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New Combinations and One New Name for the Moss Genus *Taxithelium* (Pylaisiadelphaceae)

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ABSTRACT. During the taxonomic revision of *Taxithelium* Spruce ex Mitt. (Pylaisiadelphaceae), species previously treated in the genus are excluded, and eight new combinations are presented here: *Camptochaete novae-zeelandiae* (E. B. Bartram & Dixon) P. E. A. S. Câmara, *Chaetomitrium spuriosubtile* (Broth.) P. E. A. S. Câmara, *Phyllodon bilobatus* (Dixon) P. E. A. S. Câmara, *P. choiropyxis* (Müll. Hal.) P. E. A. S. Câmara, *P. glossoides* (Bosch & Sande Lac.) P. E. A. S. Câmara, *Sematophyllum borneense* (Broth.) P. E. A. S. Câmara, *S. mundulum* (Sull.) P. E. A. S. Câmara, and *Trichosteleum friedense* (D. H. Norris & T. J. Kop.) P. E. A. S. Câmara. The new name *Sematophyllum laevigatum* P. E. A. S. Câmara is proposed for *Hypnum trachaelocarpum* Ångstr. Lectotypifications are also provided for *Sigmatella choiropyxis* Müll. Hal. and *Hypnum trachaelocarpum* Ångstr.

Key words: Hypnaceae, *Phyllodon*, Pylaisiadelphaceae, Sematophyllaceae, *Sematophyllum*, *Taxithelium*, *Trichosteleum*.

The genus *Taxithelium* Spruce ex Mitt. was first described by Mitten (1869) in tribe Sematophylleae. Later, Brotherus (1925) assigned the genus to the family Sematophyllaceae, but much controversy has arisen on this familiar placement due to the lack of sematophyllaceous characters in the genus such as the collenchymatous exothecial cells, long rostrate opercula, and well-developed, often inflated alar cells (Seki, 1969; Hedenäs, 1996; Tan & Jia, 1998; Hedenäs & Buck, 1999). The molecular phylogenetic works of Tsubota et al. (2001a, b) have demonstrated that *Taxithelium* is not closely related to the core Sematophyllaceae (*Sematophyllum* Mitt., *Trichosteleum* Mitt., and *Acroporium* Mitt.), but is more closely related to *Pylaisiadelpha* Cardot, *Isopterygium* Mitt., and *Brotherella* Loeske ex M. Fleisch. Therefore, Goffinet and Buck (2004) transferred the genus *Taxithelium* into a newly described family, Pylaisiadelphaceae. Unfortunately, this family was described on the basis of absence of characters (as stated in the original description: “Sematophyllaceis affine, cellulis exothecii non collenchymatosis celluli alaribus parviore plerumque non

inflates pseudoparaphyllis saepe filamentosis differt”; Goffinet & Buck, 2004), that is, as a family that lacks the typical features of Sematophyllaceae. Those absences associated *Taxithelium* more with the Pylaisiadelphaceae than with the Sematophyllaceae.

Taxithelium is a pantropical genus occurring mainly in Southeast Asia between 30°N and 20°S. The genus is currently under taxonomic revision by this author, and it has been suggested to be monophyletic by the ongoing work by Câmara and Shaw (unpublished). It is characterized by the presence in the gametophyte of multiple papillae serially disposed over the lumina of leaf cells (a rare character present only in one other genus within Sematophyllaceae: *Radulina* W. R. Buck & B. C. Tan). *Taxithelium* also has a poorly developed alar region, and the sporophytes lack collenchymatous exothecial cells and have a short-rostrate opercula. *Taxithelium* can be easily differentiated from *Radulina* due to the presence in the latter of a well-developed alar region, long rostrate opercula, and collenchymatous exothecial cells.

Eight new combinations are presented here to allow proper recircumscription of the genus. These taxa all lack pluripapillose leaf cells, which is a diagnostic character for *Taxithelium*. This observation is addressed in more detail in the SEM studies by Câmara and Kellogg (2010).

I. *Camptochaete* Reichardt, *Reise Novara* 1(3): 190. 1870. TYPE: *Hookeria arbuscula* J. E. Smith.

The genus was revised by Tangney (1997) as a group of 11 species. It occurs in Indonesia, Papua New Guinea, New Caledonia, Vanuatu, Fiji, Australia, and New Zealand.

I. *Camptochaete novae-zeelandiae* (E. B. Bartram & Dixon) P. E. A. S. Câmara, comb. nov. Basionym: *Taxithelium novae-zeelandiae* E. B. Bartram & Dixon, *Bot. Not.* 83: 7. 1937. TYPE: New Zealand. Wellington, 1874, *S. Bergren s.n.* (holotype, BM).

The lack of papillae, cell shape, size of leaves, and spiral phyllotaxy in this species do not conform to the

current circumscription of *Taxithelium*. Sainsbury (1955) suggested this species to be a synonym of *Camptochaete gracilis* (Hook. f. & Wilson) Paris. Later, Damanhuri and Longton (1996) agreed with the exclusion of this taxon from *Taxithelium*, but provided no new combination or further evidence. A closer look at the type specimen, as well as additional specimens from MO, associates it with the genus *Camptochaete* (Lembophyllaceae) on the basis of the presence of a glossy and scariose leaf with a falcate-secund arrangement, leaf shape, and the presence of a single leaf papilla per cell. However, examination of herbarium specimens shows that it is not conspecific (as suggested above by Sainsbury) with *C. gracilis*.

II. *Chaetomitrium* Dozy & Molk., Musci Frond. Ined. Archip. Ind. 117. 1846. TYPE: *Hookeria elongata* Dozy & Molk.

This Southeast Asian genus belongs to the Hookeriaceae (Goffinet & Buck, 2004). Akiyama and Suleiman (2001) studied the genus for Borneo as did Streimann (1997) for Australia. The Philippine species has not yet been investigated and is considered here.

1. *Chaetomitrium spuriosubtile* (Broth.) P. E. A. S. Câmara, comb. nov. Basionym: *Taxithelium spuriosubtile* Broth., Philipp. J. Sci. 5: 160. 1910. TYPE: Philippines. Luzon: Lepanto, Mt. Data, 1910, *For. Bur., Bacani 16016* (holotype, H; isotypes, BM, FH, JE, L, NY, PC, PNH, US).

This small taxon (ca. 0.3 mm) is known only from the type collection; it has a single papilla over the cell lumen, and the leaf margins are serrulate and have a poorly developed alar region. It is clearly not a species of *Taxithelium*, which is characterized by pluripapillose leaf cells. Damanhuri and Longton (1994), who studied the genus *Taxithelium* worldwide, stated that this taxon did not belong in *Taxithelium*, but they had no idea where it would belong and even encouraged suggestions.

Generic placement is difficult as there are, to my knowledge, very few genera that would fit with this plant's features, and there is no DNA available to help access phylogenetic information. However, the taxon resembles the genus *Chaetomitrium* in the oblong leaf shape, the near absence of alar cells, the presence of a single leaf papilla, and the similar serrulate margin. Even though the papillation pattern seen in this taxon is not typical of *Chaetomitrium*, Akiyama and Suleiman (2001: 493) have stated that the papillation pattern in *Chaetomitrium* is highly variable and one should not rely on "this feature alone in distinguishing any taxa in the genus."

Although the type specimen (*For. Bur., Bacani 16016*) is much smaller than *Chaetomitrium* (which can range from 0.6–1 mm), according to Akiyama and Suleiman (2001) the genus is highly variable in shape and size, which lends support to this taxon being a local variation of *Chaetomitrium*. Therefore, I have provisionally placed this taxon in *Chaetomitrium* as the best fit based on current evidence.

III. *Phyllodon* Bruch & Schimp., Bryol. Eur. 5: 60. 1851. TYPE: *Hookeria retusa* Wilson.

The following three taxa share a truncate leaf apex, serrulate blade margins, and costae that are strongly visible and double, all characteristics of the pantropical genus *Phyllodon*. Furthermore, the presence of a single leaf papilla and an undeveloped alar region provides strong support for their transfer to *Phyllodon*. Buck (1987) studied the Asiatic species (4), Kis (2002) the African ones (6), and Higuchi and Nishimura (2002) those distributed in the Pacific islands.

1. *Phyllodon bilobatus* (Dixon) P. E. A. S. Câmara, comb. nov. Basionym: *Taxithelium bilobatum* Dixon, Bull. Torrey Bot. Club 51: 244. 1924. *Glossadelphus bilobatus* (Dixon) Broth., Nat. Pflanzenfam., ed. 2, 11: 535. 1925. TYPE: Malaysia. Bujong Malacca: Perak, s.d., *Ridley 739* (holotype, BM; isotype, NY).

2. *Phyllodon choiropyxis* (Müll. Hal.) P. E. A. S. Câmara, comb. nov. Basionym: *Sigmatella choiropyxis* Müll. Hal., Hedwigia 40: 69. 1901. *Taxithelium choiropyxis* (Müll. Hal.) Renaud & Cardot, Rev. Bryol. 28: 111. 1901. TYPE: Brazil. São Paulo: Iporanga, 1879, *Puiggari s.n.* (lectotype, designated here, FH).

The holotype was presumed destroyed during World War II, when the Berlin herbarium was bombed. Unfortunately, most of the Müller Hallensis collections hosted there are lost forever. After studying more than 6000 plants on loan from 23 herbaria, the only extant type collection I have located is *Puiggari s.n.* (FH), which is likely an isotype from the original collection, and I therefore assign it as lectotype here.

3. *Phyllodon glossoides* (Bosch & Sande Lac.) P. E. A. S. Câmara, comb. nov. Basionym: *Hypnum glossoides* Bosch & Sande Lac., Bryol. Jav. 2: 146. 243. 1866. *Trichosteleum glossoides* (Bosch & Sande Lac.) Geh., Rev. Bryol. 21: 85. 1894. *Taxithelium glossoides* (Bosch & Sande Lac.) M. Fleisch., Nat. Pflanzenfam. 3: 1093. 1908.

Glossadelphus glossoides (Bosch & Sande Lac.)
M. Fleisch., Musci Buitenzorg 4: 1358. 1923.
TYPE: Indonesia. Java, s.d., *Teysmann s.n.*
(holotype, L not seen; isotype, H).

**IV. *Sematophyllum* Mitt., J. Linn. Soc., Bot. 8: 5.
1865. TYPE: *Hypnum demissum* Wilson.**

The following three taxa all have diagnostic features of the core Sematophyllaceae, such as the long linear laminal cells, collenchymatous exothecial cells, long rostrate opercula, and an absence of costae. In addition, they lack any leaf papillae and present a well-developed alar region with oblong leaves. Furthermore, the lack of furrowed exostome leaves little doubt of the affinity of these specimens with the pantropical (and not yet revised) genus *Sematophyllum*.

1. *Sematophyllum borneense* (Broth.) P. E. A. S. Câmara, comb. nov. Basionym: *Taxithelium borneense* Broth., Mitt. Inst. Allg. Bot. Hamburg 7(2): 135. 1928. TYPE: West-Borneo [Indonesia]. Kalimantan: Sambas, s.d., *Micholitz s.n.* (holotype, H).

2. *Sematophyllum laevigatum* P. E. A. S. Câmara, nom. nov. Replaced name: *Hypnum trachaelocarpum* Ångstr., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 30(5): 127. 1873. *Trichosteleum trachaelocarpum* (Ångstr.) A. Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876–77: 413. 1878. *Rhaphidostegium trachaelocarpum* (Ångstr.) Besch. Ann. Sci. Nat. Bot., sér. 7, 50. 1894, nom. illeg., non *Rhaphidostegium trachaelocarpum* Kindb., 1891. [= *Sematophyllum trachaelocarpum* (Kindb.) Broth., 1925]. *Taxithelium trachaelocarpum* (Ångstr.) Broth., Nat. Pflanzenfam. 3: 1091. 1908. TYPE: Tahiti. s. loc., s.d., *Anderson s.n.* (lectotype, designated here, H; isotype, L).

In making the new combination within *Sematophyllum*, we found that the epithet was in use for *S. trachaelocarpum* (Kindb.) Broth., and therefore a new name was needed. The new epithet *laevigatum* refers to the smooth surface of the leaf cells.

In the absence of a holotype, I have selected *Anderson s.n.* as the lectotype, and choose the specimen at H as the most representative specimen.

3. *Sematophyllum mundulum* (Sull.) P. E. A. S. Câmara, comb. nov. Basionym: *Hypnum mundulum* Sull., Proc. Amer. Acad. Arts 3: 75. 1854. *Taxithelium mundulum* (Sull.) E. B. Bartram, Bernice P. Bishop Mus. Bull. 101: 238. 176. 1933. TYPE: Hawaii. Puna, s.d., *Wilkes Expedition s.n.* (holotype, FH).

V. *Trichosteleum* Mitt., J. Linn. Soc., Bot. 10: 181. 1868. TYPE: *Trichosteleum fissum* Mitt.

The following taxa have diagnostic features of the core Sematophyllaceae, such as the well-developed alar cells, long linear laminal cells, long rostrate opercula, collenchymatous exothecial cells, and an absence of costae. In addition, they present unipapillose leaf cells. This combination of features associates this plant with *Trichosteleum*, a genus that has not yet been revised and is present virtually worldwide within the tropics.

I. *Trichosteleum friedense* (D. H. Norris & T. J. Kop.) P. E. A. S. Câmara, comb. nov. Basionym: *Taxithelium friedense* D. H. Norris & T. J. Kop., Ann. Bot. Fenn. 22: 383. 1985. TYPE: Papua New Guinea. West Sepik: Frieda River, *Koponen 35136* (holotype, H; isotypes, HSC not seen, L, LAE not seen, NICH, NY, PC).

This interesting plant is only known from the type collections. In the original description, the authors stated that the papillae were difficult to see, but were visible at the leaf margins. They also concluded that this plant had a pluripapillose pattern (Norris & Koponen, 1985).

Studying the type specimens with both light and electron microscopy, I was able to see only a single papilla per cell (Fig. 1), and some cells lacked any papillae. Papillae are present in the leaf margins, but again only one per cell. The papillae seen are conically shaped as described in the Sematophyllaceae by Câmara and Kellogg (2010).

The presence of linear leaf cells with a developed alar region clearly associates this genus with the Sematophyllaceae. Only a few genera in this family have unipapillose cells: *Trichosteleum*, *Papillidiopsis* (Broth.) W. R. Buck & B. C. Tan, *Acanthorrhynchium* M. Fleisch., *Warburgiella* Müll. Hal. ex Broth., and some species of *Acroporium* and *Wijkia* H. A. Crum. The absence of inwardly curved alar cells distinguishes this taxon from *Acroporium*, and the absence of concave leaves with abruptly constricted apices distinguishes it from *Papillidiopsis*. It can be distinguished from both *Wijkia* and *Papillidiopsis* by the absence of flagelliform branches, and the presence of collenchymatous exothecial cells separates it from *Warburgiella* and *Acanthorrhynchium*. Consequently, I transfer it into *Trichosteleum* here.

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