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# Three new and remarkable species of mosses from China and the Philippines

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**Abstract**: *Distichophyllum meizhii* Tan & Lin and *D. wanianum* Tan & Lin (Hookeriaceae) collected from southwestern region of China are described as new to science. Also, *Horikawaea redfearnii* Tan & Lin is described as a new species based on collections from Hainan Island of China and Palawan Island of the Philippines. The sporophytic specimen of *Horikawaea* Nog. was collected for the first time and support a family placement in Pterobryaceae.

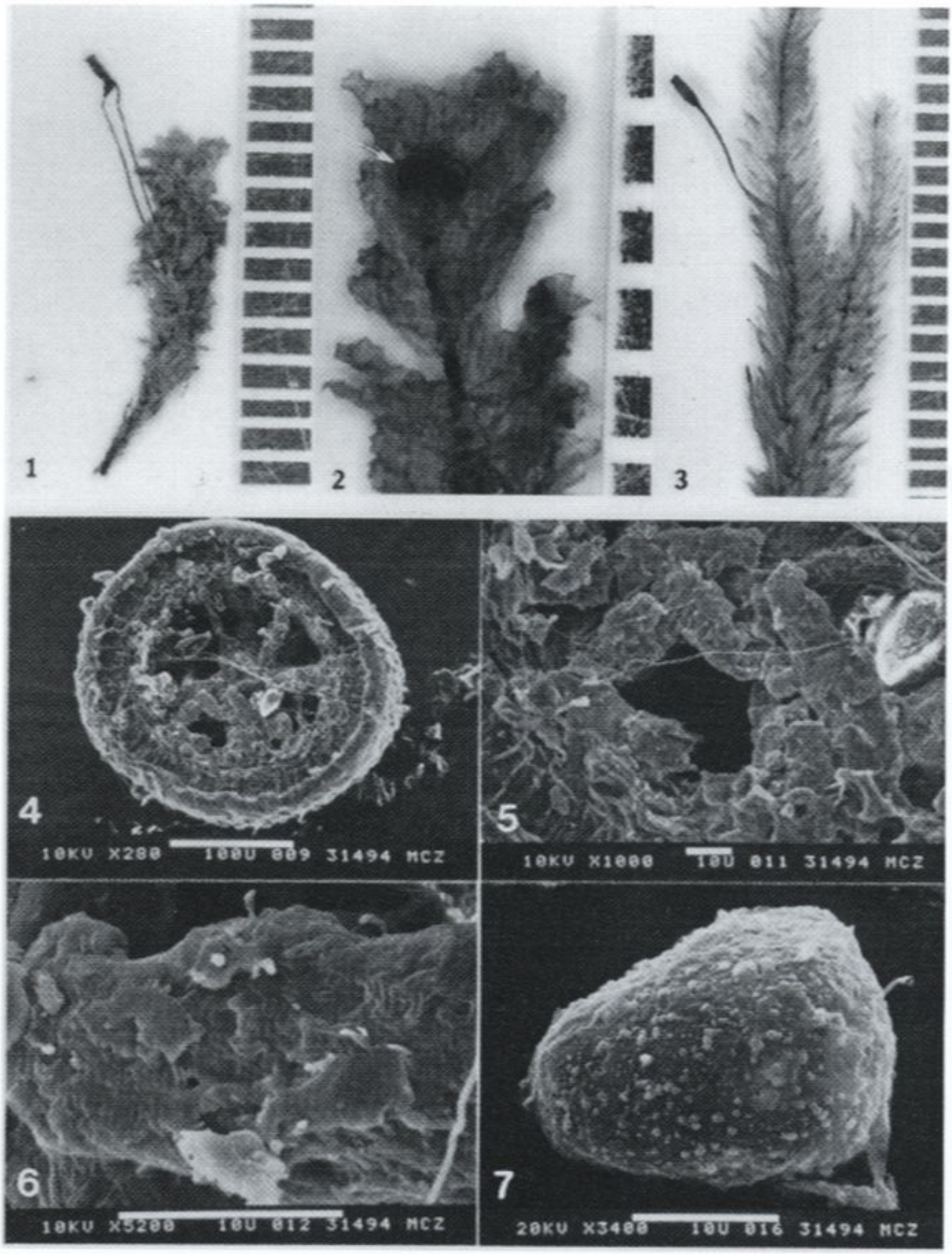
The vast territory of China (including the offshore islands of Hainan and Taiwan) offers a complex topography and diverse climatic pattern most favorable for local plant speciation. We report below three undescribed species of mosses collected recently from China, two in the genus *Distichophyllum* (Hookeriaceae) and one in *Horikawaea* (Pterobryaceae). The new species of *Horikawaea* also has a Philippine locality. It is noteworthy that the two new species of *Distichophyllum* are from southwestern region of China, a well known area of endemism of Chinese seed plants (Ying, Zhang and Boufford 1993). Likewise, Hainan Island, with all three species of the genus, appears to be the center of speciation for *Horikawaea*.

*Distichophyllum meizhii* B. C. Tan & P.-J. Lin, *sp. nov*.

Holotypus: [China] Yunnan Province, Gongshan-xian (county), Du-long-jiang Commune, on boulder by the Ching-lang-tang river bank, about 1300 m. elev., August 1982, *Mei-zhi Wang 10040* (PE). Figs. 2, 8-11.

*Folia dimorpha, usque foliis gemmiferis apice late cucullatis diagnoscenda.*

Plants in lax tufts, flaccid. Stems tall and




**Figures 1-7.** (1) Plant habit of *Distichophyllum wanianum*. (2) Plant habit of *Distichophyllum meizhii* showing the hooded gemmiferous leaf near branch tip (see arrow). (3)-(7). *Horikawaea redfearnii*: (3). plant habit showing sporophyte; (4) capsular mouth showing reduced and deeply inserted peristome teeth; (5) close up of the reduced peristome teeth; (6) weakly striate surface of an exostome tooth; (7) spore. [All photos taken from type specimens; bar for plant habit pictures = 1 mm].

large, sparsely branched, ascending to 4.5-5 cm long and 3 mm wide including lateral leaves. Leaves complanate to erect-spreading, strongly dimorphic; vegetative leaves wrinkled when dry, broadly obovate to lingulate, with a short narrow leaf base, 2-2.5 mm long and 1-1.25 mm wide, the leaf apex broadly rounded with a short mucro measuring 40 to 50 µm long, the lower half of the lamina carinate. Leaf margins entire, except at the leaf mucro which becomes irregularly denticulate, wavy even when wet, with a differentiated, narrow border consisting of 2-3 rows of thin to moderately thick-walled, linear cells. Laminal cells irregularly quadrate-polygonal, 22-33 µm wide, thin-walled, not collenchymatous, gradually becoming slightly smaller at the margins and apex, 13-22 µm wide, and rectangular at leaf base, 56-101 x 18-27 µm. Gemmiferous leaves (fig. 2) broadly ovate, about 2 mm long, and 2 mm wide at broad base, the upper part of the lamina constricted into a rounded hood about 1 mm wide which contains numerous basally branched, filiform and multiseptate propagules borne on the adaxial surface of a much expanded leaf costa (fig. 9). Costa in vegetative leaves slender, ending well below the apex, often split distally into two short branches, but becoming coarse and wide in gemmiferous leaves.

Autoicous? Perichaetia lateral, leaves small, 0.3-0.5 mm long, ovate-lanceolate, acuminate, ecostate, with a narrow border. Archegonia numerous per perichaetium, about the length of the perichaetial leaf. Perigonia and sporophyte not seen.

The development of propagules on a specialized gemmiferous leaf and the strongly dimorphism shown between the vegetative and gemmiferous leaves in *D. meizhii* are striking features. The new species is probably closely related to *D. heterophyllum* (Mitt.) Par. from Darjeeling, India; the two taxa forming a natural section with leaf dimorphism as its synapomorphic character. Both species exhibit an evolutionary trend towards the development of specialized and morphologically distinctive gemmiferous leaves. Unfortunately, both are only known from gametophytic plants which probably reproduce asexually in nature.

*Distichophyllum meizhii* is a Yunnan endemic from the majestic Hengduan Mountain range in southwestern China. We are pleased to name the new moss after Ms. Mei-zhi Wang of PE Herbarium who has collected in the past many bryophyte novelties from remote parts of China, including the first Chinese record of *Takakia* from Xizang Province (Tibet).

*Distichophyllum wanianum* B. C. Tan & P.-J. Lin, *sp. nov.*

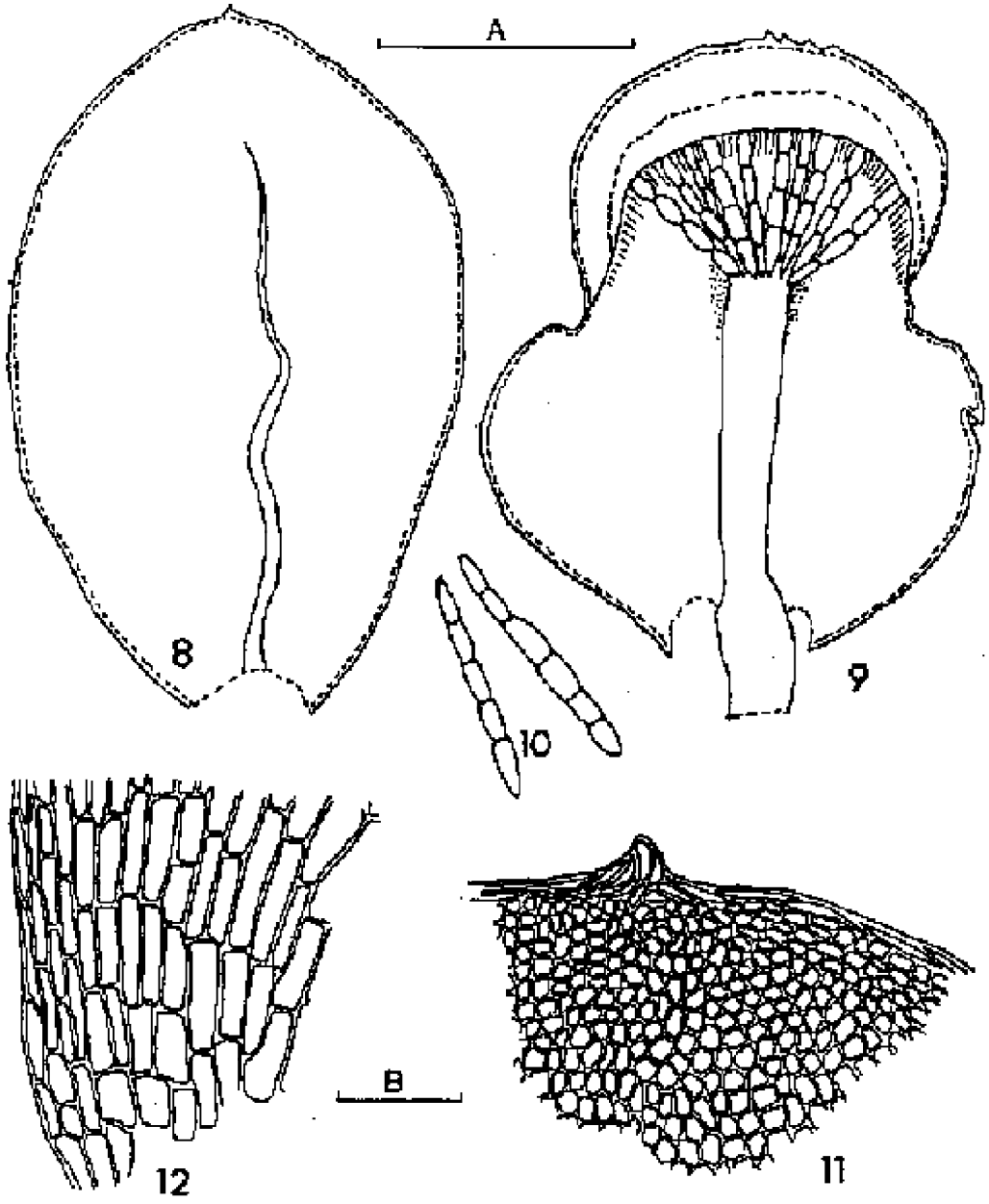
Holotypus: [China] Yunnan Province, Luchun, on branches, *M. Zhang 550* (IBSC; isotypes, KUN, FH). Paratypes: Yunnan Province, ibid, *M. Zhang 653* (IBSC, FH, KUN); Guangdong Province, Ruyuan County, *P.-J. Lin 865* (IBSC, FH); Hainan Province, Mt. Diao-luo, *P.-J. Lin et al. 945B* (IBSC, FH). Figs. 1, 13-18.

*Plantae minimae. A D. oblongo Tan & Lin foliis late spathulatis, folii cellulis minoribus necnon seta longiori differt.*

Plants small, mat-forming. Stems up to 1.6(-2) mm tall and 2 mm wide including lateral leaves. Leaves strongly crisped or cirrate when dry, broadly spathulate with a long narrow basal part when wet, 2-2.5 x 1-1.2 mm, the leaf apex broadly round, at times with a tiny mucro. Leaf margins plane, wavy in the upper half when wet, with strongly differentiated border all around; the border about 10-15 µm wide, consisting of 2-3 rows of thick-walled, linear cells, but becoming one row around leaf apex. Costa single, reaching near the apex. Laminal cells homogenously small, quadrate to polygonal, 11-13(-18) µm wide, smaller apically, 9-13 µm wide, and becoming rectangular basally, 33-45(-67) x 11-22 µm. Perichaetial leaves small, oblong-spathulate, distinctly mucronate, with a well developed costa.

Sporophytes lateral. Setae 5-10 mm, remarkably long for a small species in the genus, smooth below, gradually becoming papillose distally. Capsules oblong, 2-2.25 mm long. Peristome teeth typical for the genus.

*Distichophyllum wanianum* is known from Yunnan, Guangdong and Hainan. Its often broadly spathulate leaves are reminiscent of a miniature of *D. mittenii* Bosch & Lac. but differ from the latter in having a strong and thick leaf border all around and in the absence of submarginal rows of smaller




**Figures 8-12.** *Distichophyllum meizhii* (based on M. Zhang 550, holotype): (8) vegetative leaf; (9) gemmiferous leaf; (10) propagules or gemmae; (11) leaf apex; (12) basal leaf cells. [A bar = 1 mm for figs. 8 & 9; B bar = 60 um for figs. 10-12].

laminal cells. Its closest affinity is with *D. oblongum* Tan & Lin, another Chinese endemic from southwestern region of China (Tan and Lin 1991).

The new species grows on branches inside dense forests between 100 and 2300 m elevation. We like to honor Prof. Zhung-ling Wan with this new Chinese endemic. Ms. Wan is the surviving wife of the late Prof. P.-C. Chen, the founder of Chinese Bryology. Both husband and wife are renowned Chinese bryologists.

*Horikawaea redfearnii* B. C. Tan & P.-J. Lin, *sp. nov.*

Holotypus: [Philippines] Palawan Island, Aborlan Municipality, Barangay Aporawan, Mt. Tinikbasan, on tree trunk in disturbed *Agathis-Ficus-Calamus-Pandanus* lowland dry forest, ca 2000 ft, April 1992, *B. C. Tan & W. Sm. Gruezo 92-379* (FH; isotypes, CAHUP, L, BM, H, MO, NY, US, IBSC, BO). Paratypes: [China] Hainan Island, Changjiang Co., Bawanglin Forest Reserve, on tree trunk in lowland forest in valley, between 1000-1100 m elevation, March 1990, *P. L. Redfearn 35918* (FH, MO); Mt. Jianfengling, on tree trunk, 1962, *P.-C. Chen et al. 431g* (IBSC). Figs. 3-7, 19-25.

*Plantae graciles, cauli longo pendulo. Folia complanata quasi-conduplicata imbricata, oblonga vel ligulata, apice acuta nec cucullata; costae nunc duplicatae, curtae, ad 1/5 folii usque productae, nonnumque nullae. Folii cellulae lineares vel angustissimae. Theca lateralis oblonga erecta; operculum conico-rostratum; peristomii dentes minimi, indistincte striati.*

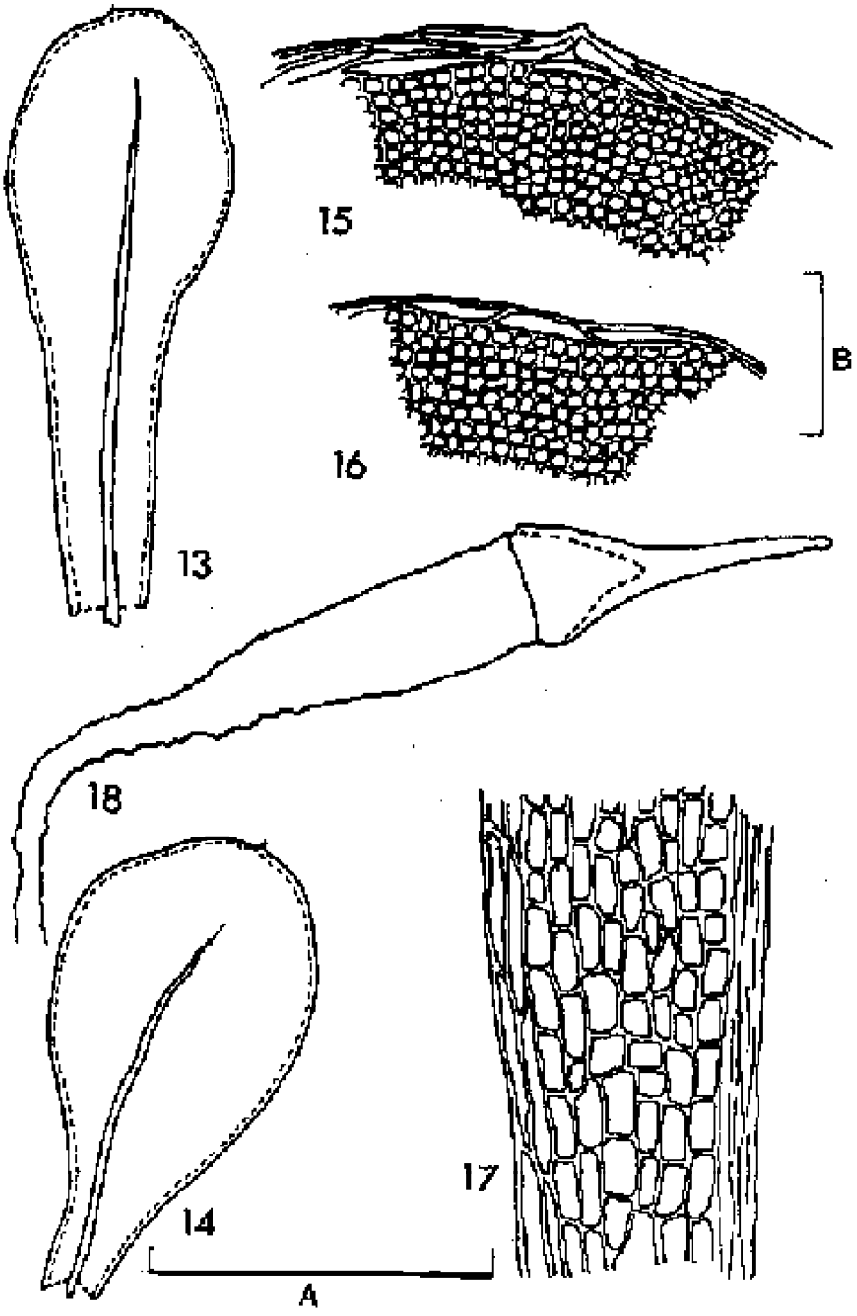
Plants stoloniferous, laxly gregarious, yellow green, more or less lustrous. Stolons threadlike, long creeping, with tightly appressed leaves and clusters of rhizoids at interval. Stolon leaves small, light green, broadly ovate-lanceolate to triangular, acute to short-acuminate or cuspidate, ecostate, margins entire. Secondary stems erect, long pendent to 10 cm long, 2-3 mm wide including lateral leaves, irregularly branched, often with attenuated or flagellate branch tips, in cross-section without a central strand. Pseudoparaphyllia filamentous, at times branched. Basal stem leaves small, ovate-lanceolate, appressed. Middle and upper stem leaves strongly complanate, octostichous, lateral rows spreading, more or less equitant, median rows appressed; laminae oblong-lanceolate to narrowly lingulate, 2.5-3 mm long and 0.5 to 0.8 mm wide, asymmetrically folded or pseudo-conduplicate, or simply flattened, acute to obtuse, basal region with or without a colored, constricted alar-like area across insertion; leaf costae often double, short, or none; margins entire, mostly plane, slightly incurved at leaf base on one side, weakly crenulate at apex. Laminal cells prosenchymatous, with narrow and vermicular lumen, 67.5-135 µm long, cell walls thin to moderately thick, pitted, becoming oval-oblong at leaf apex, 22.5-35 µm long; cells at basal constricted area oblong to rectangular, if well developed, incrassate, strongly pitted, colored.

Dioicous? Outer perichaetial leaves small, broadly ovate; inner perichaetial leaves broadly ovate to lanceolate, broadly sheathing at base and abruptly long acuminate or ligulate in upper half, margins weakly denticulate in upper 1/3; perichaetial paraphyses abundant, stiff, thick-walled, long pointed. Perigonia not seen.

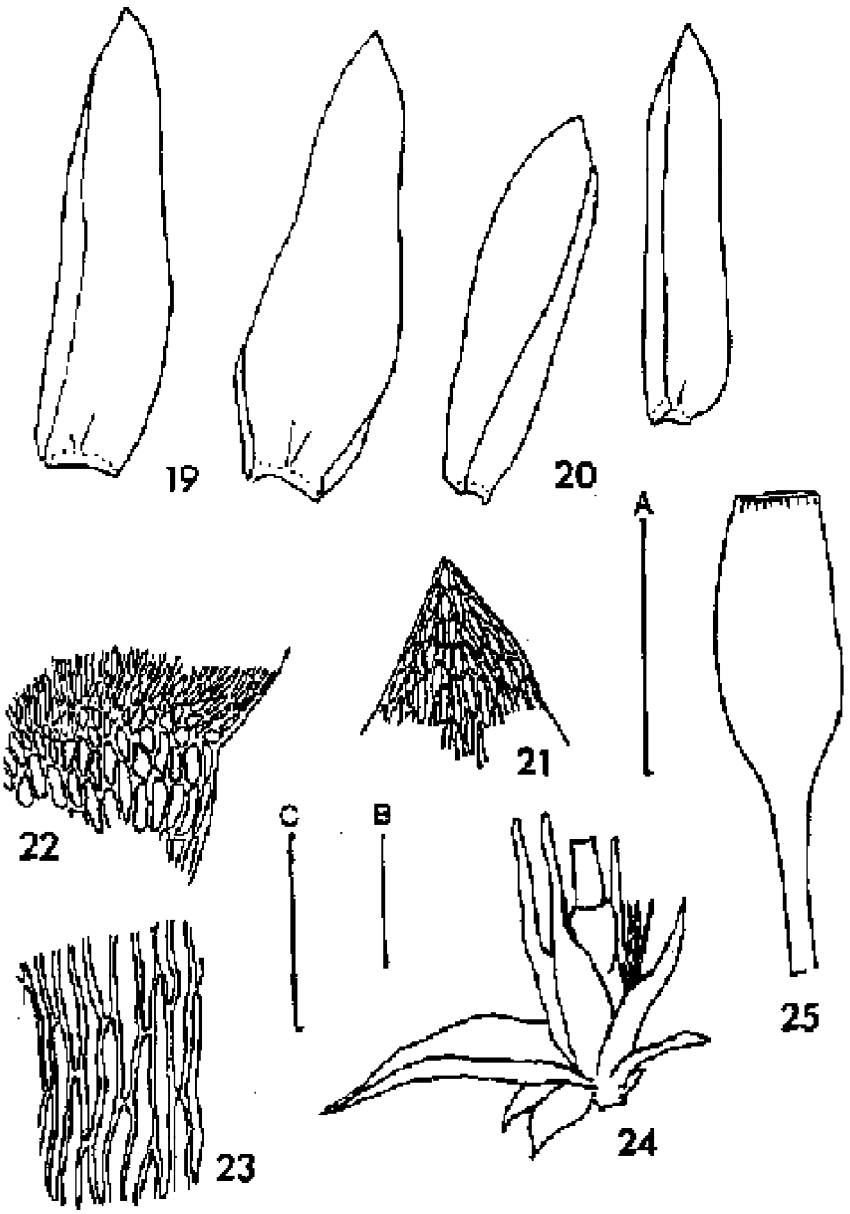
Sporophyte lateral, capsule exserted. Setae 4-5 mm long, weakly trabeculate. Capsules ovoid-oblong, erect, 1-1.5 mm long, slightly wrinkled when dry, opercular lid conic to rostrate; capsular mouth bordered with 3-5 layers of square to short rectangular cells forming an unrevoluble annular region; exothecial cells oblong to rectangular, with a few oval in shape, the walls thick and wavy. Stomata and mature calyptra not seen, although young elongating calyptrae were observed to bear papillae. Peristome highly reduced (fig. 4), exostome teeth about 8, small, deeply inserted, outer surface weakly striate (fig. 6). Spores round to tetrahedral, 24-44 µm diameter, granulose and chlorophyllose (fig. 7).

We are pleased to name the new species after our American colleague, Dr. P. L. Redfearn Jr., who has pursued with determination the task of doing field work in China during his retired senior years. It was he who first called our attention to this new taxon among his large collections of Hainan mosses.

*Horikawaea redfearnii* is most closely related to *H. dubia* in having long, pendent, and strongly complanate secondary stems and bran-




**Figures 13-18.** *Distichophyllum wanianum* (based on *M.-Z. Wang 10040*, holotype): (13)-(14) leaves; (15)-(16) leaf apices; (17) basal leaf cells; (18) capsule with operculum. [A bar = 1.5 mm for figs. 13-14, 18; B bar = 60 μm for figs. 15-17].




**Figures 19-25.** *Horikawaea redfearnii* (based on *Tan & Gruezo 92-379*, holotype): (19)-(20) leaves; (21) leaf apex; (22) leaf base; (23) laminal cells; (24) perichaetial leaves showing the paraphyses; (25) capsule. [A bar = 1.5 mm for figs. 19-20, 24-25; B bar = 100 µm for figs. 21-22; C bar = 50 µm for fig. 23].

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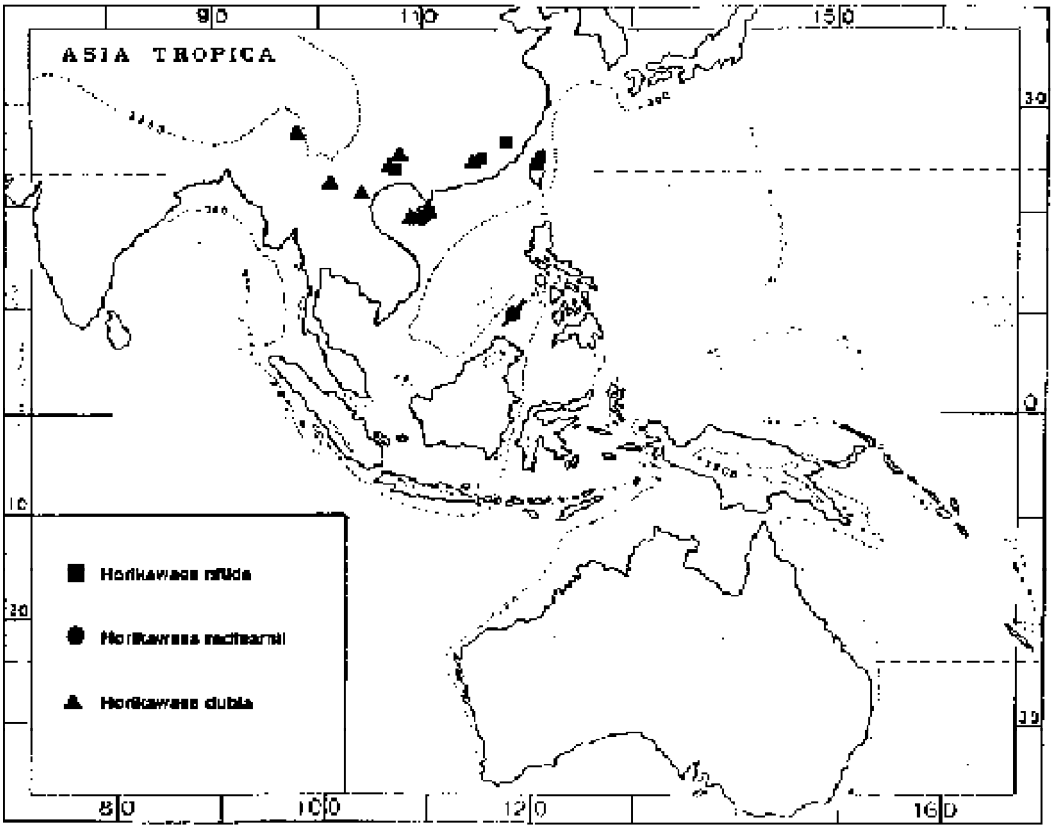


Map. 1. Circum-South China Sea distribution of *Horikawaea* species (see text for comment).

ches, often with flagellate branch tips. The new species, however, differs from *H. dubia* and *H. nitida* in having narrower and longer leaves with short, double costae, or none, and a flat apex. The leaves of the other two species are ovate-oblong to broadly oblong-lanceolate, often concave, markedly uni- or bi-costate, and, most diagnostically, with cucullate and often recurved apices. In addition, the colored, constricted, basal part of leaves of *H. redfearnii* is rather poorly differentiated and not as conspicuous as seen in *H. dubia* and *H. nitida*.

Among the three congeners, *H. nitida* has the shortest and broadest secondary stems, measuring 1-4 cm long and 4-7 mm wide including lateral leaves, and has loosely complanate foliation. The morphological distinctions between *H. nitida* and *H. dubia* outlined by Lin (1984, 1986) and Luo (1989) are not sharply defined. In our opinion, *H. dubia* is probably best considered a long, pendent variety of *H. nitida* growing epilithically on calcareous substrates. Because we have not seen the type of *H. nitida* from Taiwan, we have reservation about the conspecificity of these two taxa.

The Philippine collection of the new species has abundant fruiting specimens. *Horikawaea redfearnii*, thus far, is the only species in the genus that has sporophytic materials (fig. 3). Peristome details of *H. redfearnii* (figs. 4-6) support a family placement of the genus in Pterobryaceae as suggested by Lin (1984).

The exserted capsule of *H. redfearnii* allies *Horikawaea* to *Orthorrhynchidium* Ren. & Card., a related African endemic genus. In Southeast

Asia, *Horikawea* can be confused with *Crytogonium*, a genus with similarly complanate, although more strongly conduplicate, stem and branch leaves. The latter genus has a sessile capsule inside the perichaetial leaves. The report of *Cryptogonium phyllogonoides* from Hainan in Lin et al. (1992) is based on a misidentified *H. redfearnii*. Thus the genus *Cryptogonium* is not present in China.

A key to the species of *Horikawaea* is presented below -

1. Leaf apex flat; costae double or none, short if present, not reaching 1/2 of the leaf; basal alar region across leaf insertion not well differentiated *H. redfearnii*

1. Leaf apex cucullate; costa mostly single, rarely double, strong, reaching 1/2 of the leaf; basal alar region across leaf insertion well differentiated 2

2. Plants large, width of erect, secondary stems including leaves 4-7 mm; secondary stems short, 1-3(-5) cm long, infrequently branched, flagellate branch tips rarely seen; stem and branch leaves loosely complanate *H. nitida*

2. Plants smaller, width of erect and pendent secondary stems including leaves 2-3(-4) mm; secondary stems long, more than 3 cm long, profusely branched, flagellate branch tips common; stem and branch leaves strongly complanate *H. dubia*

*Horikawaea* has a restricted circum-South China Sea distribution (Lin 1984, 1986; Luo 1989; see map 1). Tan (1995) discusses the phytogeographical implication of the genus for the floras of China and the Philippines. *Horikawaea dubia* is reported here new to the provinces of Yunnan (Xishuangbanna, Menglun area, *L. Zhang 901, 897,* FH, IBSC), Guizhou (Lipo County, *L. Zhang 1646,* FH, IBSC), Guangdong (Yangshan County, *G.-Q. Cheng 308, 409,* FH, IBSC) and Hainan (Changjiang County, Bawanglin Forest Reserve, *L. Zhang 1224, 1338,* FH, IBSC). All specimens of *H. dubia* are collected from calcareous rock outcrops between 450 and 1150 m elevation. In addition, we have seen unpublished herbarium collections of *H. nitida* from Guangdong (Ruyuan County, *P.-J. Lin 837, 840,* FH, IBSC) and Hainan (Changjiang County, Bawanglin Forestry Station, *Reese 17516B,* FH). The island of Hainan, with all three species present, appears to be the center of speciation for the genus (Map 1).

**Acknowledgments**

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