Polish Botanical Journal 55(2): 499–506, 2010

BUCKLANDIELLA SHEVOCKII (BRYOPHYTA, GRIMMIACEAE), AN EXQUISITE NEW SPECIES FROM YUNNAN, CHINA

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Abstract. *Bucklandiella shevockii* Bednarek-Ochyra & Ochyra is described as a new species from five localities in the Gaoligong Shan mountains of the Sino-Burmese border region in western Yunnan Province of China. The species is known only in the barren state, with a few perichaetia only, but it exhibits a set of peculiar gametophyte characters, including prominent, pellucid, yellow to orange-brownish, lax alar cells forming longly decurrent auricles; a faint, bistratose costa reaching ½–¾ of the leaf length and situated at the bottom of a deep furrow; a distinctly twisted leaf acumen; and a short, hyaline, dentate, flat and twisted hair-point. These traits make it only distantly related to other congeners and therefore a new subsection, *Bucklandiella* Roiv. subsect. *Shevockiella* Bednarek-Ochyra & Ochyra, is established to accommodate this new species which on account of the shape of the perichaetial leaves is tentatively placed in *Bucklandiella* Roiv. sect. *Subsecunda* (Bednarek-Ochyra) Bednarek-Ochyra & Ochyra.

Key words: *Bucklandiella*, *Codriophorus*, *Racomitrium*, Grimmiaceae, Bryophyta, taxonomy, Yunnan, China, Asia

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INTRODUCTION

Yunnan is the fourth province of China in respect of size and it has also an exceptionally rich bryoflora which consists of 572 species of hepatics (Gao & Cao 2000) and 1024 species of mosses (Li 2002, 2005). These figures are not definite and current field work continuously yields taxa new to this province and China, for instance *Cryptocoleopsis imbricata* Amakawa (Wu & Gao 2002), *Hydrocryphaea wardii* Dixon (Shevock *et al*. 2006) and *Prasanthus suecicus* (Gottsche) Lindb. (Váňa *et al*. 2010), as well as new to science, for example *Shevockia inunctocarpa* Enroth & M. C. Ji (Enroth & Ji 2006), *Yunnanobryon rhyacophilum* Shevock, Ochyra, S. He & D. G. Long (Shevock *et al*. 2011), *Lobatiriccardia yunnannesis* Furuki & D. G. Long (Furuki & Long 2007), *Gottschelia grollei* D. G. Long & Váňa (Long & Váňa 2007), *Nardia grollei* Váňa & D. G. Long and *Solenostoma dulongense* Váňa & D. G. Long (Váňa & Long 2009), and *Hamatostrepta concinna* Váňa & D. G. Long (Váňa & Long 2008). Most of these records are credited to James R. Shevock, San Francisco, California, and David G. Long, Edinburgh, Scotland, who made large collections of bryophytes in the remote Gaoligong Shan mountains in western Yunnan Province during several expeditions organised within a joint biodiversity inventory project developed between the Chinese Academy of Sciences, Kunming, the California Academy of Sciences, San Francisco, and the Royal Botanic Garden, Edinburgh. The project began in 1998 and bryophytes were added to the taxonomic groups to be inventoried in 2002 (Long 2008).

Jim Shevock and David Long regularly transmitted to us specimens of racomitrialean mosses collected during their expeditions to Yunnan. In the instalment sent to us in 2007 by J. Shevock we found an exquisite specimen of a strange and bizarre species of *Bucklandiella* Roiv. Additional specimens of the same moss we found in the collection from the same area obtained from David Long. Despite its sterility, the moss exhibited a set of unique gametophyte characters which warranted its recognition as a species new to science and we are pleased to dedicate it to our friend Jim Shevock whose specimen of this species we studied first.

DESCRIPTION

Bucklandiella shevockii Bednarek-Ochyra & Ochyra, ***sp. nov.*** Figs 1 & 2

Species pulcherrima et distinctissima a speciebus alliis generis cellulis alaribus magnis, luteis vel luteo-brunneis auriculas magnas pellucidas decurrentes formantibus, costis indistinctissimis tenuibusque in sulcis profundis sitis et in folii medio vel supra medio evanidis et cellulis laminae laevissimis confestim dignoscenda.

Plants moderately large and robust, coarse, stiff and rigid, dull, olive- to yellowish-green or light green above, brown below, in loose tufts or mats. Stems ascending to erect-ascending, 5–10 cm high, irregularly branched, sometimes almost simple and unbranched, usually denuded of leaves below, yellow or orange-brownish and glistening, sparsely radiculose at the base or in the lower part with light brownish-red, smooth, glossy, sparingly branched rhizoids, in transverse section rounded, without a central strand, comprising 3–5 layers of sclerenchymatous stereid cortical cells, with markedly incrassate, yellow or orange-brownish walls and very small lumina, rather abruptly grading into a medulla of 4–6 layers of large, hyaline cells with firm to slightly thickened, yellowish walls; axillary hairs numerous, filiform, uniseriate, hyaline throughout, 8–10-celled, with relatively short, barrel-shaped cells near the base and elongate to cylindrical ones in the distal part. Stem and branch leaves similar in shape, crowded to somewhat distant, rigid and stiff, loosely erect to erect-spreading, usually contorted or crisped on drying, erect-spreading to wide- or squarrose-spreading on wetting, ovate-lanceolate to lanceolate, straight to secund, (3.5–)3.7–4.0(–4.2) long, (1.1–)1.2–1.3(–1.4) mm wide, concave below, canaliculate above, usually folded on one or both sides of the costa or indistinctly multiplicate in the basal part, from a laxly sheathing, ovate-cordate, conspicuously decurrent base gradually narrowed to a broad, canaliculate subula, narrowly acute and distinctly twisted at the apex when wet, ending in a short hair-point or the apex muticous, subacute to rounded-obtuse, sometimes cucullate, entire or with a few teeth at the extreme tip; hair-point hyaline or yellowish-hyaline at the base, 0.04–0.24 mm, flat, sharply serrulate, twisted when wet, with a distinct cell areolation, usually decurrent down the margin of the leaf subula; margins narrowly recurved on both sides for varying distances, from the base to ¾ or more of the leaf, unistratose throughout, entire all around or with a few teeth at the extreme tip on epilose leaves; costa single, narrow, indistinct and faint, unbranched or indistinctly forked at the apex, yellow, concolorous and imperceptibly merging with laminal cells, gradually tapering upwards, (50–)60–80(–90) μm wide at the base, extending to mid-leaf or vanishing at ¾ of the leaf length, lying at the bottom of a deep, fairly narrow-angled and partly enclosed furrow, in transverse section plano-convex or sometimes biconvex, with a convex ventral side, bistratose throughout, except for a tristratose portion at the extreme base, flat or sometimes convex, consisting of 4–6 enlarged cells on the ventral side, flat to slightly convex on the dorsal side, composed of 8–13 small stereid cells, in the base with the second, imperfect row of (2–)4–6 stereid cells; laminal cells smooth, transparent, unistratose throughout, uniformly rectangular throughout the lamina, (20–)30–50(–60) μm long, 4–6(–8) μm wide, with moderately to strongly incrassate, sinuose longitudinal walls, becoming up to 80 μm long near the base with markedly nodulose longitudinal walls; cells at the insertion short-rectangular, 25–30 μm long, 9–11 μm wide, strongly porose, forming a biseriate golden strip along the insertion; basal marginal cells undifferentiated; alar cells short-rectangular to quadrate, 30–80 μm long, 20–25 μm wide, lax, thin-walled, yellow or pale golden-brownish, forming prominent, to 0.3–0.4 mm long, pellucid, plane auricles, decurrent along the stem. Asexual reproduction unknown. Dioicous. Perichaetia terminal on

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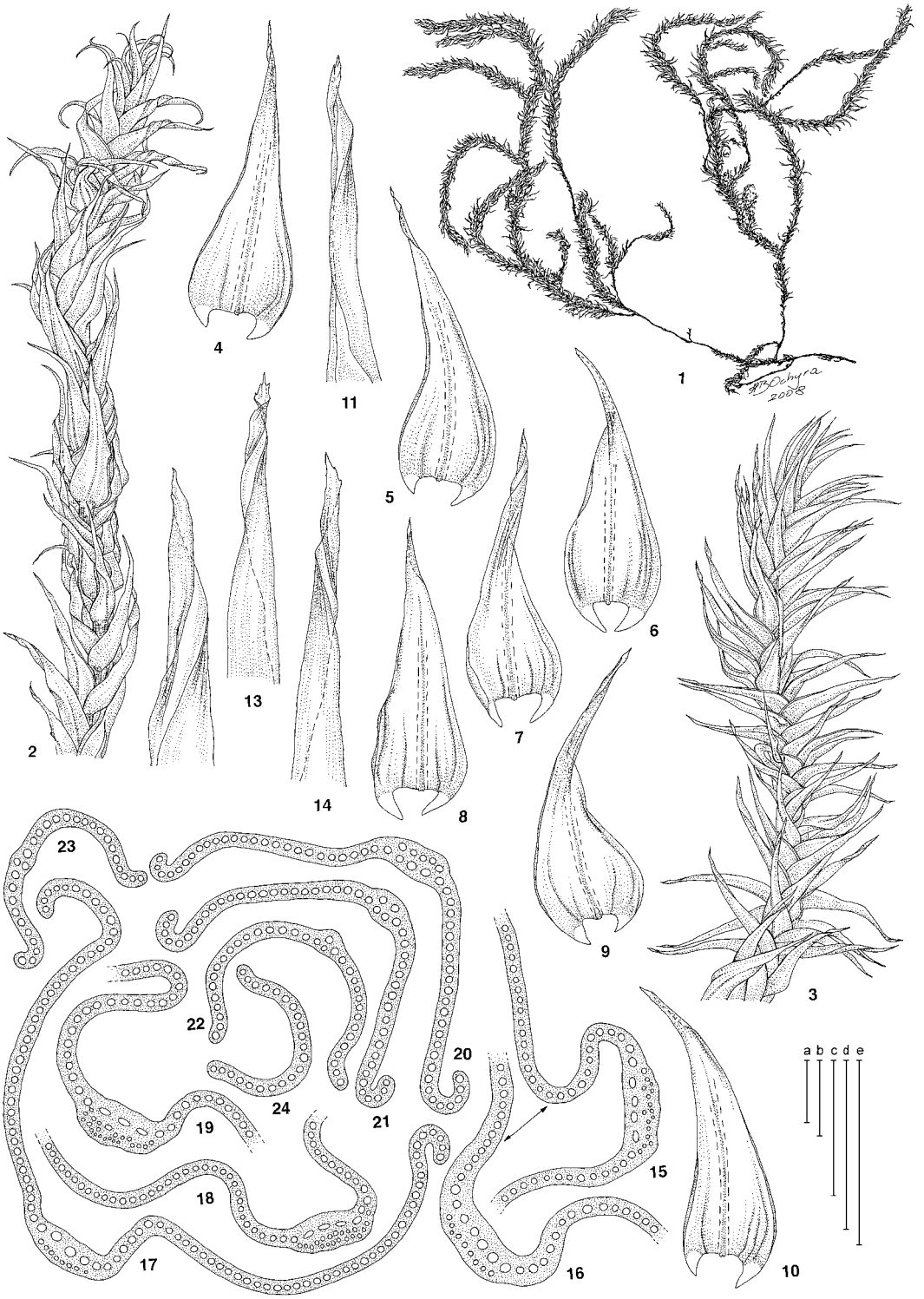
Fig. 1. *Bucklandiella shevockii* Bednarek-Ochyra & Ochyra, *sp. nov.* 1 – habit; 2 – portion of shoot, dry; 3 – portion of shoot, wet; 4–10 – leaves; 11–14 – leaf apices; 15–24 – cross-sections of costa and leaf lamina, sequentially from base to apex. (1–5, 9–11, 13, 14, 17–24 from *Shevock 31007*, isotype, KRAM; 6–8, 12, 15, 16 from *Long 33725*, paratype, KRAM). Scale bars: a – 1 mm (3); b – 1 cm (1) and 1 mm (4–10); c – 100 μm (15–24); d – 0.5 mm (11–14); e – 0.5 cm (2).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lateral branches, bud-like, 3.0–3.5 mm long; outer perichaetial leaves similar to the vegetative leaves, 3.2–3.5 mm long, 1.1–1.2 mm wide, from an ovate or oblong-ovate base abruptly narrowed to a subulate, canaliculate and twisted acumen, epilose, with areolation similar to that in the vegetative leaves, only with less prominent and non-decurrent auricles; median perichaetial leaves ovate, broadly short acuminate, 2.8–3.0 mm long, weakly plicate, with a subpercurrent costa; innermost perichaetial leaves oblong-ovate, broadly acute, 2.1–2.5 mm long, convolute, with yellowish-hyaline, thin-walled, hexagonal cells in the distal portion except for a median row of sturdy cells with thicker and sinuose walls, becoming rectangular, firm and somewhat sinuose-walled in the proximal portion. Perigonia and sporophytes unknown.

TYPE: CHINA, YUNNAN PROVINCE, GONGSHAN COUNTY, GAOLIGONG SHAN MOUNTAINS: Cikai Xiang: along the Qi Qi Trail about 2.5 km below the Qi Qi Forestry Field Station and 0.5 km above the Qi Qi He Bridge; on slopes on north side of the Qi Qi He, lat. 27°41′21.5″N, long. 98°34′59.4″E; elev. 1945 m; mixed hardwood forest along cascading stream, on top of granitic boulder in filtered light, rheophyte, 1 Oct. 2007, *Shevock 31007* (with David G. Long and Xuezhong Fan) (HOLOTYPE: CAS; ISOTYPES: E, KRAM, KUN).

SPECIMENS SEEN ADDITIONAL TO THE TYPE (PARATYPES). CHINA. YUNNAN PROVINCE, GONGSHAN COUNTY: (1) Dulong Xiang, west slope of Gaoligong Shan mountains, Irrawaddy catchment, Qi Qi Trail just below San Dui between Shu Gung Qiao (Stone Arch Bridge) and Xishaofang, lat. 27°43′14.3″N, long. 98°25′06.0″E; alt. *ca* 2373 m; steep valley slope with mossy *Quercus lamellosa*, along streamside below waterfall; on mossy boulder, 29 Oct. 2004, *Long 33725* (E, KRAM). FUGONG COUNTY: (2) Lumadeng Xiang, Yaping Cun, east slope of Gaoligong Shan mountains, Nu Jiang catchment, south bank of South Fork Yamu River, Old Shibali, lat. 27°04′40.0″N, long. 98°46′21.0″E; alt. *ca* 2290 m; disturbed river bank in evergreen broadleaf forest, with boulders and shingle; on top of large boulder by river, 21 Aug. 2005, *Long 35107* (E, KRAM); (3) same locality, lat. 27°10′01.2″N, long. 98°46′24.7″E; alt. *ca* 2575 m; mixed evergreen broadleaf forest with scattered *Tsuga* on river bank; on top of boulder by river, 18 Aug. 2005, *Long 35012* (E, KRAM); (4) same locality, lat. 27°10′26.6″N, long. 98°46′02.0″E; alt. *ca* 2750 m; ravine in dense evergreen oak forest; on rock slab by waterfall, 6 Aug. 2005, *Long 34396* (E, KRAM).

ETYMOLOGY. The species name honours James R. Shevock in recognition of his astute bryological collecting which has contributed significantly to our knowledge of the bryophytes in Yunnan Province.

DISCUSSION. This new species is assigned to *Bucklandiella*, a genus segregated from the broadly conceived *Racomitrium* Brid. which proved to be an unnatural, heterogeneous and highly morphologically diverse taxon (Ochyra *et al*. 2003). The genus is the largest segregate of *Racomitrium s.l.*, consisting of about 60 species which are distributed on all continents. In contrast to *Racomitrium s.str.* and the other two segregates, namely *Codriophorus* P. Beauv. and *Niphotrichum* (Bednarek-Ochyra) Bednarek-Ochyra & Ochyra, *Bucklandiella* is characterised by having smooth or pseudopapillose laminal cells and relatively short, lanceolate or triangular peristome teeth which are irregularly divided in the upper half into two or three or, occasionally, four prongs, or sometimes they are only irregularly perforate along the median line. In some cases they remain undivided or are deeply divided into two regular branches. The genus exhibits a remarkable morphological variation in shape and areolation of the vegetative and perichaetial leaves upon which the sectional and subsectional division is based (Bednarek-Ochyra 1995; Bednarek-Ochyra & Ochyra 1996, 2011; Ochyra *et al*. 2003; Köckinger *et al.* 2007). This classification is still only provisional because the genus has not been revised taxonomically in some parts where it shows

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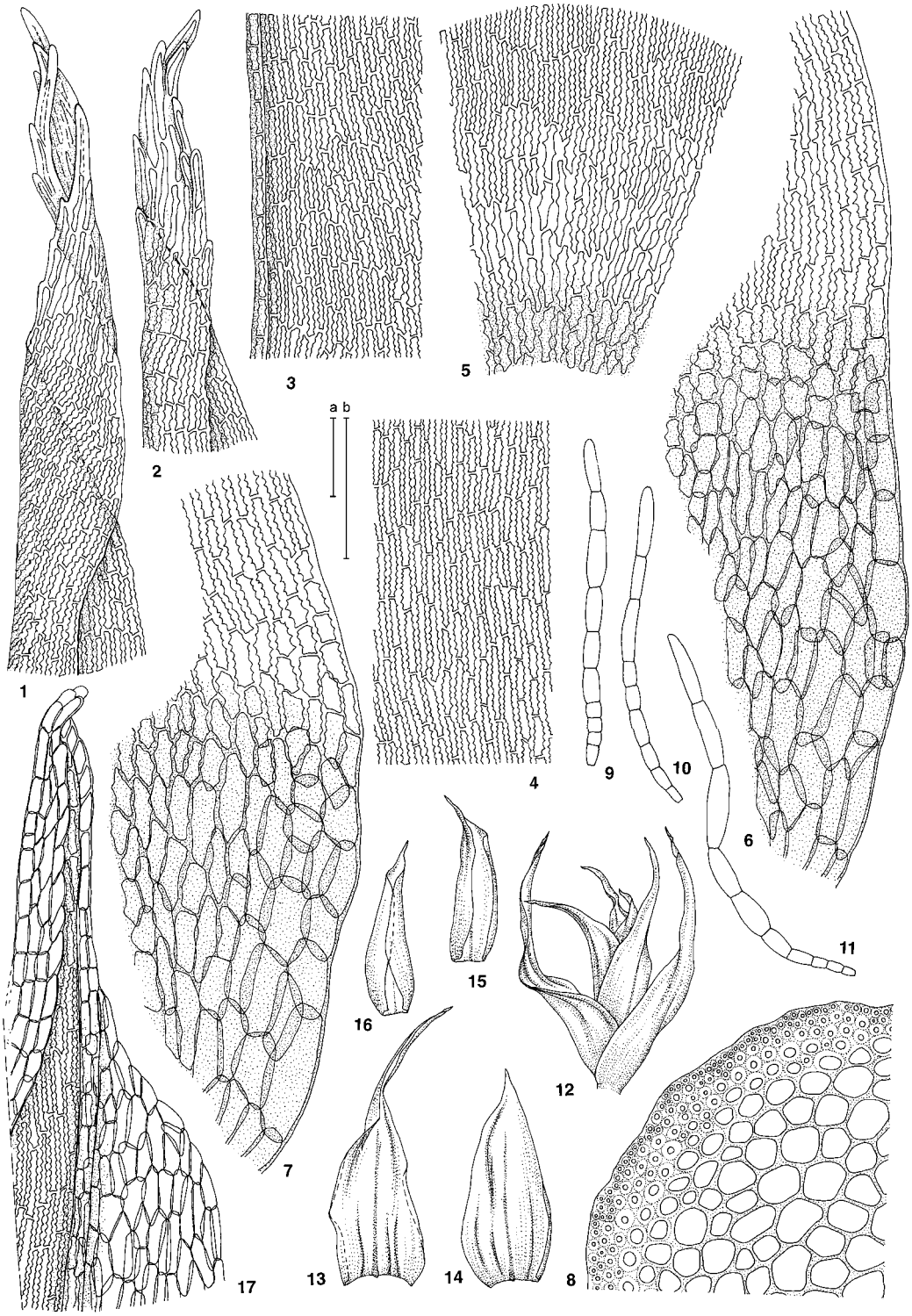
Fig. 2. *Bucklandiella shevockii* Bednarek-Ochyra & Ochyra, *sp. nov*. 1 & 2 – leaf apices; 3 – upper cells at margin; 4 –mid-leaf cells; 5 – basal juxtacostal cells; 6 & 7 – alar cells; 8 – portion of cross-section of stem; 9–11 – axillary cells; 12 – perichaetium; 13 – outer perichaetial leaf; 14 – median perichaetial leaf; 15 & 16 – innermost perichaetial leaves; 17 – apex of innermost perichaetial leaf. (1–5, 7–17 from *Shevock 31007*, isotype, KRAM; 6 from *Long 33725*, paratype, KRAM). Scale bars: a – 100 μm (1–11, 17); b – 1 mm (12–16).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great diversity, for example in Australasia, Subantarctica and Asia.

Morphologically, *Bucklandiella shevockii* is a very distinct species which can be distinguished at first glance by its robust plants. Upon wetting it resembles some species of *Breutelia* in having widespreading limbs arising from laxly sheathing bases.

Additionally, the leaf acumen, including hair-point, is markedly twisted on wetting and such a condition of the leaves is unknown in any other species of *Bucklandiella*. In this feature *B. shevockii* resembles somewhat *Codriophorus corrugatus* Bednarek-Ochyra in which the leaf acumen is distinctly corrugate and wavy (Bednarek-Ochyra 2004, 2006). However, the typical racomitrioid leaf areolation of strongly thickened and sinuose longitudinal cell walls, coupled with the presence of the hyaline leaf hair-point, immediately indicates the true relationship of this moss. *Bucklandiella shevockii* is easily distinguished from its congeners on the basis of at least two features which make it a bizarre and anomalous species in the genus.

Many species of *Bucklandiella* have well developed alar cells but these are mostly sturdy cells with thick and often porose walls. In *B. shevockii* the alar cells are large and thin-walled and form prominent, pellucid, yellow to orange-brownish auricles which are longly decurrent down the stem as clearly visible in stem transverse sections. These unusual auricles resemble those in the genus *Niphotrichum* but this genus differs by the papillose laminal cells with true conical papillae densely covering the cell lumina. This is the principal taxonomic character that warrants recognition of *Niphotrichum* as a genus in its own right and the truly papillose laminal cells are unknown in any other genus in the family Grimmiaceae.

The second unique trait of *Bucklandiella shevockii* is the structure of the costa. In the vast majority of congeners, the costa is prominent and percurrent to short-excurrent. Only in some populations of *B. subsecunda* (Harv.) Bednarek-Ochyra & Ochyra is the costa subpercurrent, ceasing several cells below the leaf apex (Frisvoll 1988; Bednarek-Ochyra *et al*. 1999). In *B. shevockii* the costa is faint and indistinct, lying on the bottom of a deep groove, and typically vanishes in mid-leaf or at three fourths of the leaf length where it imperceptibly merges with the laminal cells. A similar shape of the costa is present in the type section of *Niphotrichum* (Frisvoll 1983; Bednarek-Ochyra 1995) as well as in most species of *Codriophorus* (Bednarek-Ochyra 2006) but it is very occasional in *Bucklandiella*. Actually, such a costa condition is a constant feature of the Colombian *B. cucullatifolia* (Hampe) Bednarek-Ochyra & Ochyra in which the costa regularly ceases well below the obtuse and epilose leaf apex.

The lack of sporophytes in *Bucklandiella shevockii* precludes detailed assessment of its relationships. Discovery of a few immature perichaetia may be, however, quite indicative. The outer perichaetial leaves have recurved apices and the innermost ones are hyaline, lax and thin-walled in the distal part, except for a narrow central region which is composed of chlorophyllose cells with moderately thickened and sinuose walls. These features suggest, with some reservation, an alliance of *B. shevockii* with *Bucklandiella* sect. *Subsecunda* (Bednarek-Ochyra) Bednarek-Ochyra & Ochyra, which is characterised by having squarrose outer perichaetial leaves on wetting and almost entirely chlorophyllose innermost perichaetial leaves in the upper half, except for the more thin-walled marginal and submarginal cells. However, on account of its unusual morphological characters, *B. shevockii* should be best placed in the separate subsection, *Bucklandiella* subsect. *Shevockiella*.

Bucklandiella Roiv. subsect. ***Shevockiella*** Bednarek-Ochyra & Ochyra, ***subsect. nov.***

Folia perichaetialia inferiora foliis externis dissimilissima, convoluta, superne hyalina, in parte centrali chlorophyllosa. Acumina foliorum caulinarium et ramealium tubulosa, madida tortuosa, pilis planis, hyalinis denticulatis breviusculo terminatis, costis concoloribus, in folii medio vel ad ¾ folii longitudinem attingentibus et cellulis alaribus pellucidis, magnis tenuibus, auriculas decurrentes formantibus.

TYPE: *Bucklandiella shevockii* Bednarek-Ochyra & Ochyra.

ECOLOGY. *Bucklandiella shevockii* is a rheophytic or semi-aquatic saxicolous moss growing

directly attached to granitic boulders, shingles or slabs by waterfalls and along rivers and cascading streams. It is most often found in shaded or diffusely lit sites in hardwood forest forming large almost pure stands and as small admixture of such species as *Campylopus gracilis* (Mitt.) A. Jaeger, *Dicranella* sp., *Rhizomnium nudum* (E. Britton & R. S. Williams) T. J. Kop., *Trachypodopsis auriculata* (Mitt.) M. Fleisch., *Macrothamnium javense* M. Fleisch., *Brachythecium* sp., *Plagiochila* sp. and *Scapania* sp. were found.

Most species of the genus *Bucklandiella* are associated with dry and open habitats, but a few species are aquatics associated with swiftly flowing streams, brooks, waterfalls and cascades. These are *B. lamprocarpa* (Müll. Hal.) Bednarek-Ochyra & Ochyra., *B. bartramii* (Roiv.) Roiv. (Ochyra *et al*. 1988; Bednarek-Ochyra & Ochyra 1994, 1998), *B. didyma* (Mont.) Bednarek-Ochyra & Ochyra and *B. visnadiae* (W. R. Buck) Bednarek-Ochyra & Ochyra (Buck 1997; Bednarek-Ochyra *et al*. 1999) from the Southern Hemisphere and *B. macounii* (Kindb.) Bednarek-Ochyra & Ochyra and *B. lusitanica* (Ochyra & Sérgio) Bednarek-Ochyra & Ochyra (Ochyra & Sérgio 1992) from the Northern Hemisphere. Discovery of *B. shevockii* contributes one more species to this group of ecologically distinct species within the genus *Bucklandiella*.

DISTRIBUTION. At present *Bucklandiella shevockii* is a rare endemic of the Gaoligong Shan mountains in western Yunnan Province of southwestern China. Here, it occurs in the subtropical evergreen broad-leaved forest zone at elevations ranging from 1945 to 2750 m a.s.l. Hitherto, only seven species of *Bucklandiella* have been reported from Yunnan (Cao & Yi 2002) and the present discovery is an addition to the bryoflora of this region. Yunnan is a remarkable centre of endemism and a number of genera and species of moss have been found to occur exclusively in this province, for example *Ditrichopsis clausa* Broth., *Pringleella sinensis* Broth., *Dicranella rotundata* (Broth.) Takaki, *Symblepharis oncophoroides* Broth., *Rhabdoweisia laevidens* Broth., *Leptotrichella sinensis* (Herzog) Ochyra, *Gymnostomum laxirete* (Broth.) P.-C. Chen, *Tayloria grandis* (D. G. Long) Goffinet & A. J. Shaw, *Pohlia laticuspis* (Broth.) Redf. & B. C. Tan, *P. tapintzensis* (Besch.) Redf. & B. C. Tan, *Rozea diversifolia* Broth., *Distichophyllum meizhii* B. C. Tan & P.-J. Lin, *Neckeropsis takahashi* Higuchi, Z. Iwats. Ochyra & X.-J. Li, *Shevockia inunctocarpa*, *Leptocladium sinsense* Broth., *Leptohymenium hokinense* Besch., *Microctenidium assimile* Broth., *Leiodontium gracile* Broth., *L. robustum* Broth. and *Plagiothecium subulatum* Broth.

ACKNOWLEDGEMENTS. We thank Jim Shevock, San Francisco, and David G. Long, Edinburgh, for kindly allowing us to study their Chinese collections of racomitrialean mosses, and Rod Seppelt, Kingston, Tasmania for his comments on the manuscript and valuable suggestions. The Polish Ministry of Science and Higher Education provided financial support for this study through grant No. N 303 063 32/2264 for H. Bednarek-Ochyra, this assistance is gratefully acknowledged.

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Received 30 October 2010