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# *Plagiomnium wui* (Mniaceae), a New Combination from Hubei, China

Yan-Jun Yi

College of Life Science, Qingdao Agricultural University, and Key Laboratory of Plant Biotechnology in Universities of Shandong Province, Qingdao 266109, Shandong, People's Republic of China. qdyiyanjun@163.com

Si He

Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166, U.S.A.  
Author for correspondence: si.he@mobot.org

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**ABSTRACT.** *Orthomnion wui* T. J. Kop. is transferred to *Plagiomnium* T. J. Kop. (Mniaceae) as *P. wui* (T. J. Kop.) Y. J. Yi & S. He, based on the presence of well-defined stereid cells in its costa, a key character distinguishing *Plagiomnium* from *Orthomnion* Wilson. Originally described in 2007 from Hubei, China, *O. wui* is closely related to *P. rostratum* (Schrad.) T. J. Kop. but differs from the latter by enlarged juxtacostal cells, the thin-walled, almost undifferentiated epidermal cells of the dorsal costa and non-mammillate laminal cells. An updated key to the species of *Plagiomnium* in China is provided.

**Key words:** Mniaceae, moss, *Orthomnion*, Plagiomniaceae, *Plagiomnium*.

*Orthomnion* Wilson (Mniaceae) is a moss genus primarily distributed in tropical and subtropical Asia. The genus, currently consisting of 11 species (Crosby et al., 2000), is characterized by entire or seldom bluntly serrate leaf margins that are usually narrowly or indistinctly bordered, costae that end well below the leaf apex, absence of the stereid cells in the costa, and erect capsules with a reduced peristome. Without sporophytes, sterile plants of *Orthomnion* are very similar to those of *Plagiomnium* T. J. Kop. Gametophytically, the presence of the stereid cells in the costa has been an important character used to separate the two genera (Koponen, 1980; Eddy, 1996; Li et al., 2007; Harris, 2008).

Eight species of *Orthomnion* have been reported from China (Li, 2006; Koponen, 2007; Li et al., 2007; Jia & He, 2013). In reviewing the Chinese species of the genus, we had an opportunity to examine the holotype and paratypes of *O. wui* T. J. Kop. deposited at MO. Our examination reveals that it has well-defined stereid cells in the dorsal costa (Fig. 1D, E). Indeed, in the illustrations of *O. wui* (Koponen, 2007: fig. 1J–K), there are two cross-sections of the costa that clearly show stereid cells. The presence of stereid cells in *O. wui* obviously does not fit the well-

established generic concept of *Orthomnion* (Koponen, 1968, 1980; Eddy, 1996; Li, 2006; Li et al., 2007; Harris, 2008). Several other features of this species are atypical for *Orthomnion*: the leaf margin is distinctly bordered by multi-rowed linear cells with serrulate marginal teeth; the laminal cells are thin-walled, hardly porose, but with corner thickenings; and the costae end just below the apex or sometimes are percurrent in lower leaves (Fig. 2A, B). These characters, in combination with the presence of the costal stereid cells, place the species in *Plagiomnium*. In our opinion, *O. wui* is closely related to *P. rostratum* (Schrad.) T. J. Kop. in *Plagiomnium* sect. *Rostrata* (Kindb.) T. J. Kop. (Koponen, 1972). We therefore propose the following new combination.

***Plagiomnium wui*** (T. J. Kop.) Y. J. Yi & S. He, comb. nov. Basionym: *Orthomnion wui* T. J. Kop., Ann. Bot. Fenn. 44: 376. 2007. TYPE: China. Hubei: Mt. Shennongjia, Song-luo-shan, Tong-cha-gou, on moist rock, 1000 m, June–July 1976, *P. C. Wu* 282 (holotype, MO-2846750; isotype, PE). Figures 1, 2.

Gametophytic plants medium-sized, yellowish brown when old, in loose tufts. Primary stems (stolons) and infertile stems prostrate, tomentose,  $\leq$  5 cm long, sparsely foliate; fertile stems erect,  $\leq$  ca. 2 cm high, radiculose below; in cross-section a central strand present. Leaves crisped when dry, spreading when moist; stolon leaves oblong to ovate or elliptic,  $4\text{--}4.8 \times 2.2\text{--}2.5$  mm, obtusely apiculate; lower fertile stem leaves similar to stolon leaves, becoming elongate obovate to oblong ligulate toward apex; all leaves not decurrent at the base; margins bordered by 3 or 4(5) rows of elongate cells at leaf base, by 1 or 2(3) at the apex, bluntly serrate; costa ending slightly below the apex to percurrent, costal cross-section with 2 or 3 layers of thick-walled cells on ventral costa, with stereid cells in dorsal costa; laminal cells  $\pm$  similar, elongate hexagonal to

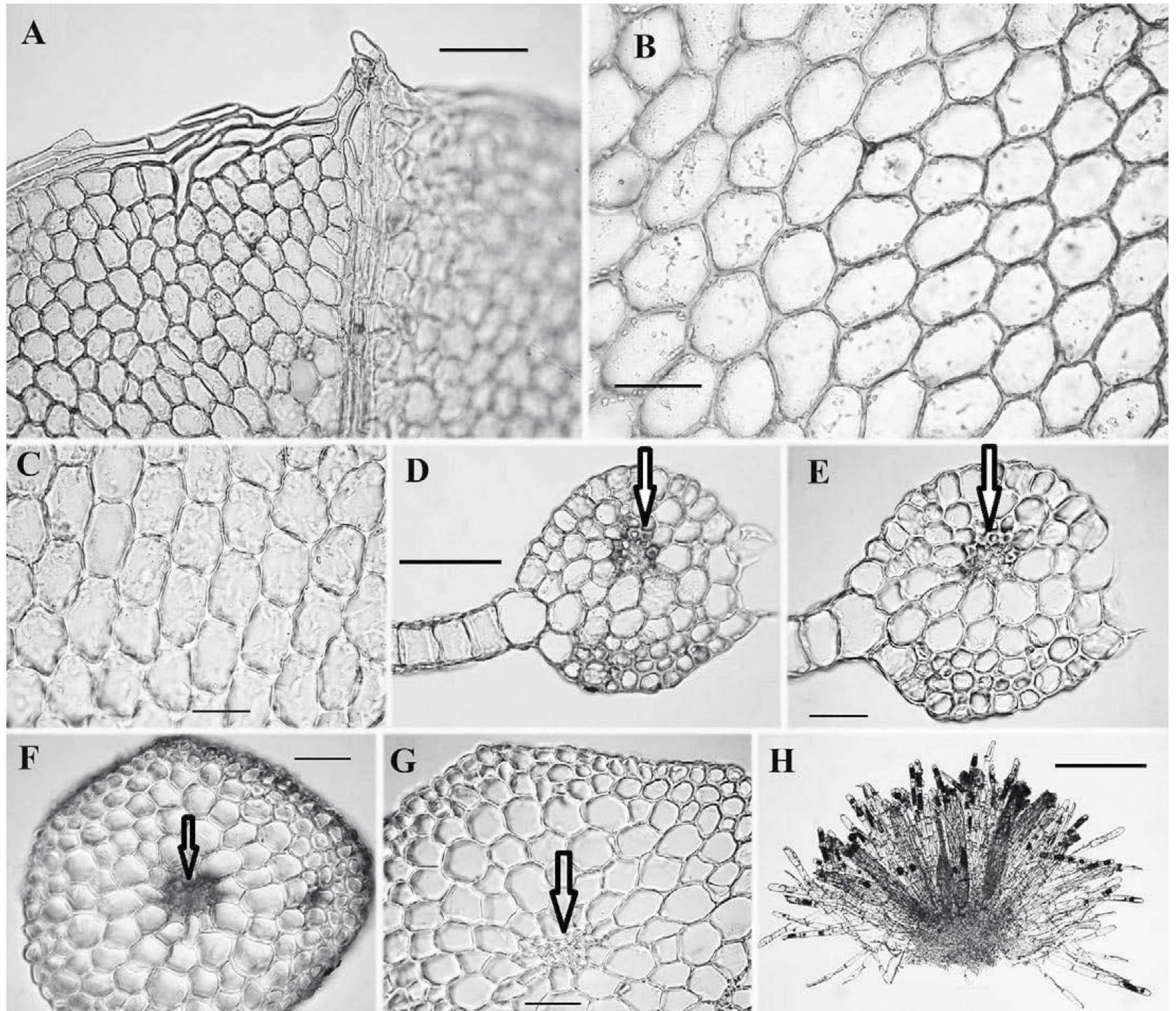


Figure 1. *Plagiomnium wui* (T. J. Kop.) Y. J. Yi & S. He. —A. Apical laminal cells. —B. Median laminal cells. —C. Basal laminal cells. —D, E. Cross-sections of leaf costa showing stereid cells pointed by arrows. —F, G. Cross-sections of stem with a central strand pointed by an arrow. —H. Antheridia and archegonia mixed with paraphyses. Scale bars = 100  $\mu\text{m}$  (A, D, G); bars = 50  $\mu\text{m}$  (B, C, E, F); bar = 0.5 mm (H). A–H, prepared from the holotype *P. C. Wu* 282 (MO).

rounded quadrate,  $40\text{--}63 \times 20\text{--}40 \mu\text{m}$ , median and basal juxtacostal cells somewhat larger than apical and basal cells, thin-walled, hardly porose, with distinct corner thickenings. Synoecious. Archegonia and antheridia mixed with abundant colorless paraphyses. Sporophytes unknown.

*Distribution and habitat.* *Plagiomnium wui* is known only from the type locality in Hubei Province of China, growing on moist rocks or on bases of trees.

*Discussion.* *Plagiomnium wui* is similar to *P. rostratum* in sharing numerous aspects of morphology, including synoecious sexuality, multi-rowed leaf borders, and non-projecting, 1-celled marginal teeth that are sometimes indistinct. *Plagiomnium wui* differs from *P. rostratum* in juxtacostal cells that are distinctly larger than adjacent laminal cells, epidermal cells of the dorsal costa that are thin-

walled, not much smaller than the inner cells, and laminal cells that are never mammillate. In contrast, in *P. rostratum* juxtacostal cells are not larger than adjacent laminal cells; epidermal cells of the dorsal costa are thick-walled and much smaller than the inner cells; and laminal cells are slightly mammillate (Koponen, 1972).

In general, species of *Orthomnion* have erect capsules with reduced peristomes, whereas those of *Plagiomnium* have horizontal to pendulous capsules with well-developed peristomes. Gametophytically, *Orthomnion* differs from *Plagiomnium* primarily by the absence of a stereid band in the costa (Koponen, 1980; Eddy, 1996; Harris 2008). As Eddy (1996: 195) points out: “Non-fruiting plants of *Orthomnion* are difficult to distinguish from those of *Plagiomnium*, but doubtful sterile plants, however, can be separated on costal anatomy, since the costa of

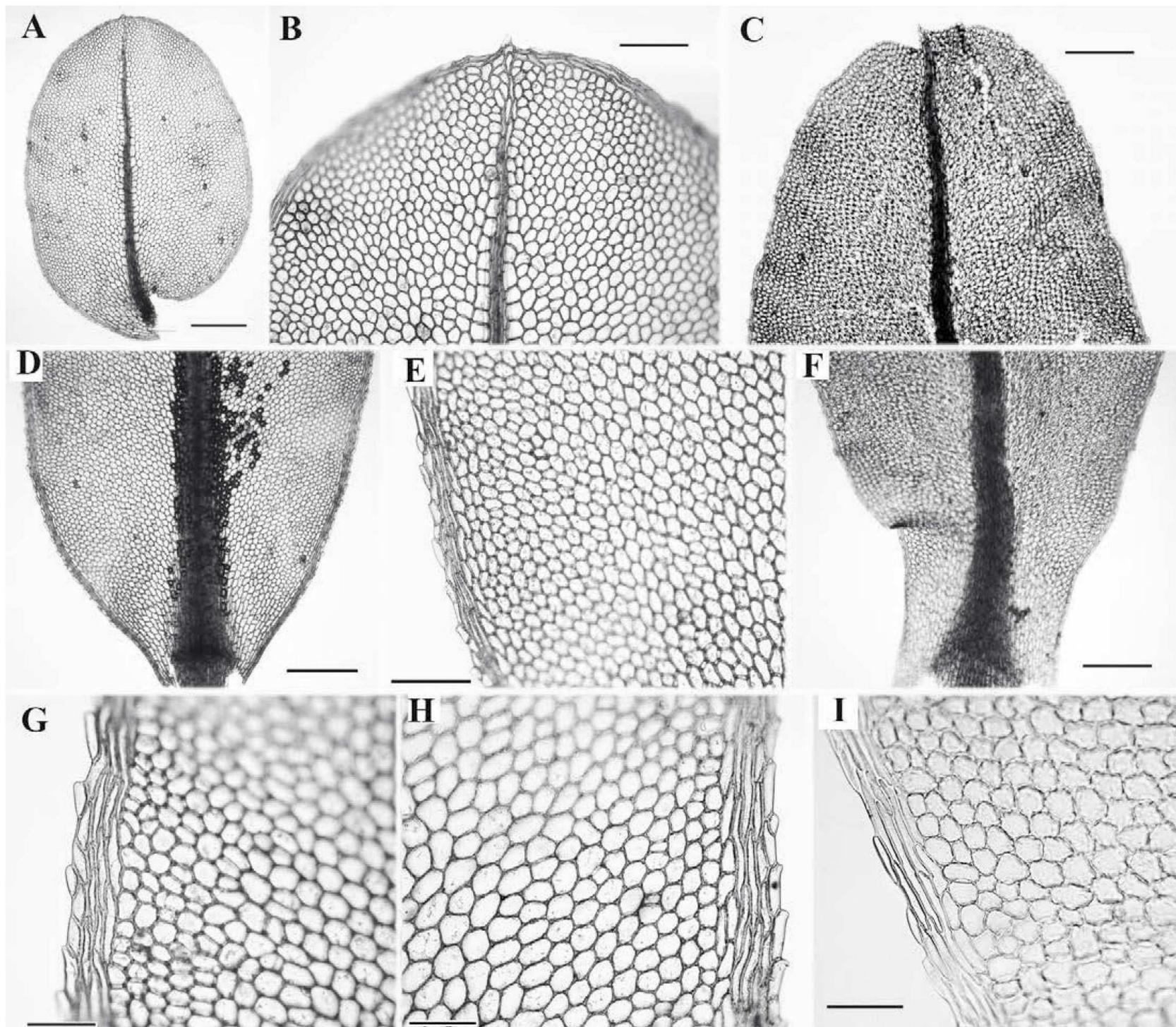


Figure 2. *Plagiomnium wui* (T. J. Kop.) Y. J. Yi & S. He. —A. Stolon leaf. —B. Apex of stolon leaf. —C. Apex of fertile stem leaf. —D. Base of stolon leaf. —E. Median part of stolon leaf. —F. Base of fertile stem leaf. —G, H. Stolon leaf margins at middle. —I. Stolon leaf margin at base. Scale bars = 0.5 mm (A, C, D, F); bars = 200  $\mu$ m (B, E); bars = 100  $\mu$ m (G–I). A–I, prepared from the holotype *P. C. Wu 282* (MO).

*Plagiomnium* has a distinct stereid band which is lacking in *Orthomnion*.” In our view, the stereids in the costa are the only useful character that can be used to separate *Orthomnion* (without stereids) from *Plagiomnium* (with stereids). In a study of the genus *Orthomnion*, Koponen (1980: 38) also indicates: “The sterile plants of *Plagiomnium* sect. *Rostrata* with entire leaves may be difficult to differentiate from sterile *Orthomnion*. The only character always separating *Orthomnion* is the absence of the stereids of the costa.” Using the absence of stereid cells in the costa to define the genus *Orthomnion* held up very well until *O. wui* and *O. yunnanense* T. J. Kop., X. J. Li & M. Zang (both with stereids in the costa and serrulate leaf margins) were placed into the genus (Koponen et al., 1982; Koponen, 2007). The importance of the costal stereid cells in the taxonomic

placement of *Orthomnion* species can be seen in the treatment of *O. handelii* (Broth.) T. J. Kop. (Koponen, 1980). The latter does not have stereids in the costa but has horizontal capsules with a well-developed peristome (a *Plagiomnium*-like sporophyte). Clearly, the character of stereid cells outweighs sporophytic features in this instance, which could be interpreted that even a species with *Plagiomnium*-type sporophytes can occur in *Orthomnion*, while a species that lacks stereid cells in the costa cannot be placed in *Plagiomnium*. If the stereid cells in the costa were not considered as a distinguishing character, the generic distinction between *Orthomnion* and *Plagiomnium* would collapse because there are no other unique characters and there are exceptions for other potentially useful diagnostic characters within the two genera. Consequently, among several characters

separating *Orthomnion* from *Plagiomnium* (i.e., porose cell walls, cell corner thickenings, leaf sequence, and even sporophytic features), the stereid cells have become the only key character, in our opinion, that can be used in the separation of the two genera. The present study of *O. wui* has validated this concept, and we believe that future study of *O. yunnanense* will affirm this hypothesis/assertion. A recent molecular study by Harris (2008) indicated that the genus *Orthomnion* is well nested within *Plagiomnium*. The previous sectional classification of *Plagiomnium* (Koponen, 1968) is not supported by molecular phylogenies since all of the sections are paraphyletic. *Plagiomnium* sect. *Rostrata* would be monophyletic if *Orthomnion* was included (Harris, 2008). This implies that there is also a molecular basis for placing *O. wui* in the genus *Plagiomnium*.

Seventeen species of *Plagiomnium* were treated in the Chinese moss floras and in recent literature (Li, 2006; Li et al., 2007; Jia & He, 2013). Among these, *P. vesicatum* (Besch.) T. J. Kop. has been excluded from China due to the absence of any voucher specimens (Koponen, 1981; Koponen & Lou, 1982). The Chinese specimens of *P. elimbatum* (M. Fleisch.) T. J. Kop. have not been verified by the recently published flora (Li et al., 2007). *Plagiomnium venustum* (Mitt.) T. J. Kop. is essentially a species of western North America, and its occurrence in China is doubtful. With the addition of *P. wui*, 15 species of *Plagiomnium* are confirmed for China based on the present study.

KEY TO THE SPECIES OF *PLAGIOMNIUM* IN CHINA

Note: This key should work for both stoloniferous and fertile stem leaves.

- 1a. Marginal teeth often short and blunt, sometimes indistinct or absent; leaf borders usually colored; opercula rostrate ..... 2
- 1b. Marginal teeth often long and sharp, sometimes multi-celled; leaf borders often not colored; opercula not rostrate ..... 7
- 2a. Leaves not decurrent ..... 3
- 2b. Leaves decurrent ..... 5
- 3a. Dioicous; leaf margins often bordered by 1 to 4 rows of  $\pm$  broadly rectangular cells or by 1 or 2 rows of linear cells in stolon leaves; laminal cells  $60\text{--}120 \times 40\text{--}60 \mu\text{m}$  ..... *P. succulentum* (Mitt.) T. J. Kop.
- 3b. Synoecious; leaf margins always bordered by 3 to 5 rows of linear cells in all leaves; laminal cells  $30\text{--}60 \times 20\text{--}40 \mu\text{m}$  ..... 4
- 4a. Juxtacostal cells not larger than adjacent cells; epidermal cells of the dorsal costa thick-walled, much smaller than inner cells; laminal cells somewhat mammillate ..... *P. rostratum* (Schrad.) T. J. Kop.
- 4b. Juxtacostal cells larger than adjacent cells; epidermal cells of the dorsal costa thin-walled, not particularly smaller than inner cells; laminal

- cells not mammillate ..... *P. wui* (T. J. Kop.) Y. J. Yi & S. He
- 5a. Leaves elliptic, plane; juxtacostal cells not larger than adjacent laminal cells ..... *P. integrum* (Bosch & Sande Lac.) T. J. Kop.
- 5b. Leaves linear to oblong or narrowly ligulate, often undulate; juxtacostal cells clearly larger than adjacent laminal cells ..... 6
- 6a. Dioicous; laminal cells  $12\text{--}25 \times 10\text{--}20 \mu\text{m}$  ... *P. maximoviczii* (Lindb.) T. J. Kop.
- 6b. Synoecious; laminal cells  $15\text{--}40 \times 10\text{--}25 \mu\text{m}$  ..... *P. rhynchophorum* (Harv.) T. J. Kop.
- 7a. Leaves obovate to elongate obovate; margins serrate only to the middle ..... 8
- 7b. Leaves elliptic to elongate oblong; margins serrate nearly to the base ..... 11
- 8a. Plants to 6(–10) cm tall; leaf marginal teeth sharp and large, sometimes consisting of 2(3) cells; laminal cells hexagonal to elongate-hexagonal, to  $50\text{--}60 \mu\text{m}$  long ..... 9
- 8b. Plants often shorter than 3.5 cm tall; leaf marginal teeth always single-toothed; laminal cells isodiametric to rounded hexagonal, to ca.  $35 \mu\text{m}$  in diameter ..... 10
- 9a. Leaves shiny; costa percurrent to shortly excurrent; laminal cells not thickened at the corners; synoecious ..... *P. drummondii* (Bruch & Schimp.) T. J. Kop.
- 9b. Leaves dull; costa ending below leaf apex; laminal cells slightly thickened at the corners; dioicous ..... *P. japonicum* (Lindb.) T. J. Kop.
- 10a. Dioicous; leaves elongate-obovate; laminal cells isodiametric, not at all thickened at the corners, usually  $20\text{--}25 \mu\text{m}$  wide ..... *P. acutum* (Lindb.) T. J. Kop.
- 10b. Synoecious; leaves shortly obovate; laminal cells irregularly rounded hexagonal, slightly thickened at the corners, usually to  $30\text{--}35 \mu\text{m}$  wide ... *P. cuspidatum* (Hedw.) T. J. Kop.
- 11a. Leaves narrowly oblong, often undulate; plagiotropic stolons not common ..... 12
- 11b. Leaves broadly elliptic, often plane; plagiotropic stolons common ..... 13
- 12a. Stems often with subapical branchlets; leaf apices acute; costa percurrent ..... *P. arbusculum* (Müll. Hal.) T. J. Kop.
- 12b. Stems scarcely with subapical branchlets; leaf apices rounded apiculate to mucronate; costa ending below leaf apex to percurrent ..... *P. confertidens* (Lindb. & Arnell) T. J. Kop.
- 13a. Dioicous; leaves not decurrent at the base; margins bordered by 4 to 8 rows of linear cells; marginal teeth always formed by a single cell ..... *P. ellipticum* (Brid.) T. J. Kop.
- 13b. Synoecious or dioicous; leaves decurrent at the base; margins bordered by 2 to 4 rows of linear cells; marginal teeth formed by 1 to 3(4) cells ... 14
- 14a. Synoecious; leaf apices acute; marginal teeth short, formed by 1 or 2 cells; laminal cells isodiametric to slightly elongate; cell walls not or indistinctly porose ..... *P. medium* (Bruch & Schimp.) T. J. Kop.
- 14b. Dioicous; leaf apices obtusely mucronate; marginal teeth long, sharp, formed by 1 to 3(4) cells; laminal cells elongate, twice as long as wide; cell walls clearly porose ..... *P. tezukai* (Sakurai) T. J. Kop.

*Selected specimens examined (Plagiomnium rostratum).* CHINA. **Hubei:** Mt. Shennongjia, Song-luo-shan, Tong-cha-gou, on moist rock, *P. C. Wu 81* (paratypes, MO-2846780, PE); Song-bo-ping, on base of tree, *P. C. Wu 135* (paratypes, MO-2846669, PE). **Yunnan:** Yangbi Co., *Redfearn et al. 418* (MO). JAPAN. **Kiushiu:** Kumamoto, *Mayebará 116* (MO). KAZAKHSTAN. **Alma-Ata:** Kazachka Gorge & River, *Allen 10691* (MO). RUSSIA. **Karachaevo-Cherkessian Republic:** Teberda Nature Reserve, *Ignatov & Ignatov 135* (MO).

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#### Literature Cited

- Crosby, M. R., R. E. Magill, B. H. Allen & S. He. 2000. Checklist of the Mosses. Missouri Botanical Garden Press, St. Louis.
- Eddy, A. 1996. Handbook of Malesian Mosses, Vol. 3 (Splachnobryaceae to Leptostomataceae). Natural History Museum Publications, London.
- Harris, E. S. J. 2008. Paraphyly and multiple causes of phylogenetic incongruence in the moss genus *Plagiomnium* (Mniaceae). *Taxon* 57: 417–433.
- Jia, Y. & S. He. 2013. Species Catalogue of China, Vol. 1 (Plants: Bryophytes). Science Press, Beijing.
- Koponen, T. 1968. Generic revision of Mniaceae Mitt. (Bryophyta). *Ann. Bot. Fenn.* 5: 117–151.
- Koponen, T. 1972. The East Asiatic species of *Plagiomnium* sect. *Rostrata* (Bryophyta). *Acta Bot. Fenn.* 97: 1–29.
- Koponen, T. 1980. A synopsis of Mniaceae (Bryophyta). II. *Orthomnion*. *Ann. Bot. Fenn.* 17: 35–55.
- Koponen, T. 1981. A synopsis of Mniaceae (Bryophyta). VI. Southeast Asian taxa. *Acta Bot. Fenn.* 117: 1–34.
- Koponen, T. 2007. *Orthomnion wui* (Mniaceae, Musci), a new species from Hubei Province, China. *Ann. Bot. Fenn.* 44: 376–378.
- Koponen, T. & J. S. Lou. 1982. Miscellaneous notes on Mniaceae (Bryophyta). XII. Revision of specimens in the Institute of Botany, Academia Sinica, Beijing, China. *Ann. Bot. Fenn.* 19: 67–72.
- Koponen, T., X. J. Li & M. Zang. 1982. Miscellaneous notes on Mniaceae (Bryophyta). XIII. *Orthomnion yunnanense*, species nova. *Ann. Bot. Fenn.* 19: 73–74.
- Li, X. J. 2006. Eubryales. Pp. 111–178 in X. J. Li (editor), *Flora Bryophytorum Sinicorum*, Vol. 4. Science Press, Beijing.
- Li, X. J., S. He & M. Zang. 2007. Bryaceae–Timmiaceae. Pp. 93–144 in X. J. Li, M. R. Crosby, & S. He (editors), *Moss Flora of China*, Vol. 4. Science Press, Beijing; Missouri Botanical Garden Press, St. Louis.