroidea* Fr., and soon after (Nylander 1863: 25), *Physcia obsessa* (Mont.) Nyl. was finally presented at species level, perpetuating a non existing name.

So, *Physcia obsessa* in Montagne's sense continued to be used. Worse, Vainio (1890) combinated the name into *Physcia integrata* Nyl. (emend.) Vain. var. *obsessa* for a non sorediose lichen, in which was followed by Lynge (1924) when proposed *Physcia alba* var. *obsessa* (Mont.) Lynge.

During a visit to UPS, Dr. Roland Moberg showed two collections from Wright (Wright, *Lich. Cubae* no. 86), one deposited in UPS and another one loaned from PC. Annotations with Nylander's handwriting are present in these two collections: "*Physcia stellaris* (L.) var. *astroidea* Tuck. f. *obsessa*", and one line below, "*Parmelia obsessa* Montagne, Cuba". These two collections are composed by fragments of *Physcia integrata* Nyl., *P. lobulata* Moberg and *P. tenuis* Moberg, as indicated by Dr. Moberg in the envelop from UPS, more fragments of a sorediate species in the two exsiccates. At that occasion, there was no time to confirm the identity of the sorediose species.

So, the true identity of material determined by Montagne remains unknow, as well those of the material studied by Vainio (1890) and Lynge (1924).

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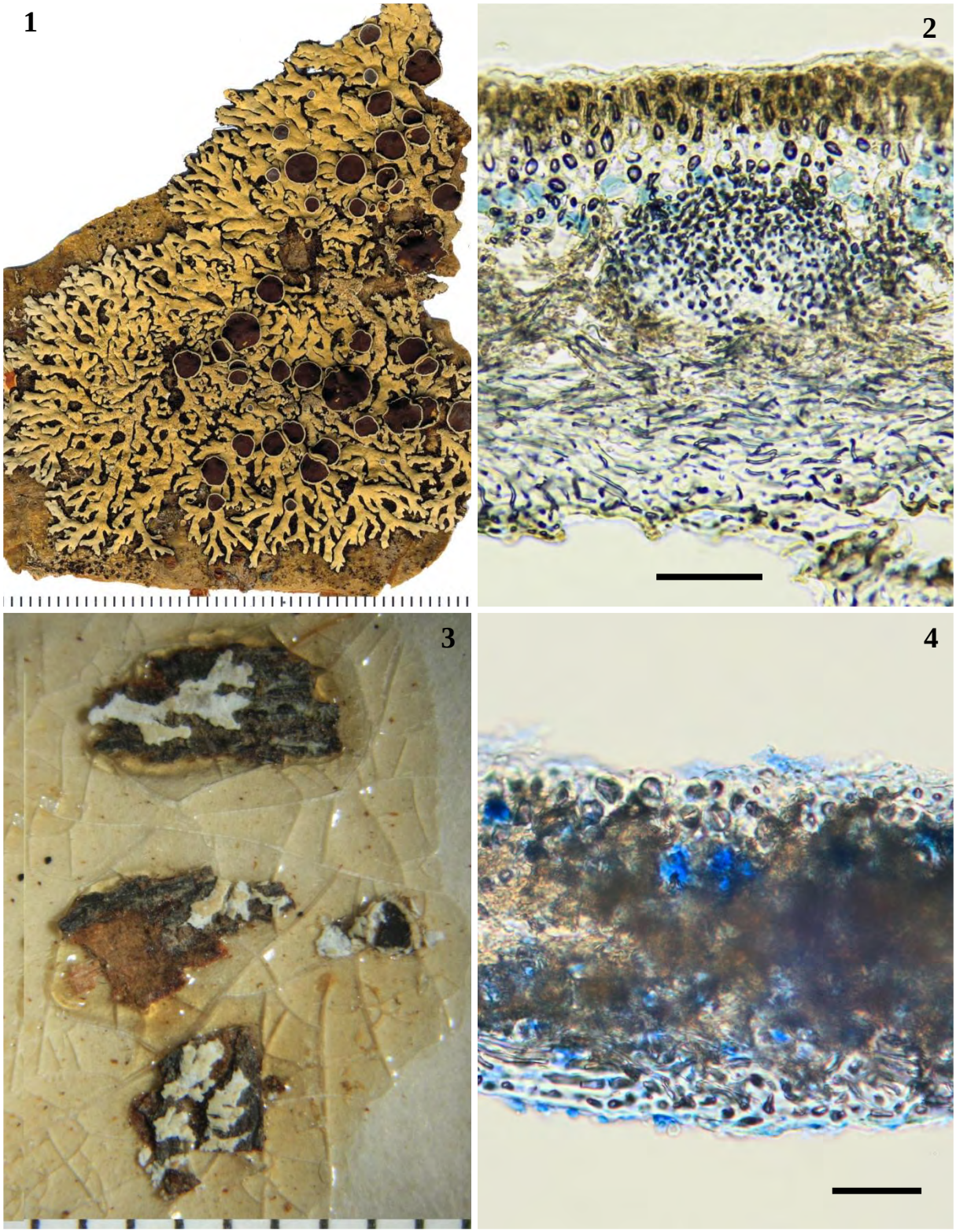
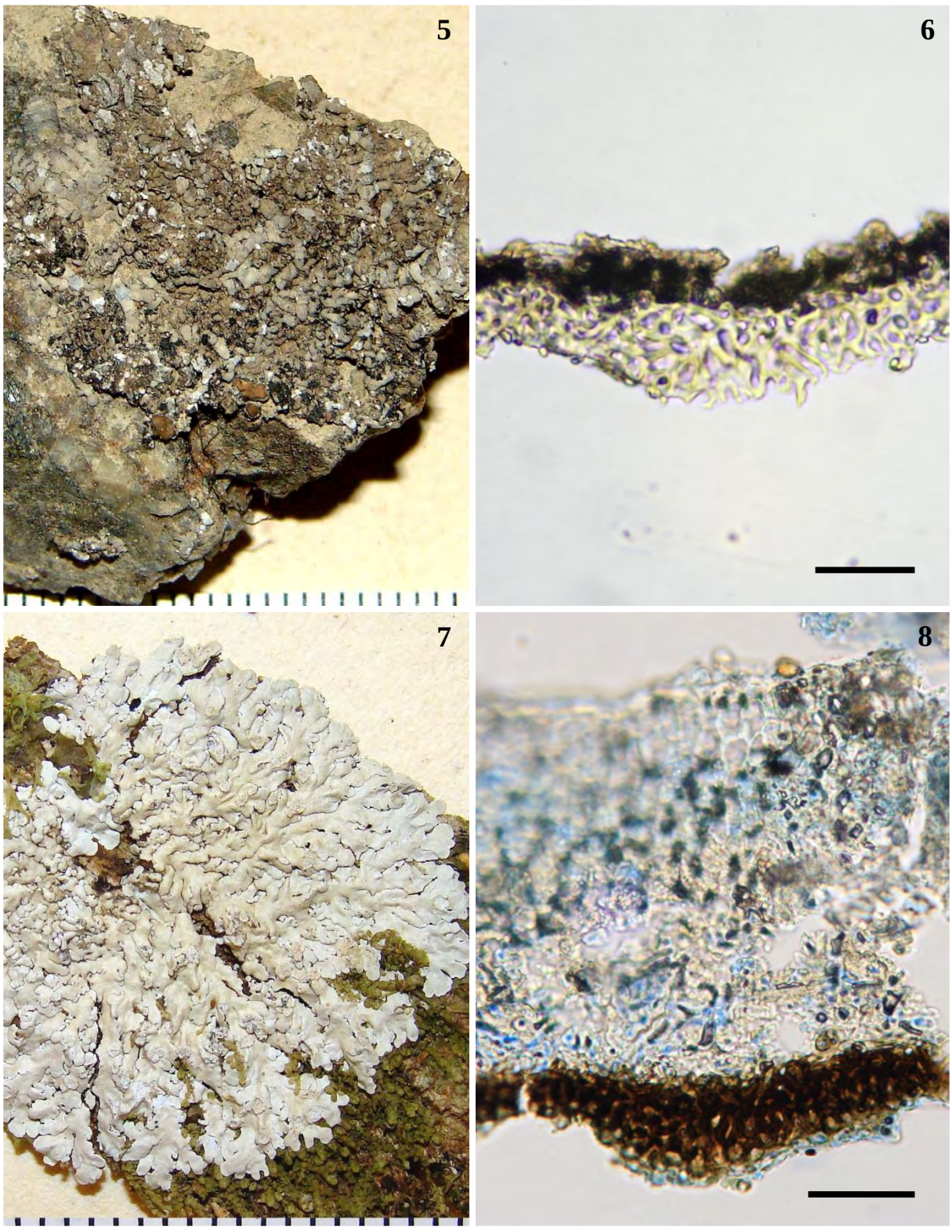
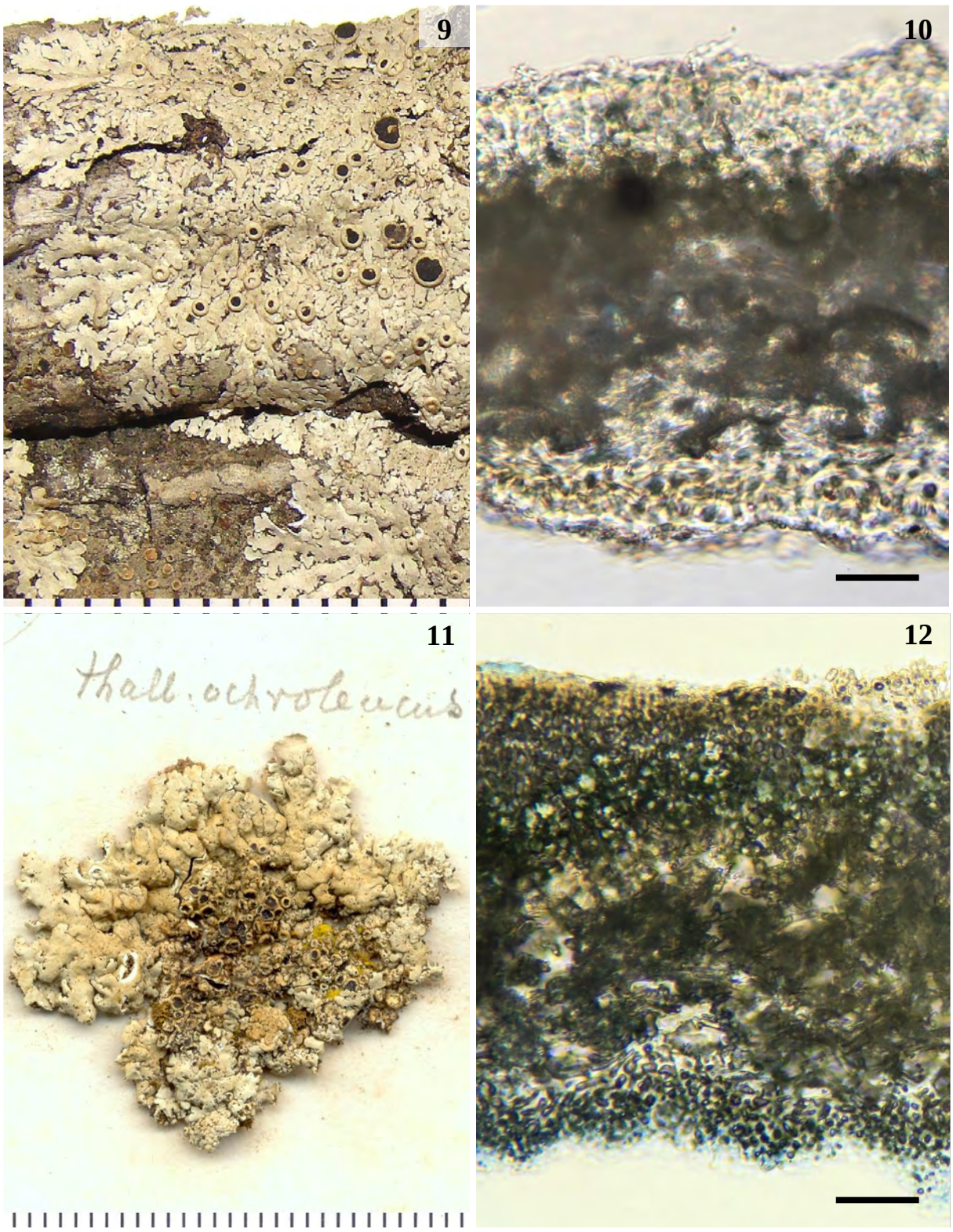


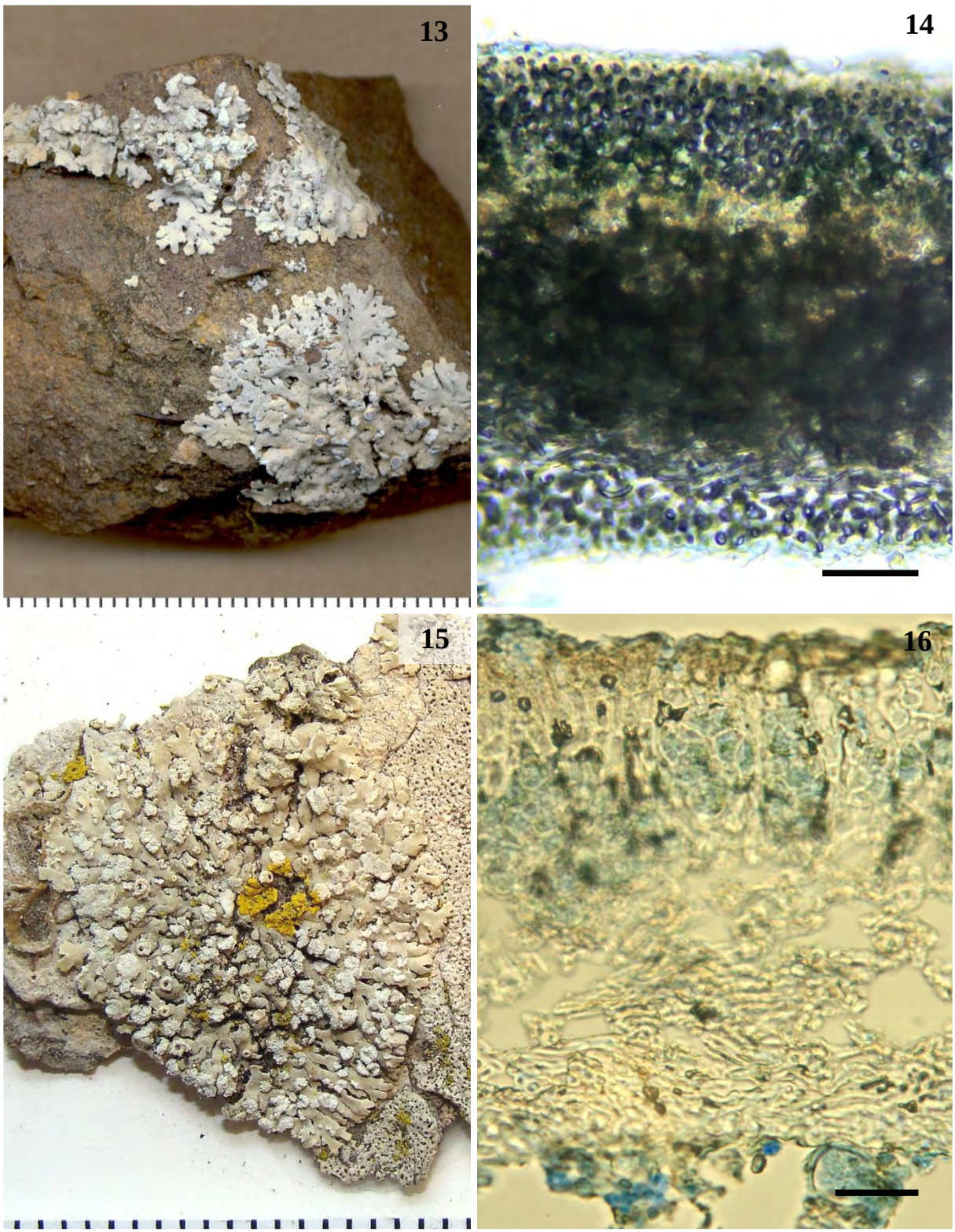
Figures 1-4: **1** – Habit of *Physcia aipolia* var. *decolorata* (lectotype: TUR-V no. 8079); **2** – Transversal section showing the prosoplectenchymatous to slightly intermediate lower cortex of *P. aipolia* var. *decolorata* (lectotype: TUR-V no. 8079) (bar = 50 µm); **3** – Paratype of *P. alba* (G); **4** – Transversal section showing the prosoplectenchymatous to paraplectenchymatous lower cortex of *P. alba* (paratype: G) (bar = 25 µm). Rules in millimeters.



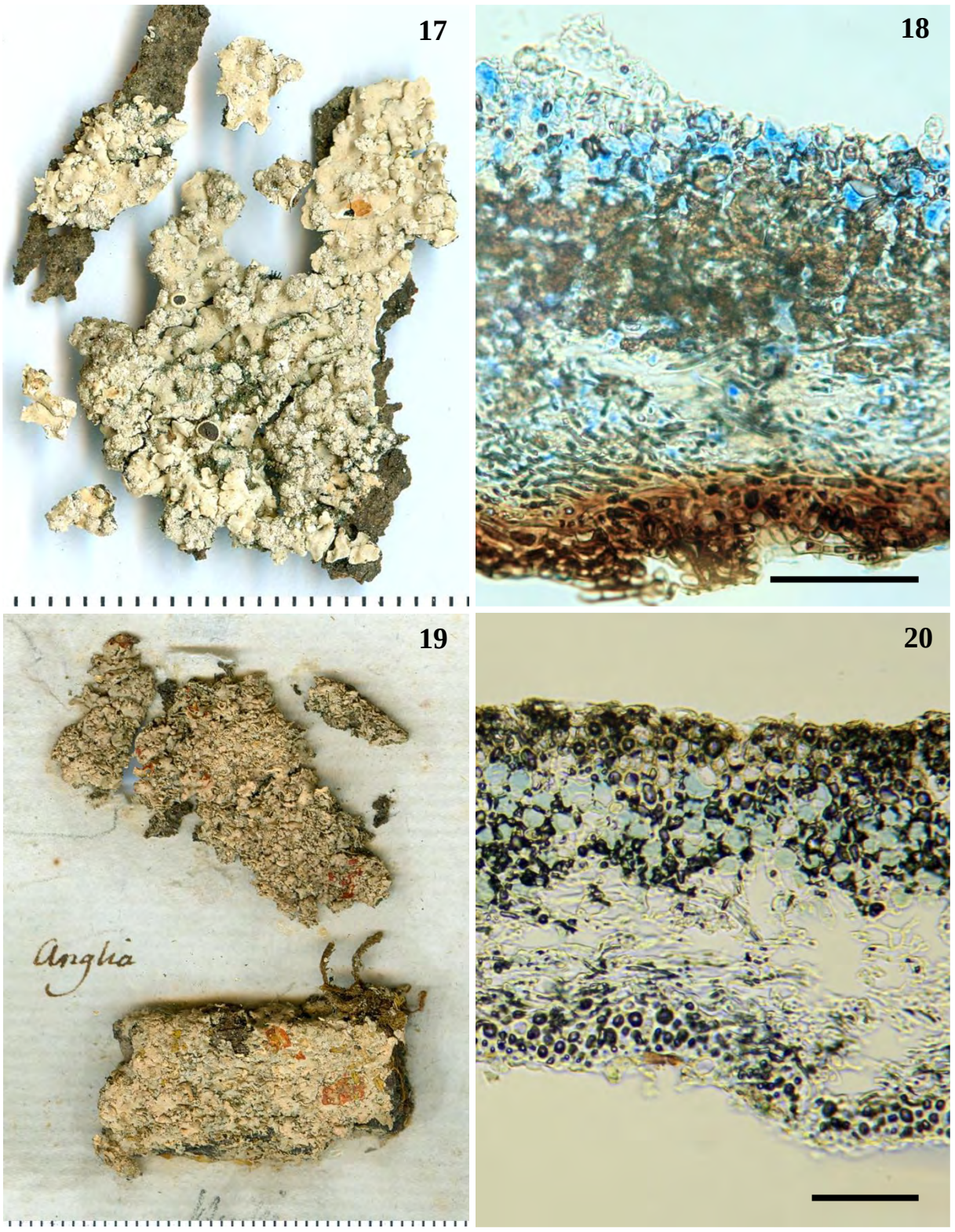
Figures 5-8: **5** – Habit of *Physcia decorticata* (holotype: S); **6** – Transversal section showing the prosoplectenchymatous to slightly paraplectenchymatous lower cortex of *P. decorticata* (holotype: S), the thallus is so fragile that just part of the medulla remains with the lower cortex (bar = 25 µm); **7** – Habit of *P. erumpens* (holotype: UPS); **8** – Transversal section showing the paraplectenchymatous lower cortex of *P. erumpens* (holotype: UPS) (bar = 25 µm). Rules in millimeters.



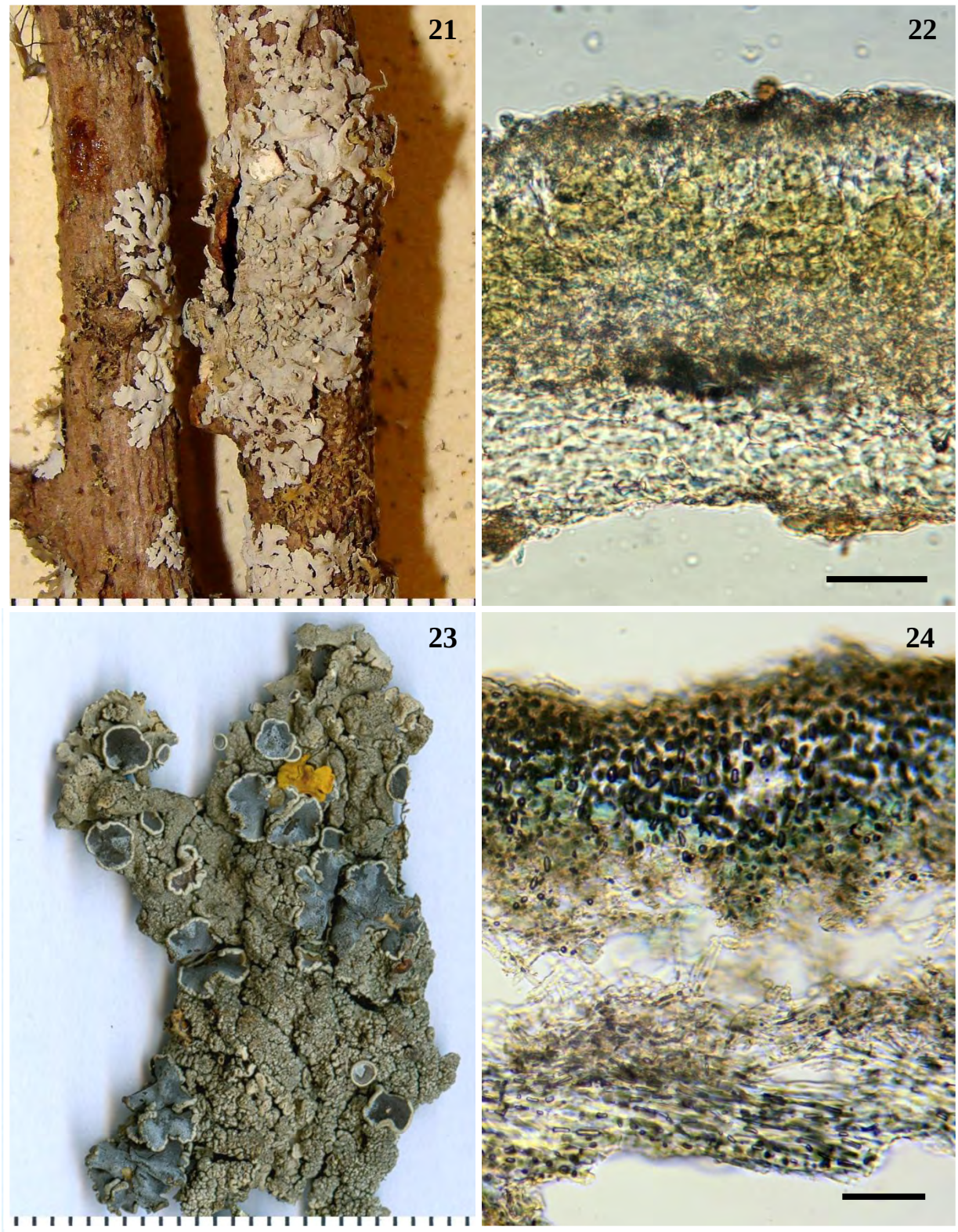
Figures 9-12: **9** – Habit of *Physcia kalbii* (isotype: Herb. Kalb); **10** – Transversal section showing the prosoplectenchymatous lower cortex of *P. kalbii* (isotype: UPS) (bar = 25 µm); **11** – Habit of *P. ochroleuca* (holotype: G); **12** – Transversal section showing the paraplectenchymatous lower cortex of *P. ochroleuca* (holotype: G) (bar = 25 µm). Rules in millimeters.



Figures 13-16: **13** – Habit of *Physcia rolfii* (holotype: S); **14** – Transversal section showing the prosoplectenchymatous to paraplectenchymatous lower cortex of *P. rolfii* (holotype: S) (bar = 25 µm); **15** – Habit of *P. sinuosa* (holotype: Herb. Kalb); **16** – Transversal section showing the prosoplectenchymatous to intermediate lower cortex of *P. sinuosa* (holotype: Herb. Kalb) (bar = 25 µm). Rules in millimeters.



Figures 17-20: **17**– Habit of *Physcia sorediosa* (lectotype: TUR-V); **18** – Transversal section showing the paraplectenchymatous lower cortex of *P. fragilescens* (lectotype: W) (bar = 25 µm); **19** – Habit of *P. tribacia* (lectotype: H-Ach., upper specimen); **20** – Transversal section showing the paraplectenchymatous lower cortex of *P. tribacia* (lectotype: H-Ach.) (bar = 25 µm). Rules in millimeters.



Figures 21-24: **21**– Habit of *Physcia undulata* (holotype: UPS); **22** – Transversal section showing the prosoplectenchymatous to paraplectenchymatous lower cortex of *P. undulata* (holotype: UPS) (bar = 25 µm); **23** – Habit of *P. verruculosa* (lectotype: TUR-V); **24** – Transversal section showing the intermediate to paraplectenchymatous lower cortex of *P. verruculosa* (lectotype: TUR-V) (bar = 50 µm). Rules in millimeters.

Capítulo 3

The *Pyxine pungens* complex (*Physciaceae*) in São Paulo State, Brazil

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The *Pyxine pungens* complex (*Physciaceae*) in São Paulo State, Brazil

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Abstract. The present work deals with a group of species of *Pyxine* with atranorine in upper cortex, without vegetative propagules and that reacts K+ black purple in the pigmented medulla, named here as *P. pungens* complex. Based mainly on the development of apothecia, pigmentation and development degree of the internal stipe and chemistry, three new species morphologically similar to *P. pungens* are described: *P. astipitata* Jungbluth & Marcelli, *P. exoalbida* Jungbluth & Marcelli and *P. mantiqueirensis* Marcelli & Jungbluth. *Pyxine rhodesiaca* and *P. schechingeri* are also treated and compared to this group of species.

Key-words. Taxonomy, lichens, lichenized fungi, new species.

INTRODUCTION

Pyxine Fr. (*Physciaceae*) is represented by ca. 65 species, mainly from tropical and subtropical regions of the world. Only *P. sorediata* (Ach.) Mont. and *P. subcinerea* Stirt. have an relatively expanded distribution, occurring also in temperate Europe (Moberg 1983).
This foliose genus is characterized by the pigmented hypothecium, the epihymenium K+ purple, two to rarely three celled brown *Dirinaria*-type ascospores, and bacillary to sublageniform conidia, from 3 to 4 µm long.
The most related genus is *Dirinaria*, that differs in not having rhizines and the epithecium does not react with potassium hydroxide. In addition, differing from *Dirinaria*, many *Pyxine* species have lichexanthone in upper cortex and a pigmented upper medulla.
Important characters to distinguish the species in *Pyxine* are the chemistry – specially the thin layer chromatographic profile –, the presence, localization and development of vegetative propagules and maculae, the color of the medullar layers, the characterization of the different parts of apothecia, as the carbonization process of the margin and the pigmentation and degree of development of the internal stipe.

Some publications of *Pyxine* with interesting point of views and discussions of morphology, anatomy and/or chemistry are Malme (1897), Stirton (1898), Imshaug (1957), Swinscow & Krog (1975), Kalb (1987) and Scutari (1990, 1995) and are essential for the comprehension of this genus.

Twenty-nine species and two varieties of *Pyxine* are recorded from Brazil and little was added to the knowledge of this genus in this country since Kalb's monograph (1987). Six of these species have atranorine in upper cortex and do not produce vegetative propagules: *P. endolutea* Kalb, *P. primaria* Kalb, *P. pungens* Zahlbr., *P. rhizophorae* Kalb, *P. rhodesiaca* Vain. ex Lynge and *P. schechingeri* Kalb. From these species, *Pyxine endolutea* and *P. rhizophorae* have the upper medulla cream to sulphur yellow reacting K+ yellow to orange, and *P. primaria* has K– cream upper medulla. The remaining species have at least the upper layer of the medulla yellow to orange or ochre, reacting K+ dark purple.

This group of species without vegetative propagules, neither lichexanthone in upper cortex but with K+ black purple upper medulla is commonly considered well delimited. It is intended to show here that this group is more diversified than expected and reaffirms the importance of characters as the upper cortex maculation, apothecial margin, internal stipe and chemistry for discerning *Pyxine* species.

MATERIALS AND METHODS

The specimens studied here were collected in Southeast Brazil, more frequently in the States of São Paulo and Minas Gerais. Type specimens were kindly lent by the curators of BM, S, TUR and W or were studied in the herbaria Kalb and UPS.

Anatomical studies were made by examinations of sections in water under light microscope, cut by hand with razor blade.

Apothecia whose thalline margins become excluded are named *cocoës*-type, while apothecia without thalline margins in any stage of development are called *obscurascens*-type, following the nomenclature proposed by Kalb (1987). Except from the types, more than five apothecia in different states of maturity were cut in the middle from each thallus in order to understand the development and pigmentation process of the internal stipes.

The chemistry of the thalli was determined through traditional color reactions (K, C, KC and P) and thin layer chromatography (TLC) in solvent A and C, following Bungartz (2001). Types were tested when there was sufficient material to allow such studies.

The descriptions presented below refer to all studied specimens of the taxa, including the types. When significant differences between the types and additional specimens are present, they were discussed under "remarks".

RESULTS AND DISCUSSION

Key to the Brazilian species without lichexanthone and vegetative propagules with orange to ochre upper medulla

1a) Medulla completely orange to ochre; norstictic acid present in epithecium .... *P. schechingeri*
1b) Medulla with a white lower layer; without norstictic acid in epithecium 2

2a) Maculae very evident through the entire upper surface, effigurate to subreticulate .... *P. rhodesiaca*
2b) Maculae, if present, paler and resembling veins, restrict to distal parts of the thallus 3

3a) Apothecia of *obscurascens*-type ..... *P. mantiqueirensis*
3b) Apothecia of *cocoës*-type 4

4a) Apothecia without stipe ..... *P. astipitata*
4b) Apothecia with stipe at least partially tinged orange 5

5a) Internal stipe orange with a white external layer; norstictic acid in medulla ..... *P. exoalbida*
5a) Internal stipe orange at all, sometimes with a white layer below; norstictic acid absent .... *P. pungens*

THE SPECIES

Pyxine astipitata Jungbluth & Marcelli, sp. nov.

Fig. 1 and 2

Similis *Pyxine pungens*, sed terpenis continenti differt et stipitibus destitutus.

TYPE: BRAZIL. SÃO PAULO STATE: Municipality of Altinópolis, Fazenda da Gruta, 21°04′08,9″S, 47°26′14,5″W, 650 m alt., on trunk of a thin tree in the border of a secondary forest, 06-VI-2008, *P. Jungbluth* & *M.J. Kitaura 2078* (holotype: SP).

THALLUS orbicular, corticolous, grey to brownish grey, laciniate, 2.5–7.0 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous to cracked, smooth to rugose, dull, convex.

DISTAL UPPER SURFACE continuous, smooth, some parts with depressions, slightly shiny, convex to slightly convex to plane, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous, rarely overlapping laterally, 0.5–0.8 (–1.2) mm wide; apices mainly rounded, flat to concave, adnate; lateral margin irregular to sinuous; axils acute. PRUINA farinaceous or glistening in very small patches, subapical. TRUE MACULAE absent or very rare, mainly restrict to the margins, sometimes with elevated veins paler than the upper cortex in distal parts, laminal. MEDULLA very strong yellow to vivid orange above, lower layer white and very thin. DISTAL LOWER SURFACE grey to black, slightly shiny, smooth to slightly rugose. PROXIMAL LOWER SURFACE black, slightly shiny, smooth to irregular. RHIZINES concolored with the lower cortex, simple to few irregularly branched, abundant, evenly distributed, up to 0.3 mm long. APOTHECIA *cocoës*-type, frequent, plane to convex, sessile, laminal, up to 1.0 mm diam.; margin sometimes with an orange or brown tone because of the inner tissues color, smooth to slightly undulate, not visible in very convex apothecia; disc black, slightly shiny, epruinose. INTERNAL STIPE absent or poorly developed, when a vestige is present, yellow to orange, sometimes white above; the stipital lacuna can sometimes be occupied by an invagination of the lower cortex. EPIHYMENIUM 10 µm high; hymenium 60–80 µm high; subhymenium 50–80 µm high. ASCOSPORES ellipsoid, (12–) 13–18 × 6–7 µm. PYCNIDIA frequent, subapical. CONIDIA sublageniform, 3.0–4.5 × ca. 1.0 µm.

Color tests: upper cortex K+ yellow, UV–; upper medulla K+ violet, C+ reddish, KC+ reddish brown, P+ blackish violet, UV–. **Secondary metabolites:** atranorine, triterpenes (Fig. 3).

Remarks. *Pyxine astipitata* is characterized by the *cocoës*-type apothecia, the poorly developed to absent internal stipe and the K+ violet, P+ blackish violet upper medulla. It is common to observe the lower cortex turning inward in the place where the internal stipe would develop.

True maculae are absent or very rare and restrict to the margins. Elevated veins in the upper cortex can be present and sometimes resembles maculae when are discreetly paler than the upper cortex. These elevated veins, when present, are restrict to distal parts of the thallus. *Pyxine rhodesiaca* (TUR!) differs by its abundant effigurate to irregularly linear laminal and marginal maculae, dispersed through all the upper surface and developed white internal stipe. *Pyxine pungens* (W!) differs by having an almost totally orange K+ rose well developed internal stipe.

Pyxine exoalbida Jungbluth & Marcelli has a well-developed orange internal stipe and norstictic acid in the medulla.
Pyxine elixii Kalb (Herb. Kalb!), *P. mantiqueirensis* and *P. schechingeri* (Herb. Kalb!) differ by the *obscurascens*-type and apothecia with well developed internal stipe. Moreover, *P. elixii* and *P. schechingeri* have smaller ascospores (up to 13 µm) and medulla pigmented throughout; *P. elixii* until now is known just from Australia and have evident maculae in upper surface. *Pyxine schechingeri* has norstictic acid present in the epithecium.
The name "astipitata" refers to the absence of the internal stipe in the apothecia.

Distribution. Until the moment, this species was found just in Altinópolis municipality in São Paulo State, near the border with Minas Gerais State.

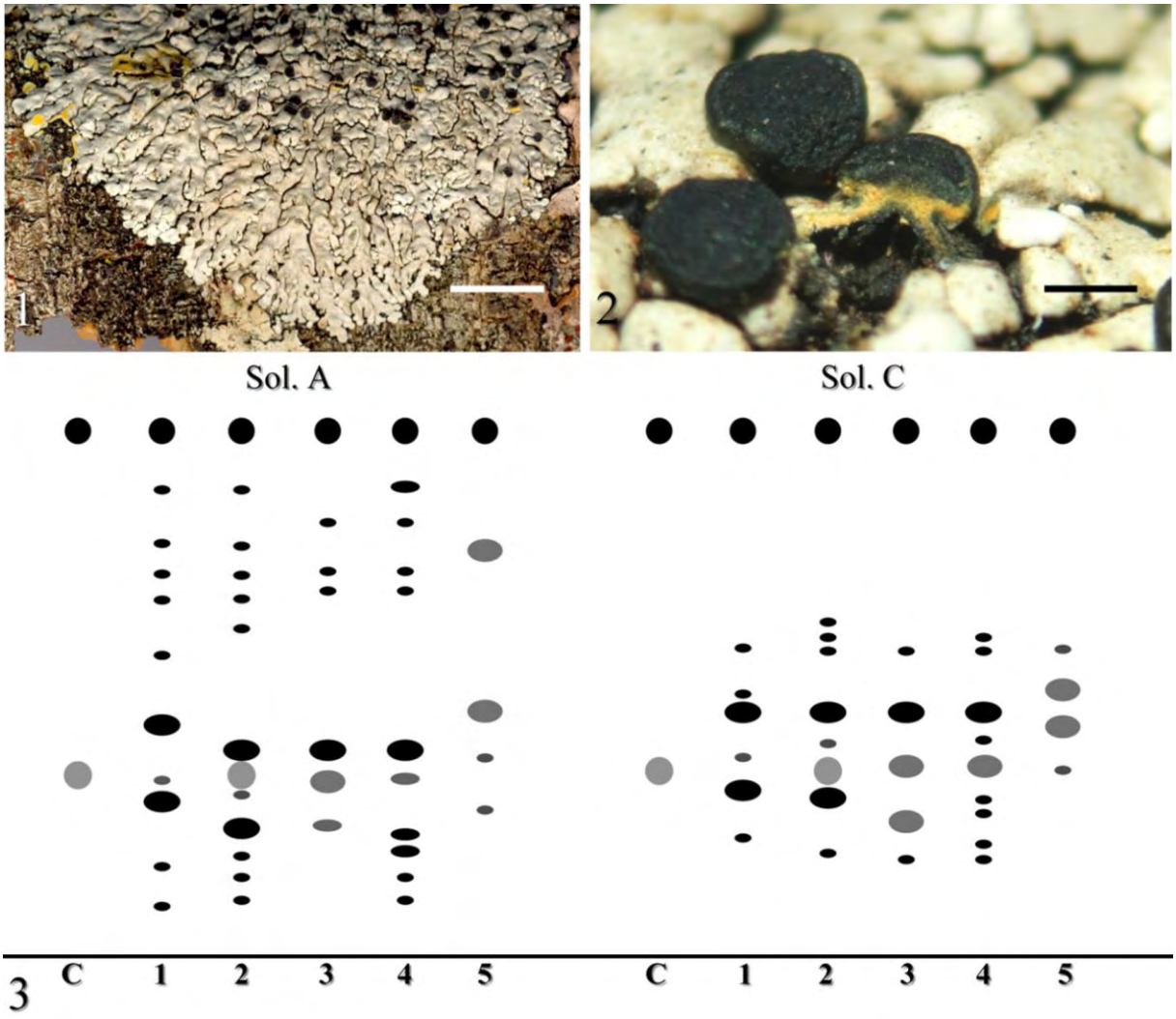
Additional material examined. BRAZIL. SÃO PAULO STATE: Municipality of Altinópolis, 21°04′08,9″S, 47°26′14,5″W, 650 m alt., 06-VI-2008, *P. Jungbluth 2079*; idem, *M.J. Kitaura 1063, 1065* (SP).

Pyxine exoalbida Jungbluth & Marcelli, sp. nov.

Fig. 4 and 6

Similis *Pyxine pungens*, sed acidum norsticticum continenti et stipitibus anatomia differt.
TYPE: BRAZIL. SÃO PAULO STATE: Municipality of Bauru, Tibiriçá District, secondary forest managed by Instituto Florestal, 22°13′45,0″S, 49°04′50,3″W, 575 m alt., on tree branch, 04-VI-2008, *M.J. Kitaura* & *P. Jungbluth 1021* (holotype: SP).

THALLUS orbicular, corticolous, grey to brownish grey, laciniate, 3.5–6.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous, smooth or rugose to smooth, slightly shiny, convex. DISTAL UPPER SURFACE continuous, smooth, sometimes scrobiculate because of the "maculae", slightly shiny to shiny, mainly convex but sometimes plane, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to rarely overlapping laterally, 0.5–1.0 (–1.4) mm wide; apices subrounded, convex, loosely adnate; lateral margin smooth to irregular to sinuous; axils acute. PRUINA rare, farinaceous, disperse, subapical. TRUE MACULAE rare, mainly restrict to the margin or projecting depart the axils; elevated veins sometimes paler than the upper cortex present, abundant in distal parts, irregularly linear to network, laminal, giving to the distal upper surface a scrobiculate appearance, mainly



Figures 1–3. **1–2**. *P. astipitata*, *P. Jungbluth 2078* (holotype: SP). **1**. Habit (Bar = 5.0 mm). **2**. Apothecia without internal stipe (Bar = 0.5 mm). **3**. TLC array of *P. pungens* complex in solvents A and C. Control: atranorine (black circle) and norstictic acid (gray circle). 1: *P. astipitata*; 2: *P. exoalbida*; 3: *P. mantiqueirensis*; 4: *P. pungens*; 5: *P. rhodesiaca*. Black ellipses: purple tone stains after charring and heat; gray ellipses: rose tone stains after charring and heat.

laminal. MEDULLA orange to ochre to pale brown, lower layer white. DISTAL LOWER SURFACE grey, slightly shiny, rugose. PROXIMAL LOWER SURFACE grey to black, slightly shiny, smooth to rugose. RHIZINES concolored with the lower cortex, the apices becoming paler, irregularly branched, mainly at the tips, frequent, evenly distributed, up to 0.4 mm long. APOTHECIA *cocoës*-type, frequent, plane to slightly convex, sessile, laminal, up to 1.5 mm diam.; margin sometimes with a orange or brown tone because of the color of the inner tissues, smooth to undulate, not visible in old convex apothecia; disc black, dull, epruinose. INTERNAL STIPE well developed, orange, circled by a white outside layer. EPIHYMENIUM 5–10 µm high; hymenium 60–65 µm high; sub-hymenium 25–70 µm high. ASCOSPORES ellipsoid, (13–) 14–16 (–20) ×

5–7 µm. PYCNIDIA frequent, submarginal or subapical. CONIDIA sublageniform, 4.0–5.5 × ca. 1.0 µm.

Color tests: upper cortex K+ yellow, UV–; upper medulla K+ blackened violet, C+ faint reddish, KC+ reddish, P+ blackened, UV–; **internal stipe** K+ faint rose. **Secondary metabolites:** atranorine, norstictic acid, triterpenes (Fig. 3).

Remarks. *Pyxine exoalbida* is characterized by the *cocoës*-type apothecia with orange internal stipe K+ faint rose, circled by a white outside layer, and the notably presence of norstictic acid in the medulla, which makes this the first species without vegetative propagules with norstictic acid in South America. It is important to note that the norstictic acid is present in higher concentrations in proximal parts of the thallus and cannot be detected if only tips of laciniae are taken to the analysis. Moreover, the strong reactions K+ blackened violet and P+ blackened in the upper medulla do not allow the visualization of the typical reactions of norstictic acid. So, it is strongly advised the use of TLC to confirm the identity of this species.

It is very similar in morphology with *P. pungens*. However, *P. pungens* does not produce norstictic acid and does not have a white layer surrounding the orange internal stipe. *Pyxine africana* Kalb, *P. schechingeri* (Herb. Kalb!) and *P. vermiformis* Swinscow & Krog (BM!) are similar species with pigmented internal stipe and norstictic acid in medulla, but the three differs from *P. exoalbida* in having *obscurascens*-type apothecia. Moreover, *P. africana* has K+ orange, C–, KC– and P+ orange medulla (Kalb 1987); *P. schechingeri* has norstictic acid in epihymenium, smaller ascospores (up to 13 µm) and medulla pigmented throughout, without the white layer below; and finally, *P. vermiformis* has markedly convex laciniae, a different triterpenes array, smaller ascospores (12–15 × 6–7) and until now was recorded only on lava rocks in restrict African areas.

The name “exoalbida” refers to the outer white layer that involves the orange internal stipe.

Distribution. Brazil, São Paulo State, Municipalities of Bauru, Altinópolis, Luiziânia, Cachoeira de Emas and Mogi-Guaçu.

Additional material examined. BRAZIL. SÃO PAULO STATE: Municipality of Luiziânia, 21°42′26,8″S, 50°08′28,0″W, 358 m alt., 01-VI-2008, *M.J. Kitaura 882, 887*; idem, Municipality of Altinópolis, 21°04′08,9″S, 47°26′14,5″W, alt. 650 m, *M.J. Kitaura 989, 990* (SP).

Pyxine mantiqueirensis Marcelli & Jungbluth, sp. nov.

Fig. **5 and 7**

Similis *Pyxine pungens*, sed apotheciis differt.

TYPE: BRAZIL. MINAS GERAIS STATE: Municipality of São Tomé das Letras, 21°44′36″S, 44°58′39″W, 959 m alt., on rock in open woodland next to the Flávio Waterfall, 19-I-2009, *M.J. Kitaura, M.P. Marcelli* & *B.R. da Hora 1361* (holotype: SP).

THALLUS orbicular, saxicolous, grey to brownish grey, laciniate, 5.5–7.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous to sometimes cracked, smooth to slightly rugose, slightly shiny, convex. DISTAL UPPER SURFACE continuous, smooth to irregularly rugose and veined, shiny, convex, plane to slightly convex near the tips, with a pale brown zone near the tips. LACINIAE linear to sublinear, irregularly branched, contiguous to overlapping laterally, (0.5–) 0.7–1.0 (–1.3) mm wide; apices rounded, flat to concave, when concave with apical margins ascendant; lateral margin sinuous to crenate; axils acute. PRUINA farinaceous, faint, disperse, subapical. TRUE MACULAE rare, mainly restrict to the margin or projecting depart the axils, elevated veins sometimes paler than the upper cortex, abundant in distal parts, irregularly linear to network, laminal. MEDULLA dark yellow to orange above, lower layer thin and white. DISTAL LOWER SURFACE brown to slightly greenish brown, slightly shiny, smooth to rarely papillate. PROXIMAL LOWER SURFACE black, shiny, smooth. RHIZINES concolored with the lower cortex, sometimes with the apices white, simple to subdichotomously and irregularly branched, frequent, evenly distributed, up to 0.7 (–1.0) mm long. APOTHECIA *obscurascens*-type common, slightly concave to plane, sessile, laminal, up to 1.5 mm diam.; margin sometimes with an orange tone because of the orange color of the inner tissues, smooth to slightly undulate, not visible in very convex apothecia; disc black, slightly shiny, epruinose. INTERNAL STIPE developed, orange, sometimes orange above and white below. EPIHYMENIUM 10 µm high; hymenium 60–70 µm high; sub-hymenium 80–120 µm high. Ascospores ellipsoid, 14–17 × 6–8 µm. PYCNIDIA frequent, laminal. CONIDIA sublageniform, 3–4 × ca. 1.0 µm.

Color tests: upper cortex K+ yellow, UV–; upper medulla K+ purple black, C–, KC–, P+ purple black, UV–; **internal stipe** K+ faint rose in pigmented parts. **Secondary metabolites:** atranorine, triterpenes (Fig. 3).

Remarks. *Pyxine mantiqueirensis* is characterized by the *obscurascens*-type apothecia with orange internal stipe K+ faint rose.

This species has not evident effigurate to irregularly linear maculae as *P. rhodesiaca*, but develops elevated veins limited to distal parts of the thallus, as do *P. astipitata*, *P. exoalbida* and *P. pungens*. However, different from these species, *P. mantiqueirensis* has apothecia from *obscurascens*-type.

The general morphology is similar to *P. africana*, *P. schechingeri* and *P. vermiformis*. Nevertheless, *P. schechingeri* (Herb. Kalb !) and *P. vermiformis* (BM!) have smaller ascospores (10–13 × 5–6 μm in *P. schechingeri* and 12–15 × 6–7 μm in *P. vermiformis*). Moreover, *P. schechingeri* has medulla pigmented throughout and norstictic acid restrict to the epithecium, while *P. vermiformis* and *P. africana* have norstictic acid in the medulla. Also, *P. africana* has color tests different from the others species: K+ orange, C–, KC– and P+ orange medulla (Kalb 1987).

A specimen very similar to *P. mantiqueirensis* was found in Herb. Kalb (no. 12283, São Paulo State), but it was not chemically studied.

The epithet *mantiqueirensis* refers to the Serra da Mantiqueira, a great range that represents one of the major geological Brazilian formations, from where the specimens were collected.

Distribution. Brazil, Minas Gerais State and São Paulo State.

Additional material examined. BRAZIL. MINAS GERAIS STATE: Municipality of São Tomé das Letras, 21°43′S, 44°58′W, 1300 m alt., 18-I-2009, *M.J. Kitaura 1250* (SP); SÃO PAULO STATE: between Municipalities of Monteiro Lobato and São Bento do Sapucaí, 22°50′ S, 45°45′ W, 24-II-1980, *K. Kalb 12283*(SP).

Pyxine pungens Zahlbr., *Ann. Crypt. exot.* 1(2): 210. 1928.

Fig. 8 and 9

TYPE: INDONESIA. JAVA: Hortus Bogoriensis, ramicola, *C. van Overeem 23* (holotype: W!; isotype: O).

= *Pyxine meissneri* Tuck. var. *subobscurascens* Malme, *Bihang Kongl. Svenska Vet. -Akad. Handl.* 23, afd. 3(13): 37. 1897. TYPE: PARAGUAY. COLONIA RISSO: pr. Rio Apa, 21.10.1893, *Malme 1950 C* [lectotype: UPS!; duplicate from the lectotype: S! (specimen above, typification made by Kalb 1987)]. – *Pyxine berteriana* Fée var. *subobscurascens* (Malme) Imshaug, *Tr. Amer. Micros. Soc.* **76**: 256. 1957.

THALLUS orbicular, corticolous, brownish grey, laciniate, 2.0–8.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous, strongly rugose and irregular, slightly shiny, slightly convex. DISTAL UPPER SURFACE continuous, smooth to rugose, sometimes with concavities,

slightly shiny, plane to slightly convex, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to slightly overlapping laterally, (0.3–) 0.5–1.0 mm wide; apices rounded, usually flat and adnate, rarely ascendant; lateral margin smooth to sinuous, occasionally lacinulate; axils acute. PRUINA absent or farinaceous, sparse, subapical. TRUE MACULAE rare, pale, laminal, elevated veins present, sometimes paler than the upper cortex, abundant in distal parts, irregularly linear to network, laminal. MEDULLA vivid orange to ochre above, lower layer thin and white. LOWER SURFACE totally black, slightly shiny, smooth to papillate, sometimes the distal surface paler. RHIZINES concolored to the lower surface, simple to rarely irregularly branched, frequent, evenly distributed, up to 0.5 mm long. APOTHECIA *cocoës*-type, numerous, plane, rarely convex, sessile, laminal, up to 1.0 mm diam.; margin smooth to slightly undulate; disc black, slightly shiny, epruinose. INTERNAL STIPE developed, quite totally orange, white inferior part rarely visible. EPIHYMENIUM 5–10 µm high; hymenium 60–80 µm high; sub-hymenium 40–100 µm high. Ascospores *Dirinaria*-type, ellipsoid, (11–) 14–17 × (4–) 6–8 µm. PYCNIDIA frequent, subapical. CONIDIA sublageniform, 3.0–4.0 × ca. 1.0 µm.

Color tests: upper cortex K+ yellow, UV–; upper medulla K+ violet, C–, KC–, P+ blackish purple, UV–; **internal stipe** K+ faint orange to yellow. **Secondary metabolites:** atranorine, triterpenes (Fig. 3).

Remarks: *Pyxine pungens* is characterized by the *cocoës*-type apothecia with orange internal stipe.

The lectotype (UPS) and the duplicate of the lectotype of *Pyxine meissneri* var. *subobscurascens* (S, specimen below) differs from the holotype of *P. pungens* by the absence of the rugosities, so frequent in the upper surface of the holotype of *P. pungens*. The thin layer chromatographic indicates that the duplicate of the lectotype of *P. meissneri* var. *subobscurascens* and the holotype of *P. pungens* do have very similar chemistry, differing subtly, probably because of different concentrations of the same substances.

The specimen *Jungbluth 1026* has a similar rugose upper surface as the holotype of *P. pungens*, but differs in having elevated veins, absent from the holotype.

We prefer to maintain *P. meissneri* var. *subobscurascens* as synonym of *P. pungens* and so keep the Brazilian specimens under this name until more material is studied, as these specimens share the same chemistry, the same apothecia type and similar ascospores measure interval (14–17× 4–8 µm).

Kalb (1987) wrote that *P. pungens* have pruina and apothecia *cocoës*-type, but does not have maculae, while *P. rhodesiaca* has evident reticular maculae, *obscurascens*-type apothecia and is epruinose. There is no doubt about the evident maculation in *P. rhodesiaca*, not present in *P. pungens*. However, farinaceous, sparse and subapical pruina can occur in the two taxa. Moreover, the holotype of *P. rhodesiaca* has apothecia from the *cocoës*-type (TUR-Vainio!). *Pyxine rugulosa* Stirt. (BM!) is a morphologically similar species from Australia that differs by the flat to concave laciniae tips (Rogers 1986b, just few laciniae left in the holotype), the plates of pruina, the yellow to pale yellow medulla and the distinct triterpenes array.
The three new species morphologically very similar to *P. pungens*, *P. astipitata*, *P. exoalbida* and *P. mantiqueirensis*, differ in apothecial characters and in chemistry. *Pyxine astipitata* does not have stipe in the apothecia and has a distinct triterpene array. *Pyxine exoalbida* has orange internal stipe well developed circled by a white outside layer and produce norstictic acid in the medulla. *Pyxine mantiqueirensis*, although with very similar triterpene array, differs from *P. pungens* by the *obscurascens*-type apothecia and more convex laciniae.

Distribution. Australia (Elix 2009, Kalb 1987, Kalb 1994 in the preliminary key, Rogers 1986a/b), Indonesia (Zahlbruckner 1928) and Central and South America, reported to Brazil (Brako *et al*. 1985, Kalb 1987), Costa Rica (Kalb 1987), Guyana (Aptroot 1987), Paraguay (Kalb 1987; Malme 1897, as *Pyxine meissneri* Tuck. var. *subobscurascens* Malme) and Venezuela (López-Figueiras 1986, Kalb 1987). In Brazil, it was cited to the States of Bahia (Kalb 1987), Minas Gerais (Kalb 1987; Krempelhuber 1873, as *P. meissneri* fide Kalb1987; Malme 1897, as *Pyxine meissneri* Tuck. var. *subobscurascens* Malme), between Mato Grosso and Pará States [Brako *et al*. 1985, as *Pyxine berteriana* var. *subobscurascens* (Malme) Imshaug], Mato Grosso do Sul (Kalb 1987) and São Paulo (Zahlbruckner 1909, as *P. retirugella* fide Kalb 1987; Kalb 1987).

Additional specimens examined: BRAZIL. SÃO PAULO STATE: Municipality of Mogi-Mirim, 22°26′S 46°57′W, 630m alt., 14-V-2004, *P. Jungbluth 1026* (SP).

Pyxine rhodesiaca Vain. ex Lynge, *Rev*. *bryol*. *lichènol*. 10 (N.S.): 90. 1937.

Fig. **10 and 11**

TYPE**:** RHODESIA. SALISBURY: on *Ficus, F*. *Eyles 3953* (holotype: TUR-Vainio 34628!).

= *Pyxine retirugella* Nyl. var. *endoxantha* Müll. Arg., *Bull*. *Herb*. *Boiss*. 4: 91 (1896). TYPE: AMER. AUSTR.?, *Humboldt 129* (holotype: G).

THALLUS orbicular, corticolous, grey to brownish grey, laciniate, 3.0–11.5 cm diam., adnate to closely adnate. PROXIMAL UPPER SURFACE continuous, sometimes with cracks, rugose to very irregular, dull, slightly convex to convex. DISTAL UPPER SURFACE continuous, with irregularities (concavities) caused by the maculae, rarely smooth, slightly shiny, convex to plane, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to laterally overlapping, (0.5–) 0.7–1.2 (–1.5) mm wide; apices rounded, flat and adnate, sometimes slightly concave, then somewhat ascendant; lateral margin sinuous and irregular, sometimes becoming sublacinulate in proximal parts; axils acute. PRUINA absent or farinaceous, sparse, subapical. MACULAE distinct, abundant, irregularly linear to subreticulate, laminal and marginal, rarely originating cracks. MEDULLA ochre above, sometimes orange to dark orange near the tips, lower layer white. LOWER SURFACE totally black or distal lower surface grey to black, slightly shiny, smooth to papillate. PROXIMAL LOWER SURFACE black, slightly shiny to shiny, smooth to papillate. RHIZINES concolored with the lower cortex or with paler apices, irregularly branched, abundant, evenly distributed, up to 1.0 mm long. APOTHECIA *cocoës*-type, common to numerous, plane, sometimes becoming convex, sessile, laminal, up to 1.5 mm diam.; margin smooth to slightly undulate; disc black, slightly shiny, epruinose. INTERNAL STIPE developed, white, sometimes upper layer the same color as the medulla. EPIHYMENIUM 5–10 µm high; hymenium 40–80 (–100) µm high; sub-hymenium 60–160 µm high. ASCOSPORES ellipsoid, 14–19 (–21) × 6–8 µm. PYCNIDIA few, subapical. CONIDIA sublageniform, 4.0–5.5 × ca. 1.0 µm [microscope data from additional specimens, not from the holotype].

Color tests: upper cortex K+ yellow, UV–; upper medulla K+ black purple, C–, KC–, P+ black purple, UV–; **internal stipe** K–. **Secondary metabolites:** atranorine, triterpenes (Fig. 3).

Remarks. *Pyxine rhodesiaca* is characterized by the abundantly irregularly maculate upper surface, the ochre upper medulla that reacts K+ and P+ black purple and the white internal stipe.

Kalb (1987) described the apothecia of *P. rhodesiaca* as *obscurascens*-type, but he did not see the holotype, which consists of three small fragments of a thallus with three apothecia and another half apothecia glued to the herbarium cardboard. It is possible to determine that the development of apothecia is really of the *cocoës*-type, as the two young ones have thalline margins and the other have carbonized margins. The additional specimens studied agree with this observation.

For other differences from others species, see remarks under *P. pungens*.

It is the first time that *Pyxine rhodesiaca* is cited to Distrito Federal, in central Brazil.

Distribution. Africa (Lynge 1937, Swinscow & Krog 1975, 1988) and South America, reported to Brazil (Kalb 1987) and Venezuela (López-Figueiras, 1986). In Brazil, it was cited to the States of Mato Grosso, Mato Grosso do Sul and São Paulo (Kalb 1987).

Additional material examined. BRAZIL. DISTRITO FEDERAL: Municipality of Brasília, 15°46′S, 47°55′W, 1150 m alt., 12-VIII-1991, *M.P. Marcelli 30781, 30819, 30824* (SP); SÃO PAULO STATE: Municipality of Bauru, 22°13′45,0″S, 49°04′50,3″W, 575 m alt., 04-VI-2008, *M.J. Kitaura 1999* (SP); idem, 22°21′01,4″S, 49°00′29,8″W, 598 m alt., 04-VI-2008, *M.J. Kitaura 1951, 1971, 1972, 1973* (SP); idem, Municipality of Mogi-Guaçu, 22°15′03″S 47°09′25″W, 630 m alt., 05-XI-2007, *P. Jungbluth 1682* (SP).

Pyxine schechingeri Kalb, *Bibl. Lichenol.* 24: 71. 1987.

Fig. 12

TYPE**:** BRAZIL. ESTADO DA BAHIA: bei Roda Velha, 650 m alt., an Sandstein, 15-VII-1980, *K. Kalb 12313* (holotype: Herb. Kalb!).

THALLUS orbicular, saxicolous, brownish grey, laciniate, 3.5 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous, rarely cracked, smooth, shiny, convex. DISTAL UPPER SURFACE continuous, smooth, shiny, convex to plane, with a weak darker zone near the tips. LACINIAE linear to sublinear, irregularly to subdichotomously branched, contiguous, 0.4–0.8 mm wide; apices rounded, flat to convex, adnate; lateral margin smooth to slightly sinuous; axils acute. PRUINA farinaceous, disperse, subapical. MACULAE absent. MEDULLA reddish orange to ochre. DISTAL AND PROXIMAL LOWER SURFACE black, shiny, smooth to rarely irregular. RHIZINES (very few seen) black, simple, frequent, up to 0.3 mm long. APOTHECIA *obscurascens*-type, frequent, plane to slightly convex, sessile, laminal, up to 0.6 mm diam.; margin smooth to slightly undulate; disc black, slightly shiny, epruinose. INTERNAL STIPE developed, white, upper part reddish brown. EPIHYMENIUM 10–15 µm high;

hymenium 50–60 µm high; subhymenium 90–100 µm high. ASCOSPORES ellipsoid, 10–13 × 5–6 µm. PYCNIDIA frequent, laminal. CONIDIA not seen.

Color tests: upper cortex K+ yellow, UV–; medulla K+ purple, C–, KC–, P+ purple black, UV–; **internal stipe** K–. **Secondary metabolites:** atranorine, norstictic acid (in the epithecium), triterpenes (see Kalb 1987 fig. 10–12 to see the chromatographic array of this species).

Remarks. *Pyxine schechingeri* is characterized by the medulla orange throughout, the *obscurascens*-type apothecia, the presence of norstictic acid in the epihymenium, the white internal stipe with reddish brown upper part and the small ascospores up to 13 µm long. For differences from other species, see remarks under the new species presented above, especially *P. exoalbida*.
Distribution: this species is known only from the type locality.

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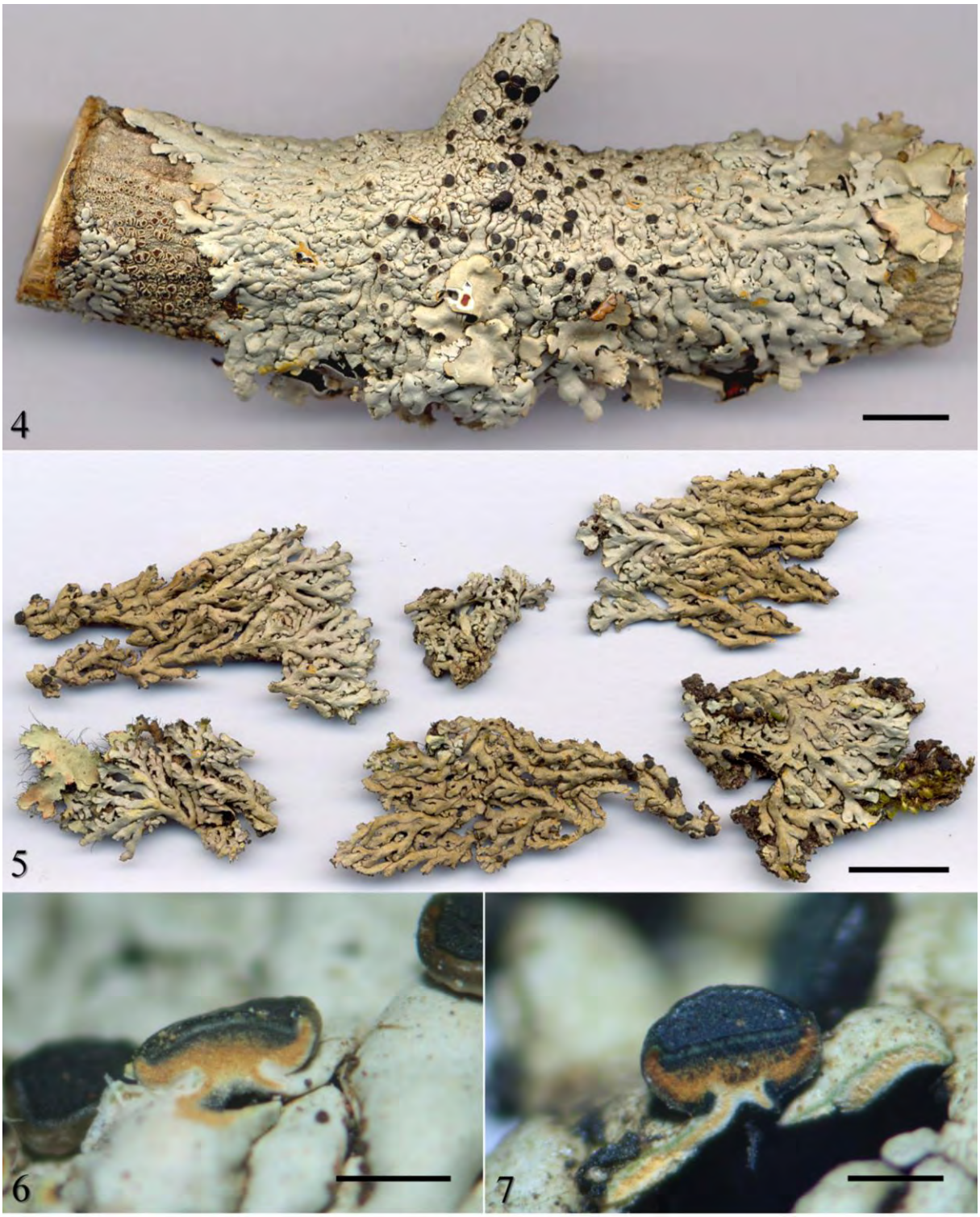
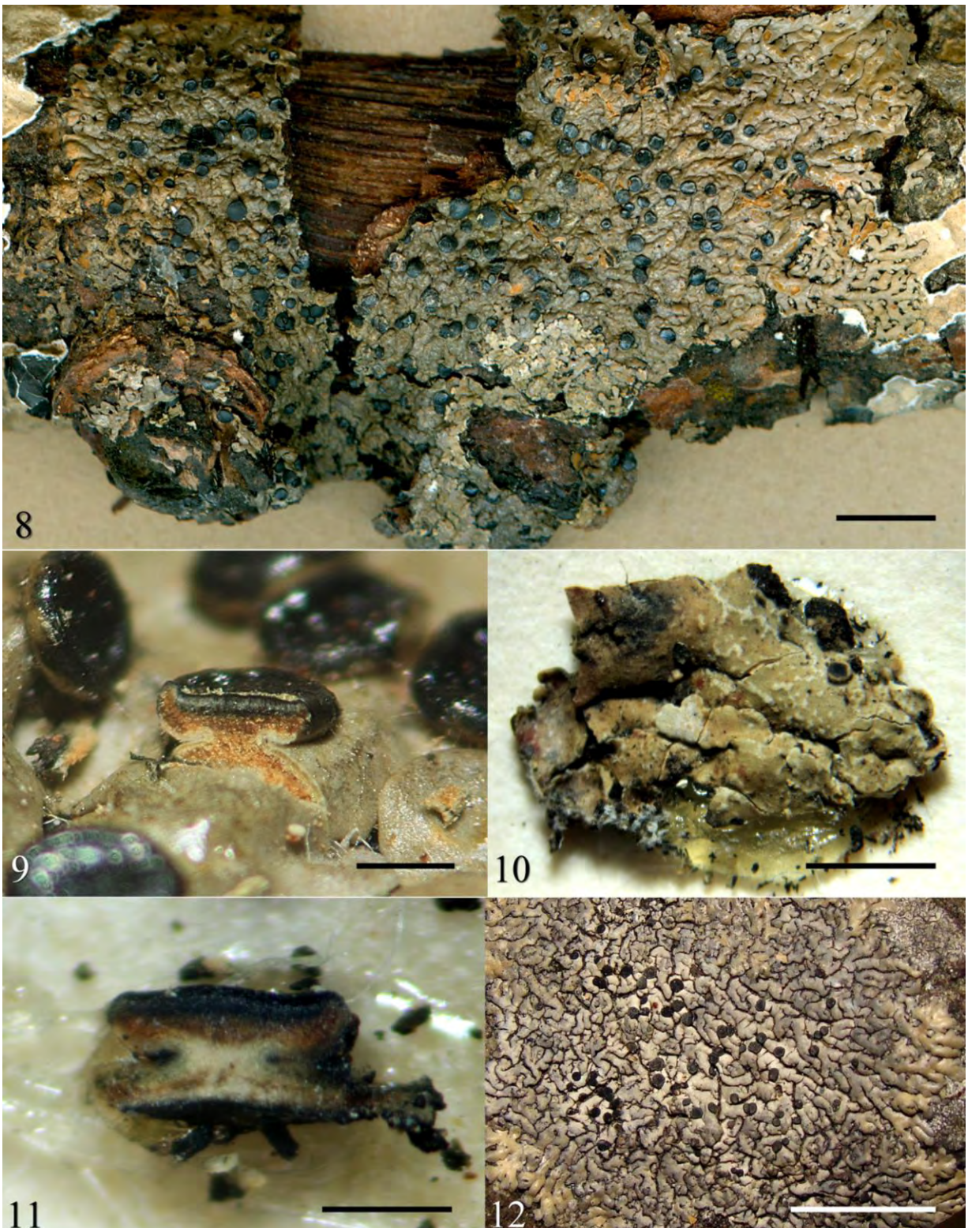


Figures 4–7. **4**. Habit of *P. exoalbida*, *M. J. Kitaura 1021* (holotype: SP) (Bar = 5.0 mm). **5**. Habit of *P. mantiqueirensis*, *M. J. Kitaura 1361* (holotype: SP) (Bar = 1.0 cm). **6**. The orange internal stipe of *P. exoalbida* (holotype: SP), surrounded by a white outside layer (Bar = 0.5 mm). **7**. The internal stipe of *P. mantiqueirensis* orange above and white below (holotype: SP) (Bar = 0.5 mm).



Figures 8–12. **8–9**. *P. pungens*, *Overeem 23* (holotype: W). **8**. Habit (Bar = 1.0 cm). **9**. Totally orange internal stipe (holotype: W) (Bar = 0.5 mm). **10–11**. *P. rhodesiaca*, *Eyles 3953* (Holotype: TUR). **10**. Habit (Bar = 0.5 cm). **11**. Totally orange internal stipe (holotype: W) (Bar = 0.5 mm). **12**. Habit of *P. schechingeri*, *K. Kalb 12313* (holotype: herb. Kalb) (Bar = 1.0 cm).

Capítulo 4

Studies in Brazilian *Pyxine* (*Physciaceae*) with vegetative propagules, with emphasis on species from São Paulo State

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Studies in Brazilian *Pyxine* (*Physciaceae*) with vegetative propagules, with emphasis on species from São Paulo State

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ABSTRACT

This work deals with 15 species of *Pyxine* with vegetative propagules recorded to Brazil. Key, descriptions and discussions are presented; their synonyms and additional species with taxonomic affinities are commented. *Pyxine jolyana* Jungbluth, Kalb & Marcelli is described as new. *Pyxine heterospora* Vainio and *P. oceanica* Zahlbruckner, formerly considered synonyms of *P. eschweileri* (Tuckerman) Vainio and *P. cocoës* (Swartz) Nylander, respectively, are proposed as good species. *Pyxine retirugella* Nylander var. *capitata* Zahlbruckner is proposed as synonym of *P. fallax* (Zahlbruckner) Kalb. *Pyxine caesiopruinosa* (Nylander) Imshaug and *P. physciaeformis* (Malme) Imshaug previously thought as synonyms, are considered distinct species. A lectotype was chosen to *P. meissneri* ssp. *connectens* Vainio. *Pyxine fallax* and *P. katendei* Swinscow & Krog are new records to South America. In Brazil, several new reports were found: *P. albovirens* (G. Meyer) Aptroot and *P. obscurascens* Malme to São Paulo State, *P. caesiopruinosa* to Minas Gerais State, *P. coccifera* (Fée) Nylander to the States of Maranhão and Tocantins, and *P. coralligera* Malme to Goiás State.

Key-words: lichenized fungi, new records, new species, taxonomy

INTRODUCTION

Pyxine Fries differs from the other genera in *Physciaceae* by the epithecium becoming purple in potassium hydroxide solution, the presence of a dark pigmented hypothecium and the ascospores of the *Dirinaria*-type. Another important feature of this genus is the occurrence of apothecia with carbonized margins in the major part of the species (Malme 1897, Imshaug 1957, Swinscow & Krog 1975, Kashiwadani 1977a, Awasthi 1980, Rogers 1986, Kalb 1987). This pigmentation process, usually called carbonization, can occur in different stages of the ascoma development, according to the species. *Pyxine obscurascens* Malme, for example, has apothecia that begin their development with black margins (*obscurascens*-type, fide Kalb 1987), while *P. berteriana* (Fée) Imshaug has apothecia initially with thalline margins that gradually become black (*cocoës*-type, fide Kalb 1987). On the other hand, apothecial margins such as those present in *P. astridiana* Kalb never become carbonized (*physciaeformis*-type, fide Kalb 1987).

The internal part of the stipe of the apothecia in *Pyxine* is also taxonomically useful, since it can vary in color and chemistry (Imshaug 1957, Swinscow & Krog 1975, Awasthi 1980, Rogers 1986, Kalb 1987).

Also maculae and pruina are typical features of some species (Imshaug 1957, Swinscow & Krog 1975, Awasthi 1980, Rogers 1986, Kalb 1987). Maculae could be absent or have typical forms in different degrees of development and be restricted to specific areas of the thallus. Some examples are *P. coccifera* (Fée) Nylander, with red, mostly marginal maculae, or *P. fallax* (Zahlbruckner) Kalb, with subreticulate white maculae throughout the upper surface. Subapical pruina in small amounts could be found generally in all the species and may be dependent of habitat conditions, but in some species, as *P. cocoës* (Swartz) Nylander, the pruina usually forms white dense laminal plaques.

It is frequent in *Pyxine* species with the upper part of the medulla pigmented from a very pale yellow to a sulphur yellow, dark orange, or ochre color (Kalb 1987). Some species have an upper medulla with constant color, but *P. daedalea* Krog & R. Santesson has a cream upper medulla in distal parts of the thallus that is generally pale salmon in the central ones. Generally, a white and thin layer of medulla is present below the pigmented one (Kalb 1987, 2002). This layer does not react with the usual color tests (spot tests) used in Lichenology.

The range of medullar color denotes the complex chemistry of the genus. The array of triterpenes obtained through thin layer chromatographic is also very useful (Swinscow & Krog 1975).

About half of the species of *Pyxine* has lichexanthone in upper cortex, rendering the thallus bright yellow under UV light (Swinscow & Krog 1975, Kashiwadani 1977a, Awasthi 1980, Rogers 1986, Kalb 1987).

The genus *Dirinaria* Clements is morphologically similar to *Pyxine*, and also has dark hypothecium and, of course, *Dirinaria*-type ascospores, but the epithecium is K− instead of K+ purple as in *Pyxine*, and the margins of apothecia never become carbonized. Additionally, lichexanthone does not occur in *Dirinaria* and the medulla is generally white, exceptionally of some different color in some delimited regions, but never forming distinct layers. Moreover, the absent of rhizines in *Dirinaria* is a practical feature to distinguish it from *Pyxine*.

Isidia, polysidiangia and soredia are the vegetative propagules found in *Pyxine*. Polysidiangia is the name that Kalb (1987) gave to the projections of the upper cortex from which additional verruciform structures (polysidia) are produced. These polysidia break, exposing the medulla. In the sequence, the remaining scars of the broken tissue regenerate and grow again, giving a shapeless to coralloid appearance to the resulting structure. *Pyxine coralligera* Malme is an example. Sometimes, these structures disintegrate into soredia (Kalb 1987).

The development of this structure is not yet understood in all the species where these shapeless masses occur. It is possible that this name has been applied to somewhat similar structures that grow through different processes of ontogeny. In the literature, they received the following denominations: "pustulate isidia with soredia-like granules" (Swinscow & Krog 1975), pustules (Kashiwadani 1977c), "crateriform isidia that produce granular soredia" (Awasthi 1980), schizidia (Brodo et al. 2001) or dactyls (Elix 2009).

In a different way, isidia are solid, cylindrical, base-constricted structures that do not burst nor release granules, while pustules usually do not branch and are always hollow, frequently bursting at the apices to produce soredia, granules or fragments. True isidia are present in the Asiatic *P. cilindrica* Kashiwadani (Kashiwadani 1977c), while pustules in the sense used here are not usually found in *Pyxine*.

Soralia vary in color, form and localization and constitute a good character to distinguish species (Swinscow & Krog 1975, Kalb 1987). Soralia can be laminal or marginal, orbicular, maculiform or ellipsoid. For example, *Pyxine daedalea* Kalb has orbicular to semi-spherical laminal soralia, while *P. subcinerea* Stirton has marginal, orbicular, becoming crescent-shaped soralia.

The first mention of a *Pyxine* species to Brazil appeared in “Flora Brasiliensis” (Eschweileri 1833) as *Lecidea sorediata* Acharius, with *Circinaria berteroana* Fée as

synonym. However, the first detailed study of Brazilian taxa is found in the classic Vainio's (1890) "Étude", where he provided meticulous descriptions of *P. eschweileri* (Tuckerman) Vainio, *P. meissneri* Tuckerman [= *P. berteriana* (Fée) Imshaug], *P. meissneri* ssp. *connectens* Vainio [= *P. cocoës* (Swartz) Nylander], *P. minuta* Vainio [= *P. pyxinoides* (Müller Argoviensis) Kalb] and *P. retirugella* Nylander.

Later, Malme (1897) published the first monograph of this genus to Central and South regions of Brazil, describing *P. coralligera*, *P. obscurascens*, the varieties *P. meissneri* var. *convexula* [≡ *P. petricola* var. *convexula* (Malme) Kalb], *P. meissneri* var. *genuina* (= *P. petricola* Nylander), *P. meissneri* var. *physciaeformis* [≡ *P. physciaeformis* (Malme) Imshaug] and *P. meissneri* var. *subobscurascens* (= *P. pungens* Zahlbruckner). Besides these taxa, Malme added *P. coccifera* (Fée) Nylander to the list of *Pyxine* known to Brazil.

Almost a century later, Kalb (1987) monographed the genus to Brazil. In his work, 24 species and two varieties were described and discussed, of which seven taxa were new to Science.

The present work is a study of the types of the Brazilian *Pyxine* that produce vegetative propagules and their synonyms.

MATERIALS AND METHODS

The specimens studied are mainly from São Paulo State, Southeastern Brazil. Type specimens were kindly lent by the curators of BM, G, GLAM, H, PC, S, SP, TUR and W or were studied in Herbarium Kalb and UPS, or photos were sent by FH from the types asked.

The nomenclature of the apothecia adopted follows Kalb (1987). Anatomical studies of the apothecia were made by examinations of sections by hand with razor blade, in water under light microscope. After get the ascospores measured, a saturated potassium hydroxide solution was added and the resulting color reactions from the epithecium and internal stipe of the apothecia were annotated. These studies were made preferentially in additional specimens or in those types that have sufficient material.

The chemistry of the thalli was determined through traditional color reactions and thin layer chromatography (TLC) in solvent A and C, following Bungartz (2001). These studies were avoided when the types consist of very poor material.

The descriptions presented refer to the type indicated or, when no type was available, to all studied specimens of the taxa. When significant differences between the types and additional specimens are found, they were discussed in "remarks".

RESULTS AND DISCUSSION

Key to the Brazilian *Pyxine* with vegetative propagules

1 Upper cortex K−, UV+ yellow, lichexanthone present 2
- Upper cortex K+ yellow, UV−, atranorine present 10

2 Medulla entirely white, K−, P− 3
- Medulla usually pigmented above, K+, P+ 6

3 Soralia laminal, orbicular to ellipsoid; maculae absent; pruina sparse ..... *P. katendei*
- Soralia marginal and laminal, orbicular to linear irregular; maculae sparse to abundant; pruina forming patches 4

4 Laciniae very confluent; maculae evident and abundant ..... *P. oceanica*
- Laciniae not confluent; maculae pale and sparse 5

5 Internal stipe red to wine, K+ purple ..... *P. cocoës*
- Internal stipe white, K− ..... *P. cocoës* var. *pallida*

6 Polysidiangia present, maculae absent 7
- Polysidiangia absent, maculae present 8

7 Apothecia *obscurascens*-type; apices of the laciniae flat or slightly convex ..... *P. caesiopruinosa*
- Apothecia *physciaeformis*-type; apices of the laciniae mainly concave ..... *P. physciaeformis*

8 Soralia crescent-shaped to labriform, becoming concave; medulla K+ orange ..... *P. subcinerea*
- Soralia orbicular or on polysidiangia; medulla K+ purple 9

9 Laciniae concave; norstictic acid present ..... *P. jolyana*
- Laciniae convex; norstictic acid absent ..... *P. albovirens*

10 Maculae and soralia red ..... *P. coccifera*
- Maculae and soralia white, yellowish or grayish 11

11 Medulla white throughout ..... *P. fallax*
- Medulla pigmented above 12

12 Soralia present, polysidiangia absent ..... *P. daedalea*
- Soralia absent, polysidiangia present 13

13 Polysidiangia marginal 14
- Polysidiangia laminal 15

14 Ascospores 1-septate ..... *P. heterospora*
- Ascospores 2-septate ..... *P. eschweileri*

15 Medulla K+ purple-black, P+ purple-black ..... *P. obscurascens*
- Medulla K−, K+ pale yellow or yellow to red, P+ orange 16

16 Laciniae convex to plane; medulla K− or K+ pale yellow (norstictic acid absent) .....
..... *P. coralligera*
- Laciniae plane to strongly concave; medulla K+ yellow to red (norstictic acid present)
..... *P. retirugella*

THE SPECIES

***Pyxine albovirens* (G. Meyer) Aptroot**, *Flora of the Guianas*. Ser. E, fasc. **1**: 42. 1987. **(Fig. 1)**

Lecidea albovirens G. Meyer, *Prim. Fl. Esseq.*: 295. 1818. TYPE: Guyana, Essequibo, in cortice arborum, leg. *G. Meyer* (holotype: GOET) fide Aptroot (1987).

THALLUS orbicular, corticolous or saxicolous, brown grey, laciniate, 3.5–6.0 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous, rarely with cracks, smooth to slightly rugose, dull, convex to slightly convex. DISTAL UPPER SURFACE continuous, mainly smooth, slightly shiny, convex to plane, sometimes with concavities, without a darker zone near the tips. LACINIAE sublinear, irregularly to branched, continuous to overlapping laterally, (0.5–) 1.0–1.5 mm wide; apices rounded to subrounded, concave and ascendant, sometimes flat then adnate; lateral margin smooth or with irregularities; axils acute. PRUINA absent or rare, farinaceous, sparse, subapical. MACULAE pale, rarely distinct, sparse or absent in proximal parts, sparse to abundant in distal parts, irregularly linear to subreticulate, laminal.

POLYSIDIANGIA absent. SORALIA yellowish white to yellowish pale grey, orbicular to subspherical, submarginal to laminal; soredia farinaceous to granular. MEDULLA cream to pale yellow to salmon above, sometimes orange, or white in old parts, lower layer thin and white. DISTAL LOWER SURFACE pale brown, sometimes with a yellow tinge, to black, slightly shiny, papillate. PROXIMAL LOWER SURFACE black, shiny, smooth to papillate. RHIZINES black, simple to irregularly branched, frequent, evenly distributed, up to 0.7 mm long. APOTHECIA *obscurascens*-type, frequent in *Marcelli* 4172 and *Marcelli* 4178, absent in the others, plane, sessile, laminal, up to 1.3 mm diam.; margin smooth; disc black, dull, epruinose. INTERNAL STIPE white, above yellow to reddish. EPITHECIUM 5–10 µm high; hymenium 60–70 µm high; subhymenium 90–100 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 11–15 × 5–6 µm. PYCNIDIA not found.

COLOR TESTS: upper cortex K–, UV+ yellow; upper medulla K+ violet, C–, KC+ reddish to violet, P–, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K+ yellowish. **Secondary metabolites**: lichexanthone, triterpenes.

REMARKS. *Pyxine albovirens* is characterized by the lichexanthone in upper cortex, its laminal orbicular soralia becoming submarginal, the cream to pale yellow to salmon upper medulla K+ violet, P–, and the *obscurascens*-type apothecia.

Aptroot (1987) considered *P. caesiopruinosa* (Tuckerman) Imshaug a synonym of *P. albovirens*. However, Harris (1990) noted two different taxa during his studies with Florida lichens, which he could clearly separate by the vegetative propagules and the terpene array, commenting that one of these taxa resembled the illustration of *P. albovirens* in Aptroot (1987). Later, Harris (1995) was able to see the holotype of *P. caesiopruinosa* and separated [in his key] the specimens with marginal dactyls (the *P. caesiopruinosa* sensu stricto) from those with laminal soralia (*P. caesiopruinosa* sensu lato), such the one illustrate by Aptroot (1987), and pointed the necessity of determine the correct application of the name *P. albovirens*.

Amtoft (2002) clarified the differences between these two species. She had access to the holotype of *P. albovirens* from GOET and discovered it to be sorediate: "*P. caesiopruinosa* can be separated from *P. albovirens* by its marginal dactyls (schizidia sensu Brodo et al. 2001, isidangia sensu Kalb 1987) and coarse soredia. *Pyxine albovirens* has round laminal to sometimes marginal soralia and smaller, more numerous soredia".

The specimens from São Paulo State of these two species fits well these observations, and the holotype of *P. caesiopruinosa* (H-NYL 31760!) could be restudied (see ahead): it has

granular to flocculate soredia that forms isidia-like structures and polysidiangia that separate it easily from the exclusively sorediate *P. albovirens*.

Kalb (2004) commented after Aptroot (1987), Harris (1995) and Amtoft (2002) that the specimen reported from Australia as *P. albovirens* in Kalb (1994) represents *P. physciaeformis* (Malme) Imshaug. He was referring to *P. caesiopruinosa*, not *P. physciaeformis*, as none of these authors mentioned this species (pers. comm. 2009).

Kalb (1987) observed crystals of lichexanthone on the upper cortex of *P. caesiopruinosa* while studying South American material. Such crystals were observed here for the first time in *P. albovirens*.

Two fertile specimens of *P. albovirens* were found in São Paulo State, with ascospores 11–15 μm long. These specimens have no pruina in the discs of the apothecia. Nevertheless, it is easy to see pruina in fertile specimens at least in young apothecia of *P. caesiopruinosa*.

Pyxine subcinerea Stirton differs from *P. albovirens* by the crescent-shape marginal soralia and the medulla with negative color tests. *Pyxine jolyana* Jungbluth, Kalb & Marcelli differs by the slightly concave laciniae, the farinaceous to granular soredia and the presence of norstictic acid in medulla, detected only by TLC.

This is the first time this species is being cited to São Paulo State.

SPECIMENS EXAMINED. BRAZIL, SÃO PAULO STATE, Itanhaém Municipality, Bairro Cibratel, granitic rocks between Praia dos Sonhos and Praia de Itanhaém, 24°11′S, 46°47′W, ca. 20-30 m alt., saxicolous, 10-I-1989, leg. *M. P. Marcelli* 4172, 4178 (SP); idem, Peruibe Municipality, mangrove in margins of the Guaraú River, next to the mouth, 24°22′S, 47°01′W, 1 m. alt., corticolous, 24-07-1988, leg. *M. P. Marcelli* 3946, 3970 (SP); idem, Reserva Ecológica Juréia-Itatins, Núcleo Guarauzinho, 24°19′S, 47°59′W, Arpoador Beach, 1 m. alt., saxicolous, 27-07-1993, leg. *M. P. Marcelli* 23711 (SP).

DISTRIBUTION. The distribution of this species and of *P. caesiopruinosa* is confuse, as the differences between the two were for long misunderstood. Nevertheless, the literature that cited the name of this species is presented for reference: North America (Brodo et al. 2001, as *P. caesiopruinosa* fide Amtoft 2002, Hansen et al. 2008) and South America, where it was recorded to Brazil (Aptroot 2002, Kalb 2004), French Guiana (Aptroot 1987), Guyana (Meyer 1818, Aptroot 1987), and Surinam (Aptroot 1987). In Brazil it was cited to the States of Minas Gerais (Aptroot 2002), Rio Grande do Sul (Fleig 1990, 1995), Rio de Janeiro and Santa Catarina (Kalb 2004). Excluded: Australia, fide Kalb (2004).

***Pyxine caesiopruinosa* (Nylander) Imshaug**, *Trans. Am. micros. Soc*. 76(3): 262. 1957. **(Fig. 2)**

Pyxine cocoës var. *caesiopruinosa* Nylander, *Syn. Meth. Lich*. 2: 2. 1869. TYPE: in Carolina & Georgia, leg. *Ravenel* (holotype: H-NYL 31760!). – *Pyxine sorediata* f. *caesiopruinosa* (Nylander) Hue, *Nouv. Arch. du Mus*. 4(2): 86. 1900.

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, saxicolous, brownish grey, laciniate, 3–4 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous, rarely with cracks, smooth, dull, convex to plane. DISTAL UPPER SURFACE almost absent, continuous, smooth, rarely with cracks, dull, plane to slightly convex. LACINIAE sublinear, irregularly to dichotomously branched, contiguous, 0.7–1.0 mm wide; apices rounded (very few left), flat to slightly convex, adnate; lateral margin smooth to sinuous and irregular; axils acute. PRUINA absent. MACULAE absent. POLYSIDIANGIA present. SORALIA white and yellowish mixed, with flocculate soredia that form structures simple to branched becoming coralloid, erect, marginal to submarginal (the polysidiangia); soredia granular to isidia-like. MEDULLA stramineous to yellowish to yellow above, sometimes pale orange, lower part thin and white. LOWER SURFACE black, shiny, smooth to papillate and irregular. RHIZINES black, simple to irregularly branched, sometimes palmed at the tips, frequent to abundant, evenly distributed, up to 3.0 mm long. APOTHECIA *obscurascens*-type, frequent, plane to slightly concave, sessile, laminal, up to 1.0 mm diam.; margin smooth to undulate; disc black to gray, dull, with grayish pruina, dense to scarce. INTERNAL STIPE developed, yellow to orange. EPITHECIUM 10 µm high; hymenium 40–50 µm high; subhymenium 100–120 µm high. ASCOSPORES not found [12–18 × 6–7 µm (Nylander1869), 14–19 × 6–7 µm in additional material examined]. PYCNIDIA few, subapical. CONIDIA not found [sublageniform, 3–4 × ca. 1 µm in M.P. Marcelli 18192].

COLOR REACTIONS: upper cortex K–, UV+ yellow; upper medulla K+ purple, C–, KC–, P–, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K+ rose. **Secondary metabolites**: lichexanthone, triterpenes.

REMARKS. *Pyxine caesiopruinosa* is characterized by the lichexanthone in upper cortex, marginal to submarginal sorediate polysidiangia, pale yellow to yellow to orange upper medulla K+ violet, P– and the *obscurascens*-type apothecia.

There is uncertainty if the type-material H-NYL 31760 is a holotype or could be a lectotype. In the protologue, Nylander (1869) wrote: “in Carolina et Georgia, Americae

Borealis lecta a Ravenel". Are there two specimens, one from Carolina and another from Georgia?

Imshaug (1957) probably had the same doubt or did not have the chance to study this material, as he did not mention the type of type. He just wrote "Type: North America". Culberson & Hale (1965) were the first to mention that the material in H-NYL 31760 was the holotype. Indeed, this material has the handwriting from Tuckerman, who gave it the herbarium name *P. sorediata* var. *caesiopruinosa* Tuckerman He indicated that the material was collected by Ravenel "in Carolina et Georgia", as the protologue by Nylander.

Kalb (1987) cited an isotype at UPS (L 016959 – 47276!), but there is no evidence that it has the same origin as the H-NYL specimen. It is indicated in a label, probably with the handwriting from Tuckerman, that the collector was Ravenel at South Carolina and that it is a *Parmelia sorediata* Tuckerman In fact, the material at UPS does not have polysidiangia, but orbicular soralia that resemble the soralia of *P. albovirens* (G. Meyer) Aptroot and *P. jolyana* Jungbluth et al., as well as a different type of apothecia: the specimen in H-NYL has *obscurascens*-type, the UPS material has *cocoës*-type. As there is no way to prove that this material was part of the holotype or even was collected at the same place, it is rejected as reference to the name of this species.

Aptroot (1987) cited another different isotype deposited in PC. This material was not localized, but as some collections from Ravenel are deposited at this herbarium (Stafleu & Cowan 1976); so, this isotype probably exists.

Elix (2009) synonymised *P. caesiopruinosa* with *P. physciaeformis*, a species with polysidiangia (see remarks of this species). However, there is no doubt that these two species are distinct. *Pyxine physciaeformis* rarely liberate fragments of thallus, has apothecia *physciaeformis*-type and upper medulla K+ faint reddish orange, while *P. caesiopruinosa* has apothecia *obscurascens*-type and upper medulla K+ purple. The description presented is a mixture of these two taxa, as clearly perceptible in the description of the polysidiangia and the K medullar color test.

Other morphologically similar species are *P. subcinerea* Stirton and *P. jolyana* (SP!). Both differ from *P. caesiopruinosa* by the absence of polysidiangia. Moreover, *P. subcinerea* (BM!) has crescent-shape marginal soralia and medulla with negative color tests, while *P. jolyana* has concave laciniae and medulla with norstictic acid.

In the material from São Paulo State, two specimens were found fertile: Marcelli 18192 and 30262 have apothecia frequent, plane to slightly concave, sessile, laminal, up to 2.0 mm diam., with smooth to slightly undulate margins, black disc with grey scarce to dense pruina.

The internal stipe is sulphur yellow to reddish, K+ violet. Epithecium is 5–10 µm high, hymenium 60–100 µm, subhymenium 40–100 µm. The ascospores are ellipsoid, 14–19 × 6–8 µm. Conidia was found in Marcelli 18192 and are sublageniform, 3–4 µm long.

Kalb described the apothecia of *P. caesiopruinosa* as *cocoës*-type. Nevertheless, the holotype and the additional specimen examined have apothecia *obscurascens*-type.

The specimen Marcelli 33298 has notable abundant and confluent polysidiangia. This is the first time that this species was cited to Minas Gerais State.

DISTRIBUTION. The distribution of this species and of *P. albovirens* is confuse, as the differences between the two were for long misunderstood. Nevertheless, the literature that cited the name of this species is presented: Australia (Kalb 1994 as *P. albovirens*, Kalb 2004 as *P. physciaeformis*), North America (Moore 1968, Amtoft 2002, Hansen et al. 2008), South America. In South America and Central America it was cited to Brazil, Costa Rica, Dominican Republic, Gulf of Mexico and Venezuela (Kalb 1987). In Brazil, it was cited to the States of Rio de Janeiro (Kalb 1987), Rio Grande do Sul (Osorio *et al*. 1997), Santa Catarina (Kalb 1987) and São Paulo (Kalb 1987).

SPECIMENS EXAMINED. BRAZIL, SÃO PAULO STATE, Campos do Jordão Municipality, Parque Estadual de Campos do Jordão, highway to Itajubá, 4 km from the Horto Florestal, Araucaria and *Podocarpus* Forest next to the highway, near to the Sapucaí-Mirim River, 22°44′22″S, 45°35′29″W, 1400 m alt., corticolous,13-01-1996, leg. *M.P. Marcelli* 30262 (SP); MINAS GERAIS STATE, Catas Altas Municipality, Serra do Caraça, Parque Natural do Caraça, , 20º 5′ 51.57″ S 43º 29′ 17.49″ W, 1350 m alt., garden in front of the hotel, saxicolous, 22-04-1999, leg. *M.P. Marcelli* 33298 (SP).

***Pyxine coccifera* (Fée) Nylander**, *Mém. Soc. imp. Sci. nat. Cherbourgh* 5: 108. 1857.

Parmelia coccifera Fée, *Ess. Cryptog. Ecorc. Exot. Offic.*: 126. 1824. TYPE: supra epidermidem Alconocae (holotype: G).

= *Parmelia coccinea* Sprengel, *Syst. Veg.* 4(1): 302. 1827. Type: ad truncos ficuum Hispaniolae. – *Parmelia coccinea* Schaerer in Moritzi, *Syst. Verz.*: 128. 1846. TYPE: Java, in trunco Coci nuciferae prope Tijirita prope Bantam, 13-X-1843, leg. *Zollinger* 1318 (holotype: G). – *Pyxine coccinea* (Schaerer) Montagne et v.d. Bosch in Junghuhn, *Plantae Junghuhnianae* 4: 466. 1855. – *Parmelia coccinea* Schaerer in Zollinger, *Syst. Verz.*: 6. 1854.

= *Parmelia coccinea* Lynge, *Arkiv f. Bot.* 15(1): 3. 1917. TYPE: Brazil, Mato Grosso, Santa Ana da Chapada, corticola, 14 et 16-X-1902, leg. *G. A. Malme* (holotype: ?).

ILLUSTRATIONS: Awasthi (1980), Rogers (1986) and Kalb (1987).

THALLUS orbicular, mainly corticolous, brownish grey, laciniate, 1.5–8.5 cm diam., adnate. PROXIMAL UPPER SURFACE continuous to cracked, smooth, shiny, plane to concave. DISTAL UPPER SURFACE continuous, smooth, shiny, plane to concave, with a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous, rarely laterally overlapping, 0.4–1.0 (–1.5) mm wide; apices rounded to subrounded, flat, sometimes slightly concave, then ascendant; lateral margin smooth to irregular, sometimes crenulate; axils forming acute angle. PRUINA absent or rarely present, then farinaceous, disperse, subapical. MACULAE distinct, red, abundant, irregular to irregularly linear, marginal, sometimes parting from the margin and going in direction of the centre, originate cracks that expose the red medulla and become sorediate. POLYSIDIANGIA absent. SORALIA red to reddish grey to grey, orbicular to linear or irregularly linear to irregular, mainly marginal to submarginal, in the cracks formed by the maculae; soredia granular, red and grey. MEDULLA pale yellow to yellow above, lower layer white, some parts under the maculae with red pigment (chiodectonic acid or pyxiferine) K+ purple. DISTAL LOWER SURFACE white to pale brown to pale grey, shiny, smooth, sometimes papillate. PROXIMAL LOWER SURFACE black, shiny, smooth, rarely with irregularities. RHIZINES concolored with the lower cortex or darker, sometimes paler near the apices, simple to irregularly branched, abundant, evenly distributed, to 0.5 mm long. APOTHECIA *obscurascens*-type, rare, plane to slightly concave, sessile, laminal, up to 0.7 mm diam.; margin smooth; disc black, dull, epruinose. INTERNAL STIPE developed, cream above, white below. ASCOSPORES not found [14–18 × 6–8 μm, fide Kalb 1987]. PYCNIDIA absent.

COLOR REACTIONS: upper cortex K+ yellow, UV–; yellow medulla K–, C–, KC–, P–, UV–; white medulla K–, C–, KC–, P–, UV–; red pigment K+ purple (it seems this pigment dissolve with K), C–, KC+ purple-black, P–, UV–, internal stipe K–. **Secondary metabolites**: atranorine, triterpenes, pyxiferine (chiodectonic acid).

REMARKS. *P. coccifera* is characterized by the reddish maculae that could crack, exposing the red medulla in the fissures and sometimes producing red soredia. The medulla is yellow above and white below, except under the maculae and soralia, where the red pigment is present. There is no other known species with red pigment.

The soredia are generally granular, but Rogers (1986) related a variance from farinaceous soredia to isidia-like to irregular coralloid isidia and even to lacinulae. This variation was not reported to others regions of the world.

Kalb (1987) detected norstictic acid in the subhymenium of the apothecia. Unfortunately, there were no apothecia to chemistry analyses. By the way, the apothecia appear to be rare in this species, as related by Malme (1897), Awasthi (1980) and Elix (2009), or not seen, as Lynge (1917), Rogers (1986), Sammy (1988) and Swinscow & Krog (1975).

This species is being reported for the first time to the States of Maranhão and Tocantins, North Region of Brazil.

SPECIMENS EXAMINED. BRAZIL, MARANHÃO STATE, Carolina Municipality, Fazenda Santa Rita, Cerrado Forest, 07°22'16,4''S 47°12'0,5''W, 240 m alt., in the shadow, corticolous, 08-VI-2007, leg. *A.A. Spielmann & I.P.R. Cunha* 5374 (SP); TOCANTINS STATE, Itaguatins Municipality, Fazenda São Paulo, next to Domingos River, 05°45'15,9''S 47°33'23,5''W, 160 m alt., on fern, in the shadow, corticolous, 07-VI-2007, leg. *A.A. Spielmann & I.P.R. Cunha* 5299, 5300, 5302, 5303, 5305, 5306, 5307, 5317 (SP).

DISTRIBUTION. Africa (Swinscow & Krog 1975, Kalb 1987), Australia (Rogers 1986, Sammy 1988, Elix 2009), India (Awasthi 1980), Thailand (Wolseley et al. 2002) and South America, cited to Brazil and Paraguay (Malme 1897). In Brazil, it was cited to the State of Mato Grosso (Malme 1897, Lynge 1917, Kalb 1987) and Mato Grosso do Sul (Kalb 1987, Fleig & Riquelme 1991).

***Pyxine cocoës* (Swartz) Nylander**, *Mem. Soc. imp. Sci. nat. Cherbourgh* **5**: 108. 1857.

Lichen cocoës Swartz, *Nov. Gen. Sp. Pl.*: 146. 1788. TYPE: Jamaica, supra caudices vetustas *Cocoes nucifera*, leg. *Swartz* (lectotype: S!; duplicate from the lectotype H-ACH 379!).

= *Lecidea acaciae* Sprengel, *Kongl. Vetensk. Akad. Handl.*: 46. 1820. TYPE: Malabar, in cortice *Acaciae odoratissimae* (lectotype: L), fide Kalb (1987).

= *Lecidea arecae* Sprengel, *Kongl. Vetensk. Akad. Handl.*: 47. 1820. TYPE: Guadalupe, in cortice *Arecae oleraceae* (holotype: L), fide Kalb (1987).

= *Circinaria dissecta* Fée, *Ess. Cryptog. Ecorc. Exot Offic.*: 127. 1824. TYPE: Guadalupe, on Areca oleracea (holotype G, photo!). – *Pyxine dissecta* (Fée) Vainio, *Phillip. Jorn. Sci.* 8: 108. 1913, fide Kalb (1987).

= *Pyxine cocoës* var. *congensis* Stein. *Jber. schles. Ges. vaterl. Kult.*: 140. 1888, fide Müller Argoviensis (1890).

= *Pyxine cocoës* (Swartz) Nylander f. *sorediigera* Müller Argoviensis, *Engl. Bot. Jahrb*. 20: 262. 1894. Type: D.O. Africa, Usambara, leg. *Holst* 1423; Lich. Usambar. 103 (lectotype: G!).

= *Pyxine meissneri* ssp. *connectens* Vainio, *Acta Soc. Fauna et Flora fenn*. **7**(1): 154. 1890. TYPE: Rio de Janeiro, leg. *E. Vainio*: Lich. Bras. Ex. 62 (**lectotype selected here**: TUR-V!; duplicates from the lectotype: two materials in BM!, M!, PC!, UPS). – *Pyxine connectens* (Vainio) Vainio, *Ann. Acad. Sci. Fenn. Ser.* A 6(7): 70. 1915. **(Fig. 3)**

= *Pyxine promicula* Stirton, *Trans. New Zealand Inst*. 30: 397. 1897. TYPE: corticola prope Chinsurah Indiae leg. *P. Watt* (lectotype: GLAM!; duplicate of the lectotype: BM!). – *Pyxine cocoës* var. *promicula* (Stirton) Awasthi. *In* Awasthi & Upreti, *Indian J. Bot.* 3(2): 183. 1980 (n.v.), fide Kalb (1987).

ILLUSTRATIONS: Awasthi (1980), Rogers (1986), Kalb (1987), Sammy (1988) and Brodo et al. (2001).

DESCRIPTION OF THE LECTOTYPE

THALLUS irregular, corticolous, brownish white, laciniate, 2.5–3.0 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous, sometimes with cracks, smooth, dull, plane to concave. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane, sometimes with concavities, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous, 0.5–0.7 (−1.0) mm wide; apices rounded, flat and adnate, sometimes concave, then slightly ascendant; lateral margin smooth to irregular, rarely sublacinulate; axils acute. PRUINA forming small to large patches on the lamina of the distal parts of the laciniae. MACULAE pale, sparse, irregular to irregularly linear, mostly marginal expanding to the lamina, originate openings and cracks. POLYSIDIANGIA absent. SORALIA orbicular to irregular to irregularly linear, mostly laminal, sometimes originate from the cracks of the upper cortex; soredia farinaceous to granular. MEDULLA white. LOWER SURFACE black, slightly shiny, smooth to papillate (just a little region seen). RHIZINES (just few seen) black, simple, frequent, evenly distributed, up to 0.3 mm long. APOTHECIA *cocoës* to *obscurascens*-type, frequent, plane to concave, sometimes convex (irregular?!), sessile, laminal, up to 1.3 mm diam.; margin smooth to undulate, not visible in the convex apothecia; disc black, slightly shiny, epruinose. INTERNAL STIPE developed, red to wine. EPITHECIUM 5 µm high; hymenium 80–

100 µm high; subhymenium 80–120 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 14–19 × 7–9 µm. PYCNIDIA absent.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K+ purple. **Secondary metabolites**: lichexanthone, triterpenes in low concentrations, hardly to see in TLC with solvents A and C.

REMARKS. *Pyxine cocoës* is characterized by the lichexanthone on the upper cortex, the white medulla with negative color tests and the orbicular to irregularly linear soralia. The internal stipe is reddish and the pruina forms patches on the centre of the distal parts of the laciniae.

Here, the specific epithet is written as the protologue. The Botanical Code (McNeill et al. 2007, article 60.6) allows the use of diaeresis indicating that a vowel is to be pronounced separately from the preceding vowel.

The lectotype consists of three fragments of lichens on bark. Two of these are glued to a piece of paper with the handwriting of Swartz. This piece of paper is glued to a bigger one, where the barks of the other fragments are glued. The specimens appear to come of different trees: coconut and another undetermined. The duplicate of the lectotype is a small piece of thallus grown on coconut tree.

Pyxine cocoës f. *sorediigera* was cited by Kalb (1987) and Sammy (1988) as having as holotype the specimen Holst 1423. Nevertheless, Müller Argoviensis (1894) also cited Holst 1368 pr. p. from Zanzibar, Dar-es-Salem, in the protologue. These materials had been glued together, but Holst 1368 pr. p. was cut off and now it is in another herbarium label (pers. comm., Philippe Clerk 2009, G curator). Therefore, the specimen Holst 1423 is a lectotype, not a holotype.

Müller Argoviensis (1890) cited *P. cocoës* var. *congensis* Stein. as synonym of *P. cocoës*, as noted by Swinscow & Krog (1975). Unfortunately, no material was localized.

Pyxine meissneri ssp. *connectens* Vainio is another taxon in the synonym of *P. cocoës*. Kalb (1987) wrote that Aptroot, by personal communication, would choose the lectotype. Nevertheless, the lectotypification was never made; here, the specimen from TUR is chosen (Fig. 3).

Pyxine promicula Stirton is also a synonym of *P. cocoës*. Rogers (1986) and Kalb (1987) cited the specimen deposited in BM as its holotype. However, Awasthi (1980) had already pointed another specimen deposited at GLAM as holotype (the correct designation would be lectotype) and the BM specimen as isotype (indeed, a duplicate of the lectotype). Following

the Vienna Code, Awasthi decision has priority. The two materials are in good condition, but as the GLAM specimen is larger than the BM specimen, the choice made by Awasthi (1980) was evidently reasonable. The lectotype consists of a colony or a large specimen on cortex. There is another *Pyxine* species growing together, but this one has an ash grey upper surface and yellow upper medulla. Awasthi (1980) considered *P. promicula* as a variety of *P. cocoës*, differing in the wider laciniae and the absence of maculae. Nevertheless, the lectotype of *P. promicula* has laciniae with the same width as the holotype of. *P. cocoës* and is maculate too.

Pyxine oceanica Zahlbruckner, cited by Kalb (1987) and Sammy (1988) as synonym of *P. cocoës,* is considered a separate species here (see description and considerations ahead).

Pyxine cocoës var. *pallida* Kalb differs from *P. cocoës* by the white K– internal stipe. Another species with white medulla and negative color reactions is *P. katendei* Swinscow & Krog, which differs by having orbicular becoming ellipsoid laminal soralia, being not maculate and the pruina does not form large patches.

DISTRIBUTION. This is a pantropical species. It was cited to Africa (Aptroot 1988, Swinscow & Krog 1975, 1988, Kalb 1987), Australia (Rogers 1986, Sammy 1988, Kalb 1994, in the preliminary key, Elix 2009), Central America (Kalb 1987, Barclay-Estrup 1992), China (Aptroot & Sipman 2001, Gu & Chen 2003), India (Awasthi 1980, Kalb 1987), Japan (Kashiwadani 1977a), North America (Imshaug 1957, Moore 1968, Brodo et al. 2001, Kalb 2002, DeBolt 2007), Papua New Guinea (Kashiwadani 1977c), Philippines (Vainio 1913, Kalb 1987), Sri Lanka (Kalb 1987) and South America (Vainio 1890). In South America, it was cited to Argentina (Scutari 1995, Calvelo & Liberatore 2002), Brazil (Vainio 1890), French Guiana, Guyana (Aptroot 1987), Paraguay (Kalb 1987), Surinam (Aptroot 1987), Uruguay (Osorio 1992) and Venezuela (Vareschi 1973). In Brazil, it was cited to the States of Bahia (Kalb 1987), Minas Gerais (Aptroot 2002), Maranhão and Piauí (Zahlbruckner 1909), Paraná (Zahlbruckner 1909), Rio de Janeiro (Krempelhuber 1876 – as *Pyxine cocoës* (Swartz) Tuckerman–, Müller Argoviensis 1891 and Vainio 1890 – as *Pyxine meissneri* ssp. *connectens* Vainio –, Malme 1897, Zahlbruckner 1902), Rio Grande do Sul (Malme 1897), Santa Catarina (Kalb 1987) and São Paulo (Marcelli 1991 – as *Pyxine meissneri* ssp. *connectens* Vainio –, Kalb 1987).

***Pyxine cocoës* (Swartz) Nylander in Crombie var. *pallida* Kalb**, *Bibl. Lichenol.* **24**: 43. 1987.

TYPE: Brasil, Estado do Mato Grosso, Santo Antonio de Leverger, etwa 40 km südlich von Cuiabá, an freistehenden Bäumen am Rio Cuiabá, 100 m alt., 5-VII-1980, leg. *K. Kalb* 12322 (holotype: Herb. Kalb!).

ILLUSTRATION: Kalb (1987).

THALLUS orbicular, corticolous, white slightly beige, laciniate, 6–7 cm diam., adnate. PROXIMAL UPPER SURFACE continuous, sometimes with cracks, smooth, slightly shiny, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth to slightly nodular, slightly shiny, plane to slightly convex, without a darker zone near the tips. LACINIAE sublinear, irregularly to dichotomously branched, contiguous to overlapping laterally, 0.5–1.0 (−1.5) mm wide; apices rounded, slightly convex, adnate; lateral margin smooth to sinuous; axils acute. PRUINA agglutinate, forming small and large patches on the lamina of the distal parts of the lacinulae. MACULAE pale, rarely distinct, frequent but not abundant, linear to irregular, mainly marginal but sometimes expanding to the lamina. POLYSIDIANGIA absent. SORALIA white, orbicular to irregularly linear, originate from small cracks, starting marginally expanding to the upper surface, laminal and sometimes submarginal; soredia farinaceous, rarely granular. MEDULLA white. LOWER SURFACE black, shiny, smooth to slightly irregular. RHIZINES black, simple, few to frequent, evenly distributed, to 0.3 mm long. APOTHECIA *cocoës*-type, frequent, plane to slightly convex, sessile, laminal, to 1.0 mm diam.; margin smooth, not visible in very convex apothecia; disc black, shiny, epruinose. INTERNAL STIPE developed, brown on highest part. EPITHECIUM 10–15 µm high; hymenium 60–70 µm high; subhymenium 50–60 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 15 × 4.5 (only one found) µm. PYCNIDIA frequent, laminal. CONIDIA not studied.

COLOR REACTIONS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K–. **Secondary metabolites**: lichexanthone, triterpenes in low concentrations.

REMARKS. *Pyxine cocoës* var. *pallida* is characterized by the lichexanthone on the upper cortex, the white medulla with negative color tests, the orbicular to irregularly linear soralia and the apothecia with white internal stipe K−.

Pyxine cocoës (Swartz) Nylander differs by the internal stipe reddish brown K+ wine/purple.

Pyxine katendei Swinscow & Krog differs in the form of the soralia, the absence of maculae and the sparse pruina.

DISTRIBUTION. Known only from the type locality.

***Pyxine coralligera* Malme**, *Bihang Kongl. svenska Vet.-Akad. Handl.* 23, afd. 3(13): 40. 1897. TYPE: Brasiliae civit., Mato Grosso State, Serra da Chapada, prope São Jeronymo, ad rupes apricas, 3 June 1894, Exped. Primae Regnellian, leg. *Malme* 2749 C (lectotype: S!).
= *Pyxine cocoës* f. *isidiophora* Müller Argoviensis, *Flora* 65: 319. 1882. TYPE: Cuba, leg. *Wright*, Lichenes Cubae Nr. 97 [lectotype: FH pr. p., photo!, with the lectotype of *P. eschweileri* (Tuckerman) Vainio; duplicates from the lectotype: M!, PC! pr. p., with *P. cocoës* (Swartz) Nylander, UPS! pr. p., with *P. cocoës* and *P. eschweileri*]. – *Pyxine isidiophora* (Müller Argoviensis) Imshaug, *Trans. Am. micros. Soc.* 76(3): 257. 1957.
= *Pyxine retirugella* f. *isidiigera* Müller Argoviensis, *Engl. Bot. Jahrb.* 20: 262. 1894. TYPE: D.O. Afrika [Tanzania], Usambara, leg. *Holst* 8879, Lich. Usambar. 104 (holotype: G) fide Swinscow & Krog (1975) and Kalb (1987).

ILLUSTRATIONS: Swinscow & Krog (1975), Kashiwadani (1977c) and Kalb (1987).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, saxicolous, grey to brownish grey, laciniate, 6.0 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous with cracks, mainly smooth, dull, convex to plane. DISTAL UPPER SURFACE continuous, sometimes with cracks, scrobiculate (the ridges corresponding to the maculae), slightly shiny, convex to plane, with a darker zone near the tips. LACINIAE sublinear, irregularly to dichotomously branched, contiguous to rarely overlapping, 0.5–1.0 mm wide; apices rounded, flat to slightly convex, adnate, sometimes concave, then slightly ascendant; lateral margin smooth to sinuous or irregular, occasionally lobulate; axils acute. PRUINA absent. MACULAE pale to distinct, abundant, subreticulate to reticulate, mainly laminal, gives a scrobiculate aspect to the upper surface. POLYSIDIANGIA concolored with the upper surface, occasionally paler, starting as laminal warts that produce scarce branched to coralloid erect structures with apices sometimes bursting into granules or fragments. SOREDIA absent. MEDULLA pale yellow and cream, lower part white. LOWER SURFACE black, shiny, smooth to irregular. RHIZINES black, simple to sometimes irregularly branched, frequent, evenly distributed, up to 0.7 mm long. APOTHECIA just one present, *obscurascens*-type, young, plane, sessile, laminal, up to 0.7 mm diam.; margin black; disc

black, shiny, epruinose. Microscopical observations were avoided [ascospores 1-septate, ellipsoid to oblong, (11–) 13–15 (–16) × (5–) 6–7 (–7.5) µm (Malme 1897, protologue)]. PYCNIDIA absent [CONIDIA sublageniform, 4.5 × 0.5 µm (Malme 1897, protologue)].

COLOR TESTS: upper cortex K+ yellow, UV–; upper medulla K– or K+ pale yellow, C– and KC– not tested, P+ orange (herbarium labels: P+ according to Kashiwadani 1977c, and P+ orange according to T.D.V. Swinscow 1974), UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe brownish yellow, K+ greenish in Marcelli 25982. **TAXONOMIC IMPORTANT SUBSTANCES**: atranorine, triterpenes.

REMARKS. *Pyxine coralligera* is characterized by the presence of atranorine in upper cortex, the polysidiangia that occasionally liberate fragments (polysidia) or granular soredia, the pale yellow and cream medulla K– or K+ pale yellow and P+ orange and the *obscurascens*-type apothecia.

Wright's Lichenes Cubae Nr. 97 is a mixture of *P. cocoës* (Swartz) Nylander, *P. coralligera* and *P. eschweileri* (Tuckerman) Vainio *Pyxine cocoës* do not produce polysidiangia nor soredia and could be differentiated by its white medulla throughout and lichexanthone in upper cortex; *P. eschweileri* has plane to concave laciniae (in *P. coralligera*, the laciniae are generally convex to plane) and the medulla is K+ reddish orange, besides the abundant production of soredia.

Imshaug (1957) did not consider *Pyxine isidiophora* (Müller Argoviensis) Imshaug as synonym of *P. coralligera* because the white medulla and the longer "isidia". Nevertheless, the medulla of the duplicates of the lectotype have parts pigmented cream, pale yellow and rose, and the lectotype of *P. coralligera* have some polysidiangia with the same dimensions or longer, not shorter. Swinscow & Krog (1975) also considered it a distinct species because of the white medulla and the absence of maculae. Nevertheless, the duplicates of the lectotype have pale to distinct, sparse to abundant laminal maculae.

The holotype of *P. retirugella* f. *isidiigera* Müller Argoviensis, another synonym, was not examined, but the comments in Swinscow & Krog (1975) about this form agree with the lectotype of *P. coralligera* and the additional material studied here. It seems that habitat conditions could somehow influence in the robustness of the polysidiangia.

The color of the superior medulla is not always homogeneous; it could vary from cream to pale yellow to rose. In the additional material studied, parts of the medulla were orange. TLC revels that the chemistry of the additional material examined is identical with the lectotype of *P. coralligera* and the duplicates of *P. isidiophora* deposited in M and in PC.

Pyxine obscurascens Malme is morphologically similar but differs by the medulla K+ purple and P+ blackish purple that is orange to dark orange throughout.

Pyxine daedalea Swinscow & Krog has the same chemistry array and medulla cream to pale salmon, but this species does not produce polysidiangia. It produces laminal soralia mainly orbicular to semi-spherical.

Pyxine retirugella Nylander differs from *P. coralligera* by producing abundant soredia and the medulla white throughout K+ yellow to red, because of the presence of norstictic acid.

Pyxine coralligera could be found on rocks, bark and even on twigs. It is being reported for the first time to Goiás State.

ADDITIONAL SPECIMENS EXAMINED. BRAZIL, DISTRITO FEDERAL, Brasília Municipality, Reserva Ecológica do IBGE, 15°46′S, 47°55′W, 1150 m alt., old tree near the Disabled Administration building, 27-III-1996, leg. *M.P. Marcelli* 30826 (SP); idem, GOIÁS STATE, Goiânia Municipality, Universidade Federal de Goiás (UFG), Campus II, residual trees from cerradão surrounding the Biociências Department building, 16°40′S, 49°15′W, 650 m alt., corticolous, 12-09-1996, leg. *M.P. Marcelli* 31582 (SP); idem, MINAS GERAIS STATE, [Catas Altas Municipality], Caraça, Alto do Morro do Cruzeiro and Pedra do Cruzeiro, 20°28′S, 43°01′W, 1200 m alt., saxicolous, 06-XII-1993, leg. *M.P. Marcelli* 25982 (SP); idem, SÃO PAULO STATE, Altinópolis Municipality, Fazenda da Gruta, 21°04′08,9″S, 47°26′14,5″W, alt. 650 m, on branch of a tree in the border of a secondary forest, 06-VI-2008, leg. *P. Jungbluth* & *M.J. Kitaura* 2098, 2099 (SP); idem, Mogi-Guaçu Municipality, Reserva Biológica de Mogi-Guaçu, 22°22'S 46°56'W, 590 m alt., inside an orchard enclosure near cerradão and riparian woodland beside Goiabeiras stream, corticolous, 02-IV-1999, *M. P. Marcelli* & *M. Falco* 33131 (SP); idem, Mogi-Mirim Municipality, Estação Experimental do Instituto Florestal, 22°26′S 46°57′W, 630 m alt., cerradão, on branch of tree in the border of a footpath, 14-V-2004, leg. *M.N. Benatti* & *M.P. Marcelli* 1817 (SP).

DISTRIBUTION. Africa (Swinscow & Krog 1975, Kalb 1987), Australia (Elix 2009, McCarthy 2009), Central America (Kalb 1987), China (Gu & Chen 2003), India (Awasthi 1980), North America [Imshaug 1957, as *P. isidiophora* (Müller Argoviensis) Imshaug, Kalb 1987], Papua New Guinea (Kashiwadani 1977c), South America (Malme 1987), Thailand (Wolseley et al. 2002). In South America, it was cited to Brazil (Kalb 1987) and Venezuela (Vareschi 1973). In Brazil, it was cited to the States of Minas Gerais (Krempelhuber 1873 as *Pyxine cocoës* var. *sorediata* Acharius fide Kalb 1987, Aptroot 2002), Mato Grosso (Malme 1897, lectotype, Kalb 1987), between Mato Grosso and Pará States (Brako *et al*. 1985), Mato Grosso do Sul

(Kalb 1987, Fleig & Riquelme 1991), Paraná (Kalb 1987), Rio Grande do Sul (Fleig 1990) and São Paulo (Zahlbruckner 1909, Kalb 1987).

***Pyxine daedalea* Krog & R. Santesson**, *Thunbergia* **2**: 7. 1986. TYPE: Costa Rica, Cartago Prov., 13 km SE of Cartago, 2,5 km SE of Orosi near the bridge over Rio Grande de Orosi, on a large boulder in a field, 9º47`N 83º50`W, ca. 1150m alt., 10-I-1979, leg. *H. Krog* & *R. Santesson* 29074 (holotype: O), fide Kalb (1987).

ILLUSTRATION: Swinscow & Krog (1975), Kashiwadani (1977c) and Kalb (1987).

THALLUS orbicular, corticolous or saxicolous, brownish grey, laciniate, 5–15 cm diam., adnate to loosely adnate. PROXIMAL UPPER SURFACE continuous, rarely with cracks, with small concavities but smooth too, dull, convex. DISTAL UPPER SURFACE continuous, with small concavities but smooth too, slightly shiny, convex to plane or concave near the tips, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to overlapping laterally, 0.5–1.0 (–1.5) mm wide; apices rounded, mainly concave and ascendant, but occasionally flat or convex, and then adnate; lateral margin sinuous to irregular, sometimes crenulated; axils acute. PRUINA absent or very rare, farinaceous, sparse, subapical. MACULAE pale to distinct, abundant, irregularly linear to subreticulate, laminal, sometimes originate cracks. POLYSIDIANGIA absent. SORALIA white, darkened when old, mainly orbicular to semi-spherical, laminal; soredia farinaceous to granular. MEDULLA cream to white in proximal parts to pale salmon in distal parts above, lower layer very thin white. LOWER SURFACE black or sometimes with a paler zone near the tips, slightly shiny to shiny, papillate. RHIZINES black, simple to irregularly branched, frequent to abundant, evenly distributed, up to 1.0 mm long. APOTHECIA few, *obscurascens*-type, slightly concave to very convex when older, sessile, laminal, up to 2.0 mm diam.; margin smooth to undulate, not visible in very convex apothecia; disc black, dull, epruinose. INTERNAL STIPE developed, very pale yellow or not pigmented. EPITHECIUM 10 µm high; hymenium 60–80 µm high; subhymenium 60–90 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 12–15 × 4–6 µm. PYCNIDIA not found.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellowish to dirty yellow, C–, KC–, P+ yellow to orange, UV–; epithecium K+ faint rose; hymenium K–; subhymenium K–; internal stipe K–. **Secondary metabolites**: atranorine, triterpenes.

REMARKS. *Pyxine daedalea* is characterized by atranorine in upper cortex, the laminal orbicular soralia, the upper medulla cream to salmon, rarely pale orange, K+ yellowish to dirty yellow, P+ yellow to orange and the *obscurascens*-type apothecia.

This species has the same terpene array in TLC as *P. coralligera*. It differs from that by the absence of polysidiangia and the relatively more plane laciniae.

Pyxine fallax Kalb differs by its capitate to sub-stipitate soralia and white medulla with norstictic acid. *Pyxine retirugella* Nylander produces norstictic acid as well, but has polysidiangia that burst in granular soredia and the ascospores are longer (17–22 µm, Australian specimens, Elix 2009).

Pyxine eschweileri (Tuckerman) Vainio has marginal and laminal polysidiangia that bursts in granular soredia and laciniae generally more concave.

Pyxine obscurascens Malme differs by the presence of polysidiangia and the medulla orange throughout K+ purple P+ blackish purple.

All the specimens examined had young thalli growing on the proximal parts of the older ones.

SPECIMENS EXAMINED. BRAZIL, DISTRITO FEDERAL, Brasília Municipality, forest in front of the Jardim Botânico de Brasília, in old cerradão, 15°46′S, 47°55′W, 1050 m alt., corticolous, in fallen *Qualea parviflora* in the shadow, 11-IV-1996, leg. *M.P. Marcelli* 31291 (SP); idem, SÃO PAULO STATE, Mogi-Guaçu Municipality, Reserva Biológica de Mogi-Guaçu, 22°15'S 47°10'W, 590 m alt., inside close cerrado (cerrado denso), corticolous, 19-XII-2002, *M. P. Marcelli* 35539 (SP); idem, Serra Negra Municipality, Alto da Serra, next to the television tower, nebular Forest, 22°36′S, 46°42′W, 1210m alt., corticolous, 05-04-1993, leg. *M.P. Marcelli* 22630 (SP).

DISTRIBUTION. Central and South America, cited to Brazil (Kalb 1987) and Costa Rica (Moberg 1986, holotype; Tenorio et al. 2002). In Brazil, it was cited to the States of Minas Gerais (Kalb 1987), Mato Grosso (Kalb 1987), Mato Grosso do Sul (Fleig & Riquelme 1991), between Maranhão and Piauí (Kalb 1987), Paraná (Zahlbruckner 1909 – as *P. cocoës* Nylander– fide Kalb 1987), Rio de Janeiro (Kalb 1987), Rio Grande do Sul (Fleig 1990) and São Paulo (Kalb 1987).

***Pyxine eschweileri* (Tuckerman) Vainio**, *Acta Soc. Fauna et Flora fenn.* 7: 156. 1890.

Pyxine cocoës var. *eschweileri* Tuckerman, *Proc. Amer. Acad. Arts* 12: 167. 1877. TYPE: Cuba, leg. *Wright*, Lichenes Cubae 97 pr. p. (lectotype: FH pr. p., photo!, with the lectotype of *P. cocoës* f. *isidiophora* Müller Argoviensis; duplicates from the lectotype: L, UPS! pr. p., with *P. cocoës* f. *isidiophora* and *P. cocoës* (Swartz) Nyl). **Syntype excluded**: PC! (*P. cocoës* f. *isidiophora* with *P. cocoës*). – *Pyxine sorediata* var. *eschweileri* Tuckerman, *Syn. North Am. Lich.* 1: 80. 1882. – *Phragmopyxine eschweileri* (Tuckerman) Clements, *Gen. Fung.* 175. 1909.

= *Pyxine rosacea* Zahlbruckner, *Denkschr. math. - naturw.* Kl. 83: 197. 1909. TYPE: Brasilien, Prov. São Paulo, in itinere "Fazenda Bella Vista", Santo Grande do Rio Paranapanema, VII-1901, leg. *Wettstein* et *Schiffner* (holotype: W).

= *Pyxine niveomarginata* Bouly de Lesdain, *Rev. Bryol. Lichénol.* 2(7): 60 (1934). Type: Cuba, Olimpo, La Prenda, La Confianza. B. Hioram., ramulicola (neotype, designed by Kalb 1987 as isotype: Herb. Kalb 15046), fide Kalb (1987).

ILLUSTRATION: Kalb (1987).

THALLUS orbicular, corticolous, grey to brownish grey, laciniate, 2–14 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous to cracked, smooth, shiny, plane to slightly concave. DISTAL UPPER SURFACE continuous, with shallow concavities or smooth, shiny, plane to slightly concave, sometimes with a darker zone near the tips. Laciniae sublinear, irregularly branched, contiguous, 0.5–0.7 (–1.0) mm wide; apices rounded, rarely subrounded, concave, rarely, adnate to slightly ascendant; lateral margin sinuous; axils acute. PRUINA absent or very sparse, farinaceous, subapical, only in Canêz 2388 large plaques were observed. MACULAE distinct, sparse to very frequent, irregularly linear to subreticulate, marginal and laminal, sometimes originate cracks. SMALL POLYSIDIANGIA present, starting as small groups of short isidia-like structures that can burst, showing the medulla and liberating soredioid granules and fragments, sometimes producing farinaceous soredia, simple becoming coralloid, erect, marginal. SOREDIA absent. MEDULLA pale sulphur yellow above, lower layer thin and white. DISTAL LOWER SURFACE dark brown to black, shiny, papillate. Proximal lower surface black, shiny, papillate. Rhizines black, mainly simple, frequent, evenly distributed, up to 0.4 mm long. APOTHECIA rare, *obscurascens*-type, plane to concave, sessile, laminal, up to 1.0 mm diam.; margin smooth; disc black, slightly shiny, epruinose. INTERNAL STIPE white.

EPITHECIUM 5–10 µm high; hymenium 60–100 µm high; subhymenium 60–140 µm high. ASCOSPORES mainly 2-septate, *Dirinaria*-type, ellipsoid, (14–) 16–20 (–24) × (4–) 6–10 µm. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla above K+ reddish orange, C–, KC–, P+ orange-red to red, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K–. **Secondary metabolites**: atranorine, triterpenes.

REMARKS. *Pyxine eschweileri* is characterized by the atranorine in upper cortex, the marginal small polysidiangia that burst to produce polysidia and sometimes soredia, the pale sulphur yellow medulla K+ reddish orange P+ orange-red to red, the *obscurascens*-type apothecia and the ascospores generally with four cells. It is interesting in this species the appearance of cotton-like crystals along the margins or cracks in the upper surface in old herbarium species, probably first noted by Imshaug (1957).

Tuckerman(1877) cited Wright 94 in the protologue, but it was an error, as already mentioned by Aptroot (1987): Wright 94 contains a *Dirinaria* species, while Wright 97 deposited in FH has a card with the handwriting of Tuckerman "*Pyxine cocoës* var. *eschweileri* mihi". Aptroot chose as lectotype this specimen deposited in FH.

Pyxine heterospora Vainio (1915) was considered by Kalb (1987) synonym of *P. eschweileri*. Indeed, the chromatographic array of triterpenes is very similar, despite the K+ yellow to slightly orange reaction in the medulla of *P. heterospora*. Nevertheless, the lectotype of *P. heterospora* (C!) does not have three-septate ascospores that are slightly smaller [(14–) 16–18 (–20) × 7–8 µm] with a very distinct aspect, as described by Imshaug (1957): "sporoblasts enlarged near septum and narrow near ends" (see fig. 6 in Imshaug 1957). Aptroot (1987) observed ascospores of *P. eschweileri* up to 25 µm and Malme (1897) ascospores up to 30 µm long. Moreover, the lectotype of *P. heterospora* is not so evidently maculate.

Imshaug (1957) cited the color of the medulla as another difference between these two species, with that of *P. heterospora* being totally white. However, the lectotype of *P. heterospora* has yellow medulla in the proximal parts of the thallus. The same characteristics were observed in a paratype, collected in St. John, Reef bay, by F. Boergesen in 1906 (C!), and in the holotype of *P. heterospora* f. *rugulosa* Vainio (C!), proposed as synonym of *P. heterospora* by Imshaug (1957). Perhaps, Imshaug observed only the distal parts of the thalli.

Imshaug's (1957) opinion that *P. heterospora* could be an endemic species from parts of Central America (Caribbean) is attractive; nevertheless, more studies in the distribution of this species are needed. It is not excluded the possibility of part of the additional material without ascospores present below be a mixture of these different taxa.

The holotype of *P. rosacea* Zahlbruckner, from São Paulo State could not be studied by us, but Kalb (1987) studied the material and concluded that it is a synonym of *P. eschweileri*. Indeed, the original description (Zahlbruckner 1909) fits very well to *P. eschweileri.*

The neotype of *P. niveomarginata* Bouly de Lesdain (part of an isotype that Dr. A. Vězda presented to Dr. Kalb, now in his herbarium) was also not studied, but the original description is very detailed and also agrees with *P. eschweileri*.

Species morphologically similar are *P. coralligera* Malme, that differs by its better developed laminal polysidiangia, rarely producing soredia and the medulla K– or K+ pale yellow; *P. obscurascens* Malme, that differs in having a dark orange medulla K+ purple and laminal polysidiangia; and *P. retirugella* Nylander, differing by the presence of norstictic acid in the medulla, and laminal polysidiangia (marginal in *P. eschweileri*).

SPECIMENS EXAMINED. ANTILLES, VIRGIN ISLANDS, Insulis Danicis Indiae occidentalis, St. John, Cruxbay, leg. *F. Boergesen*, 1906, (C, **paratype**; is *P. eschweileri*); idem, St. John, Reef bay, leg. *F. Boergesen*, 1906 (C, **paratype**; is *P. heterospora*). BRAZIL, SÃO PAULO STATE, Américo Brasiliense Municipality, Clube Náutico de Araraquara, 21°42′33,1″S, 48°01′48,2″W, 580 m alt., on tree growing in the border of a cerrado denso Forest, 05-VI-2008, leg. *P. Jungbluth* & *M.J. Kitaura* 2024 (SP); idem, Boa Esperança do Sul Municipality, Fazenda Santa Rita, 21°58′32,0″S, 48°21′23,9″W, 579 m alt., on tree on the border of a lake, 05-VI-2008, leg. *P. Jungbluth* & *M.J. Kitaura* 2008; idem, Luiziânia Municipality, Sítio Santa Maria, 21°42′26,8″S, 50°08′28,0″W, 358 m alt., on twig of tree in the border of Feio River, 01-VI-2008, leg. *P. Jungbluth* & *M.J. Kitaura* 1857 (SP); idem, leg. *M.J. Kitaura* & *P. Jungbluth* 879 (SP); idem, Peruíbe Municipality, Reserva Ecológica Juréia-Itatins, Núcleo Guarauzinho 24°19′S, 47°59′W, 10 m alt., Arpoador Beach, on rocks in the North side, with herbs, with bromeliads and *Cladonia*, saxicolous, 29-VII-1993, leg. *M.P. Marcelli* 23853 (SP); idem, Ubatuba Municipality, Parque Estadual da Serra do Mar, Núcleo Picinguaba, Praia da Fazenda, 23º21’25” S; 44º51’55” W; 1 m alt., rocks on the Praia da Fazenda, 18-III-2006, leg. *P. Jungbluth* & *M.F.N. Martins* 1253 (SP); idem, Praia da Fazenda, 23º21’21,3” S, 44º51’52” W; 1 m alt., on the border of Forest in front of the sea, next to the Camping Caracol, 13-I-2007, leg. *A.A. Spielmann, P. Jungbluth, L.S. Canêz* & *M.J. Kitaura* 3145 (SP);

idem, in restinga near the Camping Caracol, on trunk of little dying tree 13-I-2007, leg. *M.J. Kitaura, P. Jungbluth, L.S. Canêz* & *A.A. Spielmann* 459, 460 (SP); idem, on twig of the same little tree, leg. *M.J. Kitaura, P. Jungbluth, L.S. Canêz* & *A.A. Spielmann* 465, 478 (SP); idem, on twig from the same little tree, leg. *P. Jungbluth, L.S. Canêz, M.J. Kitaura* & *A.A. Spielmann* 1525, 1566A (SP); idem, in the base of a tree in the border of the restinga, 13-I-2007, leg. *L.S. Canêz, P. Jungbluth, M.J. Kitaura* & *A.A. Spielmann* 2388 (SP).

DISTRIBUTION. Africa (Kalb 1987), Central America (Tuckerman1877, Bouly de Lesdain 1934), North America (Imshaug 1957, Moore 1968, Brodo et al. 2001, Tenorio et al. 2002, DeBolt 2007, Hansen et al. 2008) and South America (Vainio 1890). In South America it was cited to Brazil (Kalb 1987), Guyana (Aptroot 1987) and Paraguay (Malme 1987). In Brazil it was cited to the States of Minas Gerais (Vainio 1890, Kalb 1987, Aptroot 2002), Mato Grosso (Malme 1897, Kalb 1987), Mato Grosso do Sul (Kalb 1987), Paraná (Zahlbruckner 1909) and São Paulo (Zahlbruckner 1909 – as *P. rosacea* Zahlbruckner, Kalb 1987).

***Pyxine fallax* (Zahlbruckner) Kalb**, *Bibliotheca Lichenologica* **88**: 315. 2004. **(Fig. 4)**

Parmelia fallax Zahlbruckner, *Ann. Mycol.* 10: 381. 1912. TYPE: Hawaii, Islands, Oahu, Kalimooa Valley, leg. *Rock* 89 (lectotype: W).

= *Pyxine patellaris* Kurokawa, *Bull. Natl. Sci. Mus. [Tokyo]* 12: 689. 1969. TYPE: Bonin Islands, between Okumura and Ohgiura, Chichijima Island, along trail in the forest of *Calophyllum inophyllum – Terminalia catappa*, alt. 0-100 m, leg. *Hiroshi Inoue* 19027 (holotype: TNS).

= *Pyxine retirugella* var. *capitata* Zahlbruckner in Magnusson & Zahlbruckner, *Ark. f. Bot.* 32(A)2: 59. 1945. TYPE: United States, Hawaii, Kauai, Haena, S. of Hilo. *Pandanus* forest, 1922, leg. *Skottsberg* 1267 (lectotype: S!) (new synonym) (Fig. 5)

THALLUS orbicular, corticolous, grey to brownish grey, laciniate, 2.0–4.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous to cracked, slightly scrobiculate, slightly shiny, plane. DISTAL UPPER SURFACE continuous to cracked, smooth with concavities sometimes, shiny, slightly convex to convex, with a darker zone near the tips of few laciniae. LACINIAE sublinear, irregularly branched, contiguous to rarely overlapping laterally, 0.3–1.0 mm wide; apices rounded, sometimes subtruncate, mainly slightly concave, slightly ascendant; lateral margin crenate to irregular; axils acute. PRUINA quite absent, farinaceous, sparse, subapical. MACULAE distinct, abundant, irregularly linear, rarely subreticulate, marginal and laminal,

parting mainly from the axils, sometimes originate cracks. POLYSIDIANGIA absent. SORALIA white, orbicular to capitate, initially a wart that soon start to disintegrate apically but continuing to elongate, elevating the soralia, laminal or submarginal; soredia farinaceous. MEDULLA white. DISTAL LOWER SURFACE cream to pale brown, shiny, smooth to papillate. PROXIMAL LOWER SURFACE black, shiny, smooth. RHIZINES black, simple to irregularly branched, frequent, evenly distributed, up to 0.5 mm long. APOTHECIA absent [*obscurascens*-type, rare, 0.4–1.1 mm wide, disc epruinose, internal stipe distinct, white (Elix 2009), ascospores 13–17 × 6–8 µm (Kalb 2004, Elix 2009)]. PYCNIDIA few, laminal. CONIDIA not found [sublageniform, 3.4–3.6 × 0.5 µm (Zahlbruckner 1912, protologue)].

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow to orange, C–, KC–, P+ orange, UV–; internal stipe K–, P–. **Secondary metabolites**: atranorine, norstictic acid, triterpenes.

REMARKS. *Pyxine fallax* is characterized by atranorine in upper cortex, orbicular, laminal to sublaminal soralia, white medulla K+ yellow to orange, P+ orange (norstictic acid) and *obscurascens*-type apothecia.

It is notable in this species the development of soralia that progressively become slightly elevated by a small base of upper cortex (quite stalked). The same was observed in the holotype of *P. copelandii* Vainio (TUR-V 08703!), that differs from *P. fallax* by its longer ascospores [16–22 µm (Swinscow & Krog 1975)], less maculate upper cortex and different terpene array.

Another similar species with white medulla and norstictic acid is *P. retirugella* Nylander, that differs from *P. fallax* by the presence of polysidiangia.

Pyxine retirugella var. *capitata* Zahlbruckner (Fig. 5) is proposed here as a new synonym of *P. fallax*. Rogers (1986) proposed it as synonym of *P. retirugella*. However the lectotype (S!) of this variety has orbicular soralia instead polysidiangia and has the same chromatographic triterpenes array of *P. fallax*. Kalb (2004) placed *P. retirugella* var. *capitata* into the synonymy of *P. asiatica* Vainio; however, *P. asiatica* does not have norstictic acid (Kashiwadani 1977a, Awasthi 1980, Kalb 2004).

This is the first time this species was cited to South America.

SPECIMENS EXAMINED. BRAZIL, SÃO PAULO STATE, Praia Grande Municipality, Cidade Ocean District, 24°02′S, 46°30′W, 2 m alt., ca. 1 km after the Iemanjá's statue, 2 km after the Netuno's statue, in direction of Mongaguá Municipality, low Restinga forest, corticolous, 07-07-1988, leg. *M.P. Marcelli* 3303 (SP).

DISTRIBUTION. Australia (Kalb 2004), Hawaii Islands (Zahlbruckner 1912, Magnusson & Zahlbruckner 1945, as *P. retirugella* var. *capitata* Zahlbruckner), Japan (Kurokawa 1969, as *P. patellaris* Kurokawa), Taiwan (Kalb 2004) and South America, cited to Brazil, São Paulo State.

Pyxine heterospora **Vainio**, *Ann. Acad. Sci. Fenn.* A **6**(7): 73 (1915). **(Fig. 6)**

TYPE: [Antilles, Virgin Islands] Monte Crown, St. Thomas, Plantae ex Ind. Occid., 31-XI-1905, leg. *Raunkier* 420 (lectotype: C!).
= *Pyxine heterospora* f. *rugulosa* Vainio, *Ann. Acad. Sci. Fenn.* A, 6(7): 73. 1915. TYPE: Loevenlund, St. Thomas, leg. *Raunkier* 409 (holotype: C!).

THALLUS orbicular, corticolous, brownish grey, laciniate, 0.5–2.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous to cracked, smooth, slightly shiny, plane. DISTAL UPPER SURFACE continuous to cracked, smooth, shiny, plane to concave, without a darker zone near the tips. LACINIAE sublinear, irregularly to dichotomously branched, contiguous, 0.5–0.8 mm wide; apices rounded, slightly concave to concave, ascendant; lateral margin crenate; axils acute. PRUINA farinaceous, rare, disperse, subapical. MACULAE very pale, rare, irregularly linear, mainly marginal, originate cracks. POLYSIDIANGIA simple to very branched, but the branches very small, erect, mainly marginal, liberating granules. MEDULLA white to yellow at the centre of the thallus. LOWER SURFACE black, slightly shiny, smooth to papillate. RHIZINES black, simple to irregularly branched, abundant, evenly distributed, up to 0.7 mm long. APOTHECIA *obscurascens*-type, frequent, plane, sessile, laminal, up to 1.0 mm diam.; margin smooth to slightly undulate; disc black, shiny, epruinose. INTERNAL STIPE not well developed, brownish. EPITHECIUM 10–15 µm high; hymenium 80–90 µm high; sub-hymenium 130–150 µm high. ASCOSPORES 1-septate, Dirinaria-type, ellipsoid, (14–) 16–18 (–20) × 7–8 µm. PYCNIDIA frequent, subapical. CONIDIA sublageniform, 3–4 × ca. 1.0 µm.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow to pale orange, C–, KC–, P+ orange-red, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; **internal stipe** K– or K+ greenish yellow. **Secondary metabolites:** atranorine, triterpenes.

REMARKS. *Pyxine heterospora* is characterized by the atranorine in upper cortex, the marginal small polysidiangia that in polysidia and sometimes soredia, the pale yellow medulla K+ yellow to pale orange and P+ orange, the *obscurascens*-type apothecia and the ascospores with two cells.

Pyxine heterospora f. *rugulosa* has a more irregular and slightly rugose upper surface, but is not significantly different from the lectotype of *P. heterospora* to justify a distinct infra-species category nowadays.

Pyxine eschweileri is differentiated by the ascospores mainly three-septate and slightly longer [(14–) 16–20 (–24) µm]. See more comments under *P. eschweileri*.

Pyxine jolyana Jungbluth, Kalb & Marcelli, sp. nov. (Fig. 7)

DIAGNOSIS: Similis *Pyxine albovirens* (G. Meyer) Aptroot sed terpenis et acidum norsticticum continenti differt.

HOLOTYPE: Brazil, São Paulo State, Municipality of Peruíbe, Reserva Ecológica Juréia-Itatins, Núcleo Guarauzinho, 24°44′58″S, 47°02′57″W, 5 m alt., on rock next to the entrance of the Reserve, 26-07-1993, leg. *M.P. Marcelli* 23690 (SP; isotype in Herb. Kalb).

THALLUS orbicular, saxicolous or corticolous, brownish grey, laciniate, 7 cm diam., closely adnate, 100–150 µm. PROXIMAL UPPER SURFACE continuous, rarely with cracks, smooth to slightly irregular and sometimes with concavities, dull, plane. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane to concave, without a darker zone near the tips. UPPER CORTEX 10–20 µm. LACINIAE sublinear, irregularly to rarely dichotomously branched, contiguous to overlapping laterally, 0.5–1.0 mm wide; apices subtruncate to rounded, concave, slightly ascendant to adnate; lateral margin smooth to sinuous; axils acute. PRUINA very rare, farinaceous or forming small patches, subapical. MACULAE mainly indistinct, sparse, irregularly linear, when marginal more distinguishable. POLYSIDIANGIA absent. SORALIA frequently pale yellow, orbicular to capitate, submarginal; soredia powder to granular. MEDULLA cream to pale yellow to salmon above, sulphur yellow under the soralia, lower layer with, K+ reddish to purple pigment present, 60–80 µm. ALGAL LAYER continuous, 10–20 µm. DISTAL LOWER SURFACE black but paler near the tips, slightly shiny, smooth to rarely irregular. PROXIMAL LOWER SURFACE black, slightly shiny, smooth to slightly irregular. LOWER CORTEX 15–20 µm. RHIZINES concolored with the lower cortex, the apices sometimes becoming paler, mainly simple, numerous, evenly distributed, to 0.7 mm long. APOTHECIA absent. PYCNIDIA rare, laminal. CONIDIA sublageniform, 3.75–4 × ca. 1.0 µm.

COLOR TESTS: upper cortex K–, UV+ yellow; pigmented distal medulla K– or K+ yellow to red, C –, KC–, P+ yellowish orange, sometimes the color of the medulla just becomes stronger; pigmented proximal medulla K+ yellow to red, C–, KC–, P+ strong yellow or

yellowish orange, with pigment K+ purple in oldest parts. **Secondary metabolites:** lichexanthone, norstictic acid, unidentified triterpenes.

REMARKS. *Pyxine jolyana* is characterized by the lichexanthone in upper cortex, the orbicular to capitate laminal soralia, the upper medulla yellow to orange in distal regions of the thallus and cream to salmon in proximal regions, some parts with negative tests, others K+ yellow to red (norstictic acid).

It is important to note in this species that the color of the pigmented medulla is not constant throughout the thallus. In *P. jolyana*, norstictic acid is not detected in TLC using as samples just of tips of laciniae: pieces of proximal parts of the thallus must be analyzed too.

Pyxine jolyana is the only species with lichexanthone in upper cortex and norstictic acid in medulla known in the genus. *Pyxine fallax* (Zahlbruckner) Kalb and *P. retirugella* Nylander also have norstictic acid in the medulla, but could be easily separated because of the presence of cortical atranorine instead of lichexanthone.

Pyxine albovirens (G. Meyer) Aptroot differs by the absence of norstictic acid and the crystals of lichexanthone that Kalb (1987) observed on the upper cortex of *P. caesiopruinosa* (Tuckerman) Imshaug while studying South America material could be observed in *P. jolyana* too.

The epithet *jolyana* is in honor of Dr. Carlos Alfredo Joly, the main mentor of the BIOTA/FAPESP Program of inventory and characterization of the biodiversity of the São Paulo State.

SPECIMENS EXAMINED. BRAZIL, SÃO PAULO STATE, Peruíbe Municipality, border of the Guaraú River, near to the mouth of the river, 24°22′24″S, 47°00′25″W, 4 m alt., on palm stipe next to the base of the Faculdade de Ciência e Tecnologia Santa Cecília, windy and direct sun, 24-07-1988, leg. *M.P. Marcelli* 4014 (SP); idem, São Luís do Paraitinga Municipality, Parque Estadual da Serra do Mar, Núcleo Santa Virgínia, beginning of the Trilha do Pirapitinga footpath, 23º20'17"S, 45º08'45"W, 915 m alt., in tree in the border of shadow forest, corticolous, 14-I-2007, leg. *P. Jungbluth, M.J. Kitaura, L.S. Canêz* & *A.A. Spielmann* 1637 (SP); idem, Ubatuba Municipality, Parque Estadual da Serra do Mar, Núcleo Picinguaba, Praia da Fazenda, 23º21'41" S, 44º50'53" W; 1 m alt., on twig of tree in the border of restinga Forest, in front of the sea, 13-I-2007, leg. *P. Jungbluth, M.J. Kitaura, L.S. Canêz* & *A.A. Spielmann* 1566B (SP).

DISTRIBUTION. São Paulo State, littoral zone, at municipalities of Peruíbe, São Luís do Paraitinga and Ubatuba.

Pyxine katendei Swinscow & Krog, *Norw. J. Bot.* **22**: 54. 1975. **(Fig. 8)**

TYPE: Uganda, Kigezi District, Ndorwa County, Kabale, White House Inn, on tree trunk in a garden, 1800 m alt., December 1971, leg. *T.D.V. Swinscow* 3U 34/1 (holotype: BM!; isotype: O).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, white to pale grey, laciniate, 1.5–3.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous, smooth, slightly shiny, convex. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, convex to slightly convex, without a darker zone near the tips. LACINIAE linear to sublinear, irregularly to dichotomously branched, contiguous, 0.3–0.8 mm wide; apices subtruncate to rounded, flat to slightly reflexed, adnate; lateral margin smooth, occasionally sublacinulate; axils acute, sometimes auriculate. PRUINA quite absent, farinaceous, disperse, subapical laminal. MACULAE absent. POLYSIDIANGIA absent. SORALIA orbicular becoming ellipsoid to linear, at the centre of the lamina; soredia farinaceous. MEDULLA white. PROXIMAL LOWER SURFACE pale brown to black, shiny, smooth to papillate. DISTAL LOWER SURFACE pale, shiny, smooth to papillate. RHIZINES concolored with the lower cortex, simple, abundant, evenly distributed, to 0.3 mm long. APOTHECIA absent. PYCNIDIA absent.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–. **Secondary metabolites**: lichexanthone, triterpenes.

REMARKS. *Pyxine katendei* is characterized by the presence of lichexanthone in the upper cortex, laminal orbicular to ellipsoid soralia and white medulla K–, P–.

Two others species with lichexanthone, white medulla and negative color tests are *P. cocoës* (Swartz) Nylanderand *P. reticulata* (Vainio) Vainio. Nevertheless, these two species are maculate and *P. cocoës* has orbicular to irregularly linear, marginal to laminal soralia sometimes originate from the maculae and plates of pruina; *P. reticulata* has orbicular marginal and laminal soralia.

Others species with laminal soralia and white medulla are *P. asiatica* Vainio, *P. copelandii* Vainio and *P. fallax* (Zahlbruckner) Kalb, but the three have orbicular soralia and very different chemistry, without lichexanthone in upper cortex and positive K and P medullar color tests.

Pyxine farinosa Kashiwadani and *P. meissneriana* Nylander have orbicular to elongated soralia and medullar negative color tests, but have pale yellow or straw medulla, marginal maculae. Besides, *P. meissneriana* has plates of pruina and marginal to laminal soralia.

This is the first report of *P. katendei* outside Africa.

SPECIMENS EXAMINED. BRAZIL, SÃO PAULO STATE, São Paulo Municipality, Instituto de Botânica, Paineira tree near the street from the Portaria 2 to the Diretoria, 23°33′S, 46°38′W, 680 m alt., corticolous, 22-05-1989, leg. *M.P. Marcelli* 6266 (SP); idem, Jardim Botânico de São Paulo, old trees between the Seção de Fisiologia and the Rua das Palmeiras, 23°33′S, 46°38′W, 680 m alt., corticolous, 06-10-1992, leg. *M.P. Marcelli* 14276 (SP).

DISTRIBUTION: Africa (Swinscow & Krog 1975, 1988); South America, cited to Brazil, São Paulo State, municipality of São Paulo.

Pyxine obscurascens **Malme**, *Bihang Kongl. svenka Vet.- Akad. Handl.* **23**, afd 3(13): 42. 1897. **(Fig. 9)**

TYPE: Brasiliae civit. Matto Grosso, Serra da Chapada, prope Bocca da Serra, ad rupem sat apricam, 3 June 1894, leg. *Malme* 3895 (lectotype: S!).

= *Pyxine granulifera* Swinscow & Krog, *Norw. J. Bot.* 22: 125. 1975b. TYPE: Zambia, Central Province, 12 miles S of Chilanga, 3500 ft altitude s.m., dry hilly bush, on bark, 2 may 1973, leg. *R.K. Brinklow* s.n. (holotype: BM! pr. p., with *Pyxine reticulata* (Vainio) Vainio; isotype BM).

= *Pyxine cocoës* var. *chrysantha* Müller Argoviensis, *Flora Jena* 73: 341. 1890. Type: Africa Aequatoriali, Lich. Afr. trop. 44, leg. *Rev. J. Hannington* (lectotype: G, duplicate from the lectotype BM!).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, saxicolous, very dark grey, laciniate, 4.0–6.0 cm diam., adnate. PROXIMAL UPPER SURFACE continuous to cracked, verrucose to smooth, dull, plane to convex. DISTAL UPPER SURFACE continuous, sometimes cracked, smooth to verrucose to slightly scrobiculate because of the maculae, slightly shiny, plane to slightly convex, sometimes slightly concave, with a discreet darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to slightly overlapping laterally, 0.5–1.0 (–1.5) mm wide at the basis of the branches; apices rounded to subtruncate, varying from flat to convex to concave, slightly

ascendant when concave; lateral margin slightly irregular to crenate; axils forming acute angle. PRUINA farinaceous, forming small dots, subapical. MACULAE pale to distinct, abundant at the distal parts of the thallus, subreticulate to reticulate, mainly laminal at the distal parts of the upper surface. POLYSIDIANGIA concolored with the upper cortex or exposing the orange medulla, papilliform to branched, quite coralloid, erect, short, resembles orbicular soralia, apices with fragments or becoming sorediate, laminal. TRUE SOREDIA absent; granules on the apices of the polysidiangia. MEDULLA orange to dark orange. LOWER SURFACE black, shiny, smooth to papillate. RHIZINES black, simple to irregularly branched, frequent, evenly distributed, up to 0.5 mm long. APOTHECIA *obscurascens*-type, common to frequent, plane to convex, sessile, laminal, up to 2.5 mm diam.; margin dark from the start of the development, smooth to undulate, not visible in very convex apothecia; disc black, shiny, epruinose. INTERNAL STIPE well developed, orange brown on the upper layer, orange in the lowest layers. EPITHECIUM 5–10 µm high; hymenium 65–90 µm high; subhymenium 110–220 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 13–16 × 5–8 µm. PYCNIDIA rare, subapical. CONIDIA not studied.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ black-purple, C–, KC–, P+ black-purple, UV–; epithecium K+ purple; hymenium K–; subhymenium K+ yellowish orange; internal stipe K+ yellowish orange. **Secondary metabolites**: atranorine, triterpenes.

REMARKS. *Pyxine obscurascens* is characterized by the atranorine in the upper cortex, the laminal polysidiangia, the orange medulla throughout, K+ and P+ black-purple, and apothecia from *obscurascens*-type.

The holotype of *P. granulifera* Swinscow & Krog in BM consists of fragments mixture with *P. coralligera* Malme (upper medulla pale yellow and cream, K– or K+ pale yellow and P+ orange). Five fragments are glued to the herbarium card, while one is free. There is a label by Dr. Klaus Kalb warning that the fragments indicated by "a" are from *P. reticulata* (Vainio) Vainio and those indicated by "b" are the holotype from *P. granulifera*. In fact, "a" are fragments of *P. coralligera*, as later Kalb (1987) himself wrote down.

The duplicate from the lectotype of *P. cocoës* var. *chrysantha* Müller Argoviensis in BM is a very small fragment. We are not sure if it is really a duplicate, as the information in the label is insufficient. Just the basis of the polysidiangia are left in this specimen, but the relief of the upper surface and the color of the medulla agree with the lectotype of *P. obscurascens*.

Pyxine retirugella Nylander, a morphologically similar species, has also polysidiangia; nevertheless, it has convex laciniae, paler and stratified medulla (pale salmon above, white

below) and has norstictic acid in the medulla (upper medulla K+ yellow turning red, P+ orange).

This is the first time that *P. obscurascens* is cited to São Paulo State.

SPECIMENS EXAMINED. BRAZIL, SÃO PAULO STATE, Cachoeira de Emas Municipality, near to the houses of the officers of the Air Force, cerrado field burnt annually, 21°58′S, 47°20′W, alt. 530m, on bark of mangabeira tree (*Hancornia speciosa* Gomez), 14-VI-1979, leg. *M.P. Marcelli* 16494 (SP); idem, Mogi-Guaçu Municipality, Reserva Biológica e Estação Experimental de Mogi-Guaçu, Trilha T-1, between cerrado and riparian Forest, 22°16′S 47°09′W, 630 m alt., on tree in shadow, 06-XI-2007, leg. *M.N. Benatti, M.P. Marcelli & R. Lücking* 2794 (SP).

DISTRIBUTION. Africa (Tavares 1961, Swinscow & Krog 1975, 1988, Kalb 1987), Central America (Tenorio et al. 2002), Oceania (Kalb 1987, but not really sure, material scarce) and South America (Malme 1897). In South America, it was cited to Brazil (Kalb 1987), French Guiana, Guyana, Surinam, Venezuela (Aptroot 1987). In Brazil, it was cited to the States of Bahia, Minas Gerais (Kalb 1987), Mato Grosso (Malme 1897, type locality; Kalb 1987), Mato Grosso do Sul (Kalb 1987, Fleig & Riquelme 1991), and now cited to São Paulo State.

Pyxine oceanica Zahlbruckner, *Palmyra Island*: 37. 1916.

TYPE: Oceania, insula Palmyra, leg. *J. Rock*, Lich. Rar. Ex. 207 (lectotype: W!, duplicates from the lectotype: BM!, O, UPS!). **(Fig. 10)**

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, corticolous, yellowish grey, laciniate, 4.5–5.0 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous, rugose to verrucose, dull, with many concavities, sometimes plane. DISTAL UPPER SURFACE continuous, rugose to verrucose, dull, with many concavities, convex to plane, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to overlapping laterally, 0.5–0.7 (–1.3) mm wide; apices subtruncate to rounded, concave and ascendant or flat then adnate; lateral margin smooth to sinuous; axils acute. PRUINA in patches, laminal to apical, at the distal parts of the thallus. MACULAE distinct, abundant, spotted to irregularly linear, laminal and marginal, originate openings and cracks. POLYSIDIANGIA absent. SORALIA orbicular to irregularly linear, sometimes confluent, laminal and marginal; soredia farinaceous to granular. MEDULLA white. DISTAL LOWER SURFACE brown to black, shiny, smooth to papillate. PROXIMAL LOWER

SURFACE black, shiny, smooth to papillate. RHIZINES black, simple, rarely irregularly branched, frequent, evenly distributed, up to 0.4 mm long. APOTHECIA *cocoës*-type to *obscurascens*-type, frequent, plane and slightly concave, sometimes convex, sessile, laminal, up to 1.1 mm diam.; margin smooth, not visible in convex apothecia; disc black, dull (with mold), epruinose. INTERNAL STIPE well developed, brownish red. EPITHECIUM 5–10 µm high; hymenium 90–130 µm high; subhymenium 80–120 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 14–18 × 5–7 µm. PYCNIDIA frequent, subapical. CONIDIA not seen.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; epithecium K+ purple; hymenium K–; subhymenium K+ red wine; internal stipe K+ red wine. **Secondary metabolites**: lichexanthone, triterpenes in low concentrations, hardly to see in TLC with solvents A and C.

REMARKS. *Pyxine oceanica* is characterized by the confluent laciniae, the presence of lichexanthone on the upper cortex, white medulla with negative color tests and the orbicular to linear irregular soralia. The lectotype is slightly moldy, as the syntypes deposited at BM and UPS.

Many authors consider this species as synonym of *P. cocoës*. Nevertheless, the upper surface is irregular, the laciniae are very confluent and the maculae are more evident and frequent. Nevertheless, more material is needed from Palmyra Island, a very isolate island in the middle of the Pacific, to understand the variations in this species, as the type and the syntypes are slightly moldy.

DISTRIBUTION. Known only to the type locality.

***Pyxine physciaeformis* (Malme) Imshaug**, *Trans. Am. micros. Soc.* **76** (3): 257. 1957. **(Fig. 11)**

Pyxine meissneri Tuckerman var. *physciaeformis* Malme, *Bihang Kongl. svenska Vet.-Akad. Handl.* 23 afd. 3(13): 36. 1897. TYPE: Brasiliae civit. Matto Grosso: Corumbá, in silva minus densa, in declivibus collis, 10-VIII-1894, *leg. Malme* 3880 (lectotype: S!; duplicate from the lectotype: UPS!).

DESCRIPTION OF THE LECTOTYPE

THALLUS (seem to be orbicular – fragments left), corticolous, yellowish grey, laciniate, 5.5 cm diam., closely adnate. PROXIMAL UPPER SURFACE continuous with cracks in some parts,

verrucose and rugose, rarely smooth, dull, plane to convex. DISTAL UPPER SURFACE continuous and cracked, nodular to smooth, dull, mainly plane to concave, with a very weak darker (brown) zone near the tips. LACINIAE sub linear, irregularly branched, contiguous, (0.5–) 0.7–1.5 mm wide; apices rounded, mainly concave, adnate but not firmly fixed at the substrate; lateral margin smooth, rarely irregular; axils forming acute angles. PRUINA rare, farinaceous, disperse mainly on the lamina of the laciniae tips. MACULAE absent. POLYSIDIANGIA entire, globular to contorted and sinuous, start as laminal warts, growing and becoming shortly branched, sometimes broken apically exposing the medulla, initially isolated, than confluent, occupying large areas from the upper surface, laminal. PUSTULES occasionally present, mixture with the polysidiangia. SOREDIA absent. MEDULLA yellow to yellowish orange [yolk yellow] above, lower layer white. LOWER SURFACE black, shiny, smooth to slightly rugose and irregular. RHIZINES concolored with the lower cortex, mainly simple, sometimes with the apices palmed, frequent, evenly distributed, up to 1.5 mm long (just few observed). APOTHECIA *physciaeformis*-type, common, usually plane, sessile, laminal, up to 1.3 mm diam.; smooth to crenate, sometimes verrucose; disc black, shiny, epruinose. INTERNAL STIPE not well developed, white to faint yellow. EPITHECIUM 5–10 µm high; hymenium 70–80 µm high; subhymenium 80–100 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, 16–19 × 6–8 µm. PYCNIDIA frequent, laminal. CONIDIA sublageniform, 4–5 × ca. 1.0 µm.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K+, the color of the medulla becoming more evident to faint reddish orange, C–, KC–, P+ faint red, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K–. **Secondary metabolites**: lichexanthone, triterpenes.

REMARKS. *Pyxine physciaeformis* is characterized by the lichexanthone in upper cortex, the presence of polysidiangia, the upper medulla yellow to yolk yellow, K+ faint reddish orange and P+ faint red, and the *physciaeformis*-type apothecia.

The vegetative structures produced in this species are not the typical polysidiangia found in the others species treated in this work, as they are relatively more robust and just rarely (by mechanical injury?) release fragments. Occasionally, some of these structures produced are globular, hollow and not branched, what are more adequately denominated as pustules.

Pyxine berteriana (Fée) Imshaug is morphologically similar. This species has apothecia from the *cocoës*-type, but it is frequent that the margins of the apothecia of this species become carbonized just latter and is frequent to collect specimens without carbonized

margins; this species does not produce polysidiangia, but sometimes the upper cortex is rugose and verrucose, resembling the structures produce in *P. physciaeformis*. These rugose and verrucose specimens of *P. berteriana* could be distinguished from *P. physciaeformis* by the presence of distinct maculae and the diverse terpene array.

Pyxine simulans Kalb (Herb. Kalb!) is another similar species, characterized by the *physciaeformis*-type apothecia and absence of vegetative propagules, sometimes resembling young thalli of *P. physciaeformis*. Here again, the distinct maculae present in *P. simulans* and the different triterpenes array separate these species, besides the longer ascospores (21–23 μm long in the holotype of *P. simulans*).

Elix (2009) synonymised *P. caesiopruinosa* (Tuckerman) Imshaug with *P. physciaeformis*. Nevertheless, *P. caesiopruinosa* has small polysidiangia that burst abundantly into fragments and soredia, apothecia from *obscurascens*-type and upper medulla K+ purple. The description presented in Elix (2009) is a mixture of these two taxa. For more information, see remarks under *P. albovirens* and *P. caesiopruinosa*.

Kalb (2004) cited this species to Australia, but he was actually making reference to *P. caesiopruinosa* (pers. comm. 2009).

ADDITIONAL MATERIAL EXAMINED. BRAZIL, MATO GROSSO, Corumbá Municipality, in declinibus collis, ad Cereum arborescentem, 7-VIII-1894, leg. *Malme* 3878 S! and UPS! (is *Pyxine berteriana* (Fée) Imshaug); idem, SÃO PAULO STATE, Ribeirão Preto Municipality, Universidade de São Paulo, campus of Ribeirão Preto, 21°09′12,0″S, 47°51′47,8″W, 652 m alt., on tree trunk, 06-VI-2008, leg. *P. Jungbluth* & *M.J. Kitaura* 2062 (SP).

DISTRIBUTION. Australia (Elix 2009, however, see comments under *P. albovirens* and *P. caesiopruinosa*), Africa (Swinscow & Krog 1975, 1988), Central America (Imshaug 1957) and South America (Malme 1897). In South America, it was cited to Brazilian States of Mato Grosso (Malme 1897, type locality), Rio Grande do Sul (Fleig 1988) and São Paulo (Kalb 1987).

Pyxine retirugella Nylander, *Ann. Sci. Nat.* (*Bot.*) Ser. 4, **11**: 240. 1859. **(Fig. 12)**

TYPE: Antilles, Martinique, Noukahiva, ad saxa, leg. D.E.S.A. Jardin (lectotype: H-NYL 31789!).

= *Pyxine retirugella* var. *laevior* Vainio, *Bot. Tiddskr.* 29, 113. 1909. TYPE: Thailand, Koh Chang, prope Lem Ngob ad corticem arborum no. IX, leg. *Johs. Schmidt* (lectotype: TUR-V 08701!).

= *Pyxine consocians* Vainio, *Philipp. J. Sci.* 8: 109. 1913. TYPE: Philippines, Comiran Island, Sulu Sea, ad corticem arboris frondosae, Sept. 1910, leg. *E.D. Merrill* 7167 (holotype: TUR-V 7167!; duplicate from the holotype: BM!).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, saxicolous, grayish brown, laciniate, 1.5–3.0 cm diam., adnate. PROXIMAL UPPER SURFACE reticulate to cracked, scrobiculate and with irregular concavities too, slightly shiny, plane. DISTAL UPPER SURFACE continuous to reticulate to cracked, scrobiculate, slightly shiny, plane to strongly concave, without a darker zone near the tips. LACINIAE sublinear, irregularly branched, overlapping laterally, 0.4–1.3 mm wide; apices subrounded, flat to concave, generally adnate; lateral margin smooth to slightly crenulated; axils acute. PRUINA in glistening small patches, not frequent, subapical. MACULAE very distinct, abundant, irregularly linear becoming subreticulate, laminal and marginal, originate cracks and depressions. POLYSIDIANGIA starting as pustules, simple, erect, bursting at the apices and liberating granular soredia, laminal. SOREDIA absent. MEDULLA pale salmon above, lower layer thin and white. LOWER SURFACE black, dull, smooth to irregular. RHIZINES black, simple, few, evenly distributed, to 0.5 mm long. APOTHECIA absent [*obscurascens*-type (Elix 2009), ascospores 18–20 × 8–9 µm (Nylander1859, protologue)]. PYCNIDIA absent.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow becoming red, C–, KC–, P+ orange, UV–. **Secondary metabolites**: atranorine, norstictic, triterpenes.

REMARKS. *Pyxine retirugella* is characterized by the presence of atranorine in upper cortex, the polysidiangia that burst in granular soredia, the pale salmon medulla K+ yellow becoming red (norstictic acid) and the *obscurascens*-type apothecia.

The medulla of *P. retirugella* is sometimes mentioned as white (Swinscow & Krog 1975), while to *P. consocians* is cited as stramineous (Swinscow & Krog 1975, 1988) or pale yellow parts in medulla (Gu & Chen 2003), and with yellow parts in *P. retirugella* var.

laevior (Vainio 1909). Nevertheless, the color of the upper medulla in the lectotypes of *P. retirugella* (H!) and *Pyxine retirugella* var. *laevior* (TUR!) as well the holotype of *P. consocians* (TUR!) is pale salmon. It is possible that fresh material has white upper medulla that gradually becomes pigmented in the herbarium.

In the protologue (Nylander1859), the material studied was cited as "ad cortices et saxa" indicating the existence at least of two thalli from different substrata. Rogers (1986) named H-NYL 31789, a saxicolous thallus, as holotype; the correct designation is lectotype. Besides, the protologue mentioned apothecia absent in H-NYL 31789. Unhappily, no syntypes were localized in H (pers. com. Leena Myllys 2009, curator).

Rogers (1986) considered *P. retirugella* var. *laevior* Vainio (TUR-V!) as a synonym of this species. There are two thalli of this species in TUR, and Rogers (1986) did not designate which specimen should be the lectotype. Nevertheless, he left the annotation "holotype of *P. retirugella* var. *laevior*" inside the envelop of specimen TUR-V 08701 indicating that he was referring to this specimen when he did the typification. He probably didn't know about the existence of the specimen TUR-V 08700, a better developed thallus with more propagules. These two specimens deposited in TUR are not so abundantly maculate and scrobiculate as *P. retirugella* and the polysidiangia have a tendency to be more marginal than laminal. Here, the synonym proposed by Rogers (1986) was maintained, but more studies are necessary on this Asian variety.

Pyxine retirugella var. *capitata* Zahlbruckner (S!), *P. copelandii* Vainio (TUR-V 08703!) and *P. patellaris* Kurokawa were proposed by Rogers (1986) as synonym of *P. retirugella*. Nevertheless, none of these species have polysidiangia (for *P. retirugella* var. *capitata* see remarks under *P. fallax*).

In his concept, Rogers (1986) considered the presence of norstictic acid not sufficient to the maintenance of a species. He considered *P. asiatica* Vainio as synonym of *P. retirugella*, despite the absence of norstictic acid in the medulla. Additionally this species does not have polysidiangia (Kashiwadani 1977a, Awasthi 1980, Kalb 2004).

Pyxine consocians Vainio (holotype: TUR-V 7167!; duplicate from the holotype: BM!) was considered by Vainio (1913) as different from *P. retirugella* because of different results in color testes. Nevertheless, the TLC showed the same triterpenes array.

Vainio (1890) and Zahlbruckner (1909) cited *P. retirugella* to Brazil. Kalb (1987) had the opportunity to study the material cited by Zahlbruckner (1909) and discovered it be *P. pungens*. However, the specimens cited by Vainio (1890) were not studied and nobody else

mentioned *P. retirugella* for South America. Perhaps, this species can be absent from Brazil or be a very rare one.

DISTRIBUTION. Africa (Swinscow & Krog 1975, as *P. consocians*; Aptroot 1988, as *P. consocians*), Australia (Rogers 1986, Sammy 1988, Elix 2009), Central America (Nylander 1857, type locality), China (Gu & Chen 2003, as *P. consocians*), India (Awasthi 1980, as *P. consocians*), North America (Imshaug 1957), Papua Nova Guinea (Kashiwadani 1977c), Philippines (Vainio 1813), South America (Vainio 1890), Taiwan (Aptroot 2002, Aptroot et al. 2002, as *P. consocians*), Thailand (Vainio 1909, as *P. retirugella* var. *laevior*, Wolseley et al. 2002). In South America, it was cited to Brazil, Minas Gerais State (Vainio 1890, see discussion above).

Pyxine subcinerea **Stirton**, *Trans. New Zealand Inst.* **30**: 397. 1897.

TYPE: Australia, Queensland, leg. *F.M. Bailey* 22 (holotype: BM).

= *Pyxine meissneri* Tuckerman ex Nylander var. *sorediosa* Müller Argoviensis, *Flora*, *Jena* 62: 290. 1879. TYPE: [Africa], Djur, Brauneisenstein, Seriba Ghattas, 1877, leg. *Schweinfurth* s.n. (lectotype: G!).

= *Pyxine chrysantha* Vainio, *Cat. Afr. Pl. Welwitsch* 2 (2): 412. 1901. TYPE: Angola, Golungo Alto, ad truncus arb. vigent. in sylvis primaevis prope Sange, ni fallor, ad *Spondiaceae*, leg. *C. Welwitsch* 178 p. min. p., July 1857 (lectotype: BM!; duplicate from the lectotype: TUR-V 08659!).

= *Pyxine chrysanthoides* Vainio, *Ann. Acad. sci. Fenn.*, ser. A, 6(7): 71 (1915). TYPE: Antilles, Morne Rouge, 480-600 m alt. (lectotype: TUR-V 08648) fide Kalb (1987).

ILLUSTRATIONS: Swinscow & Krog (1975), Moberg (1983), Rogers (1986), Kalb (1987), Sammy (1988), Scutari (1995).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, grey to brownish grey, laciniate, 0.5–2.5 cm diam., adnate. PROXIMAL UPPER SURFACE continuous to cracked, smooth, slightly shiny, plane to slightly convex. DISTAL UPPER SURFACE continuous, smooth, slightly shiny, plane, sometimes slightly concave, with a darker zone near the tips. LACINIAE sublinear, irregularly branched, contiguous to slightly overlapping laterally, 0.5–0.7 (–1.0) mm wide; apices rounded, mainly flat, adnate; lateral margin smooth to crenulated to irregular; axils oval to auriculate or acute.

PRUINA farinaceous, forming glistening patches, subapical. MACULAE pale, rare, irregularly linear, marginal. POLYSIDIANGIA absent. SORALIA white, initially orbicular, then forming crescents or remaining orbicular, auriculate, but then becoming concave, best developed in the axils, marginal; soredia powder to granular. MEDULLA pale yellow to orange above, lower layer white and very thin. LOWER SURFACE black, shiny, smooth to papillate. RHIZINES black, simple, frequent, evenly distributed, to 0.3 mm long. APOTHECIA *obscurascens*-type, uncommon, plane to very convex, sessile, laminal, to 0.7 mm diam.; margin smooth, not visible in convex apothecia; disc black, shiny, epruinose. INTERNAL STIPE developed, not pigmented. EPITHECIUM 10 µm high; hymenium 60–70 µm high; subhymenium 70–80 µm high. ASCOSPORES 1-septate, *Dirinaria*-type, ellipsoid, (13–) 14–19 × 6–8 µm. PYCNIDIA frequent, mainly subapical. CONIDIA bacillary, 4–5 × ca. 1.0 µm.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K–, C–, KC–, P–, UV–; epithecium K+ purple; hymenium K–; subhymenium K–; internal stipe K–. **Secondary metabolites**: lichexanthone, triterpenes.

REMARKS. *Pyxine subcinerea* is characterized by the lichexanthone in upper cortex, the marginal soralia initially orbicular becoming crescent-shape to auriculate and the upper medulla pale yellow to dark orange with negative color tests and the apothecia from *obscurascens*-type.

As the African species (Swinscow & Krog 1975), pruina could be more abundant in some specimens than in the holotype, sometimes forming patches, and some specimens do not have maculae.

Pyxine meissneriana Nylanderand *P. sorediata* (Acharius) Montagne in Sagra have marginal to laminal soralia and pigmented medulla with negative color tests. These species are not known to Brazil, but in parts of the world where these three species occur, they could be easily separate from *P. subcinerea* by the absence of lichexanthone in upper cortex.

Another similar species is *P. cocoës* (Swartz) Nylander, that could be distinguish from *P. subcinerea* by the white medulla and concave laciniae. *Pyxine albovirens* differs in having orbicular to subspherical submarginal to laminal soralia and medulla K+ violet.

Pyxine jolyana Jungbluth et al. differs by its orbicular to capitate submarginal soralia and by the K+ purple medulla with norstictic acid (detect just with TLC).

ADDITIONAL MATERIAL EXAMINED. BRAZIL, SÃO PAULO STATE, Ibiúna Municipality, Morro Grande District, SKY Ranch, 23°39′S 47°13′W, 830 m alt., in tree in shadow between the garden and corral, 07-03-1992, leg. *M.P. Marcelli* 13298 (SP); idem, Morro Grande District,

23°39′S 47°13′W, 850 m alt., in tree in humid forest near to the highway, 07-03-1992, leg. *M.P. Marcelli* 31366 (SP); idem, Mogi-Mirim Municipality, Estação Experimental do Instituto Florestal, 22°26′S 46°57′W, 630 m alt., cerradão, on bark of tree, 14-V-2004, leg. *P. Jungbluth* & *M.P. Marcelli* 1002 (SP).

DISTRIBUTION. Africa (Swinscow & Krog 1975, 1988), Australia (Rogers 1986; Kalb 1994, in the key; Elix 2009), Europe (Moberg 1983), India (Awasthi 1980), Japan (Kashiwadani 1977b), Papua New Guinea (Kashiwadani 1977c), North America (Brodo et al. 2001, Amtoft 2002, Kalb 2002, Hansen et al. 2008), South America. In South America, it was cited to Argentina (Scutari 1995, Calvelo & Liberatore 2002), Brazil (Kalb 1987), Uruguay (Osorio 1992) and Venezuela (López-Figueiras 1986). In Brazil, it was cited to the States of Minas Gerais (Aptroot 2002), Mato Grosso do Sul, Rio de Janeiro (Kalb 1987), Rio Grande do Sul (Spielmann 2006) and São Paulo (Kalb 1987).

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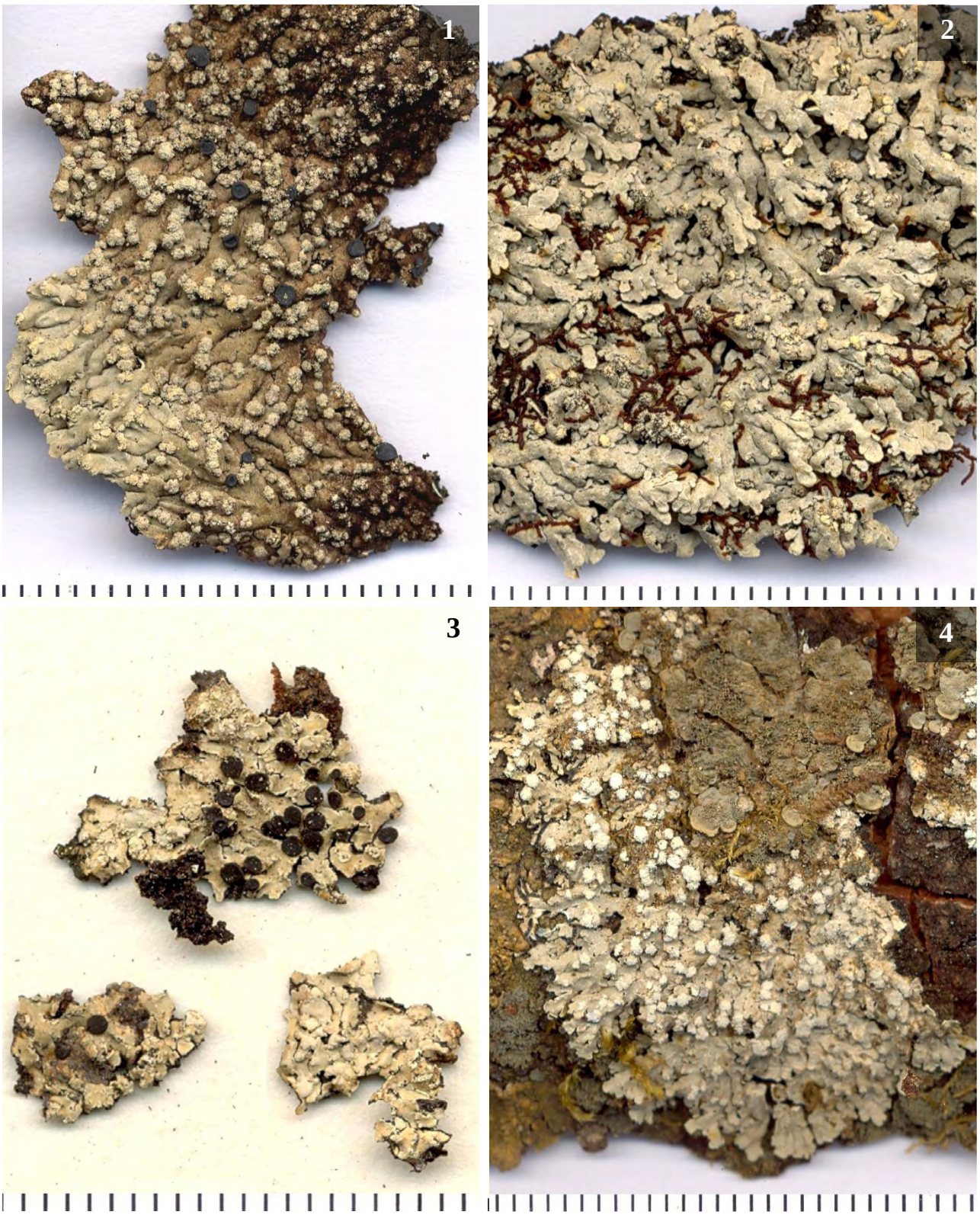
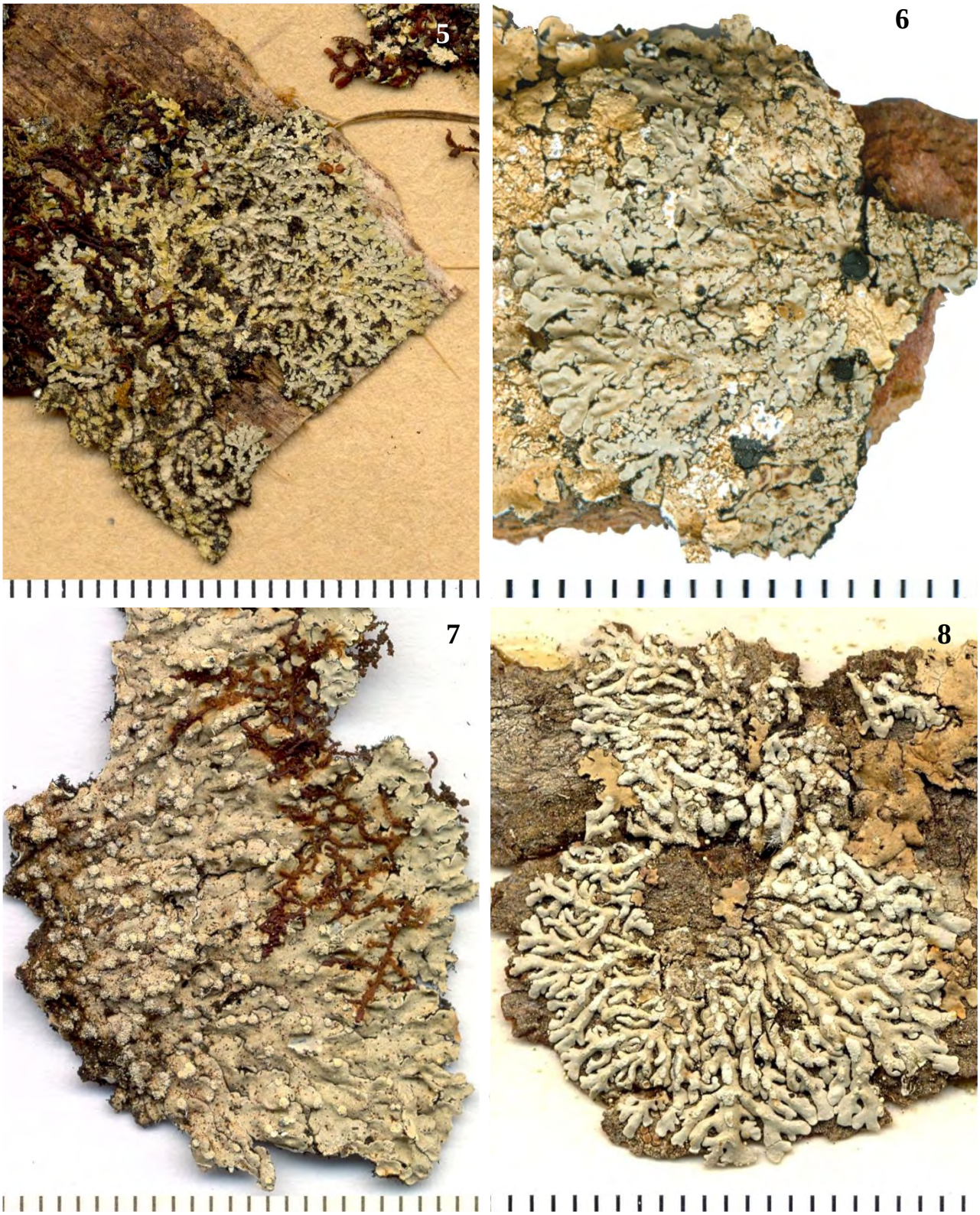
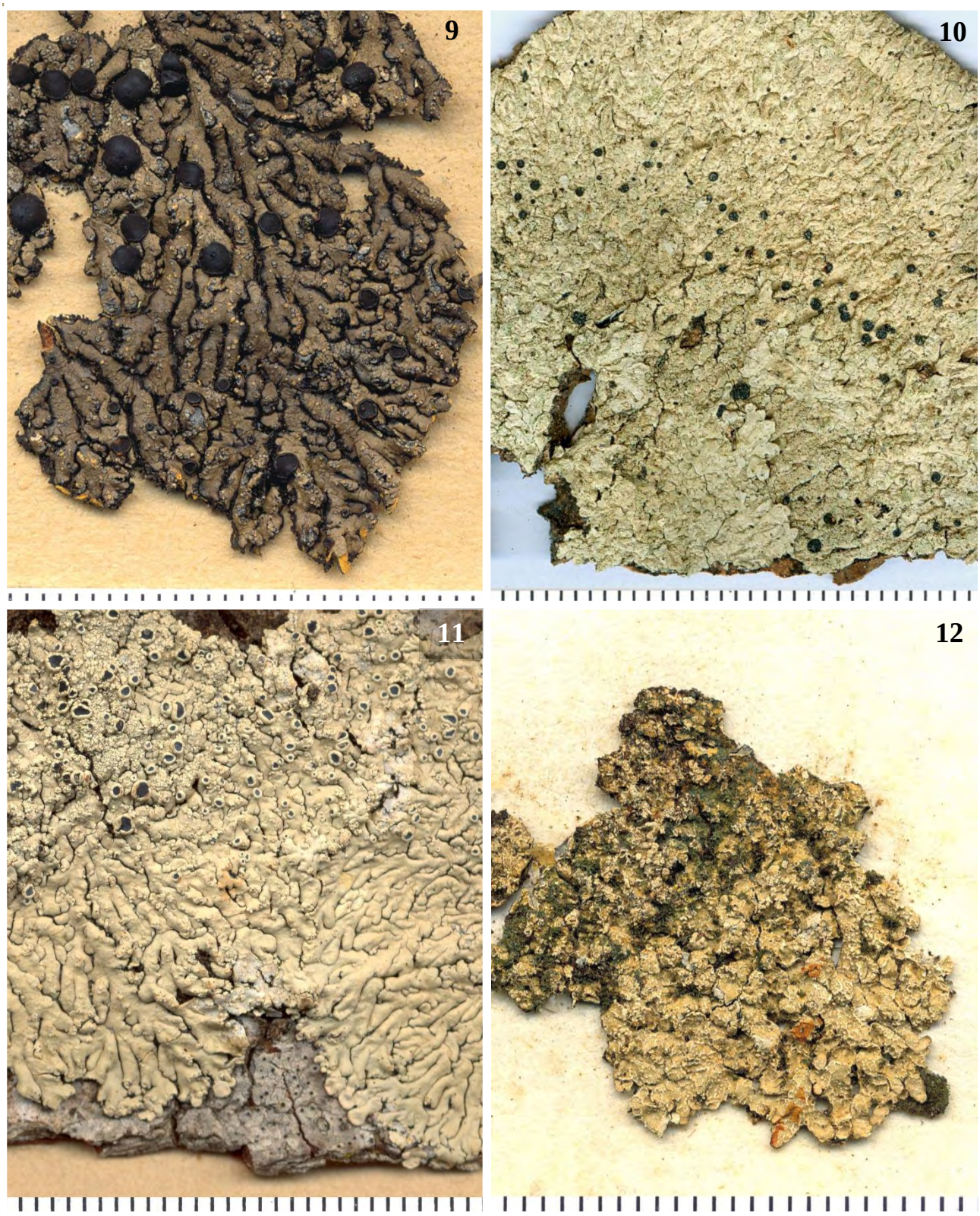


Figures 1-4: **1** – *Pyxine albovirens* (leg. M.P. Marcelli 4172); **2** – *P. caesiopruinosa* (leg. M.P. Marcelli 18192); **3** – Lectotype of *P. meissneri* var. *connectens* (leg. E. Vainio, Lich. Bras. Ex. 62, TUR); **4** – *P. fallax* (leg. M.P. Marcelli 3303). Scales in millimeters.



Figures 5-8: **5** – Lectotype of *Pyxine retirugella* var. *capitata* (leg. Skottsberg 1267, S); **6** – Lectotype of *P. heterospora* (leg. Raunkier 420, C); **7** – Holotype of *P. jolyana*. (leg. M.P. Marcelli 23690, SP); **8** – Holotype of *P. katendei* (leg. *T.D.V. Swinscow* 3U 34/1, BM). Scales in millimeters.



Figures 9-12: **9** – Lectotype of *Pyxine obscurascens* (leg. Malme 3895, S); **10** – Lectotype of *P. oceanica* (leg. J. Rock, Lich. Rar. Ex. 207); **11** – Lectotype of *P. physciaeformis* (leg. Malme 3880, S); **12** – Lectotype of *P. retirugella* (leg. D.E.S.A. Jardin, H-NYL.). Scales in millimeters.

Capítulo 5

Studies in *Pyxine* (*Physciaceae*) without vegetative propagules in Brazil

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Studies in *Pyxine* (*Physciaceae*) without vegetative propagules in Brazil

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ABSTRACT: Eighteen species and one variety of *Pyxine* without vegetative propagules are recorded to Brazil and are treated in this work. Key, illustrations and descriptions are presented. Also, some synonyms are discussed. *Pyxine minuta* Vainio, formerly considered synonyms of *P. pyxinoides* (Müll. Arg.) Kalb, is here considered as good species. *Pyxine nitidula* Müll. Arg., considered synonym of *P. minuta*, is proposed as synonym of *P. pyxinoides*.

KEY-WORDS: lichens, lichenized fungi, *Physciaceae*, taxonomy

INTRODUCTION

Pyxine Fries is a typically tropical genus with more than 65 known species. It is characterized by the epithecium becoming purple in potassium hydroxide solution, the dark pigmented hypothecium and the *Dirinaria*-type ascospores.

Other characteristics of this genus are the different types of ontogeny of the apothecia, the presence of lichexanthone in upper cortex in about half of the species and also the frequent pigmentation of the medulla, generally the upper layer.

The internal part of the stipe is an interesting taxonomically useful feature; it can be pigmented and react differentially with the color tests routinely used in Lichenology, depending of the taxa.

For more information about others morphological characteristics of *Pyxine* and the history of the genus in Brazil, see Jungbluth & Marcelli (2010a/b), Malme (1897), Imshaug (1957), Swinscow & Krog (1975) and Kalb (1987).

The present work is a study of the types of names and synonyms of the Brazilian species that do not produce vegetative propagules.

MATERIALS AND METHODS

Type specimens were kindly lent by the curators of BM, C, FH, G, H, M, PC, S and TUR or were studied in Herbarium Kalb and UPS. Additional specimens, when present, were mainly collected in São Paulo State, southeastern Brazil.

All the methodology and terminology used follow Jungbluth & Marcelli (2010a/b).

RESULTS AND DISCUSSION

Key to the Brazilian *Pyxine* species without vegetative propagules

1a) Upper cortex K+ yellow, UV−, atranorine present 2
1b) Upper cortex K−, UV+ yellow, lichexanthone present 10

2a) Upper medulla pale cream to cream, K− or K+ faint red ..... *P. primaria*
2b) Upper medulla yellow and/or orange and/or ochre, K+ yellow to orange or violet 3

3a) Medulla completely orange to ochre; norstictic acid present in epithecium .....
..... *P. schechingeri*
3b) Medulla with a white lower layer; without norstictic acid in epithecium 4

4a) Upper medulla K+ yellow to orange or yellow with orange borders and P+ orange .....
..... 5
4b) Upper medulla K+ purple/violet and P+ purple or blackish purple..... 6

5a) Laciniae concave; maculae marginal and linear ..... *P. rhizophorae*
5b) Laciniae convex; maculae marginal to laminal and linear to subreticulate .....
..... *P. endolutea*

6a) Maculae very evident through the entire upper surface, effigurate to subreticulate .....
..... *P. rhodesiaca*
6b) Maculae absent or pale and resembling veins restrict to distal parts of the thallus 7

7a) Apothecia *obscurascens*-type ..... *P. mantiqueirensis*
7b) Apothecia *cocoës*-type 8

8a) Apothecia without stipe ..... *P. astipitata*
8b) Apothecia with stipe at least partially tinged orange 9

9a) Internal stipe orange with a white external layer; norstictic acid in medulla .....
..... *P. exoalbida*
9b) Internal stipe orange at all, sometimes with a white layer below; norstictic acid absent .....
.....*P. pungens*

10a) Apothecia *physciaeformis*-type 11
10b) Apothecia *cocoës*-type or *obscurascens*-type 13

11a) Medulla white throughout ..... *P. astridiana*
11b) Medulla yellow to pale orange to orange above 12

12a) Laciniae 0.2–0.7 mm wide; pigmented medulla K+ wine ..... *P. nana*
12b) Laciniae 0.8–1.5 mm wide; pigmented medulla K− ..... *P. simulans*

13a) Apothecia *cocoës*-type 14
13b) Apothecia *obscurascens*-type 16

14a) Upper medulla yellow, K+ orange to yellow ..... *P. cocoës*
14a) Medulla white throughout, K− 15

15a) Internal stipe reddish to brownish red, K+ reddish rose ..... *P. petricola*
15b) Internal stipe white, K− ..... *P. petricola* var. *convexula*

16a) Laciniae 0.5–1.0 mm wide; medulla dark yellow to orange ..... *P. cognata*
16b) Laciniae 0.2–0.5 (−0.7) mm wide; medulla white or/and yellowish 17

17a) Maculae mainly marginal; medulla P− ..... *P. minuta*
17b) Maculae mainly laminal; medulla P+ yellow to orange/red 18

18a) Medulla white throughout, P+ reddish orange ..... *P. microspora*
18b) Medulla pale yellow, P+ yellow ..... *P. pyxinoides*

THE SPECIES

Pyxine astipitata Jungbluth & Marcelli

Bryologist **xx**: xx–xx. 2010 (Capítulo 3 desta tese). TYPE**:** Brazil, São Paulo State, Municipality of Altinópolis, Fazenda da Gruta, 21°04′08,9″S, 47°26′14,5″W, alt. 650 m, on trunk of a thin tree in the border of a secondary forest, 06-VI-2008, leg. *P. Jungbluth* & *M.J. Kitaura* 2078 (holotype—SP!).

The description, **illustrations and distribution of this species are presented in Jungbluth & Marcelli (2010a)**.

Remarks. *Pyxine astipitata* is characterized by the *cocoës*-type apothecia, the poorly developed to absent internal stipe and the K+ violet, P+ blackish violet upper medulla. True maculae are absent or very rare and restrict to the margins. Elevated veins in the upper cortex can be present and sometimes resembles maculae when are discreetly paler than the upper cortex. These elevated veins, when present, are restrict to distal parts of the thallus.

Pyxine rhodesiaca (TUR!) is morphologically similar, but differs by its abundant effigurate to irregularly linear laminal and marginal maculae, dispersed through all the upper surface and developed white internal stipe.

Pyxine pungens (W!) differs by having an almost totally orange K+ rose well developed internal stipe.

Pyxine astridiana Kalb

Bibl. Lichenol. **24**: 33. 1987. TYPE**:** Brazil, São Paulo, Serra do Mar, ca. 20 km E of Cruzeiro, in a light and relatively dry rainforest, 22°33'S, 44°45'W, 800 m alt., corticolous, leg. *K. Kalb* & *G. Plöbst* **12330**, 3-XI-1978 (holotype—Herb. Kalb!).

(Fig. 1)

DESCRIPTION OF THE HOLOTYPE

THALLUS roundish, corticolous, grayish white to brownish white, laciniate, 3.5 cm diam., closely adnate. **Proximal upper surface** continuous, mainly smooth, but some parts rugose, shiny, plane to convex. **Distal upper surface** continuous, smooth, shiny, plane, without a darker zone near the tips. **Laciniae** sublinear to linear, irregularly to dichotomously branched, contiguous to rarely overlapping laterally, 0.5–0.7 (−1.0) mm wide; **apices** subrounded, plane to slightly concave, adnate; **lateral margin** smooth to slightly irregularly sinuous; **axils**

forming right angles. **Pruina** absent. **Maculae** pale to rarely distinct, rare, very sparse, irregularly linear, mainly marginal, radiating from the axils base to the lamina. **Medulla** white. **Distal lower surface** in some parts brown, shiny, smooth to slightly irregular. **Proximal lower surface** black, shiny, smooth to slightly irregular. **Rhizines** black, simple, abundant, to 0.3 mm long. **Apothecia** *physciaeformis*-type, numerous, slightly concave, sessile, laminal, up to 1.5 mm diam.; **margin** smooth to slightly crenulated; **amphithecia** smooth; **disc** black, shiny, epruinose. **Internal stipe** present, white. **Epithecium** 10 µm high; **hymenium** 60–70 µm high; **sub-hymenium** 50–60 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 17–21 × 7–8 µm. **Pycnidia** few, laminal. **Conidia** not seen.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K–; **sub-hymenium** K–; **internal stipe** K–. **Secondary metabolites:** lichexanthone, terpenes.

REMARKS. *Pyxine astridiana* is characterized by the lichexanthone in upper cortex, the white medulla with negative color tests and the apothecia *physciaeformis*-type.

At a first look, *P. astridiana* resembles a *Physcia* species because of the abundant apothecia with persistent thalline margins and the white medulla. However, the presence of lichexanthone in the upper cortex, the K+ purple epithecium, the pigmented hypothecium and *Dirinaria*-type ascospores place it easily in *Pyxine*.

The other three species that occur in Brazil with this type of apothecia are *P. nana* Kalb (herb. Kalb!), *P. physciaeformis* (Malme) Imshaug (S!) and *P. simulans* Kalb (herb. Kalb!), all of them with the medulla pigmented yellow to orange-yellow.

Pyxine petricola Nyl. in Cromb. (BM!) and *P. petricola* var. *convexula* (Malme) Kalb (UPS!) have white medulla and apothecia that begin with thalline margins and become carbonized. Nevertheless, there are some thalli, especially the small ones, where the margins are not yet carbonized; they can be easily distinguish from *P. astridiana* Kalb by the wider laciniae (rarely smaller than 1.0 mm wide) with evidently concave tips and the presence of mainly marginal pale to distinct maculae.

DISTRIBUTION. *Pyxine astridiana* was cited to South America, Brazil and Colombia (Kalb 1987). In Brazil, it was cited to São Paulo State (Kalb 1987).

Pyxine berteriana (Fée) Imshaug

Trans. Am. micros. Soc. **76**(3): 254. 1957. *Circinaria berteriana* Fée, *Ess. Cryptog. Ecorc. Exot. Offic*.: 128. 1824. TYPE**:** Insula Martinicensi, ad corticem Quassiae excelsae (holotype—G, probably lost, see below).

Pyxine meissneri Tuck. ex Nyl., *Ann. Sci. nat*. **4**(11): 255. 1859. TYPE: Cuba, leg. *Wright*, Lichenes Cubae Nr. 95 (lectotype: FH pr. p., with *Pyxine cocoës* (Sw.) Nyl., photo!; duplicates from the lectotype: B, L, M!, PC! pr. p., with *Pyxine cocoës*, UPS). – *Pyxine cocoës* var. *meissneri* (Tuck. ex Nyl.) Tuck., *Proc. Am. Acad. Arts Sci* **12**: 166. 1877.

Pyxine cocoës var. *endoxantha* Müll. Arg., *Flora* **65**: 318. 1882. TYPE: Nouv. Caledonie, Balade, 1881, leg. *Vieillard* (holotype: G) fide Rogers (1986).
Pyxine meissneri var. *rinodinoides* Vainio, *Suom. Tiedeak. Tomit*. A(**6**), 69. 1915. TYPE: India, Occ. in insula St. Jan ad corticem arboris prope Coral-Bay (Caroline), 22-2-1906, leg. *C. Raunkier* (holotype: C!).

ILLUSTRATIONS: Rogers (1986), Kalb (1987), Scutari (1995) and Brodo et al. (2001).

Description of the duplicate of the lectotype of *Pyxine meissneri* Tuck. ex Nyl. deposited in M

THALLUS orbicular, corticolous, brownish white to brownish grey, laciniate, 2.0–4.3 cm diam., closely adnate. **Proximal upper surface** continuous, smooth to slightly rugose, slightly shiny, plane. **Distal upper surface** continuous, smooth, sometimes with some irregularities, as concavities, slightly shiny, plane, without a darker zone near the tips. **Laciniae** sublinear, irregularly to dichotomously branched, contiguous to overlapping laterally, 0.6–1.0 mm wide; **apices** subtruncate, flat and adnate or concave; **lateral margin** crenate to deeply incised to sublacinulate in the centre of the thallus; **axils** acute. **Pruina** in glistening large patches, dense, at the lamina of the distal parts of the laciniae. **Maculae** pale to distinct, sparse, irregularly linear, laminal and marginal. **Medulla** yellow above, lower layer white and thin. **Lower surface** black, shiny, smooth to slightly irregular. **Rhizines** black, simple to rarely branched, just few seem (closely attached), up to 2.5 mm long. **Apothecia** *cocoës*-type, numerous, plane becoming convex, sessile, laminal, up to 1.0 mm diam.; **margin** entire and undulate, not visible in very convex apothecia; **disc** black, slightly shiny, epruinose. **Internal stipe** well developed, not pigmented. **Epithecium** 10 µm high; **hymenium** 80–90 µm high; **sub-hymenium** 90–110 µm high. **Ascospores** 1-septate,

Dirinaria-type, ellipsoid, 16–20 × 6–8 μm. **Pycnidia** rare, laminal. **Conidia** sublageniform, 4–5 × ca. 1 μm.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K+ orange to yellow, C−, KC−, P+ orange, UV–; **epithecium** K+ purple +; **hymenium** K–; **subhymenium** K–; **internal stipe** K–. **Secondary metabolites:** lichexanthone, terpenes.

Remarks. *Pyxine berteriana* is characterized by the lichexanthone in upper cortex, the upper medulla yellow K+ orange to yellow, P+ orange and apothecia *obscurascens*-type.

This is a species with wide circumscription nowadays. Unhappily, the holotype of *Circinaria berteriana* Fée has been lost (Philippe Clerc, curator of G, pers. comm. 2009), but the illustration of this material in Fée (1824, Table XXX, fig. 3a and 3b) shows evidently *obscurascens*-type apothecia. Imshaug (1957) had the opportunity to see this holotype and wrote: "The type of *C. berteriana* lacks the "thalloid margin" which Tuckerman [also Nylander (1859)] ascribed to *P. meissneri*". He continued: "The type of *P. meissneri* [Wright 95, the FH "holotype", actually the lectotype], however, consists of material both with and without this pseudothalloid margin". This FH material referred by Imshaug consists of a thallus of *P. meissneri* with a thallus of *P. cocoës* glued side by side; the two specimens have apothecia *cocoës*-type. The duplicates from M and PC present *cocoës*-apothecia too and both are *Pyxine meissneri* var. *rinodinoides*.

Swinscow & Krog (1975) studied the lectotype of *C. berteriana*, but they described the apothecia of an African specimen without any mention of the margins features. Kashiwadani (1977) also gave a superficial description of the apothecia, but mentioned the presence of dark brown margins.

Rogers (1986) claimed to have seen the holotype of *C. berteriana* and observed that this material consisted of "three minute fragments poorly developed, but cannot be shown to be different from the lectotype of *P. meissneri*". He did not describe the apothecia of *C. berteriana*, if they were still present at the time he studied the material, but his description make clear that the Australian material has *cocoës*-type apothecia, as also mentioned by Elix (2009). Others authors that observed *cocoës*-type apothecia are Moore (1968), Kalb (1987), Scutari (1995) and Gu & Chen (2003).

Propably, there is two taxa involved, one with *obscurascens* and another one with *cocoës* apothecia.

While studying Brazilian material, several specimens with permanent *physciaeformis*-type apothecia were found. These material was chromatographed together the duplicates of

P. meissneri and with the holotype of *P. meissneri* var. *rinodinoides*. Besides the similar color of the upper medulla and color testes results, the triterpenes array from the Brazilian specimens was completely different from that found in the types. This Brazilian new taxon is different from the others species with *physciaeformis*-type apothecia, as it has the same color of medulla and color tests and is maculate as *P. berteriana* (see Table 1). It will be described elsewhere.

Aptroot (1987) considered *Pyxine meissneri* var. *genuina* Malme as a superfluous name applied to *P. meissneri*; nevertheless, this is legitimate and is actually synonym of *P. petricola* Nyl. in Cromb. (see remarks under this species).

DISTRIBUTION. Africa (Swinscow & Krog 1975, 1988, Kalb 1987, Aptroot 1988), Australia (Rogers 1986, Kalb 1987, Elix 2009), Central America (Kalb 1987), China (Gu & Chen 2003), North America (Moore 1968, Kalb 1987, Brodo et al. 2001), Papua New Guinea (Kashiwadani 1977), South America (Kalb 1987) and Taiwan (Aptroot et al. 2002). In South America, it was cited to Argentina (Kalb 1987, Scutari 1995, Calvelo & Liberatore 2002), Brazil (Kalb 1987), Colombia (Kalb 1987), French Guiana, Guyana (Aptroot 1987), Paraguay (Kalb 1987), Uruguay (Osorio 1972) and Venezuela (Vareschi 1973, López-Figueiras 1986, Kalb 1987). In Brazil, it was cited to the States of Goiás (Kalb 1987), Minas Gerais (Krempelhuber 1873 as *P. cocoës* fide Kalb 1987; Vainio 1890, as *Pyxine meissneri* Tuck.),

Table 1. Comparison between *Pyxine* species with lichexanthone in upper cortex and *physciaeformis*-type apothecia (except *P. berteriana*).

Species	Laciniae width (mm)	Pruina	Maculae	Upper medulla	K in medulla	P in medulla
Pyxine astridiana	0.5–0.7 (−1.0)	Absent or very sparse	Sparse	White	–	–
Pyxine berteriana	0.6–1.0	Dense	Frequent	Yellow	Orange to yellow	Orange
Pyxine nana	0.2–0.7	Absent	Sparse to frequent	Yellow to pale orange	Vine	–
Pyxine physciaeformis	0.7–1.5	Absent or very sparse	Absent	Yellowish orange to yellow	Faint reddish to orange	Faint red
Pyxine simulans	0.8–1.5	Absent or very sparse	Sparse	Orange-yellow to dark orange	–	–

Mato Grosso (Malme 1897, as *P. meissneri* var. *physciaeformis* Malme fide Kalb 1987), Mato Grosso do Sul (Kalb 1987, Fleig & Riquelme 1991, Osorio 1992), Paraná (Osorio 1977, Kalb

1987), Rio de Janeiro (Kalb 1987), Rio Grande do Sul (Osorio & Homrich 1978, Osorio & Fleig 1987, 1989) and São Paulo State (Kalb 1987, Marcelli 1998, Zahlbruckner 1909, as *P. meissneri* Tuck.).

Pyxine cognata Stirt.

Proc. Phil. Soc. Glasgow **11**: 311. 1879. TYPE: India, Nilgherries, leg. *Watt* s.n. (holotype: BM!).

= *Pyxine berteriana* (Fée) Imshaug var. *himalaica* D.D. Awasthi. *Phytomorphology* 30: 366. 1980. Type: India, Uttar Pradesh, Almora district, on way to Kasardevi, ca 1930 m alt., on bark of tree, 12-6-1956, leg. *D.D. Awasthi* 3476 (holotype: probably LWG).

(Fig. 2)

THALLUS orbicular, corticolous, brownish grey to grey, laciniate, 2.0 cm diam. (one fragment with 1.5–2.5 cm diam., the other with 1.9–2.0 cm diam.), closely adnate. **Proximal upper surface** continuous, smooth, slightly shiny, plane. **Distal upper surface** continuous, smooth, slightly shiny, plane, very slightly concave, without a darker zone near the tips. **Laciniae** linear to sublinear, irregularly branched, contiguous, 0.4–1.0 mm wide; **apices** subrounded, flat, adnate; **lateral margin** smooth, sometimes crenate, rarely deeply incised; **axils** acute. **Pruina** on glistening large patches, on the lamina of the laciniae, but not only on the distal upper surface. **Maculae** pale, very sparse, irregularly linear, marginal. **Medulla** dark yellow to orange above, lower layer white and very thin. **Distal and proximal lower surface** black, slightly shiny, smooth to rugose. **Rhizines** (just few seem) black, simple, sometimes irregularly branched, abundant, up to 0.5 mm long. **Apothecia** *obscurascens*-type, frequent, plane, rarely slightly convex, sessile, laminal, up to 1.0 mm diam.; **margin** smooth, not visible in very convex apothecia; **disc** black, dull to slightly shiny, sometimes with brown and dense pruina. **Internal stipe** developed, reddish orange becoming pale below. **Epithecium** 6–10 µm high; **hymenium** 65–80 µm high; **sub-hymenium** 20–80 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 16–22 × 6–8 µm. **Pycnidia** rare, subapical. **Conidia** not found.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K+ pale red. **Secondary metabolites:** lichexanthone, terpenes.

REMARKS. *Pyxine cognata* is characterized by the lichexanthone in upper cortex, the upper medulla yellow to orange with negative color tests and apothecia *obscurascens*-type. The holotype has plates of agglutinated pruina on the lamina of the distal parts of the laciniae.

Awasthi (1980) described the material from India as "faintly pruinose in apical region". Kalb (1987) studied material from several parts of the world, including India and Brazil, and described large plates of pruina. Perhaps, there are more taxa involved or Awasthi (1980) studied populations without this feature.

Kalb (1987) observed a K+ purple reaction in the pigmented part of the internal stipe. Awasthi (1980) did not observe the positive reaction and pointed that the internal stipe was not well developed. The holotype develops a K+ pale red in the pigmented area of the stipe.

The holotype has ascospores up to 22 µm long. The original description (Stirton 1879) presented ascospores up to 25 µm long while Stirton (1898) described ascospores up to 27 µm long, the same length found years later by Awasthi (1980). Kalb (1987) and Elix (2009) found only ascospores up to 20 µm. Kalb (1987) pointed out that probably Stirton took the measurements in a solution of potassium hydroxide. Nevertheless, in the envelop of the holotype there is an annotation (possibly with Stirton's handwriting) with the ascospores dimensions: "0.17−0.22 × 0.06−0.075 µm". Probably Stirton just transcribed wrongly the measurements to the publications, while Awasthi (1980) could had a different taxa involved.

Indeed, Awasthi (1980) proposed *P. berteriana* var. *himalaica* to the specimens similar to *P. cognata* but with smaller ascospores, pale yellow to yellow medulla and agglutinate pruina. Kalb (1994) had the opportunity to study the two holotypes and was able to conclude that the two are morphologically identical and have the same array of triterpenes.

Pyxine berteriana (Fée) Imshaug is morphologically similar, differing in the chemistry: the upper medulla is slightly paler and is K+ orange to yellow and P+ orange and the apothecia are *cocoës*-type.

Pyxine minuta Vainio and *P. pyxinoides* (Müll. Arg.) Kalb have *obscurascens*-type apothecia, but are saxicolous species with smaller laciniae (up to 0.7 mm) and smaller ascospores (up to 16 µm long).

Pyxine nana Kalb and *P. simulans* Kalb are easily distinguished from *P. cognata* by the apothecia of the *physciaeformis*-type.

Distribution. Africa (Kalb 1987), Australia (Kalb 1994, Elix 2009), China (Kalb 1987), India (Stirton 1879, Awasthi 1980, Kalb 1987), Brazil (Kalb 1987). In Brazil, it was cited to the

States of Goiás, Mato Grosso, Mato Grosso do Sul (Kalb 1987), Rio Grande do Sul (Fleig 1990) and São Paulo (Kalb 1987).

Pyxine endolutea Kalb

Bibl. Lichenol. **24**: 49. 1987. TYPE**:** Venezuela, Estado Lara Numero, a lo largo de la carretera Los Naranjos – Los Aposentos, cercanias de Humocaro, 1800−1900 m alt., leg. *M. Lopez-Figueiras* **28660**, 8-I-1980 (holotype: Herb. Kalb 14498!).

(Fig. 3)

THALLUS orbicular, corticolous, brownish white to brown, laciniate, 5 cm diam., adnate. **Proximal upper surface** continuous, rarely with cracks, smooth to concave (concavities delimited by the maculae), slightly shiny, convex to concave. **Distal upper surface** continuous, smooth to concave (concavities delimited by the maculae), slightly shiny, plane to concave, without a darker zone near the tips. **Laciniae** sublinear, irregularly to rare dichotomously branched, overlapping laterally, 0.3–1.0 mm wide; **apices** rounded, flat to concave, sometimes ascendant; **lateral margin** crenate; **axils** in right angle to oval. **Pruina** faint, disperse through the centre of the lamina of the distal part of some laciniae. **Maculae** distinct, abundant, irregularly linear at the margins becoming subreticulate in the centre of the lamina. **Medulla** sulphur yellow above, lower layer very thin and white. **Lower surface** black, slightly shiny, smooth to slight irregular. **Rhizines** concolored with the lower cortex, simple, few, up to 0.5 mm long. **Apothecia** *obscurascens*-type (but in some young apothecia some parts of the margin remain with the same color of the upper cortex), frequent, plane becoming very convex, sessile, marginal, up to 1.5 mm diam.; **margin** smooth, not visible in very convex apothecia; **disc** black, slightly shiny, epruinose. **Internal stipe** well developed, brownish yellow. **Epithecium** 5–10 µm high; **hymenium** 80–100 µm high; **sub-hymenium** 130–150 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 18–19 × 8 µm (very few found). **Pycnidia** rare, laminal. **Conidia** not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellowish orange, C–, KC–, P+ dark orange, UV–; **epithecium** K+ purple; **hymenium** K–; **sub-hymenium** K–; **internal stipe** K–. **Secondary metabolites:** atranorine, terpenes.

REMARKS. *Pyxine endolutea* is recognized by the presence of atranorine in the upper cortex, the sulphur yellow upper medulla K+ yellowish orange and P+ dark orange and evident

laminal subreticulate maculae. The apothecia are from an intermediate type, as some starts with carbonized margins while others remain vestiges of thalline margins.

Pyxine rhizophorae Kalb is morphologically similar, but its laciniae are very concave and confluent, the apothecia evidently of *obscurascens*-type and the medulla has orange parts. *Pyxine endolutea* does have occasionally some concave laciniae in the very distal parts, but in the centre of the thallus the laciniae are evidently convex, and the medulla is sulphur yellow, without orange parts. Besides, the maculae in *P. rhizophorae* are linear and marginal, while in *P. endolutea* the maculae start from the margins going towards the center of the lamina, becoming more evident and subreticulate.

Until this moment, only three specimens of *P. endolutea* are known. One of these (herb. Kalb 14133!, from Bahia State) is somehow different from the holotype. Its thallus is grayish white, has more plane laciniae and is closely adnate. Besides, the laciniae are linear and contiguous, and the apices vary from subtruncate to rounded, resembling *Pyxine primaria* Kalb, a species with negative color reactions in the medulla and not so evidently maculate. Perhaps this variation is due to the relief of the substrate. Kalb (1987) confirmed the identity of this sterile specimen by TLC.

More efforts (more collections) are needed to understand the morphological variation of this species.

SPECIMEN EXAMINED. Brazil, Bahia State, opposite Porto Seguro, along the river Buranhém, 16°27’ S, 39°03’ W, 3 m alt., on thin branches of deciduous trees at the edge of a mangrove forest, 23-VII-1980, leg. *K. Kalb* & *M. Marcelli* 14133.

Distribution. SOUTH AMERICA, Venezuela and Brazil (Kalb 1987). In Brazil, it was cited to Bahia State and Minas Gerais State (Kalb 1987).

Pyxine exoalbida Jungbluth & Marcelli

Bryologist **XX**: 33. 2010 (Capítulo 3 desta tese). TYPE**:** Brazil, São Paulo State, Municipality of Bauru, Tibiriçá District, secondary forest managed by Instituto Florestal, 22°13′45,0″S, 49°04′50,3″W, 575 m alt., on tree branch, 04-VI-2008, leg. *M.J. Kitaura* & *P. Jungbluth* 1021 (holotype: SP!).

The description, illustrations and distribution of this species are presented in Jungbluth & Marcelli (2010a).

Remarks. *Pyxine exoalbida* is characterized by the *cocoës*-type apothecia with orange internal stipe K+ faint rose, circled by a white outside layer, and the notably presence of norstictic acid in the medulla, what makes this the first species without vegetative propagules with norstictic acid in South America.

It is very similar in morphology with *P. pungens*, but this species does not produce norstictic acid and does not have a white layer surrounding the orange internal stipe. See remarks under *P. exoalbida* in Jungbluth & Marcelli (2010a) for more information about similar species.

Pyxine mantiqueirensis Marcelli & Jungbluth

Bryologist **XX**: 33. 2010 (Capítulo 2 desta tese). TYPE**:** Brazil, Minas Gerais State, Municipality of São Tomé das Letras, 21°44′36″S, 44°58′39″W, 959 m alt., on rock in open woodland next to the waterfall Flávio, 19-I-2009, leg. *M.J. Kitaura*, *M.P. Marcelli* & *B.R. da Hora* 1361 (SP!).

The description, illustrations and the distribution of this species are presented in Jungbluth & Marcelli (2010a).

Remarks. *Pyxine mantiqueirensis* is characterized by the *obscurascens*-type apothecia with orange internal stipe K+ faint rose. It has not evident effigurate to irregularly linear maculae as *P. rhodesiaca*, but develops elevated veins limited to distal parts of the thallus, as do *P. astipitata*, *P. exoalbida* and *P. pungens*. However, different from these species, *P. mantiqueirensis* has apothecia from *obscurascens*-type.

The general morphology is similar *P. schechingeri* Kalb (Herb. Kalb!). Nevertheless, *P. schechingeri* has medulla pigmented throughout, smaller ascospores (10–13 × 5–6 μm) and norstictic acid restrict to the epithecium.

Pyxine microspora Vainio

Philipp. Journ. Sci., Sect. C, **8**: 110. 1913. TYPE**:** Philippines, Luzon, Province of Benguet, prope Kabayan, ad lapides, June 1909, leg. *R.C. Mc-Gregor* 8804 (lectotype: TUR-V no. 08676!; duplicate from the lectotype: BM!).

(Fig. 4)

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, saxicolous, brownish white, laciniate, 0.5–2.0 cm diam., closely adnate. **Proximal upper surface** entire cracked, smooth to rarely verrucose, slightly shiny, plane. **Distal upper surface** continuous to cracked, smooth, slightly shiny, plane to rarely concave, without a darker zone near the tips. **Laciniae** sublinear to linear, irregularly branched, contiguous, 0.2–0.4 mm wide; **apices** rounded, flat, adnate; **lateral margin** smooth to irregular; **axils** acute. **Pruina** rare, farinaceous, sparsely subapical. **Maculae** distinct, sparse, irregularly linear, laminal. **Medulla** white. **Lower surface** totally black, slightly shiny, smooth to papillate. **Rhizines** black (just few seen), simple to rarely branched, frequent, evenly distributed, to 1.5 mm long. **Apothecia** *obscurascens*-type, frequent, plane to convex, sessile, laminal, up to 0.6 mm diam.; **margin** smooth, not visible in very convex apothecia; **disc** black, shiny, epruinose. **Internal stipe** not well developed, not pigmented or yellowish brown near the subhymenium. **Epithecium** 10–15 µm high; **hymenium** 70–100 µm high; **sub-hymenium** 50–70 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 10–12 × 5–6 µm. **Pycnidia** rare, laminal. **Conidia** not seen.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P+ reddish orange, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K–. **Secondary metabolites:** lichexanthone, triterpenes.

Remarks. *Pyxine microspora* is characterized by the lichexanthone in upper cortex, the white medulla K–, P+ reddish orange, and the *obscurascens*-type apothecia.

This species is part of a confuse group of small saxicolous taxa that also includes *P. brachyloba* Müll. Arg., *P. minuta* Vainio, *P. nitidula* Müll. Arg. and *P. pyxinoides* (Müll. Arg.) Kalb, sometimes considered separated species, sometimes as synonym one of each other, as show Table 2.

Rogers (1986) had the opportunity to study all the types of the names involved and concluded, despite founding three different triterpenes arrays, that all these names were synonym of *P. minuta*. However, the oldest name has priority and Rogers should have considered *P. pyxinoides* instead *P. minuta*, published ten years later, as the valid name.

In the present work, the lectotype of *P. brachyloba* was not studied and no comments will be made about this species.

Pyxine microspora can be distinguished by its totally white medulla with laminal maculae and different terpene array. *Pyxine minuta* has white medulla, occasionally with yellowish parts, mainly marginal maculae (Table 3) and different terpene array in TLC.

Swinscow & Krog (1975) also analyzed by TLC the lectotype of *P. microspora* and the lectotype (not holotype) of *P. minuta*, proving that the two have different triterpenes array.

Pyxine pyxinoides has pale yellow medulla and laminal maculae, as *P. nitidula*, here considered synonym of *P. pyxinoides*, as these two species have the same terpene array.

Vainio (1913) considered *P. minuta* different from *P. microspora* by their larger ascospores (up to 19 µm); however, Swinscow & Krog (1975), studying the lectotype (not holotype) of *P. microspora*, found ascospores up to 16 µm. By the other hand, our measures of the ascospores of the lectotype of *P. microspora* got 12 µm as the maximum length and

Table 2. The synonyms inside the *Pyxine minuta* complex according to several authors. (OK = good species; "-" = no opinion expressed)

Species	Imshaug (1957)	Swinscow & Krog (1975)	Awasthi (1980)	Rogers (1986)	Kalb (1987)	This work
P. brachyloba	*P. minuta*	*P. minuta*	-	*P. minuta*	***P. pyxinoides***	-
P. microspora	-	OK	*P. minuta*	*P. minuta*	OK	OK
P. minuta	OK	OK	OK	OK	***P. pyxinoides***	OK
P. nitidula	-	-	-	*P. minuta*	-	***P. pyxinoides***
P. pyxinoides	-	-	-	*P. minuta*	OK	OK

Table 3. Characters found in type-material of the *P. minuta* complex.

Species	Laciniae width (mm)	Maculae	Medulla color	P test in medulla	Ascospores length (µm)
P. microspora	0.2–0.4	laminal	white	reddish orange	10–12
P. minuta	0.3–0.7	mainly marginal	white to yellowish	negative	12–14
P. nitidula	0.2–0.6	mainly laminal	pale yellow	not tested	12–14
P. pyxinoides	0.2–0.5	laminal	pale yellow	not tested	11–16

14 µm in the lectotype of *P. minuta*. Anyway, the color and the chemistry demonstrated to be sufficient in this group to separate these taxa. More studies with distinct populations from

different regions of the world are needed to test the consistency of these taxa, since only types are treated here.

Distribution. As the specific circumscription of this group is different from author to author, the real distribution of this group of taxa is confuse. Nevertheless, bibliographical references that cited the name *P. microspora* in accepted species level are presented. Africa (Swinscow & Krog 1975), Australia (Rogers 1986, Elix 2009), India (Awasthi 1980), Philippines (Vainio 1913, type locality), South America (Kalb 1987). In South America, it was cited to Brazil, Mato Grosso State (Kalb 1987).

Pyxine minuta Vainio

Acta Soc. Faun. Fl. Fenn. **7**(2): 156. 1890. TYPE**:** Brazil, supra rupem prope Rio de Janeiro, leg.Vainio 211 (lectotype: TUR-V 08677!; duplicate from the lectotype: UPS, see Alava 1988).

(Fig. 5)

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, saxicolous, grey at the centre to yellowish grey in the distal parts, laciniate, 2.0–2.5 cm diam., closely adnate. **Proximal upper surface** cracked, verrucose, dull, plane. **Distal upper surface** continuous to cracked, smooth, slightly shiny, plane to slightly convex, sometimes concave near the tips, with a paler zone near the tips. **Laciniae** sublinear, irregularly branched, contiguous, 0.3–0.7 mm wide; **apices** rounded to subrounded, flat, adnate; **lateral margin** smooth to irregular, sometimes crenulated; **axils** acute. **Pruina** absent. **Maculae** pale, rarely distinct, sparse, irregularly linear, mainly marginal. **Medulla** white to rarely somewhat yellowish. **Lower surface** black, slightly shiny, smooth to papillate. **Rhizines** black, simple, frequent, evenly distributed, up to 0.1 mm long. **Apothecia** *obscurascens*-type, numerous, plane to slightly convex, sessile, laminal, up to 0.4 mm diam.; **margin** smooth, not visible in very convex apothecia; **disc** black, dull, epruinose. **Internal stipe** not developed. **Epithecium** 10–15 µm high; **hymenium** 50–60 µm high; **subhymenium** 60–70 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 12–14 × 5–6 µm. **Pycnidia** rare, subapical. **Conidia** not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K–, C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K–. **Secondary metabolites:** lichexanthone, terpenes.

REMARKS. *Pyxine minuta* is characterized by the lichexanthone in upper cortex, the white to rarely yellowish medulla with negative color tests and the *obscurascens*-type apothecia.

Pyxine microspora Vainio is morphologically very similar, differing in the throughout white P+ orange medulla and the laminal maculae (see Tables 2 and 3 and remarks under *P. microspora*).

Pyxine pyxinoides (Müll. Arg.) Kalb is also morphologically very similar, differing in the laminal maculae and in the terpene array (see Tables 2 and 3 and remarks under *P. microspora*).

DISTRIBUTION. As the specific circumscription of this group is different from author to author, the real distribution of this group of taxa is confuse. Nevertheless, bibliographical references that cited the name *P. minuta* in accepted species level are presented. Australia (Rogers 1986), Bhutan (Aptroot & Feijen 2002), Central America (Imshaug 1957), India (Awasthi 1980), Papua Nova Guinea (Aptroot & Sipman 2001), South America (Vainio 1890). In South America, it was cited to Brazil (Vainio 1890) and Venezuela (Vareschi 1973). In Brazil it was cited to the States of Mato Grosso (Malme 1897), Rio de Janeiro (Vainio 1890, type locality) and Rio Grande do Sul (Malme 1897).

Pyxine nana Kalb

Bibl. Lichenol. **24**: 55. 1987. TYPE**:** Brazil, Estado de São Paulo, near José Bonifácio, c. 45 km SW of São José do Rio Preto, in a cerrado, 450 m, 21°05'S, 49°40'W, 13-X-1979, leg. *K. Kalb* & *G. Plobst* 12314 (holotype: Herb. Kalb!).

(Fig. 6)

Description of the holotype

THALLUS orbicular, corticolous, brownish grey, laciniate, 3 cm diam., adnate. **Proximal upper surface** continuous, smooth, slightly shiny, slightly convex to plane. **Distal upper surface** continuous, smooth, shiny, convex to plane, without a darker zone near the tips. **Laciniae** linear to sublinear, contiguous to rarely overlapping laterally, 0.2–0.7 mm wide; **apices** rounded, flat to slightly convex, adnate; **lateral margin** smooth and sometimes sublacinulate; **axils** acute to oval. **Pruina** absent. **Maculae** rare, pale, sublinear, submarginal to laminal, mainly in the distal parts. **Medulla** yellow to pale orange above, lower layer white. **Lower surface** black, shiny, smooth to slightly irregular. **Rhizines** black, simple, frequent, evenly distributed, up to 0.4 mm long. **Apothecia** *physciaeformis*-type, fairly common to

numerous, slightly concave, sessile, laminal, up to 1.5 mm diam.; **margin** smooth; **disc** black, slightly shiny, epruinose. **Internal stipe** developed, yellow to pale orange. **Epithecium** 5–10 µm high; **hymenium** 60–70 µm high; **sub-hymenium** 35–60 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 16–18 × 6–7 µm. **Pycnidia** frequent, laminal. **Conidia** not studied.

COLOR TESTS: upper cortex K–, UV+ yellow; yellow medulla K+ vine (rarely parts K–, without pigment), C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K+ vine in upper part. **Secondary metabolites:** lichexanthone, terpenes, pigment.

REMARKS. *Pyxine nana* is characterized by the lichexanthone in upper cortex, the yellow to pale orange upper medulla K+ vine, P– and the *physciaeformis*-type apothecia.

There are four species known to have apothecia whose margins never become carbonized: *P. astridiana* Kalb, *P. nana* Kalb, *P. physciaeformis* (Malme) Imshaug and *P. simulans* Kalb. All these species also share the presence of lichexanthone in upper cortex (Table 1). From these, *P. physciaeformis* is the only one to produce vegetative propagules (polysidiangia).

Pyxine astridiana is distinguished from *P. nana* by its white medulla with negative color tests.

Pyxine simulans has wider laciniae (up to 1.5 mm) and the upper medulla is darker (orange) and K−.

Despite the *cocoës*-type apothecia present in *P. berteriana* (Fée) Imshaug, it is not always easy to differentiate this species from *P. nana*, because there are specimens of *P. berteriana* with apothecia that become carbonized only when very old. Nevertheless, *P. berteriana* has concave laciniae and upper medulla without orange tones that always reacts P+ orange, while *P. nana* has plane to convex laciniae and an upper medulla always P− and with orange tonalities.

ADDITIONAL SPECIMENS EXAMINED. Brazil, São Paulo State, Fazenda 13 de Maio, ca. 18 km N of Botucatu and 14 km E von São Manuel, in a cerradão, 550 m, 22°45’ S, 48°25’ W, corticolous, leg. *K. Kalb* & *G. Gottsberger* 12316, 9-XI-1979; idem, Mogi-Mirim Municipality, Estação Experimental do Instituto Florestal, 22°26′S 46°57′W, 630 m alt., cerradão, corticolous, 14-V-2004, leg. *P. Jungbluth* & *M.P. Marcelli* 998; Brazil, Municipality of Mogi-Mirim, Estação Experimental do Instituto Florestal, 22°26′S 46°57′W, 630 m alt., cerradão, on fallen twig, 14-V-2004, leg. *M.N. Benatti* & *M.P. Marcelli* 1809.

Distribution. Africa and South America (Kalb 1987). In South America, it was cited to Brazil, São Paulo State (Kalb 1987, including the type locality).

Pyxine petricola Nyl. in Cromb.

Journ. Bot. Lond. **14**: 263. 1876. TYPE**:** Island of Rodriguez, saxicolous, leg. *Dr. I.B. Balfour* 2391, Venus Transit Expedition, 9-XII-1874 (lectotype: BM!; duplicates of the lectotype: BM s/no., H-NYL no. 31754!, no. 2336 insertum post mortem).

(Fig. 7)

Pyxine meissneri Tuck. ex. Nyl. var. *endoleuca* Müll. Arg., *Flora, Jena* **62**: 290. 1879. TYPE: habitat in territorio africano Djur, ad sepimenta magnae Seriba Ghattas, leg. Schweinfurth (lectotype: G!; duplicate of the lectotype: BM). – *Pyxine endoleuca* (Müll. Arg.) Vainio, *Hedwigia*, Beih. **37**: 42. 1898.

Pyxine meissneri var. *genuina* Malme, *Bihang Kongl. Svenska Vet.-Akad. Handl*. **23**, afd. 3(13): 36. 1897. TYPE: Paraguay, territor. Gran Chaco, in adpectu urbis Asuncion, ad *Enterolobium*, 19-7-1893, leg. *Malme* 1408 (lectotype: S!, duplicate of the lectotype UPS!).

Pyxine subvelata Stirton, *Trans. Proc. N. Z. Inst.* **30**: 396. 1898. TYPE: Queesland, Jimbour, on *H. olaefolium*, June 1895, leg. *F.M. Bailey* (holotype: BM) fide Swinscow & Krog (1975).

Pyxine pringlei Imshaug, *Trans. Am. micros. Soc.* **76** (3): 263. 1957. TYPE: in cortice arboris, Plains, Monterey, Mexico, No. 52, 19-VI-1889, leg. *C.G. Pringle* (holotype: FH, photo!).

Pyxine albida Magnusson in Magnusson & Zahlbruckner, *Ark. Bot.* **32A** (2): 57. 1945. TYPE: Hawaiian Islands, Maui, near Wailuku, in dry valley at about 350 m altitude on basaltic stone, 1922, *Skottsberg* 1012 (holotype: U) fide Rogers (1986).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, saxicolous, yellowish grey, laciniate, 2.0–7.2 cm diam., closely adnate. **Proximal upper surface** continuous to cracked, verrucose and rugose, dull, slightly convex. **Distal upper surface** continuous, verrucose and rugose, dull, slightly convex to concave, without a darker zone near the tips. **Laciniae** sublinear, irregularly to dichotomously branched, overlapping laterally, 0.5–0.7 (−1.0) mm wide; **apices** subrounded, concave before becoming convex, adnate; **lateral margin** smooth to irregular; **axils** acute. **Pruina** just in few regions, farinaceous, disperse, rarely forming small patches, subapical. **Maculae** pale to distinct, sparse to abundant, irregular, laminal, mainly in distal parts. **Medulla** white. **Distal**

and proximal lower surface black, shiny, smooth (just a little piece studied. **Rhizines** black (just few seem), simple, frequent, evenly distributed, up to 0.3 mm long. **Apothecia** *cocoës*-type, frequent, plane to convex, sessile, laminal, up to 0.1 mm diam.; **margin** smooth to undulate, not visible in very convex apothecia; **disc** black, slightly shiny, rarely with pruina, pruina when present white, scarce. **Internal stipe** well developed, rose to reddish above. **Epithecium** 10 µm high; **hymenium** 80–100 µm high; **subhymenium** 60–100 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 14–18 × 5–7 µm. **Pycnidia** abundant, laminal. **Conidia** not found.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K+ reddish rose. **Secondary metabolites:** lichexanthone, terpenes in very low concentrations.

REMARKS. *Pyxine petricola* is characterized by the lichexanthone in upper cortex, the white medulla with negative color tests, and the *cocoës*-type apothecia with pigmented internal stipe.

Imshaug (1957) considered *P. endoleuca* (Müll. Arg.) Vainio and *P. pringlei* Imshaug as distinct species because *P. endoleuca* had "stipe poorly developed, if at all, brown and confluent with exciple", while *P. pringlei* had "conspicuous red stipe". Nevertheless, the lectotype of *P. endoleuca* (G!) has well developed reddish brown to reddish rose internal stipe, as present also in *P. petricola*, as already observed by Swinscow & Krog (1975). The holotype of *P. pringlei* was not studied with details (seen just by photo), but the protologue is clear and Rogers (1986) saw these types and had the same opinion. Rogers (1986) also had the opportunity to examine the holotype of *P. albida* H. Magn. in Magnusson & Zahlbruckner (1945) and put it on the synonym of *P. petricola*.

Pyxine subvelata Stirton was not studied, but Rogers (1986), Swinscow & Krog (1975), Kalb (1987) and Elix (2009) were from the same opinion that it is synonym of *P. petricola* as well.

Kalb (1987) also considered *P. meissneri* var. *genuina* Malme as synonym of *P. petricola*. The internal stipe of the lectotype of this variety (S!) is well developed but is pale cream to very pale rose, K+ pale rose, and not evidently reddish brown and K+ reddish rose, as *P. petricola*. The TLC did not help in this group, as the terpenes are in very low concentration, what difficult the distinction between this variety and *P. petricola* var. *convexula* (Malme) Kalb.

Pyxine petricola var. *convexula* (Malme) Kalb is differentiated from *P. petricola* by its white and K− internal stipe.

According to Kalb (2002), specimens more appressed with convex laciniae and stramineous medulla had been described as *P. devertens* (Nyl.) Vainio [basyn. *Physcia devertens* Nyl., *Dirinaria devertens* (Nyl.) C.W. Dodge]. Swinscow & Krog (1975) noted the presence of norstictic acid in this species, but Kalb (2002) was unable to detect it in the holotype (H-NYL no. 31792) by HPTLC. The holotype needs to be studied again, as it was noted during the developed of this work that norstictic acid is absent or in very low concentrations near the tips. To be sure of the absence/presence of this acid, central old parts of the thallus are recommended to be chemically analyzed. Anyway, the fact of *P. devertens* presents stramineous medulla and different laciniae configuration is sufficient to maintain it as a different species for the time.

Pyxine berteriana (Fée) Imshaug is morphologically similar, differing in the yellow medulla K+ orange to yellow P+ orange.

Pyxine microspora Vainio, *P. minuta* Vainio and *P. pyxinoides* (Müll. Arg.) Kalb are exclusively saxicolous species with convex lacinulae up to 0.5 mm and smaller ascospores. See Table 3 for more differences.

Distribution. Australia (Stirton 1898, as *P. subvelata*; Rogers 1986; Sammy 1988; Kalb 1994, in the key), Africa (Müller Argoviensis 1879, as *Pyxine meissneri* var. *endoleuca*; Swinscow & Krog 1975, 1988, Kalb 1987, Aptroot 1988, Moberg 2004); Central America (Imshaug 1957, as *Pyxine pringlei*; Magnusson & Zahlbruckner 1945, as *P. albida*; Kalb 1987), North America (Imshaug 1957, as *P. endoleuca*, Kalb 2002), India (Awasthi 1980), South America (Malme 1897, as *P. meissneri* var. *genuina*), Taiwan (Aptroot et al. 2002). In South America, it was cited to Argentina (Kalb 1987, Calvelo & Liberatore 2002), Brazil (Kalb 1987), Paraguay (Malme 1897, as *P. meissneri* var. *genuina*; Kalb 1987), Uruguay (Osorio 1992) and Venezuela (Kalb 1987). In Brazil, it was cited to the States of Minas Gerais (Kalb 1987, Aptroot 2002), Mato Grosso (Malme 1897, as *Pyxine meissneri* var. *genuina*; Kalb 1987), Rio de Janeiro (Malme 1897, as *Pyxine meissneri* var. *genuina*), Rio Grande do Sul (Malme 1897, as *Pyxine meissneri* var. *genuina*; Osorio & Homrich 1978, as *Pyxine pringlei*; Osorio *et al*. 1982, as *Pyxine endoleuca*; Fleig 1995) and São Paulo State (Kalb 1987).

Pyxine petricola Nyl. in Cromb. var. *convexula* (Malme)

Pyxine meissneri Tuck. ex Nyl. var. *convexula* Malme, *Bihang till. Kgl. Svensk. Vetensk.-Akad. Handl*. **23** (3), afd. 3, no. 13: 37. 1897. TYPE: Brazil, Mato Grosso State, Corumbá, ad arborem Euphorbiaceam, 10-VIII-1894, no. 3889 [non 3885 neither 3887] (lectotype: S!; duplicates from the lectotype: G), fide Rogers (1986).

Pyxine petricola Nyl. in Cromb. var. *pallida* Swinscow & Krog, *Norw. J. Bot* **22**: 62. 1975. TYPE: Uganda, West Mengo District, Kyadondo County, Makerere Hill, on branches of a shrub in open parkland, June 1970, leg. *T.D.V. Swinscow* 2U 1/4 (holotype: BM!).

ILLUSTRATION: Kalb (1987).

DESCRIPTION OF THE LECTOTYPE

THALLUS orbicular, corticolous, yellowish grey, laciniate, 2.0–6.0 cm diam., adnate. **Proximal upper surface** continuous to cracked, smooth to verrucose, sometimes with lobules, slightly shiny, slightly convex. **Distal upper surface** continuous, smooth to slightly irregular because of the concavities induced by the maculae, sometimes with concavities, slightly shiny, slightly convex, without a darker zone near the tips. **Laciniae** sublinear, irregularly branched, contiguous to slightly overlapping laterally, 0.5–1.0 (–1.5) mm wide; **apices** rounded, mainly convex, adnate; **lateral margin** smooth to irregular, sometimes lobulate; **axils** acute. **Pruina** in large dense patches, subapical laminal to laminal. **Maculae** distinct, sparse to abundant at the laciniae tips, irregularly linear to subreticular, mainly laminal. **Medulla** white. **Proximal and distal lower surfaces** black, shiny, smooth to papillate. **Rhizines** black, simple to rarely irregularly branched, abundant, evenly distributed, up to 0.4 mm long. **Apothecia** numerous, mainly convex, sessile, laminal, 1.5 mm diam.; **margin** darkening on ageing, smooth, not visible in very convex apothecia; **disc** black, slightly shiny, without pruina. **Internal stipe** developed, not pigmented or very pale cream. **Epithecium** 10 µm high; **hymenium** 90–120 µm high; **sub-hymenium** 80–140 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 15–17 (–20) × 5–7 µm. **Pycnidia** few, subapical. **Conidia** [not found, just one pycnidia seen].

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K+ yellowish red; **sub-hymenium** K−; **internal stipe** K–. **Secondary metabolites:** lichexanthone, terpenes in very low concentration.

REMARKS. *Pyxine petricola* var. *convexula* is characterized by the lichexanthone in upper cortex, white medulla with negative color tests and the *cocoës*-type apothecia with white internal stipe K−.

Swinscow & Krog (1975) proposed P. *petricola* var. *pallida* to the specimens of *P. petricola* without K+ pigment they found in East Africa. Nevertheless, Malme (1897) had already created the name *P. meissneri* var. *convexula* to this variation.

Rogers (1986) was the first to propose a lectotype to *P. meissneri* var. *convexula*. He chose Malme no. 3889. Later, Kalb (1987) proposed Malme no. 3887 as lectotype and Aptroot (1987), by his turn, Malme no. 3885. Since Rogers (1986) has the priority, the correct lectotype is Malme no. 3889, deposited in S.

DISTRIBUTION. Africa (Swinscow & Krog 1975, as *P. petricola* var. *pallida*, Kalb 1987), Australia (Rogers 1986), South America (Malme 1897). In South America, it was cited to Brazil (Malme 1897, Kalb 1987) and Paraguay (Kalb 1987). In Brazil, it was cited to the States of Minas Gerais (Kalb 1987), Mato Grosso (Malme 1897, as *P. meissneri* var. *convexula*) and Rio Grande do Sul (Fleig 1995, Kalb 1987).

Pyxine primaria Kalb

Bibl. Lichenol. **24**: 62. 1987. TYPE**:** Brazil, Mato Grosso do Sul State, Estrada do Pantanal, a few km E von Coxim, in a dense cerrado along a tributary of Rio Taquari, 18°30’ S, 54°45’ W, 300 m alt., corticolous, 29-VI-1980, leg. *K. Kalb* 12267 (holotype: Herb. Kalb!).

(Fig. 8)

THALLUS orbicular, corticolous, brownish grey to yellowish grey, laciniate, 4 cm diam., adnate. **Proximal upper surface** continuous, smooth, rarely with irregularities, dull, plane to slightly convex. **Distal upper surface** continuous, smooth, rarely with irregularities, dull, plane to convex, without a darker zone near the tips. **Laciniae** sublinear to linear, irregularly to rarely subdichotomously branched, contiguous, 0.5–1.0 mm wide; **apices** rounded, flat to concave, sometimes slightly ascendant; **lateral margin** irregularly sinuous, sublacinulate at the centre of the thallus; **axils** acute, rarely auriculate. **Pruina** farinaceous, disperse, subapical at the centre of the laciniae. **Maculae** pale to distinct, sparse, irregularly linear, mainly marginal. **Medulla** very pale cream to cream above, lower layer white. **Lower surface** black, shiny, smooth to slightly irregular and papillate. **Rhizines** black, simple, abundant, evenly distributed, up to 0.2 mm long. **Apothecia** *obscurascens*-type, frequent, plane to slightly concave, sessile, laminal, up to 1.5 mm diam.; **margin** smooth, not visible in very convex

apothecia; **disc** black, shiny, epruinose. **Internal stipe** developed, brownish. **Epithecium** 10–15 µm high; **hymenium** 60–70 µm high; **sub-hymenium** 60–80 µm high. **Ascospores** mainly 2-septate, *Dirinaria*-type, ellipsoid, 18–21 × 7–8 µm. **Pycnidia** rare, laminal. **Conidia** not seen.

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ faint red or K–, C–, KC–, P+ orange, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K–. **Secondary metabolites:** atranorine, terpenes.

REMARKS. *Pyxine primaria* is characterized by atranorine in upper cortex, upper medulla very pale cream to cream K+ faint red or K– and P+ orange, apothecia *obscurascens*-type and ascospores two-septate.

Pyxine endolutea Kalb differs by the sulphur yellow upper medulla K+ yellowish to orange and the 2-celled ascospores.

Pyxine rhizophorae Kalb differs by the laciniae plane to concave, quite confluent, the marginal maculae, the upper medulla K+ yellowish with tinges of yellow and orange and orange borders and the 2-celled ascospores.

ADDITIONAL MATERIAL EXAMINED. Brazil, Mato Grosso do Sul State, ca. 35 km SE of Cuiabá, on old deciduous trees in an open cerradão, 15°50’S, 56°00’W, 120 m alt., corticolous, 3 to 4-VII-1980, leg. *K. Kalb* & *M.P. Marcelli* 12268. Africa, Obervolta [Burkina Faso], riparian forest by Sinlo, 10 km SE from Tiefora, 10°35’S, 4°30’W, 285m alt., leg. *J. Schreiber* & *K. Kalb*, herb. Kalb no. 12826, 12827.

DISTRIBUTION. South America, cited to Brazil, Mato Grosso do Sul State (type locality) and Africa, Burkina Faso country (Kalb 1987).

Pyxine pungens Zahlbr.

Ann. Crypt. exot. **1**(2): 210. 1928. TYPE**:** Indonesia, Java, Hortus Bogoriensis, ramicola, leg. *C. van Overeem* 23 (holotype: W!; isotype: O) fide Kalb (1987).

Pyxine meissneri Tuck. var. *subobscurascens* Malme, *Bihang Kongl. Svenska Vet. -Akad. Handl.* 23, afd. **3**(13): 37. 1897. TYPE: Paraguay, Colonia Risso pr. Rio Apa, 21.10.1893, leg. *Malme* 1950 C [lectotype: UPS!; duplicate from the lectotype: S! (specimen above, typification made by Kalb 1987)].

Pyxine berteriana Fée var. *subobscurascens* (Malme) Imshaug, *Tr. Amer. Micros. Soc.* **76**: 256. 1957.

The description and the distribution of this species are presented in Jungbluth & Marcelli (2010a).

Remarks. *Pyxine pungens* is characterized by the *cocoës*-type apothecia with orange internal stipe.

Pyxine rhodesiaca (TUR-Vainio!)differs in having evident reticular maculae and *obscurascens*-type apothecia and is epruinose.

Pyxine rugulosa Stirt. (BM!) is another morphologically similar species that differs by the presence of pruinose plates, the yellow to pale yellow medulla and the distinct triterpenes array.

Also, *P. astipitata*, *P. exoalbida* and *P. mantiqueirensis* differ in apothecial characters and in chemistry. Besides, *P. astipitata* does not have stipe in the apothecia and has a distinct triterpene array. *P. exoalbida* has orange internal stipe well developed circled by a white outside layer and produce norstictic acid in the medulla and *P. mantiqueirensis*, although with very similar triterpene array, differs from *P. pungens* by the *obscurascens*-type apothecia and more convex laciniae.

Pyxine pyxinoides (Müll. Arg.) Kalb

Bibl. Lichenol. **24**: 66. 1987. *Catolechia pyxinoides* Müll. Arg. *Flora* 64: 509. 1881. Type**:** Brazil, São Paulo State, Apiahy [Apiaí], 1880, leg. *Puiggari* 1237 (holotype: G!).

Pyxine nitidula Müll. Arg. *J. Bot. Fr.* **7**: 74. 1893. TYPE: [Oceania] New Calendonia, saxicole, Plaine de la Tamoa, 24-04-1870, leg. *B. Balansa* (holotype: G!).

(Fig. 9)

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, saxicolous, greenish to brownish grey, laciniate, 1.0–3.0 cm diam., closely adnate. **Proximal upper surface** cracked, verrucose, dull, plane. **Distal upper surface** continuous to cracked, smooth to slightly verrucose, slightly shiny, plane to slightly convex, without a darker zone near the tips. **Laciniae** sublinear, irregularly branched, contiguous to slightly overlapping laterally, 0.2–0.5 mm wide; **apices** rounded, flat to slightly concave, adnate; **lateral margin** smooth to irregular to crenate; **axils** acute. **Pruina** absent. **Maculae** pale, rare, sparse, spotted to irregularly linear, laminal. **Medulla** pale yellow. **Proximal and distal lower surfaces** black, slightly shiny, smooth to papillate. **Rhizines** black (just few studied), simple, frequent, evenly distributed, to 0.2 mm long. **Apothecia**

obscurascens-type, numerous, plane to convex, sessile, laminal, to 0.8 mm diam.; **margin** smooth, not visible in very convex apothecia; **disc** black, dull to slightly shiny, epruinose. **Internal stipe** not developed. **Epithecium** 10–14 µm high; **hymenium** 50–70 µm high; **subhymenium** 110–120 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 11–16 × 5–6 µm. **Pycnidia** few, laminal. **Conidia** not seen.

COLOR TESTS: upper cortex UV+ yellow; medulla UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K–. **Secondary metabolites:** lichexanthone, terpenes.

REMARKS. *Pyxine pyxinoides* is characterized by the lichexanthone in upper cortex, the pale yellow medulla and the *obscurascens*-type apothecia.

Pyxine nitidula was considered by Rogers (1986) synonym of *P. minuta*, but the TLC terpene array from the types showed that *P. nitidula* has the same chemistry as *P. pyxinoides*, diverging from the terpene array found in *P. minuta*. Also, *P. nitidula* has laminal maculae as *P. pyxinoides*., while *P. minuta* has mainly marginal maculae. So, *P. nitidula* is proposed here as synonym of *P. pyxinoides*.

Pyxine microspora differs by the totally white medulla and also by the triterpene array. For further informations, see remarks under *P. microspora* and *P. minuta* and the Tables 2 and 3.

DISTRIBUTION. As the specific circumscription of this group is different from author to author, the real distribution of this group of taxa is confuse. Nevertheless, bibliographical references that cited the name *P. minuta* in accepted species level are presented. Oceania (Müller Argoviensis 1893 as *P. nitidula*) and Central and South America (Kalb 1987). In South America it was cited to Brazil, cited to States of Mato Grosso, Rio de Janeiro (Kalb 1987) and São Paulo (Müller Argoviensis 1881, type locality).

Pyxine rhizophorae Kalb

Bibl. Lichenol. **24**: 68. 1987. TYPE**:** Brazil, Estado de São Paulo, Ilha de Santo Amaro, kurz vor Bertioga, etwa 20 km nordöstlich von Santos, in einer Mangrove, an *Rhizophora mangle*, 1 m alt., 21-10-1978, leg. *K. Kalb* & *G. Plobst* 12233 [not 12235] (holotype: Herb. Kalb!).

ILLUSTRATION: Kalb (1987).

DESCRIPTION OF THE HOLOTYPE

THALLUS orbicular, corticolous, brownish grey, laciniate, 6.5 cm diam., adnate. **Proximal upper surface** continuous, smooth to rugose, dull, plane to concave. **Distal upper surface** continuous, smooth to rugose, dull, plane to concave, without a darker zone near the tips. **Laciniae** sublinear, irregularly to dichotomously branched, contiguous to mainly overlapping laterally, 0.5–1.0 (−1.5) mm wide; **apices** rounded, concave to flat, adnate; **lateral margin** smooth to slightly undulate; **axils** forming right angle. **Pruina** farinaceous, disperse sparsely through the lamina of the distal parts. **Maculae** distinct, sparse, irregularly linear, marginal. **Medulla** cream to pale cream above, lower layer white. **Lower surface** black, shiny, smooth to slightly irregular. **Rhizines** black, simple, frequent, evenly distributed, up to 0.3 mm long. **Apothecia** *obscurascens*-type, rare to frequent, plane to concave, sessile, laminal, up to 3.5 mm diam.; **margin** smooth to slightly undulate, visible even in very convex apothecia; **disc** black, shiny, epruinose. **Internal stipe** developed, the same color as the medulla. **Epithecium** 10–15 µm high; **hymenium** 70–90 µm high; **sub-hymenium** 70–80 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 19–21 × 6–9 µm. **Pycnidia** frequent, laminal. **Conidia** not seen [additional material examined: sublageniform, 3.5−4.0 (–5.0) ca. 1.0 µm].

COLOR TESTS: upper cortex K+ yellow, UV–; medulla K+ yellow with orange borders, C–, KC–, P+ orange, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K+ reddish on upper part. **Secondary metabolites:** atranorine, terpenes.

REMARKS. *Pyxine rhizophorae* is characterized by atranorine in upper cortex, the upper medulla cream to pale cream sometimes sulphur yellow with small parts pale orange, K+ yellow with orange borders, P+ orange and the apothecia *obscurascens*-type.

Below the diagnosis, Kalb (1987) cited the type locality and the specimen Herb. Kalb no. 12235 as holotype. Nevertheless, in the list of examined specimens he mentioned the holotype as Herb. Kalb no. 12233. He illustrated the holotypes in his Fig. 25, but did not mentioned the number of the specimen. During a visit to his herbarium, it was possible to examine the two specimens. The thallus corresponding to the picture is really Herb. Kalb no. 12233, which has a red indication “holotype” on it. So, the holotype is 12233, not 12235 as first cited in the protologue.

The holotype has the upper medulla predominantly cream, but the additional material studied has parts of upper medulla sulphur yellow to pale orange. Additionally, the study of extra-material demonstrated that the ascospores have a greater range in size: (14–) 18–22 (–24) × 6–8 (–9) µm.

In spite of the name, referring to *Rhizophora mangle*, where the first specimens were found, this species can be found also in rocks.

Pyxine endolutea is morphologically similar, differing in the convex laciniae and the marginal to laminal and more abundant maculae.

Pyxine primaria has plane to convex laciniae, maculae mainly laminal and the medulla cream K+ faint reddish or negative.

Until the moment, *P. rhizophorae* was found only in littoral zone.

SPECIMENS EXAMINED. Brazil, São Paulo State, Municipality of Bertioga, in small island in front of the Prainha Branca beach, 23°52′18″S, 46°08′05″W, 15 m alt., in tree between rocks, 21-VIII-1979, leg. *M.P. Marcelli* 16423 (SP); idem, Municipality of Cananéia, next to the rafts, in the continent side, 24°59′S, 47°52′W, 5 m alt., tree in mangrove, 18-XII-1979, leg. *M.P. Marcelli* 18209 (SP), idem, Municipality of Iguape, Barra do Ribeira, between Suamirin River and the ocean, on mangrove, 24°42′S, 47°33′W, 1 m alt., corticolous in the shadow, 18-VII-1989, leg. *M.P. Marcelli* 6676 (SP); idem, on restinga Forest after dune, 24°42′S, 47°33′W, 1 m alt., on branch, 19-VII-1989, leg. *M.P. Marcelli* 6807, 6841 (SP); idem, vegetation in dune next to the river mouth, 24°42′S, 47°33′W, 1 m alt., corticolous in branch, 21-VII-1989, leg. *M.P. Marcelli* 6934 (SP); idem, Itanhaém Municipality, Bairro Cibratel, Itanhaém Beach, in street with palms and *Terminalia* sp. perpendicular to the beach, 24°11′S, 46°47′W, 1 m alt., corticolous in direct sun, 10-I-1989, leg. *M.P. Marcelli* 4122 (SP); idem, Municipality of Mongaguá, hills from the Serra do Mar next to the city, 24°05′S, 46°47′W, 100 m alt., corticolous, 11-VIII-1980, leg. *M.P. Marcelli* 16032 (SP); idem, Municipality of Peruíbe, Guaraú River margin, next to the mouth, 24°19′S, 47°59′W, 1 m. alt., on palm, 19-V-1990, leg. *M.P. Marcelli* 8558 (SP); idem, Reserva Ecológica Juréia-Itatins, Núcleo Guarauzinho, next to the entrance to the Núcleo Guarauzinho, 24°19′S, 47°59′W, 5 m. alt., saxicolous, 26-07-1993, leg. *M.P. Marcelli* 23684, 23688; idem, corticicolous, 26-VII-1993, leg. *M.P. Marcelli* 23693, 23694 (SP); idem, Reserva Ecológica Juréia-Itatins, Núcleo Guarauzinho, Arpoador Beach, 24°19′S, 47°59′W, 1 m. alt., rocks and trees on the south face and Center of the beach, saxicolous, 27-VII-1993, leg. *M.P. Marcelli* 23078, 23717 (SP); idem, on rocks in the North side, with herbs, bromeliads and *Cladonia*, saxicolous, 29-VII-1993, leg. *M.P. Marcelli* 23777 (SP); idem, Ubatuba Municipality, Parque Estadual da Serra do Mar, Núcleo Picinguaba, Praia da Fazenda, 23º21'25" S, 44º51'55" W; 1 m alt., rocks on the Praia da Fazenda, 18-III-2006, leg. *P. Jungbluth* & *M.F.N. Martins* 1243 (SP); idem, Praia da Fazenda, 23º21'41" S, 44º50'53" W, 1 m alt., on tree in the border of restinga Forest, in front of the sea, 18-III-2006, leg. *P. Jungbluth*, & *M.F.N. Martins* 1268 (SP);idem, Praia da

Fazenda, 23º21'21,3" S, 44º51'52" W; 1 m alt., on the border of Forest in front of the sea, next to the Camping Caracol, 13-I-2007, leg. *A.A. Spielmann*, *P. Jungbluth*, *L.S. Canêz* & *M.J. Kitaura* 3139 (SP).

DISTRIBUTION. South America, Brazil, cited to the States of Rio de Janeiro, Rio Grande do Sul and São Paulo (including type locality) (Kalb 1987).

Pyxine rhodesiaca Vainio ex Lynge

Rev. bryol. lichènol. **10** (N.S.): 90. 1937. TYPE**:** Rhodesia, Salisbury, on *Ficus*, leg. *F. Eyles* 3953 (holotype: TUR-Vainio 34628!).

Pyxine retirugella Nyl. var. *endoxantha* Müll. Arg., *Bull. Herb. Boiss.* 4: 91 (1896). Type: Amer. austr.?, leg. Humboldt 129 (holotype: G), fide Kalb (1987).

The description, **illustrations and the distribution of this species are presented in Jungbluth & Marcelli (2010a)**.

Remarks. *Pyxine rhodesiaca* is characterized by the abundantly irregularly maculate upper surface, the ochre upper medulla that reacts K+ and P+ black purple, *cocoës*-type apothecia and white internal stipe.

For other differences from others species, see remarks under *P. pungens* and see also Jungbluth & Marcelli (2010a) for additional information.

Pyxine schechingeri Kalb

Bibl. Lichenol. **24**: 71. 1987. TYPE**:** Brazil, Estado da Bahia, bei Roda Velha, 650 m, an Sandstein, 15-7-1980, leg. *K. Kalb* 12313 (holotype: Herb. Kalb!).

The description, **ilustration and the distribution of this species are presented in Jungbluth & Marcelli (2010a)**.

Remarks. *Pyxine schechingeri* is characterized by the medulla orange throughout, the *obscurascens*-type apothecia, the presence of norstictic acid in the epihymenium, the white internal stipe with reddish brown upper part and the small ascospores up to 13 μm long.

For differences from other species and additional information see remarks under *P. pungens* and Jungbluth & Marcelli (2010a).

Pyxine simulans Kalb

Bibl. Lichenol. **24**: 72. 1987. TYPE**:** Brazil, Mato Grosso do Sul State, ca. 50 km SW of Campo Grande, on a deciduous tree in a humid gallery forest 21°00’ S, 54°40’ W, 500 m alt., [corticolous], 16-XI-1979, leg. *K. Kalb* & *G. Plöbst* 12241 (holotype: Herb. Kalb!).

(Fig. 10)

DESCRIPTION OF THE HOLOTYPE COLLECTION

THALLUS orbicular, corticolous, brownish grey to white, laciniate, 7.0 cm diam., adnate. **Proximal upper surface** continuous, eventually rugose and warty, dull, convex. **Distal upper surface** continuous, smooth, rarely with irregularities, slightly shiny, plane to convex, but sometimes concave near the tips, without a darker zone near the tips. **Laciniae** sublinear to linear, irregularly to dichotomously branched, discrete to crowded, 0.8–1.5 mm wide; **apices** rounded, concave, turned downwards; **lateral margin** smooth, rarely crenate; **axils** acute to ovate. **Pruina** absent. **Maculae** distinct, elevated, sparse, irregularly linear, marginal to submarginal. **Medulla** orange-yellow to dark orange above, some parts salmon, lower layer white and thin. **Distal lower surface** black to pale in some parts, slightly shiny, irregular to smooth. **Proximal lower surface** black, slightly shiny, irregular to smooth. **Rhizines** mainly black, sometimes pale, simple to irregularly branched near the tips, abundant, evenly distributed, up to 0.3 mm long. **Apothecia** *physciaeformis*-type, frequent to numerous, plane to slightly concave, sessile, laminal, up to 1.8 mm diam.; **margin** smooth to slightly crenate; **disc** black, dull, mainly with dense grey pruina. **Internal stipe** developed, white. **Epithecium** 5–10 µm high; **hymenium** 80–90 µm high; **sub-hymenium** 45–90 µm high. **Ascospores** 1-septate, *Dirinaria*-type, ellipsoid, 21–23 × 7–8 µm. **Pycnidia** frequent, laminal. **Conidia** not seen.

COLOR TESTS: upper cortex K–, UV+ yellow; medulla K–, C–, KC–, P–, UV–; **epithecium** K+ purple; **hymenium** K–; **subhymenium** K–; **internal stipe** K–. **Secondary metabolites:** lichexanthone, terpenes.

REMARKS. *Pyxine simulans* is characterized by lichexanthone in upper cortex, upper medulla orange-yellow to dark orange with negative color tests and *physciaeformis*-type apothecia.

The Table 1 shows the principal features to separate this species from the morphologically similar ones.

Pyxine nana has narrower laciniae (up to 0.7 mm) and upper medulla yellow to yellowish orange K+ vine and P−. *Pyxine astridiana* has also narrow laciniae (up to 1.0 mm) with medulla entire white with negative color reactions.

Pyxine berteriana is evidently maculate and has an upper medulla pigmented that reacts K+ orange to yellow and P+ orange.

The holotype consists of four pieces of thalli glued to a card, not necessarily originate from the same specimen. One specimen (right) has lacinulae more frequently overlapping laterally and slightly more convexes. Another thallus from the same type-locality was found in herb. Kalb, with a label “isotype” glued to the envelop. Nevertheless, this specimen was not mentioned in the protologue and it has not any number of collector or herbarium. This "topotype" is very similar to the type collection.

Distribution. This species is known only from the type locality.

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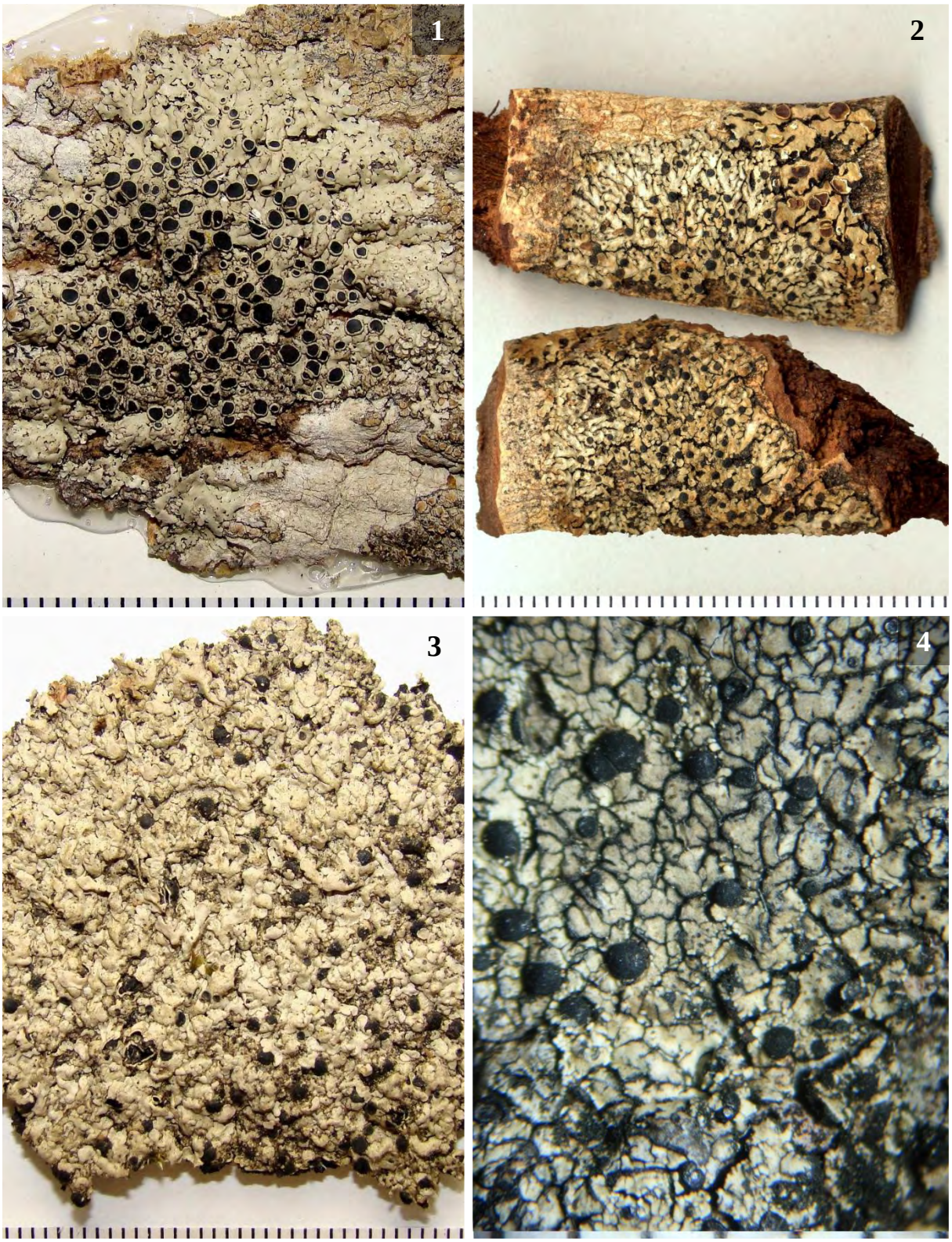
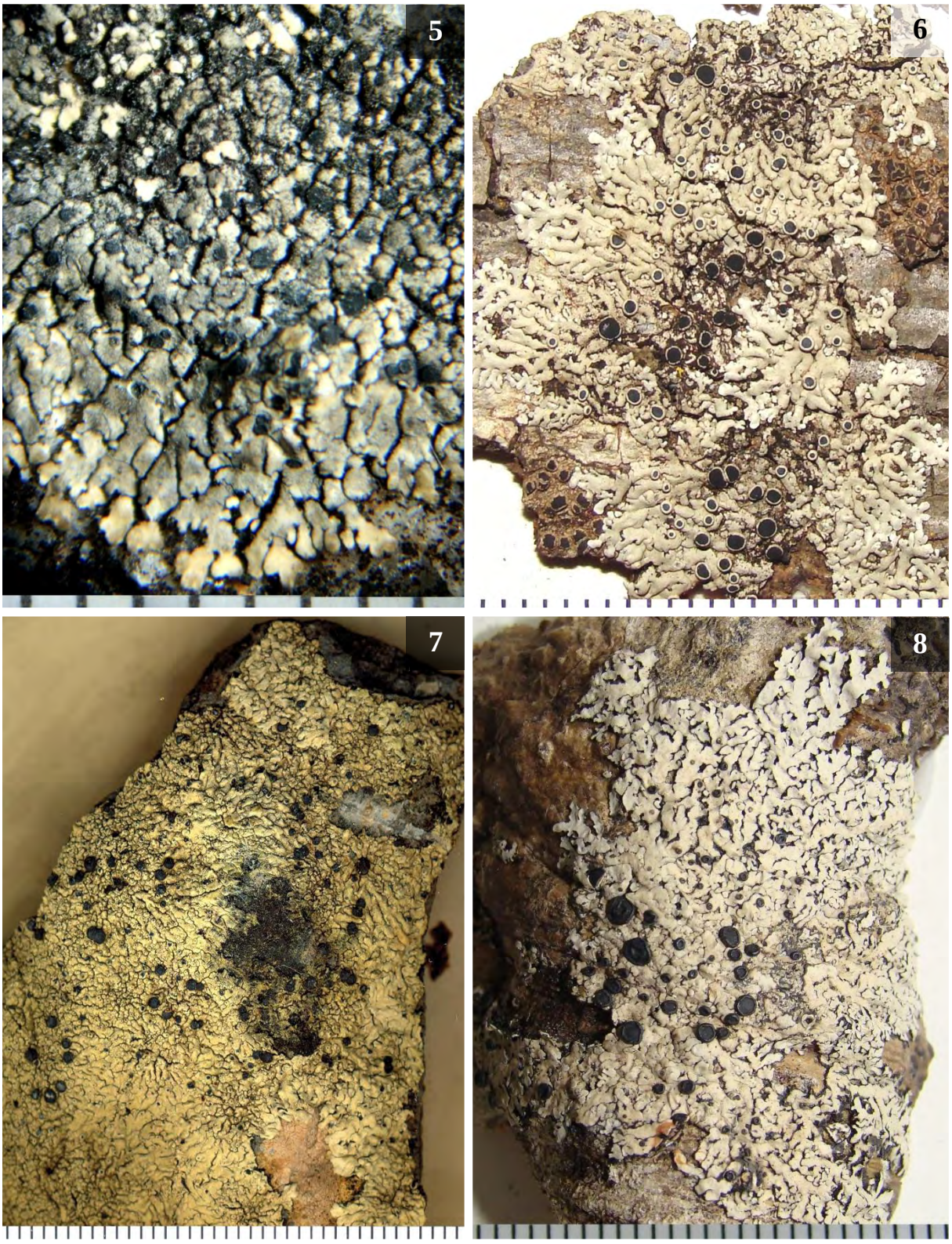
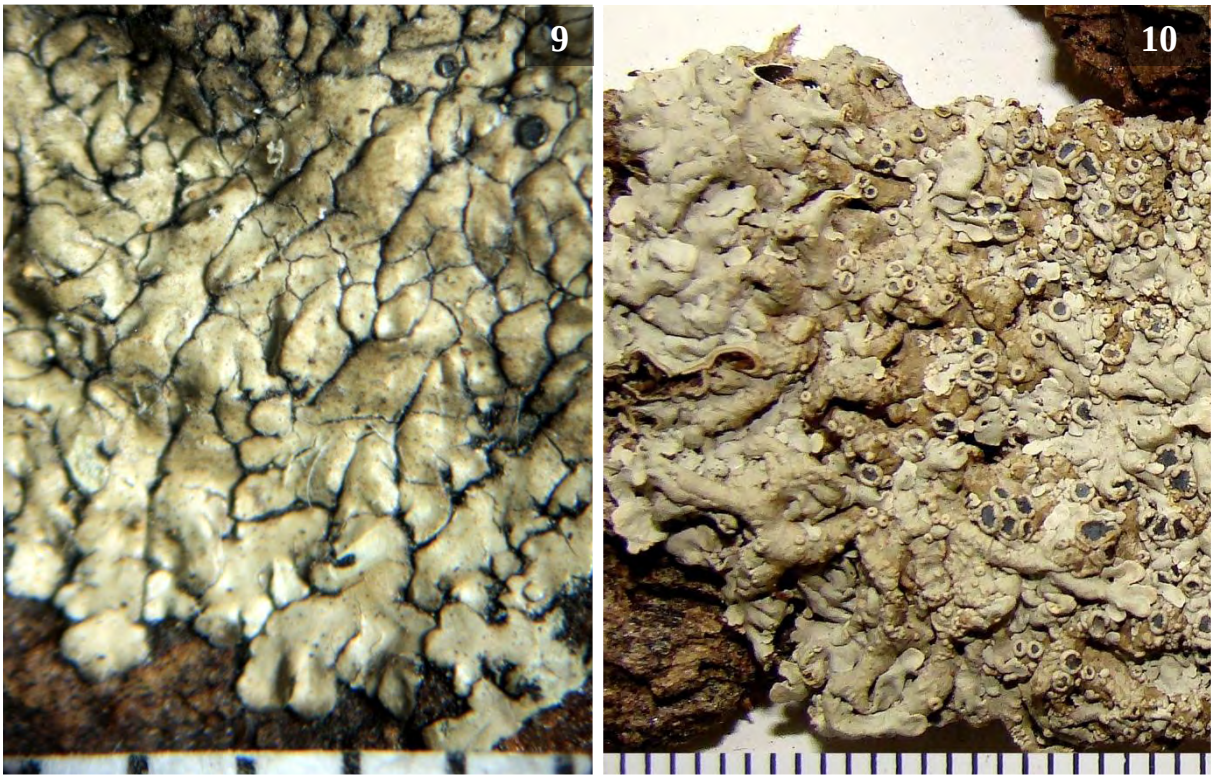


Figures 1-4: **1** – Holotype of *Pyxine astridiana* (leg. K. Kalb & G. Plöbst 12330, Herb. Kalb); **2** – Holotype of *P. cognata* (leg. Watt s.n., BM); **3** – Holotype of *P. endolutea* (leg. M. Lopez-Figueiras 28660, Herb. Kalb); **4** – Lectotype of *P. microspora* (leg. R.C. Mc-Gregor 8804, TUR). Scales in millimeters.



Figures 5-8: **5** – Lectotype of *Pyxine minuta* (leg. Vainio 211, TUR); **6** – Holotype of *P. nana* (leg. K. Kalb & G. Plobst 12314, Herb. Kalb); **7** – Lectotype of *P. petricola* (leg. I.B. Balfour 2391, BM); **8** – Holotype of *P. primaria* (leg. K. Kalb 12267, Herb. Kalb). Scales in millimeters.



Figures 9-10: **9** – Holotype of *Pyxine pyxinoides* (leg. Puiggari 1237, G); **10** – Holotype of *P. simulans* (leg. K. Kalb & G. Plöbst 12241, Herb. Kalb). Scales in millimeters.

CONSIDERAÇÕES FINAIS

O presente estudo analisou taxonomicamente vinte e nove nomes aceitos de *Physcia* e trinta e seis de *Pyxine*, inclusive seus sinônimos.

O Capítulo 1 sumarizou o estado atual de conhecimento destes dois gêneros no Brasil, determinando quais espécies são citadas por Estado, em quais obras e se os nomes mencionados na literatura (27 espécies de *Physcia* e 26 espécies e duas variedades de *Pyxine*) ainda são aceitos dentro de *Physcia* ou *Pyxine*.

O Capítulo 2 abordou a taxonomia de vinte e nove táxons aceitos de *Physcia* e seus sinônimos, o que inclui todas as espécies de *Physcia* conhecidas para o Brasil. Os principais resultados foram:

- *Physcia aipolia* f. *verruculosa* Vain. deixou de ser sinônimo de *P. aipolia* (Humb.) Fürnr. e foi combinada em *P. verruculosa* (Vain.) Jungbluth & Marcelli;
- *Physcia afra* Hue, antes considerada como sinônimo de *P. aipolia*, é proposta como sinônimo de *P. ochroleuca* (Müll. Arg.) Müll. Arg., espécie mais antiga que estava esquecida;
- *Physcia alba* var. *linearis* Lynge permaneceu por mais de um século sem tipificação; foi escolhido um lectotipo, e constatou-se que este táxon é sinônimo de *P. kalbii* Moberg;
- *Physcia obsessa* sensu (Mont.) Nyl. foi discutida e conclui-se que este nome continua dúbio, desconhecendo-se o material que foi estudado por Montagne;
- Foram confeccionadas lâminas permanentes de seções transversais da maioria dos tipos estudados, cujo estudo ressaltou a importância da estrutura do córtex inferior neste gênero;

O Capítulo 3 discorre sobre a taxonomia de um grupo de espécies de *Pyxine* tratado de maneira confusa na literatura. Estudos químicos e anatômicos da margem e do estipe interno do apotécio esclareceram a diferença entre duas espécies problemáticas, *P. pungens* Zahlbr. e *P. rhodesiaca* Vain. ex Lynge, e ainda revelou a existência de três táxons novos para a Ciência: *P. astipitata* Jungbluth & Marcelli, *P. exoalbida* Jungbluth & Marcelli e *P. mantiqueirensis* Marcelli & Jungbluth. Este trabalho ressaltou a grande importância do uso da química em *Pyxine*, principalmente através de cromatografia em camada delgada, e reafirmou a importância do estudo morfológico e anatômico deste gênero.

Este estudo revelou que a química das partes jovens do talo é diferente das partes centrais. É costume que liquenólogos tirem amostras para cromatografia ou realizem os testes de coloração na periferia do talo. Em *Pyxine*, concluiu-se que isto é desaconselhável, e talvez seja o motivo pelo qual nunca se tenha detectado ácido norstíctico na medula de táxons brasileiros até este trabalho (*P. exoalbida*).

No Capítulo 4 tratou-se da taxonomia de 15 espécies de *Pyxine* que produzem propágulos vegetativos. Os principais resultados obtidos foram:

- *Pyxine jolyana* Jungbluth, Kalb & Marcelli, espécie nova;
- *Pyxine heterospora* Vain., formalmente considerada sinônimo de *P. eschweileri* (Tuck.) Vain., foi proposta como boa espécie;
- *Pyxine oceanica* Zahlbr., antes sinônimo de *P. cocoës* (Sw.) Nyl., foi proposta como boa espécie;
- *Pyxine retirugella* var. *capitata* Zahlbr. foi proposta como sinônimo de *P. fallax* (Zahlbr.) Kalb;
- *Pyxine caesiopruinosa* (Nyl.) Imshaug e *P. physciaeformis* (Malme) Imshaug, recentemente sinonimizadas, são consideradas espécies distintas;
- Foi feita a lectotipificação de *P. meissneri* ssp. *connectens* Vainio;
- *Pyxine fallax* e *P. katendei* Swinscow & Krog são citações novas para o continente americano;
- *Pyxine albovirens* (G. Mey.) Aptroot e *P. obscurascens* Malme são citações novas para o estado de São Paulo;
- *Pyxine caesiopruinosa* é citação nova para o estado de Minas Gerais;
- *Pyxine coccifera* (Fée) Nyl. é citação nova para os estados do Maranhão e Tocantins;
- *Pyxine coralligera* Malme é citação nova para o estado de Goiás.

Demonstrou-se a existência com ácido norstíctico na medula de mais dois táxons brasileiros: *P. fallax* e *P. jolyana*.

O Capítulo 5 estudou taxonomicamente 18 espécies e uma variedade de *Pyxine* que não produzem propágulos.

Pyxine minuta Vain., antes sinônimo de *P. pyxinoides* (Müll. Arg.) Kalb, foi proposta como boa espécie e *P. nitidula* Müll. Arg., antes sinônimo de *P. minuta*, foi proposta como sinônimo de *P. pyxinoides*.

Além destes resultados, os capítulos 2, 3, 4 e 5 apresentaram chaves de identificação inéditas abrangendo todos os táxons conhecidos para o Brasil. Chaves anteriores não abordavam todas as espécies hoje conhecidas.