

A revision of the genus *Radulina* W.R.Buck & B.C.Tan (Sematophyllaceae: Bryopsida)¹

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Abstract. The palaeotropic moss genus *Radulina* W.R.Buck & B.C.Tan is revised, resulting in the genus being reduced to four species and one variety. The following 14 names become synonyms of the oldest name in the genus, *Radulina borbonica* (Bél.) W.R.Buck: *Hypnum hamatum* Dozy & Molk., *Sematophyllum subinistratum* Besch., *Hypnum trachyamphorum* Müll.Hal., *Sigmatella hamicuspis* Müll.Hal. in Paris, *nom. nud.*, *Trichosteleum borbonicum* var. *brachycarpum* Renaud & Cardot, *Trichosteleum subtile* Broth. & Watts, *Trichosteleum aequoreum* M.Fleisch. ex Dixon, *Trichosteleum elegantissimum* M.Fleisch., *Trichosteleum elegantissima* var. *scabriseta* M.Fleisch., *Trichosteleum hamatum* var. *glabriseta* M.Fleisch., *Trichosteleum hamatum* var. *tuberculisetum* M.Fleisch., *Trichosteleum carolinarum* Dixon, *Trichosteleum neocaledonicum* Thér, *Trichosteleum flexuosa-hamatum* Dixon. In addition, three of these taxa are lectotypified: *Trichosteleum subtile* Broth. & Watts, *Trichosteleum aequoreum* M.Fleisch. ex Dixon and *Trichosteleum hamatum* var. *tuberculisetum* M.Fleisch. The following are new combinations: *Radulina borbonica* var. *ferriei* (Cardot & Thér. in Thér.) O'Shea (= *Radulina hamata* var. *ferriei* (Cardot & Thér. in Thér.) B.C.Tan & Y.Jia), *Radulina sematophylloides* (Dixon) O'Shea (= *Trichosteleum sematophylloides* Dixon) and *Trichosteleum koghiense* (Thér.) O'Shea (= *Trichosteleum neocaledonicum* var. *koghiense* Thér.).

INTRODUCTION

Buck & Tan (1989), discussing Old World taxa associated with *Trichosteleum*, allocated all serially papillate species to a new genus, *Radulina*. They also characterised the genus as possessing cuspidate branch apices, concave leaves and thick-walled leaf cells. In addition, the species identified by Buck & Tan can also be characterised by narrowly ovate-lanceolate,

¹ Notes on Seychelles mosses. 7.

usually hamate leaves, and with setae that are distally verrucose. (It should be noted that species of the genus *Taxithelium*, which is sometimes aligned with Sematophyllaceae, also have multi-papillose cells, but lack swollen alar cells and ovate-lanceolate, hamate leaves.)

I first came across the genus *Radulina* when I collected *R. borbonica* (Bél.) W.R. Buck in Malawi in 1991 (Longton 1993), and subsequently found it amongst the

unaccessioned Seychelles collections of A.H. Norkett at BM, and collected it again (as *R. hamata* (Dozy & Molk.) W.R.Buck & B.C.Tan) in Malaysia in 1998. The plants had a well-defined set of characters although with a degree of variation in each of them, but which nevertheless seemed to suggest that they all belonged to one taxon, despite bearing two different names. I have since seen the taxon a number of times in both Africa and Oceania, and also a lot of herbarium material, and there seem to be convincing grounds for regarding most of the collections as one species: *Radulina borbonica*.

There seems to have been a great deal of confusion in the past about what to call the main taxon under review in this paper. In the 19th century a plethora of names were introduced, and although many of these were recognised as synonyms during the first half of the 20th century, there was still an inadequate appreciation of just how widespread and variable the taxon was, and new names continued to be coined. In addition, Index Muscorum (van der Wijk, Margadant & Florschütz, 1959-1969), which makes nomenclatural work in mosses so much easier than in many other plant groups, nevertheless carries a number of mistakes and misunderstandings for this taxon, and all entries need to be taken back to the original publications to be sure of getting the true picture.

This widespread taxon, now called by its oldest epithet, *Radulina borbonica*, was first described as *Leskea borbonica* by Bélanger in 1834 from his collections on Réunion, followed in 1844 by Dozy & Molkenboer from collections in Sumatra and Borneo (as *Hypnum hamatum*), and by Montagne on a collection from Java (as *Hypnum scaberulum*), and then in 1854 by Sullivant from Hawaii and Tahiti (as *Hypnum pickeringii*). In 1873, Mitten was able to recognise that the plant he had seen in Seeman's Fiji collections was the same as that from Réunion, and in the same year Beschereille (1873) considered Balansa's New Caledonia collection also to be the same as Bélanger's from Réunion, and the problem seemed to have been resolved - only one taxon was involved. As examples, a specimen from Hb. Beschereille (BM 000667127) collected in Samoa is labelled on

successive lines: 'H. Pickeringii Sull.', 'Hyp. Borbonicum C.Müll., II p 315' (these two both in Beschereille's handwriting) followed by 'Sematophyllum (Sigmatella) Borbonicum Bél.', and another BM specimen is labelled (by Mitten?) 'Sematophyllum borbonicum Bél., Central Prov. Ceylon, Thwaites 225'. Similarly linking the African *Radulina borbonica* and Asian *R. hamata* is an African specimen from Hb. Sande Lacoste (L 0488046, from Madagascar), leg. Pollen & van Dam, which is labelled 'Hypnum hamatum Dozy & Molk., Hypnum scaberulum Mont.'. After this wide agreement of the synonymy of *Radulina borbonica* and *R. hamata* followed the dark years of obfuscation, fuelled mainly by the multiple descriptions of Carl Müller, after which the clarity disappeared.

After Dixon re-examined the taxa (Dixon & Greenwood 1930), he commented: „I can see nothing in *T[richosteleum] Pickeringii* (Sull.) and *T. rhinophyllum* (C.M.), but slight forms, differing from the type only in minute variations of the length of the leaf point and the degree of roughness of the seta“, and subsequently Bartram (1933) stated in relation to *Trichosteleum hamatum*:

The forms of this plastic species parallel those of *Taxithelium mundulum* as far as the papillae of the leaf are concerned, varying from distinctly papillose to essentially smooth, and seem to be no more amenable to satisfactory classification.

I agree with Dixon [Dixon & Greenwood 1930] that no practical distinction can be made between this species and *T. pickeringii* Sullivant. *T. hamatum* seems to have a wide range throughout the islands of the Pacific and no doubt includes a much more extensive synonymy than that given above, which applies only to local forms.

The tuberclose seta, small cylindrical capsule, and long beaked lid in connection with the falcate-secund leaves will identify the species without much trouble.

Despite attempts by Bartram and Dixon to recognise the high level of synonymy, even Dixon

managed to describe the taxon several more times, and so it is now necessary to repeat this process to identify the remaining synonyms.

The characters by which the different species falling within the scope of *Radulina* were separated were often rather vague, and in the earliest names the published characters hardly differed, perhaps reflecting the relative isolation in which the individual authors operated. Later descriptions were also often quite brief, and often based purely on the published description (rather than an actual specimen) of previous species, so very similar plants were described several times, each description emphasising a character that was present, but not described, in an earlier protologue. Nevertheless, Sullivant (1854) recognised the wide range of variation in the taxon as the specimens collected from Hawaii and Tahiti are somewhat different in appearance (that from Hawaii being more robust in appearance), even though morphologically they can be seen to belong to the same taxon. Later authors who were aware of the existing described taxa, usually described variations on the colour of the plant, the degree of papillosity of the leaves, the degree of curvature of the leaf, the size of the leaf, the papillosity of the seta or the size of the capsule. In very few descriptions were the differences within a single branch mentioned, let alone within the whole plant, and this selectivity means that variability within plants was ignored.

Having now seen a good quantity of material, I believe that Bartram's (1933) observations (above), together with the pluripapillose cells, characterise the main species of this genus in an unmistakable fashion, but in examining holdings of *Trichosteleum* in BM, it became clear that the picture is not as simple as that described by Buck & Tan (1989), and there are a number of pluripapillose species of the Sematophyllaceae that seem to be distinctly different to the taxa originally allocated to *Radulina*. Although the taxa that Buck & Tan (1989) list fit well with *Radulina*, there are other taxa that possess characters that conflict with the circumscription, and several of these were identified recently by Tan *et al.* (2005). An example is *Trichosteleum sematophylloides* Dixon, which possesses serial

papillae and the typical sematophylloid alar cells, but has a quite different habit and appearance. However, as the true systematic position may be difficult to discern, all pluripapillose taxa are here moved to *Radulina*, and are discussed below.

KEY CHARACTERS

(NB: These characters refer to variation within *Radulina borbonica*; the level of variation in *R. orthophylla*, *R. pendens* and *R. sematophylloides* appears to be low in the few specimens so far collected.)

Plant size. There is a good deal of variation in plant size, and several taxa have been published because of a perceived difference from the norm. However, larger forms (e.g., *Hypnum punctatum*) and smaller forms (*Trichosteleum aequoreum*, *T. borbonicum* var. *brachycarpum*, *T. carolinarum*, *Sematophyllum neocaledonicum*) often overlap in size, and there are no taxa that do not overlap in size with others. Plants of *Radulina orthophylla* are noticeably more robust than *R. borbonica* (apart from the collections from the Seychelles).

Leaf shape and curvature. The most frequent leaf shape is narrowly ovate-lanceolate to ovate-acuminate, with a pronounced curvature, but leaves on the same branch can vary widely in width and to a certain degree in length, and even on plants where most of the leaves are straight, there are almost always some at the tips of shoots that are slightly hamate. There seem to be no other characters linked to leaf curvature, and the basic cell structure for instance may be identical between a straight and a curved leaf. Similarly, leaves that are apparently alike in shape may have different degrees of papillosity and different cell sizes.

Leaf papillosity. The two earliest names to be published for *Radulina* had very different degrees of papillosity, and indeed *Hypnum hamatum* was described without mentioning that papillae were present, as they were sufficiently cryptic to be missed. However, papillae were present, and in other specimens identified by the

original authors of *H. hamatum* (Dozy & Molkenboer), papillae were significantly present, and a specimen from Luzon, Philippines (L 0488050) has large almost coronate papillae, on rather wide leaves. Papillae are often variable in their size within genera of the Sematophyllaceae, and it is perhaps presence and absence that is more important than degree of papillosity. There is in many collections the tendency for papillae to be less pronounced in the lower leaf, but in Japanese and Chinese collections named as *Trichosteleum ferriei*, where this character is associated with other unusual features, this is regarded here as a distinct taxon. Specimens apparently without papillae are seen, for instance *Kurz 88*, Java, L 0488049, but nevertheless both the original identifier and an annotation by Seki in 1964 regard it as just a form.

Leaf cells. Leaf cells are normally about 35µm in length mid-leaf, but some plants, often those with wider leaves, can have mid-leaf cells only 20µm in length (e.g. Zippel's collection L 0488047 from New Guinea). In general, upper leaf cells reflect the leaf shape: a long the acumen has long cells. *Radulina orthophylla* mid-leaf cells are also short, to about 25 µm, but cannot be confused with *R. borbonica* because of the difference in cell shape: round-ended cells in *R. orthophylla*, pointed cells in *R. borbonica*.

Seta. The typical (most commonly seen) seta of *Radulina* is orange to straw-coloured (red in *R. orthophylla*), smooth, but with tubercles around the bend of the seta at the base of the capsule. However, there are taxa described with the seta tuberclose throughout (*Trichosteleum elegantissimum* var. *scabriseta*, *T. hamatum* var. *tuberculisetum*, *Hypnum scaberulum*) - although the proximal part, hidden by the perichaetial leaves, is often without papillae, and others with just the top half (or quarter) of the seta tuberclose or papillose. Others are described as having smooth setae but slightly rough at the capsule neck (*Trichosteleum hamatum* var. *glabriseta*, *T. hamatum* var. *semimammillosum*). The type specimen of *Hypnum hamatum* has the seta mostly half-tuberclose, but there is a great deal of variation; for instance L 0488082, which consists of seven small pieces stuck to a card

and checked by Dozy & Molkenboer, shows variations from fully tuberclose setae to ones with tubercles only at the very apex. It is possible that these specimens were collected at a variety of locations, and because of mixed collections it is not always easy to be sure. However, some specimens (e.g. a Junghuhn specimen, L 0488045) show setae with tubercles from the middle upward and others with them only just below the capsule. Although the degree of papillosity is variable, there seems to be a slight disjunction in that the papillae occur either throughout the seta, or variably along the distal half of the seta, with none for instance covering 75% of the seta. Treating the plants with fully papillose setae as a different taxon was considered, but the lack of consistency within and between plants in a single collection mitigates against this. Specimens from Indonesia seem to be most variable in this respect: setae from specimens from elsewhere are usually consistent in being tuberclose only near the base of the capsule. It is not appropriate to use such a character to define taxa.

RADULINA W.R.Buck & B.C.Tan, Acta Bryolichenologica Asiatica 1(1,2): 9, 1989 [1990].

Lectotype: *Hypnum pickeringii* Sull. (*vide* Buck & Tan, 1990)

A fuller description of the genus can be found in Buck & Tan (1989).

Plants medium to small in green to pale green patches, appearing somewhat opaque under the lens, often intermingled with other taxa, usually growing on the ground in forests, or on rotten logs. *Leaves* falcate-secund whether wet or dry, sometimes only at the tip of branches (never in *R. orthophylla* or *R. sematophylloides*), lanceolate to ovate-lanceolate, long-acuminate, often serrulate, usually so distally; *costa* usually absent, short and double if present; *laminal cells* long, hexagonal to linear (but with more rounded cell ends in *R. orthophylla*), quite thick-walled, usually porose, seriatly papillose, sometimes in more than one row; *alar cells* large and swollen,

in a single row, with quadrate cells above, the leaf base yellow. *Autoicous*, and often fertile (but sporophytes unknown in *R. pendens* and *R. sematophylloides*). *Perichaetial leaves* oblong-lanceolate with irregular cell structure, cells longer, wider and laxer than normal leaf cells, strongly toothed above, often without papillae, alar cells not well-marked, but a row of large cells across the base. *Seta* orange-brown to red, tuberclose below the capsule but sometimes extending to near the base. *Capsule walls* strongly collenchymatous (but not in *R. orthophylla*); peristome double.

Often appearing as small patches in collections of *Trichosteleum*.

The genus *Radulina* was created by Buck & Tan (1990) as part of their review of Asian *Trichosteleum* and related genera. It was based on Carl Müller's subsection *Thelidium* of section *Sigmatella* of the genus *Hypnum*. At the time of publication of the genus, four species were put in the genus: *Radulina aequorea* (M.Fleisch. ex Dixon) W.R.Buck & B.C.Tan, *R. elegantissima* (M.Fleisch.) W.R.Buck & B.C.Tan, *R. hamata* (Dozy & Molk.) W.R.Buck & B.C.Tan and *R. scaberula* (Mont.) W.R.Buck & B.C.Tan. Buck (1993) subsequently added *Radulina borbonica* (Bél.) W.R.Buck. Tan *et al.* (2005) took a more detailed look at the genus (but confined geographically to Western Melanesia, particularly New Guinea) and found additional taxa that fell within the scope of the genus. This review looks wider, and addresses the problem of taxa appearing distinct locally, but not being supported by a wider geographic review, and apart from *Radulina orthophylla*, *R. pendens* and *R. sematophylloides*, the conclusion of this paper is that all of these taxa represent either varieties or local names of only one widespread taxon, *Radulina borbonica*.

KEY TO SPECIES

1. Plant shortly pendent, to about 2 cm
Radulina pendens 2
1. Plant creeping 2

2. Leaves patent (almost at right-angles to the stem), straight

Radulina sematophylloides

2. Leaves erect, straight to hamate 3
3. Leaves straight, mid-leaf cells 12-24 µm × 2-4 µm, laminal cells with rounded ends

Radulina orthophylla

3. Leaves usually hamate, mid-leaf cells 24-68 µm × 4-8 µm, laminal cells with pointed ends 4
4. Leaves < 2.2 mm long; papillae usually present throughout most of the leaf

Radulina borbonica var. *borbonica*

4. Leaves ca 2.5 mm long; papillae usually only present towards the apex

Radulina borbonica var. *ferriei*

Radulina borbonica (Bél.) W.R. Buck, Trop. Bryol. 8: 208. 1993.

BASIONYM: *Leskea borbonica* Bél, Voyag. Ind. Or. Bot. 2 (Crypt.): 97. 1834. (*Hypnum borbonicum* (Bél.) Müll.Hal., Syn. 2: 315. 1851; *Stereodon borbonicus* (Bél.) Mitt., J. Linn. Soc., Bot. 7: 157. 1863; *Sematophyllum borbonicum* (Bél.) Mitt. in Seem., Fl. Vit. 398. 1873; *Sematophyllum borbonicum* (Bél.) Besch., Ann. Sci. Nat., Bot. sér. 5, 18: 238. 1873 *hom. illeg.* [= *Hypnum subrhizophyllum* Müll.Hal., Linnaea 39: 466. 1875 *nom. inval. in synon.* (*Trichosteleum subrhizophyllum* (Müll.Hal.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876-77: 419. 1878 (Ad. 2: 485), *nom. inval. in synon.*]; *Trichosteleum borbonicum* (Bél.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876-77: 420. 1878 (Ad. 2: 486)).

TYPE: „Réunion (Bourbon): sur les vieux troncs pourris des arbres, leg. Ch. Bélanger s.n., 1825-1829“ (type specimen not located).

= *Hypnum hamatum* Dozy & Molk., Ann. Sci. Nat., Bot. sér. 3, 2: 307. 1844, **syn. nov.** [non *Hypnum hamatum* (Mitt.) A.Jaeger - see below]; (*Trichosteleum hamatum* (Dozy & Molk.) A.Jaeger., Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876-77: 420. 1878 (Ad. 2: 486); *Radulina hamata*

(Dozy & Molk.) W.R.Buck & B.C.Tan, Acta Bryol. Asiat. 1(1,2): 10. 1989.

TYPE: "Borneo. Sumatra." (Holotype: L 0488080 !; isotype: L 0488075 !, NY)
= *Hypnum scaberulum* Mont., London J. Bot. 3: 633. 1844 ['1855' in Index Muscorum] (fide Müller 1851: 272) (*Trichosteleum scaberulum* (Mont.) Besch., Ann. Sci. Nat. Bot. sér. 7, 20: 51. 1895 ['1894' in *Index Muscorum*]; *Radulina scaberula* (Mont.) W.R.Buck & B.C.Tan, Acta Bryol. Asiat. 1(1,2): 10. 1989; *Radulina hamata* var. *scaberula* (Mont.) B.C.Tan, T.J.Kop. & D.H.Norris, Acta Bot. Fennica.42: 232. 2005.)

TYPE: „In cortice arborum, in insulae Java Prov. Buitenzorg (*Hb. Miq.*)“ [Miquel 50] (Holotype: PC-Montagne !; isotypes: BM BM000728215 !, NY)
= *Hypnum pickeringii* Sull., Proc. Amer. Acad. Arts Sc. 3: 74. 1854 (fide Dixon & Greenwood 1930: 299) (= *Sigmatella pickeringii* (Sull.) Müll.Hal., Flora 82: 469. 1896; *Sematophyllum pickeringii* (Sull.) Besch., Ann. Sc. Nat. Bot. sér. 7. 20: 49. 1895.)

TYPE: „Mountains behind Honolulu, Oahu, Sandwich Islands“ [leg. United States Exploring Expedition] (Isotype: BM BM000667122 !)
= *Sematophyllum subinistratum* Besch., Ann. Sci. Nat. Bot. ser. 5, 18: 238. 1873 **syn. nov.** (*Trichosteleum subinistratum* (Besch.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876-77: 420. 1878 (Ad. 2: 486)).

TYPE: [New Caledonia.] „In monte Mou (Balansa, no. 3275)“ (see notes). (Holotype: BM BM00072813 !; isotype: BM BM000728214 !).

= *Hypnum palanense* Hampe ex Müll.Hal., Linnaea 38: 567. 1874 (fide Bartram 1939: 339) (*Trichosteleum palanense* (Hampe ex Müll.Hal.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876-77: 414. 1878 (Ad. 2: 480)).

TYPE: "Insulae Philippinae, Luzon, ad latus orientale Cordillerae Centralio, in procollis montis Palanan: Dr. C.

Semper Aprilis 1860" (isotype: BM BM000728210 !, BM000728211 !).

= *Hypnum rhinophyllum* Müll.Hal., J. Mus. Godeffroy 3(6): 85. 1874. (fide Dixon & Greenwood 1930: 299) (*Trichosteleum rhinophyllum* (Müll.Hal.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1876-77: 420. 1878 (Ad. 2: 486); *Sigmatella rhinophylla* (Müll.Hal.) Müll.Hal., Bot. Jahrb. Syst. 23: 329. 1896).

TYPE: „Fidschi-insulae, Ovalou, cum *Hookeria oblongifolia* et *Hypno ventrifolio* associatim vigens“ [leg. Graeffe]. (Isotype: BM BM000667235 !)
= *Hypnum daltonioides* Schimp. in Jard., Bull. Soc. Linn. Normandie sér. 2, 9: 264, 265. 1875 *nom. nud.* (fide Besch., Ann. Sc. Nat. Bot. sér. 7, 20: 49. 1894.)

ORIGINAL SPECIMEN: (ex herb Schimp.) „Taiti.“ (BM BM000667131 !)
= *Hypnum punctatum* Müll.Hal. in Müll.Hal. & Geh., Abh. Naturwiss. Vereine Bremen 7: 213. 1881 (fide Cardot in Grandid., Hist. Madag. 39: 503. 1915) (*Rhaphidostegium punctatum* ['punctulatum'] (Müll.Hal.) Paris, Index. Bryol., ed. 1: 1103; *Trichosteleum punctatum* (Müll.Hal.) Broth. in Paris, Index Bryol. ed.2, 5: 75. 1906)

TYPE: „Wald von Ambatondrazaka, 6. Decbr. 1877 in Fragmenten mit bereits abgefallenen Früchten.“ [leg. Rutenberg] (PC - isotype? !)
= *Hypnum trachyamphorum* Müll.Hal., Bot. Jahrb. Syst. 5: 85. 1884, **syn. nov.** (*Trichosteleum trachyamphorum* (Müll.Hal.) Kindb., Enum. Bryin. Exot. 104. 1891)

TYPE: „Nova Hannovera et insulae Anachoretas“ [Leg. Naumann] (Isotype: BM BM000667136 !)
= *Hypnum buettnerianum* Müll.Hal. in Büttner, Verh. Bot. Vereins Prov. Brandenburg 31: 67. 1890 (*Trichosteleum buettnerianum* (Müll.Hal. in Büttner) Broth. in Paris, Index. Bryol. Suppl. 323. 1900) (fide Buck, Trop. Bryol. 8: 208. 1993.)

TYPE: „Arthingtonfälle bei Kisulu. Januar 1885.“

- = *Hypnum hamatum* var. *semimammillosum* Müll.Hal. in Geh., Biblioth. Bot. 13: 11. 1889 (*fide* Tan *et. al.* 2005, based on Bartram 1939) (*Trichosteleum hamatum* var. *semimammillosum* (Müll.Hal.) Paris, Ind Bryol. 1311. 1898)
 TYPE: „New Guinea. Astrolabe Range. Leg. Rev. W.G. Lawes.“ (type not seen)
- = *Trichosteleum mamillipes* Broth., Bot. Jahrb. Syst. 20: 207. 1894 (*fide* Buck, Trop. Bryol. 8: 208. 1993.)
 TYPE: [Tanzania.] „Usambara: Bulua-Wald, 1030 m, an modernden Stämmen (HOLST n. 1286).“
- = *Trichosteleum subpyncylindricum* Broth., Bol. Soc. Brot. 8: 184. 1890 (*fide* Buck, Trop. Bryol. 8: 208. 1993.) (= *T. albescens* Broth., Bol. Soc. Brot. 8: 185. 1890, *nom. nud. in synonym.*)
 TYPE: „Ins. S. Thomé, Cordilheira do Pico, 1700 m alt., ad arbores, ubi m. Aug. 1888 legit Fr. Quintas.“
- = *Pungentella capillarisetata* Müll.Hal., Flora 82: 470. 1896, *comb. inval.* (*fide* E.B.Bartram, Bishop Mus. Bull. 101: 236. 1933) (*Sematophyllum capillarisetum* Paris, Ind Bryol., 1164. 1898).
 TYPE: „Insulae Hawaïicae, West Maui, Kanapali: Dr. W. Hillebrand Augusto 1870 legit.“
- = *Pungentella leptocylindracea* Müll.Hal., Flora 82: 470. 1896 *comb. inval.* (*fide* E.B.Bartram, Bishop Mus. Bull. 101: 236. 1933). (*Sematophyllum leptocylindraceum* Paris, Index. Bryol. 1166. 1898 [‘leptocylindricum’]; *Trichosteleum leptocylindraceum* Broth., Nat. Pflanzenfam. 1(3): 1117. 1908).
 TYPE: „Insulae Hawaïicae, sine loco speciali: Dr. W. Hillebrand.“
- = *Cupressina luridissima* Müll.Hal., Flora 82: 473. 1896 *comb. inval.* (*fide* E.B.Bartram, Bernice P. Bishop Mus. Bull. 101: 236. 1933) (*Sematophyllum luridissimum* Broth. in Paris, Index. Bryol. 1167. 1898)
 TYPE: „Insulae Hawaïicae, sine loco natali: Dr. W. Hillebrand.“
- = *Trichosteleum perhamosum* Broth., Bot. Jahrb. Syst. 24: 277. 1897 (*fide* Buck, Trop. Bryol. 8: 208. 1993.) (*Sigmatella perhamosa* Müll.Hal. in Paris, Index. Bryol. 1172. 1898 *nom. nud.*)
 TYPE: „Kamerun: an faulenden Stämmen bei Ekundu N’dene, bei Etome und zwischen Bomanu und Bibundi, c. 300 m (DUSÉN)“ [s.n.]
- = *Pungentella semiasperula* Müll.Hal., Bull. Herb. Boissier 5: 852. 1897, *comb. inval.* (*fide* E.B.Bartram, Bishop Mus. Bull. 101: 236. 1933).
 TYPE: „Insulae Hawaïicae, sine loco natali: Dr. Wilh. Hillebrand 1870“
- = *Sigmatella hamicuspis* Müll.Hal. in Paris, Index. Bryol. 1261. 1898 *nom. nud.*, [‘hemicuspis’] **syn. nov.** (= *Taxithelium hamicuspis* Paris, Index. Bryol. 1261. 1898 *nom. nud.* [‘hemicuspis’]).
 ORIGINAL SPECIMEN: „Musci Africani in Camerunia a P. Dusén collecti. 809. *Sigmatella hamicuspis* C.M. Ad Ekundu N’dene emporium in truncis putridis die 17 m. Martii a. 1892.“ (Ex Herb. Émil Bescherelle. 1900.) (BM BM000667132 !, BM000667133 !, BM000667134 !).
- = *Acanthocladium hamatum* Müll.Hal., Abh. Naturwiss. Vereine Bremen. 16: 507. 1900 (*fide* E.B.Bartram, Bishop Mus. Bull. 101: 236. 1933).
 TYPE: „Hawaii: Kilauea, im „Firewood“ am Dampföchern (n. 148)“ [leg. H. Schauinsland]
- = *Sematophyllum microstictum* Broth., Boll. Soc. Bot. Ital. 1904: 23. 1904 *nom. nud.* (*fide* E.B.Bartram, Bishop Mus. Bull. 101: 236. 1933).
 TYPE: „Ins. Maui loco non notato, 1875, c.fr.“ [leg. D.D. Baldwin]
- = *Trichosteleum borbonicum* var. *brachycarpum* Renaud & Cardot, Bull. Soc. R. Bot. Belg. 41(1): 98. 1905. **syn. nov.**
 TYPE: „Madagascar: Diego Suarez (Chenagon)“ (PC !)
- = *Sigmatella tamatavensis* Müll.Hal. in Renaud & Cardot, Bull. Soc. Roy. Bot. Belgique 41(1): 98. 1905 *nom. nud. in*

synon. [= *Trichosteleum borbonicum* var. *brachycarpum*]

= *Trichosteleum subtile* Broth. & Watts, J. Roy. Soc. New South Wales 49: 153. 1915, *hom. illeg.*, **syn. nov.**

TYPE: [Vanuatu.] „New Hebrides. Paama: Gunn and Frater, June 1912 (Hb. Watts, 256, 258).“ (**lectotype (Watts 256), selected here**, BM BM000728212 !)

= *Trichosteleum aequoreum* M.Fleisch. ex Dixon, J. Linn. Soc., Bot. 43: 320. 1916, **syn. nov.** (*Radulina aequorea* (M.Fleisch. ex Dixon) W.R.Buck & B.C.Tan, Acta Bryol. Asiat. 1(1,2): 10. 1989)

TYPE: „Bismarck-Archipel, Insel Mioko, M. Frond. Arch. Ind. et Polynes., No. 446.“ (**lectotype, selected here**, BM BM000667085 !; isolectotypes: BM BM000667086 !, BM000667087 !, BM000667088 !). NY (isolectotype). [SABAH] „Sekong“ [leg. C.H. Binstead,] „nos. 104“ (syntype, BM BM000666090 !); „115“ (syntype, BM BM000667089 !).

= *Trichosteleum neocaledonicum* Thér., Rev. Bryol. 48: 57. 1921, **syn. nov.**

TYPE: [New Caledonia]. „Tao, forêt, sur les écorces, alt. 100 à 600 m. (Franc, 1910)“ (holo, PC !)

= *Trichosteleum elegantissima* M.Fleisch., Musci Fl. Buitenzorg 4: 1326. 1923., **syn. nov.** (*Radulina elegantissima* (M.Fleisch.) W.R.Buck & B.C.Tan, Acta Bryol. Asiat. 1(1,2): 10. 1989; *Radulina hamata* var. *elegantissima* (M.Fleisch.) B.C.Tan, T.J.Kop. & D.H.Norris, Ann. Bot. Fennici 42: 232. 2005).

TYPE: „Auf morschem Holz gestürzter Baumstämme im Urwald der Hülgelregion West-Java; auf den Kalkhülgen von Tjampea bei Buitenzorg 400 m. (F[leischer].)“ (**lectotype, selected here**, FH !); „bei Tjipannas 1000 m. (F[leischer].)“ (syntype FH !); „Ost-Java: am Idjen an Bambus 7-800 m. (F[leischer].)“ (syntype FH !); „Ferner Sumatra: Bataklanden 800 m. (F[leischer].)“; „Philippinen (ELMER)“ (syntype FH !)

= *Trichosteleum elegantissima* var. *scabriseta* M.Fleisch., Musci Fl. Buitenzorg 4: 1326. 1923. **syn. nov.**

TYPE: „West-Java: am Nordabhang des Salak 600 m., an Rinde spärlich zwischen anderen *Trichosteleum*-arten eingesprengt (F[leischer].)“ (type specimen not located.)

= *Trichosteleum hamatum* var. *glabriseta* M.Fleisch., Musci Fl. Buitenzorg 4: 1330. 1923. **syn. nov.**

TYPE: „Mittel-Java; am Berg Prahoe auf dem Diëngplateau ! 2100 m. (F[leischer].)“ (Holotype: FH !)

= *Trichosteleum hamatum* var. *tuberculisetum* M.Fleisch., Musci Fl. Buitenzorg 4: 1330. 1923. **syn. nov.**

TYPE: „West-Java am Poentjakpass zwischen Mengamendong und Gedeh 1300 m., leg. Fleischer; um Tjibodas! 1450 m. und Tjibeurum 1700 m., leg. Fleischer“ (syntype: specimen from Tjiburum, 1913 FH !); „Mittel-Java Merbaboe am Telemojo 1350 m., leg. Fleischer“ (syntype: FH !). „Ferner Sumatra: Bataklanden am Vulkan Sibajak 1500 m., leg. Fleischer“ (**lectotype, selected here**, FH !)

= *Trichosteleum wrayii* Broth. in Dixon, Gard. Bull. Straits Settlm. 4: 38. 1926 *nom. nud. in synon.* (*fide* Dixon *loc. cit.*)

ORIGINAL SPECIMEN: „Malaya, Perak. Gunong Batu Puteh, 3400 ft. (L. Wray Jr. 1212)“ (BM BM000728216 !, BM000728217 !, BM000728218 !, BM000728219 !, BM000728220 !)

= *Trichosteleum flexuosa-hamatum* Dixon, J. Linn. Soc., Bot. 50: 125. 4f.43 1935, **syn. nov.**

TYPE: „On wet sandstone rocks in stream-bed, c. 1,230 m., Dulit Ridge, Sarawak, 19 Sept. 1932; coll. Oxford Exped. ([P.W. Richards] 1975)“ (holotype, BM BM000850488 !; isotype BM000850489 !)

= *Trichosteleum carolinarum* Dixon, Bryologist 46: 15. 1943, **syn. nov.**

TYPE: „On dead tree, Pelew Is., Carolines, Dec. 1933; coll. S. Ogura

(10062), comm. H. Sasaoka.“
(holotype, BM_{BM}000667084 !)

Plants flattened, with usually curved branches, pale green, opaque; *branch leaves* 0.9-2.5 × 0.23-0.38 mm, narrow to broadly ovate-lanceolate with long narrow apex, variable in outline, usually strongly hamate particularly towards the branch apex, toothed with projecting cell ends, often strongly, towards the tip; *margins* often inrolled in the upper leaf, but not always consistently; *alar cells* usually 2-3, swollen, thin-walled, largest (nearest margin) ca 35-65(-95) × 20-35 μm; *basal cells* rather shorter than laminal cells; *laminal cells* 24-68 × 4.5-7.5 μm, thick-walled, porose, papillae often present on both dorsal and ventral surfaces, (4-)6-10(-15) per cell, low and inconspicuous to prominent. *Perichaetial leaves* long, triangular, 0.8-1.2 × 0.25 mm, strongly toothed at apex, row of large cells at the base, alar cells slightly larger; *laminal cells* irregularly shaped, some twice as wide as others, without papillae, cell walls thinner below, thicker above, but thinner than those of branch leaves, and cells larger, wider and laxer. *Seta* 1-1.5 cm, usually smooth apart from the curve just below the capsule, but sometimes tuberclose almost to the base, the tubercles formed from projecting cell ends.

Plants from Oceania are often rather small with branch leaves perhaps 1 mm, and cells 25-40 μm in length, and were often named *Trichosteleum elegantissima*; the most robust plants were seen from the Seychelles, with strong papillae and leaves to 2.5 mm. Considering the rather few collections available from the Seychelles, they showed a great deal of variation in the seta, from the top third with tubercles to the more typical arrangement of just below the capsule. However, the degree of variation overlaps with specimens from Asia and Africa. Description/Illustration: Ramsay *et al.* 2004: 32-36 (as *Radulina hamata*); Noguchi *et al.* 1994: 1104-1105 (as *Trichosteleum elegantissimum*)
Distribution: Tropical Africa, Asia, Oceania.

Notes: The cell walls are not always easy to see, so cell measurements are cell lumen to cell lumen. The papillae are sometimes difficult to see but easier when viewed in profile (e.g., on folded leaf),

or via prepared mounts, for instance in Hoyer's solution.

Leskea borbonica Bél. is shown in *Index Muscorum* as being published in 1846, but this is the date when the whole of the botanical section was completed. The final fascicle of cryptogams, which included *Leskea borbonica*, was published on 24 May 1834 (Ross 1964).

Some confusion has been caused by the way *Index Muscorum* (Wijk *et al.* 1959-1969) treated this taxon. *Sematophyllum borbonicum* (Bél.) Mitt. in Seem. appears in *Index Muscorum* as *Sematophyllum borbonicum* Mitt. in Seem., without acknowledging the authorship of Bélanger. The reason for this is not clear, but is presumably based on the fact that Mitten included *Hypnum pickeringii* as a synonym of *Sematophyllum borbonicum*, recognising the wide range of the taxon, whilst Dixon subsequently (Dixon & Greenwood 1930) included *H. pickeringii* in the synonymy of *Trichosteleum hamatum*. As *Index Muscorum* treats *Trichosteleum borbonicum* and *T. hamatum* as different taxa, this must mean that Mitten's name had to be disassociated from Bélanger's taxon, and synonymised with *T. hamatum* (as it was). This was a lost opportunity that made worse an already confused situation.

Radulina borbonica* var. *ferriei* (Cardot & Thér. in Thér.) O'Shea, *comb. nov.

BASIONYM: *Trichosteleum ferriei* Cardot & Thér. in Thér., Bull. Acad. Int. Géogr. Bot. 18: 251. 1908; (= *Radulina hamata* var. *ferriei* (Cardot & Thér. in Thér.) B.C.Tan & Y.Jia, J. Hattori Bot. Lab. 86: 45. 1999)
TYPE: Japan: „Oshima, environs de Naze, leg. R.P.J.-B. Ferrié, 1898-9.“ (*lecto. nov.*: PC!)

Leaves much larger than those of the type variety (ca 2.5 × 0.33 μm), similar in shape and appearance but only slightly hamate, *cells* long and narrow (48-75 × 5 μm), porose, only lightly papillose in the distal part of the leaf, although occasionally also in mid-leaf.

Description/Illustration: Noguchi *et al.* 1994: 1103-1105 (as *Trichosteleum ferriei*).

Distribution: Japan, China.

Although the range of variation in *Radulina borbonica* is quite wide, in this case there are areas of discontinuity that are recognised here as a variety, pending any evidence to unite them with the main species. In this case, the low level of papillosity, the large size and the geographical isolation of the taxon justifies retention of varietal status.

The collection details of the only specimen found in PC-Thériot do not match up exactly with the protologue (an 1898 collection is indicated), but with no other potential type collection available, and the specimen resembling closely the type description (only upper cells papillose, papillae not large) it seems correct to lectotypify the taxon from the specimen.

Naze is a town on the island of Amani O-shima [28°21' N, 29°30' E] (part of Kyushu state). The taxon also occurs further south in Ryuku, but no further north in Japan, and is also in China.

***Radulina orthophylla* (Besch.) B.C.Tan, T.J.Kop. & D.H.Norris, Acta Bot. Fennica 42: 232. 2005**

BASIONYM: *Sematophyllum orthophyllum* Besch., Bull. Soc. Bot. France 45: 122. 1898. (*Trichosteleum orthophyllum* (Besch.) Broth., Nat. Pflanzenfam. 1(3): 1117. 1908)
 PROTOLOGUE: [Tahiti]. [Nadeaud] „1^{re} herbor.“ [Montagne du Pinai et vallee de Puaa, 800 a 1000 metres d'altitude; 1er Avril 1896]“, no. 384; 6^e herbor.“ [Montagnes du Pinai et de Papeana; sans date [1896]], „no. 385. C. fr.“
 LECTOTYPE: „Mousses de Tahiti. Coll^{on} N° 2. - N° 384. *Sematophyllum orthophyllum* Besch sp. nov. Legit D^r Nadeaud, 1896“ (*lecto. nov.*: BM^{BM000852060} !)

Plants robust, olive green, leaves erect, not falcate, ovate-lanceolate, leaves ca 1.5 × 0.4 mm, denticulate above. Laminal cells shorter than those of *R. borbonica*, thick-walled, ovate-elongate, with rounded ends; alar cells usually longer than those of *R. borbonica*. Seta red, to 2 cm long, papillose below the capsule, exothecial cells not collenchymatous (i.e. no corner thickening.)

Description & illustration: Whittier 1976: 344-345. Distribution: Society Islands (Tahiti, Moorea and Raiatea), 600-1000 m.

Bartram (1931: 13) suggested that this taxon should be „considered as a form of *T. hamata*“. However, the BM specimen seems to be a distinct taxon, differing in its non-hamate leaves, smaller cells with rounded ends, longer, less opaque leaves, longer capsule and larger size.

The only collection of this species in Bescherelle's herbarium at BM is labelled as Nadeaud no. 384, the first specimen listed in the protologue. This specimen is selected as the lectotype. Only five collections have been reported (Bescherelle 1898: 123 [*Nadeaud 384, 385*, from Tahiti]; 1901: 12-13 [*Temarii/Nadeaud 17*, Tahiti & *Temarii/Nadeaud 22*, Moorea] and Bartram 1931: 13 [*Moore 35*, Raiatea]).

***Radulina pendens* (D.H.Norris & T.J.Kop.) B.C.Tan, T.J.Kop. & D.H.Norris, Acta Bot. Fennica, 42: 232. 2005**

BASIONYM: *Trichosteleum pendens* D.H.Norris & T.J.Kop., Ann. Bot. Fennici 22: 388, fig. 10. 1985
 PROTOLOGUE: Holotype: Papua New Guinea. West Sepik Prov.: Frieda River, collecting site 2a [1100 m, 8 Aug 1981], on tree trunk, *Koponen 35847* (H; isotypes in HSC and LAE). Paratype: 5b. 35424 on tree branch.

[Specimen not seen; description derived from Tan *et al.* (2005).] Plants growing pendent from tree trunk, branches to 4-5 cm, not attenuate at tip. Leaves erect-spreading, slightly falcate, ovate-to oblong-lanceolate, concave, with a well-defined, long, narrow and sharp acumen about 1/3 of the leaf length; laminal cells linear, thickened at ends, 65-95 µm × 6-8 µm, basal cells smooth, but with 2-4 seriate papillae per cell above. Perichaetia and sporophytes unknown.

This taxon was not encountered during my investigations, but appears in Tan *et al.* (2005), and clearly belongs here. Although known from only two collections, it clearly fits the 'multi-

seriate papillae *Trichosteleum*' model used to scope *Radulina*.

Description & illustration: Norris & Koponen 1985: 388-389.

Distribution: Papua New Guinea, 1100 m.

***Radulina sematophylloides* (Dixon) O'Shea, comb. nov.**

BASIONYM: *Trichosteleum sematophylloides* Dixon, J. Linn. Soc., Bot. 45: 507. 29f.16. 1922

PROTOLOGUE: [Papua New Guinea.] [Mt. Duriglo, Owen Stanley Range, Port Moresby District., 1916. Leg. Rev. J.B. Clark] (Nos. 52, 44).

TYPE: *Clark 52*. (lectotype: BM BM000725874), *Clark 44* (syntype: BM BM000725873) (*vide* Tan *et al.* 2005).

Similar in size to *R. borbonica*, but leaves carried rather rigidly almost at right-angles to the stem, ovate-lanceolate, ca 0.5 × 0.15 mm, toothed from base; alar cells attached quite strongly to the stem, thick-walled, comparatively small and narrow, largest ca 42 × 10 µm, with supra-alar cells; laminal cells 35-54 µm long, porose, with low papillae, 3-6 per cell, seen most clearly on folded leaves. Sporophytes unknown.

Known only from the two type specimens. B.C. Tan annotated *Clark 52* as the lectotype in Jan 2003, and this was published in Tan *et al.* (2005). (Note: Tan *et al.* (2005) transposed the two types in the type description, but described them correctly in the subsequent narrative.) Tan also annotated the type as a possible *Wijkia*, and in Tan *et al.* (2005) it is treated as a synonym of *Wijkia extenuata* (Brid.) H.A.Crum. However, although *Wijkia extenuata* possesses multiple seriate papillae, it is usually a particularly distinctive plant with characters that differ significantly from those of *Trichosteleum sematophylloides* (e.g. size, plant and leaf structure, stem colour) and is thus treated here as a species of *Radulina*.

Description & illustration: Dixon 1922: 507, 29.f.16.

Distribution: Papua New Guinea.

NOTES ON NEW SYNONYMS AND OTHER TAXA

(alphabetic order of species)

Trichosteleum aequoreum M.Fleisch. ex Dixon, 1916

Buck and Tan (1989[1990]) treated 'M. Frond Arch. Ind. et Polynes. No 446' as the type of this taxon, but the rather minimal description/protologue provided by Dixon included also 2 specimens from Sekong (Sabah): *C.H. Binstead 104 & 105*. The collection regarded as the type is above lectotypified, and Binstead's collections remain as syntypes.

Although there are four specimens in BM representing Fleischer's 446 collection, one appears to belong to Dixon's own herbarium and has thus been selected as the lectotype. The four Fleischer specimens and the two Binstead collections match well. Dixon says that this taxon is 'much like *T. hamatum*, but much smaller and apparently dioicous'. The size of the plant is within the range accepted here (although some shoots seem to be smaller than others in the same weft), and is similar to other collections from the Pacific islands, but the paucity of sporophytes is unusual in a taxon that is normally abundantly fertile. Although Dixon's specimen appears to have no sporophytes, perichaetial leaves and old setae are present on BM000667086 and BM000667087, and these are typical of *Radulina borbonica*. It isn't made clear by Dixon how he had come to his conclusion on the dioicy of the taxon.

Trichosteleum borbonicum* var. *brachycarpum Renaud & Cardot, 1905

This is just a small version of the typical plant, and similar forms are found throughout the range, defined as having shorter (ca 1.3 mm), more hamate leaves, with shorter cells (ca 24-42 µm) and with a shorter capsule.

Hypnum buettnerianum Müll.Hal. in Büttner, 1890

Synonymised by Buck (1993); type not seen for this study.

Pungentella capillarisseta Müll.Hal., 1896 *comb. inval.*

Synonymised by Bartram (1933); type not seen for this study.

Trichosteleum carolinarum Dixon, 1943

The type specimen is rather sparse, and mixed with detritus and other mosses, but is fairly typical of Pacific island material; perhaps not as robust as some Asian/African material, nor as strongly hamate, but usually with a few larger and more hamate shoots to be found, and within the scope of the taxon.

Hypnum daltonioides Schimp. in Jard., 1875 *nom. nud.*

Synonymised by Beschereille (1896); type specimen seen and synonymy confirmed.

Trichosteleum elegantissima M.Fleisch., 1923

No holotype was selected by Fleischer, so a lectotype has been chosen. The specimen has been selected for three reasons: it is the first in Fleischer's list; it is the most substantial specimen, and it agrees well with Fleischer's description. The fourth of Fleischer's syntypes was not found amongst the material seen from FH, although other non-type specimens of Fleischer's were present. The original description emphasised its more delicate habit than *Hypnum hamatum* and the many shorter, rougher leaves and leaf cells, as well as the short seta.

Although *Trichosteleum elegantissimum* is typified by its leaves being narrower and straighter, all collections seen had some hamate leaves, particularly at the tips of stems, and in general leaf width was quite variable. Measurements taken from the type specimen showed leaves to be around 1.1×0.3 mm, which is typical for the area. There seemed to be much variation in the overall size of plants given this name, and many were quite large, and presumably were only given the name because of the straighter leaves. The smaller plants seem to come from the Pacific islands, although most had been given the name *T. hamatum* rather than *T. elegantissima*. This form is well illustrated in the Japanese flora (Noguchi et al., 1994.)

Trichosteleum elegantissima* var. *scabriseta M.Fleisch., 1923

Another attempt to describe the 'all-tuberclose' seta form.

Trichosteleum flexuoso-hamatum Dixon, 1935

The leaves somewhat flexuose, but otherwise typical *Radulina borbonica*.

Acanthocladium hamatum Muell.Hal., 1900

Synonymised by Bartram (1933); type not seen for this study.

Hypnum hamatum Dozy & Molk., 1844

[Non *Hypnum hamatum* (Mitt.) A.Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1877-78: 312. 1880 (*Stereodon hamatus* Mitt., J. Linn Soc. Bot. 12: 533. 1869) *hom. illeg.* (= *Pylaisiella falcata* (Bruch, Schimp. & W.Gümbel) Ando, Phyt. (Allahabad) 1: 19. 1978). B.C. Tan renamed this *H. mittenohamatus* (Tan in Thiers 1992: 5)] The original description of Dozy & Molkenboer makes no mention of papillae on the leaves, although the scabrous seta is mentioned. The description that followed in *Bryologia Javanica* (1861-1870: 176-177) describes the leaves as 'tenerrime punctulatis', and the illustration (Tab. CCLXXV) shows the typical seriate papillae above, but with smooth cells in the lower leaf. The manuscript included with the type specimen (L 0488080), which appears to be the draft for *Bryologia Javanica*, makes no mention of papillae, although they are present on the upper dorsal surface, visible particularly near the apex. There are no complete setae in the holotype packet, but an isotype (L 0488075) has setae that seem to be rather more roughened than in typical plants, affecting about the top 25% of the seta. The relatively small papillae on the leaf cells compared with the roughness of the seta suggests that there is no link between these two characters.

Trichosteleum hamatum* var. *glabrisetum M.Fleisch., 1923

This is an absolutely typical, but comparatively small, *Radulina borbonica*, and was defined as seta almost smooth, slightly rough on capsule neck; this was seen as different because the type of *Trichosteleum hamatum* has such a rough seta. This is the Asian equivalent of *T. borbonicum*

var. *brachycarpum* - a slightly smaller version of the 'typical' species.

Hypnum hamatum* var. *semimammillosum Müll.Hal. in Geh., 1839

According to the protologue, this New Guinea collection differs from the typical plant by the seta, which is only tuberculose in the upper half, with the lower half smooth - representing another confusion about the nature of *Hypnum hamatum*, which of course has an identical seta to this. Bartram (1939: 340) comments: „I doubt if the variety *semimammillosum* C.M. can be segregated with any satisfaction; the setae are typically smooth below and always papillose for some distance below the top.“ A type specimen has not been seen.

Trichosteleum hamatum* var. *tuberculisetum M.Fleisch., 1923

It is not clear from Fleischer's herbarium which specimen should be selected as the lectotype, but one specimen on a sheet of three has been labelled and as it is the largest and agrees with the type description, this one is selected. The other two specimens are labelled as if intended for Fleischer's exsiccate series XI. This taxon was described on the basis of setae tuberculose from the base, now shown to be within the range of normal variation in this plant.

Sigmatella hamicuspis Müll.Hal. in Paris, 1898 *nom. nud.*

This is a typical *Radulina borbonica*, but with some rather longer leaves (to 1.8 mm) than normal for West Africa, and the leaves are straight to slightly curved. The original specimens are clearly labelled *Sigmatella hamicuspis*, but the name is published by Paris (1898) as *S. hemicuspis*, although this is corrected in the second edition (Paris 1905). The collection number is stated as Dusén 809 on the collections, but Dusén 800 in Paris (1898, and 1905): this is presumed to be a transcription error.

Pungentella leptocylindracea Müll.Hal., 1896, *comb. inval.*

Synonymised by Bartram (1933); type not seen for this study.

Cupressina luridissima Müll.Hal., 1896, *comb. inval.*

Synonymised by Bartram (1933); type not seen for this study.

Trichosteleum mamillipes Broth., 1894

Synonymised by Buck (1993). A typical specimen of *Radulina borbonica*, with all measurements near the average.

Sematophyllum microstictum Müll.Hal., 1904

Synonymised by Bartram (1933); type not seen for this study.

Sematophyllum neocaledonicum Thér., 1921.

Thériot states that this species is similar to *Trichosteleum pickeringii* (= *Radulina borbonica*), but differs in being smaller in size, with smaller leaves and a shorter seta. However, the cell size quoted (20-24 × 5-6 µm) and the seta length (6-7 mm) are well within the values accepted here for *R. borbonica*.

Hypnum palanense Hampe ex Müll.Hal., 1874

Synonymised by Bartram (1933); type seen and synonymy confirmed.

Trichosteleum perhamosum Broth. 1897

Although this taxon has already been synonymised with *Radulina borbonica* by Buck (1993), it is worth mentioning Brotherus' comment, which illustrates the level of variation: „Species inter *Tr. borbonicum* (Bél.) et *Tr. hamatum* (Doz. Molk.) locum intermedium tenens, ab hoc seta apice tantum scabra, ab illo foliis longius acuminatis, falcatis nec non theca majore, oblongo-cylindrica distinguenda.“ [Species intermediate between *Tr. borbonicum* and *Tr. hamatum*, distinguished from one by the seta hardly scabrous at the apex, from the other by the leaves long acuminate, falcate and also the large oblong-cylindric capsule.]

Hypnum pickeringii Sull., 1854

Synonymised by Dixon & Greenwood (1930); type seen and synonymy confirmed.

Hypnum punctatum Müll.Hal. in Müll.Hal & Geh., 1881

This Madagascan collection of Rutenberg is said by Müller to have longer and more falcate leaves than „H. Borbonico C.Müll.“ (= *Radulina borbonica*), although Cardot (1915) says that a specimen in Renauld's herbarium apparently of this plant has leaves shorter than the of plant of Réunion. The type specimen has leaves of around 1.4 mm, so is of average size, and quite strongly papillose, clearly falling within the scope of *Radulina borbonica*.

Hypnum rhinophyllum Müll.Hal., 1874

Synonymised by Dixon & Greenwood (1930); type seen and synonymy confirmed.

Hypnum scaberulum Mont., 1844

Although Müller (1851) recognised this as a synonym of *Trichosteleum hamatum*, as did Dozy & Molkenboer (1861-1870), Buck & Tan accepted it as a taxon in *Radulina*, making no comment on these earlier views. The type specimen from Montagne's herbarium in PC is not large, and all but one of the sporophytes lack capsules, but the setae are tuberculose throughout most of their length, being smooth only within the perichaetial leaves. However, this degree of roughness of the seta is not unusual in Java, and features also for instance in *Trichosteleum hamatum* var. *tuberculisetum*, where it was recognised as variation within this very variable taxon. Other features of the plant are quite typical of *Radulina borbonica*.

Pungentella semiasperula Müll.Hal., 1897, *comb. inval.*

Synonymised by Bartram (1933); type not seen for this study.

Sematophyllum subinstratum Besch.

Both Bescherelle's holotype and an isotype from Hampe's herbarium were available. Both specimens are labelled as 'Belanger 3725', in Bescherelle's handwriting, although the protologue states '3275'. This is assumed to be a clerical error. Bescherelle distinguished this species from '*Hypnum borbonicum*' by its habit (he likens it to '*Hypnum instratum*' (= *Taxithelium instratum*)), the leaves longer and less toothed, and by the smooth calyptra (the calyptra in *R.*

borbonica is usually smooth, sometimes roughened above).

Trichosteleum subpyncocylindricum Broth., 1890

Synonymised by Buck (1993); type not seen for this study.

Trichosteleum subtile Broth. & Watts, 1915, *hom. illeg.*

Typical *Radulina borbonica*, with verrucae only at the distal end of the seta, and very similar in detail to other Oceanic collections. Dixon annotates the type in manuscript „This I think cannot be separated from the var. of *T. hamatum* [=var. *semimamillosum*]. The shorter leaves are the only difference I can find, and these vary much on the Fiji plants leg. Steele.“

Hypnum trachyamphorum Müll.Hal., 1884

The type specimen is quite typical *Radulina borbonica*, but Müller believed in narrow endemics, and redescribed taxa in different geographical areas.

Trichosteleum wrayii Broth. in Dixon, 1926, *nom. nud. in synonym.*

Synonymised by Dixon (1926); type seen and synonymy confirmed.

EXCLUDED TAXA

Hypnum trachypyxis Müll.Hal. in Müll.Hal & Geh., Abh. Naturw. Ver. Bremen 7: 213. 1881.

Mueller describes this taxon as follows:

Monoicous, creeping, pale yellow, branches short, slightly thick, laxly foliose, apex gradually curved; stem leaves ovate-lanceolate, shortly acuminate, not falcate, concave, entire margin serrulate, costa hardly apparent, cells narrow, strongly scabrous with large linear papillae, alar cells two, large, yellow; perichaetial leaves laxly reticulate, more serrulate; short purple seta, above minutely papillose, with sporophyte old, oval-globose, scabrous. Wald von Ambatondrazaka, 6 Decbr. 1877.... A memorable species, the rough sporophyte different from all others in the genus!

I have seen no specimens, but this sounds very much like *Radulina*. Awaiting examination of an authentic specimen.

Rhaphidostegium hamulosum Schimp. in A. Jaeger, Ber. Thätigk. St. Gallischen Naturwiss. Ges. 1877-78: 486. 1880 (Ad. 2: 750), *nom. nud.*
ORIGINAL SPECIMEN: [Réunion] „Insul. Borbonis (Boivin)“ (BM!).

The leaves of this taxon are strongly hamate, ca 1.3 mm in length, strongly toothed towards the apex; alar cells with 2 or 3 supra-alar cells, laminal cells to ca 82 µm, with single papillae visible on the dorsal surface, much more obscure on the ventral surface. The three specimens in BM are identical. This taxon should be referred to *Trichosteleum*.

Trichosteleum grosso-mamillosum Paris ex Dixon, J. Linn. Soc., Bot. 45: 507. 1922

HOLOTYPE: [New Guinea] „*Thelidium grossomamillosum*, C. Muell., MSS. in lit., 1895, et in Bryoth. E. Levier, No. 697“ (BM BM000850490!)

This species is very similar in size and cell structure to *Radulina*, but there is usually only one large somewhat irregularly-shaped papilla per cell, sometimes two or three, but not usually seriate as in *Radulina borbonica*. The seta is papillose distally. This could be an erratic form of *Radulina borbonica*, and another (non-type) specimen on the same sheet identified by Dixon labelled as *Trichosteleum grosso-mamillosum* is typical *Radulina borbonica*. Tan *et al.* (2005) treat this as a synonym of *Radulina hamata* var. *scaberula* (Mont.) B.C. Tan, T.J. Kop. & D.H. Norris (= *R. borbonica*) based on the published description, but without having seen the type specimen.

Trichosteleum hamatum* var. *robustum Broth. ex Herzog, Hedwigia 50: 143. 1910, *nom. nud.*

ORIGINAL SPECIMEN: Auf faulem Holz in Urwald des Haycock-Hill (Hiniduma) ca. 300 m, Febr. 06 - ster.

This taxon appears in a list of taxa collected in Sri Lanka by Herzog, the name attributed to Brotherus (Herzog 1906: 143). The only comment in the text (Herzog 1906: 118) is that this taxon is „einer auffallend kräftigen Form“ (a remarkably

strong form). The protologue gives a locality and presumably a specimen, but no further details. It is likely that this is another synonym of *Radulina borbonica* but is treated here as excluded as no specimen has been seen.

Trichosteleum laeve-hamatum Dixon, J. Bot. 1942[?1943]: 31 (= *Radulina laevi-hamata* (Dixon) B.C. Tan, T.J. Kop. & D.H. Norris, Acta Bot. Fennica 42: 232. 2005).

TYPE: [PAPUA NEW GUINEA.] „On forest trees, circa 2450 m., above the Gap, range above Port Moresby, 16 Dec. 1935; coll. C.E. Carr (13823)“ (Holotype: BM BM000667095!)

This taxon has a similar appearance to *Radulina*, particularly with the hamate leaves of very similar shape and size, but the leaves are proportionately wider, it has no papillae and rather different cells, including quite thick-walled alar cells. Tan *et al.* (2005) described this taxon as ‘becoming clearly pluripapillose at leaf acumen’, although the type specimen examined had smooth cells throughout, suggesting a mixed collection. This taxon may belong in *Warburgiella*, and may be the same as *Trichosteleum perfalcatum* (see below).

Trichosteleum neocaledonicum* var. *koghiense

Thér., Rev. Bryol. 48: 58. 1921.

Although *Trichosteleum neocaledonicum* var. *neocaledonicum* has been made a synonym of *Radulina borbonica*, this taxon belongs in *Trichosteleum*. It has much shorter cells, not thick-walled or porose, and only one (or sometimes two) papillae per cell: apical leaves hamate, lower leaves less so, to almost straight; leaf 0.9 × 0.15 mm, cells 19-42 × 8.5 µm (+ 1.2 µm cell wall). It is here promoted to species-level, awaiting revision of *Trichosteleum*:

Trichosteleum koghiense (Thér.) O’Shea, **comb. nov.** (= *Trichosteleum neocaledonicum* var. *koghiense* Thér., Rev. Bryol. 48: 58. 1921)

TYPE: [NEW CALEDONIA]. Mont Koghis (Franc, 1913) (holo? PC!)

Trichosteleum pallidum E.B. Bartram, Lloydia 5: 285. 53. 1942, *hom. illeg.*

HOLOTYPE: [NEW GUINEA] „Abundant on mossy forest undergrowth, 18 km. SW. of Bernhard Camp, Idenburg River, 2150 m.,“ [L.J. Brass] „no. 12613 type“.

No specimen has been seen of this taxon, although the leaves are said by Bartram (op. cit.) to be very similar to *Radulina borbonica*. However, the leaves are described as smooth. *Index Muscorum* says it is *Warburgiella subleptorrhynchoides* (M.Fleisch.) M.Fleisch., *vide* Bartram, Rev. Bryol. Lichénol. 30: 204. 1962 [‘1961’]. According to Bartram (1962: 204), the leaves are glossy and broader below (< 0.4 mm), narrowing suddenly to a long, slender, toothed apiculus (about the same length as the blade), with weak occasional papillae in the upper leaf cells. Setae are usually smooth above, but can be slightly scabrous. According to TROPICOS/MOST this is *Warburgiella pallida* Zanten (1964), but no mention is made of Bartram’s earlier synonymy.

Trichosteleum perfalcatum E.B.Bartram, Lloydia 5: 285. 52. 1942

TYPE: [NEW GUINEA.] „Common epiphyte in mossy forest, 18 km S.W. of Bernhard Camp, Idenburg River, 2150 m.,“ [L.J. Brass] „no. 12612“ (isotype: BM !)

Like *T. pallidum*, but leaves more strongly curved, gradually narrowed to a strong setaceous point and entire or sparingly toothed at the apex; leaf cells smooth, with mid-leaf cells to 75 µm, alar cells quite thick-walled. The single seta present in the BM isotype (with no capsule) is much longer than that of *T. pallidum*, and has none of the characters of *Radulina*, and although the leaf has the shape of *Radulina borbonica* it is without papillae. I agree with Tan *et al.* (2005) that this taxon is best treated in *Warburgiella*, as *W. perfalcata* (E.B.Bartram) B.C.Tan, T.J.Kop. & D.H.Norris.

Warburgiella weidenii Zanten, Nova Guinea, Bot. 16: 330. pl.29, f.5. 1964

TYPE: Indonesia [New Guinea]. „Irian Barat: Wopoko, 100 m, Van Zanten 206“ (holotype, L; isotype GRO).

Treated as a synonym of *Radulina scaberula* (Mont.) W.R.Buck & B.C.Tan by Buck & Tan (1989), and as *Radulina weidenii* (Zanten)

B.C.Tan, T.J.Kop. & D.H.Norris by Tan *et al.* (2005). Type not seen. Tan *et al.* (2005) included it as a distinct taxon within *Radulina* on the basis of there being 1(-3) papillae on the cells and a strongly serrate margin, its other characters matching the genus. They consider it a separate species partly because of the often unipapillose cells, but also because the papillae appear on both dorsal and ventral surfaces, which is said to be unique in the genus; however papillae occur on both surfaces of the majority of *Radulina* specimens seen for this study. From the original description, it appears to fit neither *Radulina* nor *Warburgiella*, so is here excluded, awaiting further consideration.

SIMILAR TAXA

Hypnum novo-guineense Geh. (≡ *Trichosteleum novo-guineense* (Geh.) Kindb., ≡ *Ectropotheciopsis novo-guineensis* (Geh.) M.Fleisch.) has similar multi-papillose cells and overall leaf shape to *Radulina*, but does not have the Sematophyllaceae alar cells and looks like an *Ectropothecium*, with strongly circinate laves curled under the stem.

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APPENDIX: SELECTED SPECIMENS EXAMINED:

(All African material as *Radulina borbonica*/*Trichosteleum borbonicum*, and all Asian and Oceanic specimens as *Radulina hamata*/*Trichosteleum hamatum*, unless otherwise stated.)

AFRICA.

BIOKO (Fernando Po): *E. Seimund s.n.*, Spring 1904 (as *Trichosteleum subrhizophyllum*) (BM BM000664749, BM000664750)

CAMEROON: *Dusén 924*, 3.1891 (as *Sigmatella perhamosa*) (BM BM000664751, BM000664752); *Dr. Dunlap K.8 b*, 3 Jan 1926 (as *Trichosteleum perhamosum*) (BM BM000667053); *Staudt 728, s.d.* (as *Trichosteleum perhamosum*) (BM BM000667054); *Zenker & Staudt 4669*, 10.94 (BM BM000667078)

COMOROS: *Marie*, 21.8.1881 (BM BM000667069); *E. Marie s.n., s.d.* (BM BM000667070)

GHANA: *H.H. Saxby T.19*, 1910 (as *Trichosteleum perhamosum*) (BM BM000667052)

MADAGASCAR: *Rutenberg s.n., s.d.* (as *Hypnum punctatum*) (PC - ?isotype); *Chenagon 117c, s.d.* (PC - holotype of *Trichosteleum borbonicum* var. *brachycarpum*); R. Decary, (PC - as *Trichosteleum borbonicum* var. *brachycarpum*)

MALAWI. Mt. Mulanje. *O'Shea M7063c, M7064c, M7074a, M7084b, M7575b*, June 1991 (E)

MAURITIUS. *Robillard s.n., s.d.* (BM BM000667066, BM000667068, PC); *A. Darnty 13*, 20.6.1974 (BM BM000667067); *Balfour s.n., s.d.* (in collection of *Trichosteleum microdontium* (Besch.) Renault) (BM BM000667056); (no details) (BM BM000667079)

NIGERIA: *Vogel s.n., s.d.* (BM BM000667075)

RÉUNION: *Frappier s.n., s.d.* (BM BM000667070); *Lepervanche s.n., s.d.* (BM BM000667073); *T. Arts REU 92/09, 92/24, 92/46, 97/54*, Nov. 1998, (BR-Arts, dupl. Hb. B.J. O'Shea)

SEYCHELLES: *G. de l'Isle s.n., s.d.* (BM BM000667071); *Norkett 17184, 17236, 17273, 17302b*, Oct 1973 (BM)

TANZANIA: *Holst 4286*, 9.1893 (as *Trichosteleum mamillipes*) (isotype: BM BM000667057, BM000667058, BM000667059, BM000667060, BM000667061, BM000667062, BM000667063); *T. & S. Pócs 6091/B*, 31.12.1969 (as *Trichosteleum perhamosum*) (BM BM000667055); *T. Pócs & B.J. Harris 6167/K.L* (BM BM000667065); *T. Pócs et al., 86157/M*, Nov. 1986 (EGR); *T. Pócs 88193/S*, Sept. 1988 (EGR); *G. Kis & T. Pócs 9121/P*, Feb. 1991 (EGR)

UGANDA: *G.H.S. Wood 1041*, 18.6.1950 (as *Trichosteleum mamillipes*) (BM BM000667064); *M.J. Wigginton 3192a*, 28.1.1997 (E)

Southern Africa: *Bernier s.n., s.d.* (BM BM000667074)

West Africa: *G. Mann s.n.*, 1861 (BM BM000667076); *G. Mann 546, s.d.* (BM BM000667077)

ASIA

BISMARCK ARCHIPELAGO: *M. Fleischer 446*, 6.12.1903 (as *Trichosteleum aequoreum*) (BM BM000667085, BM000667086, BM000667087, BM000667088)

INDIA: *N.L. Bor 469*, 1.12.1938 (BM BM000667082); *N.L. Bor 231*, 14.11.1934 (BM BM000667083)

JAVA: *Miquel 50, s.d.* (PC - holotype of *Hypnum scaberulum*); *M. Fleischer s.n.* (paratype of *Trichosteleum hamatum* var. *tuberculisetum*) 1 May(?) 1913 (FH); *M. Fleischer s.n.* (paratype of *Trichosteleum hamatum* var. *tuberculisetum*) 15 June 1913 (FH); *M. Fleischer s.n.* (as *Trichosteleum hamatum* var. *tuberculisetum*), June 1913 (FH).

JAPAN: *J.B. Ferrié s.n.*, 17.10.1899 (PC) (as *Trichosteleum ferriei*)

MALAYA. Johore: Pulau Tioman. *O'Shea 98C22, 98C40c*, June 1998 (Hb. O'Shea).

NICOBAR: *J. Krieg 'sub 3841 interm', s.d.* (BM BM000667080)

PAPUA NEW GUINEA: *C.E. Carr 11560*, 1.3.1935 (as *Trichosteleum aequoreum*) (BM BM000667091)

PHILIPPINES: *G. Edaño*, 4.1929 (as *Trichosteleum elegantissimum*) (BM BM000667092)

SABAH: *C.H. Binstead 104, 115*, 23.4.1913 (as *Trichosteleum aequoreum*) (BM BM000667089,

BM000667090); *G.H.S. Wood 1454*, 6.4.1954 (as *Trichosteleum elegantissimum*) (BM BM000667094)

SUMATRA: *R.E. Holttum 15500C*, 9.1924 (as *Trichosteleum elegantissimum*) (BM BM000667083); *M. Fleischer 751* (lectotype of *Trichosteleum hamatum* var. *tuberculisetum*) 30 Aug 1919 (FH)

THAILAND: *A. Kerr M552*, 8.11.1930 (BM BM000667081)

OCEANIA/AUSTRALASIA

AUSTRALIA: *H. Streimann 42505* (BM BM000667123)

CAROLINE IS.: *S. Ogura 10062*, 12.1933 (as *Trichosteleum carolinarum*) (BM BM000667084)

COOK ISLANDS. *O'Shea 00E54b*, Nov. 2000 (Hb. O'Shea)

FIJI. *Dr. Gräffe* in *Hb. C. Müller* (as *Hypnum pickeringii*) (BM BM000667124); (as type of *Hypnum rhinophyllum*) (BM BM000667135)

HAWAII: *U.S. Expl. Exped. (Wilkes)*, 1838-1840 (as *Hypnum pickeringii*) (BM BM000667122)

SAMOA. *Rev. T. Powell 117* (as *Sematophyllum borbonicum* Bél.) (BM BM000667127); *Dr Reinecke 37*, June 1894 (BM BM000667126)

TAHITI. *Dr. Nadeaud 2*, 1896 (BM BM000667125); ex herb Schimper (original specimen of *Hypnum daltonioides*) (BM BM000667131)

