

## Bryophyte flora of Hunan Province, China. 11. Orthotrichaceae (Musci)

Shui-Liang Guo<sup>1</sup>, Johannes Enroth<sup>2</sup> & Timo Koponen<sup>2,3</sup>

<sup>1</sup> College of Life and Environmental Sciences, Shanghai Normal University, Shanghai, 200234, China

<sup>2</sup> Botanical Museum (Bryology), P.O. Box 7, FI-00014 University of Helsinki, Finland

<sup>3</sup> Finnish–Chinese Botanical Foundation, Mailantie 109, FI-08800 Lohja, Finland

Received 8 Sep. 2006, revised version received 20 Oct. 2006, accepted 30 Oct. 2006

Guo, S. L., Enroth, J. & Koponen, T. 2007: Bryophyte flora of Hunan Province, China. 11. Orthotrichaceae (Musci). — *Ann. Bot. Fennici* 44 (Supplement A): 1–34.

The moss flora of Hunan Province, China, has seven genera and 17 species in the family Orthotrichaceae. *Zygodon rupestris* Schimp. ex Lor. is new to China. New records for Hunan include the genera *Schlotheimia* and *Zygodon*, and *Macromitrium syntrichophyllum* Thér. & P. de la Varde, *M. ferriei* Card. & Thér., *Orthotrichum rupestre* Schleich. ex Schwaegr., *O. exiguum* Sull., *O. subpumilum* Bartr. ex Lewinsky, and *Schlotheimia grevilleana* Mitt. *Ulota macrocarpa* Broth. is synonymized with *U. crispa* (Hedw.) Brid. and *Macromitrium quercicola* Broth. with *M. ferriei*. A new name *Schlotheimia vittii* Guo, Enroth & T.J. Kop. is proposed for *S. rubiginosa* (Müll. Hal.) D.H. Vitt, *hom. illeg.* Eight lectotypes are selected or corrected (indexed). All species but *M. ferriei* are rare or very rare in Hunan. They are mostly epiphytic growing on trunks and branches of trees. They can survive in disturbed and man-made habitats, if suitable phorophytes are available. The species are described and most of them are illustrated in line drawings, and their altitudinal ranges in Hunan are presented in diagrams.

Key words: bryogeography, habitat ecology, Hunan, mosses, nomenclature, Orthotrichaceae, taxonomy

### Introduction

This is the eleventh paper in a series dealing with the bryophyte flora of Hunan Province in China. The previous paper was by Guo *et al.* (2004). In the check-list by Rao *et al.* (1997), eight species of the Orthotrichaceae in the genera *Drummondia*, *Macromitrium* and *Orthotrichum*, were cited for Hunan. Recent additions to Hunanese Orthotrichaceae include *Macrocoma tenue*

(Enroth & Koponen 2003), plus *Orthotrichum jetteae* (as *Orthomitrium tuberculatum*; cf. Allen 2002) and *Ulota gymnostoma* (Guo *et al.* 2005). The present study reports a total of seven genera and 17 species of Orthotrichaceae from Hunan based on the specimens obtained during the series of excursions from 1997 to 2001 by the Department of Ecology and Systematics (as of 2004: Department of Biological and Environmental Sciences) and the Botanical Museum of

the University of Helsinki in cooperation with the Forest Botanical Garden of Hunan Province. Two of the genera, viz. *Schlotheimia* and *Zygodon*, and seven species are new to Hunan. Of the species reported previously from the province, only *Macromitrium quercicola*, here synonymized with *M. ferriei*, was not found during our expeditions.

## Material and methods

Relevant background information of the province and its nature, and earlier studies of its bryoflora was given by Rao *et al.* (1997). The vegetation and geology of Mangshan Nature Reserve and Wulingyuan Global Cultural Heritage Area were described in Koponen *et al.* (2000) and Taoyandong and Yankou Nature Reserves and Badagongshan and Hupingshan National Nature Reserves in Koponen *et al.* (2004). The method for estimating the frequencies, the primevity index, and the basis for phytogeography and distribution elements are presented in Koponen *et al.* (2004). The collecting localities and the collector numbers for the areas mentioned are listed in those papers. Since only one series of collector numbers was used, the collectors are not mentioned when listing the specimens. The nature and collecting localities in Daweishan, Shunhuangshan and Yunshan visited in 2000 and 2001 will be described in a forthcoming paper. The specimens from the areas mentioned last are not included in the estimation of frequencies and primevity index, but are included in the distribution maps. Some Handel-Mazzetti collections from Changsha area and Yunshan were added in the distribution maps as well.

The taxa new to Hunan are marked with an asterisk (\*). Synonym names from outside China are given only when we have confirmed from the type specimens the synonymizations made by earlier authors. Exclamation mark (!) means that we have seen the (type) specimen. The nomenclature was checked against the original literature. However, in some cases we saw only a reprint with differing pagination. These are marked with an exclamation mark.

A complete set of the cited specimens is kept in the Botanical Museum of the University of Helsinki (H) and a second set in the herbarium of the

Forest Botanical Garden of the Hunan Province. Other sets are distributed as exchange from H.

## Taxonomic treatment

### Key to Orthotrichaceae in Hunan

1. Stems erect or ascending ..... 2
1. Stems creeping ..... 10
2. Calyptra cucullate; upper laminal cells rather coarsely papillose, papillae 5–8 per cell .. *Zygodon rupestris* p. 27
2. Calyptra mitrate; upper laminal cells smooth or with 1–3 papillae per cell ..... 3
3. Leaves crisped when dry; leaf margins differentiated at base; median and upper laminal cells smooth or slightly papillose; calyptra densely hairy throughout ..... 4
3. Leaves appressed or slightly crisped when dry; leaf margins not distinctly differentiated at base; median and upper laminal cells distinctly papillose; calyptra naked or only upper parts hairy ..... 5
4. Capsule mouth contracted; peristome absent .....  
..... *Ulota gymnostoma* p. 26
4. Capsule mouth not contracted; peristome present .....  
..... *Ulota crispa* p. 24
5. Capsule gradually contracted to a very narrow mouth; exostome teeth truncate; spores multicellular, up to 50  $\mu\text{m}$  diameter ..... *Orthotrichum jetteae* p. 19
5. Capsule contracted beneath mouth or not, never contracted at mouth; exostome teeth lanceolate; spores unicellular, less than 35  $\mu\text{m}$  diameter ..... 6
6. Stomata superficial ..... 7
6. Stomata immersed ..... 8
7. Plants small, fragile; stems clavate, becoming thicker toward apex; endostome segments with rounded apices, almost as wide as exostome teeth .....  
..... *Orthotrichum exiguum* p. 18
7. Plants robust, stems not clavate, not becoming thicker toward apex; endostome segments without rounded apices, narrower than exostome teeth .....  
..... *Orthotrichum rupestre* p. 20
8. Calyptra naked ..... *Orthotrichum consobrinum* p. 16
8. Calyptra with papillose hairs at apex ..... 9
9. Leaves narrow-lanceolate, with acute or acuminate apices; apices of perichaetial leaves acute .....  
..... *Orthotrichum subpumilum* p. 22
9. Leaves lanceolate or ovate-lanceolate, with acute, rounded-acute or obtuse apices; apices of perichaetial leaves obtuse ..... *Orthotrichum erubescens* p. 17
10. Upper laminal cells papillose or bulging; branch leaves crisped or contorted when dry; exostome teeth lanceolate or peristome absent ..... 11
10. Upper laminal cells smooth, not bulging; branch leaves spirally twisted or appressed, not crisped when dry; exostome teeth truncate ..... 15
11. Calyptra naked; capsule contracted at mouth; peristome absent ..... *Macromitrium gymnostomum* p. 9
11. Calyptra hairy; capsule not contracted at mouth; peri-

- stome present ..... 12
12. Leaf apex acuminate or mostly so, slightly incurved when moist; stem leaves distinctly deflexed ..... *Macromitrium ferriei* p. 6
12. Leaf apex obtuse to rounded-obtuse, incurved or strongly incurved when moist; stem leaves not strongly deflexed ..... 13
13. Basal laminal cells distinctly papillose ..... *Macromitrium handelii* p. 9
13. Basal laminal cells smooth ..... 14
14. Median and upper laminal cells obscure, densely pluripapillose; calyptra cucullate; seta usually 3–5 mm long; margins of perichaetial leaves entire near apex or in upper half ..... *Macromitrium japonicum* p. 11
14. Median and upper laminal cells pellucid, papillose or slightly papillose; calyptra mitrate; seta up to 7 mm long; perichaetial leaves often indistinctly notched-serrate near apex or in upper half ..... *Macromitrium syntrichophyllum* p. 14
15. Plants often reddish-brown; branch leaves spirally twisted; laminal cells rather regularly arranged in median or upper parts of leaves; calyptra elongate-mitrate and naked, with inflexed lobes at base ..... *Schlotheimia grevilleana* p. 23
15. Plants green or brownish; branch leaves appressed and somewhat flexuose; laminal cells not regularly arranged in median or upper parts of leaves; calyptra cucullate and naked, or campanulate and densely hairy, without inflexed lobes at base ..... 16
16. Leaves appressed; calyptra campanulate, densely hairy; spores ovoid, 25–43  $\mu\text{m}$  diameter, unicellular ..... *Macrocoma tenue* subsp. *sullivantii* p. 5
16. Leaves appressed and somewhat flexuose; calyptra cucullate, naked; spores variable, rectangular, ovoid or irregular, 60–95  $\times$  40–70  $\mu\text{m}$  diameter, multicellular ..... *Drummondia sinensis* p. 3

## Genus *Drummondia* Hook.

*Drummondia* differs from the other genera of Orthotrichaceae mainly in its reduced peristome of 16 truncate teeth, cucullate, naked calyptrae, and multicellular spores. According to the revision by Vitt (1972), the genus has seven taxa worldwide. Redfearn *et al.* (1996) listed five taxa from China, but one of them, *D. rubiginosa* Müll. Hal., was transferred to the genus *Schlotheimia* by Vitt (1972). Only one species is known from Hunan.

### *Drummondia sinensis* Müll. Hal. (Fig. 11–s)

Nuovo Giorn. Bot. Ital. n. ser. 3: 105. 1896 (“*Sinensis*”). — LECTOTYPE (selected by Vitt 1972): China. Shaanxi, “Prov. Schen-si, in medio monte Si-ku-tziu-san”, VII.1894 *Giraldi*

(Müller 892) (NY; isoelectotype FI!).

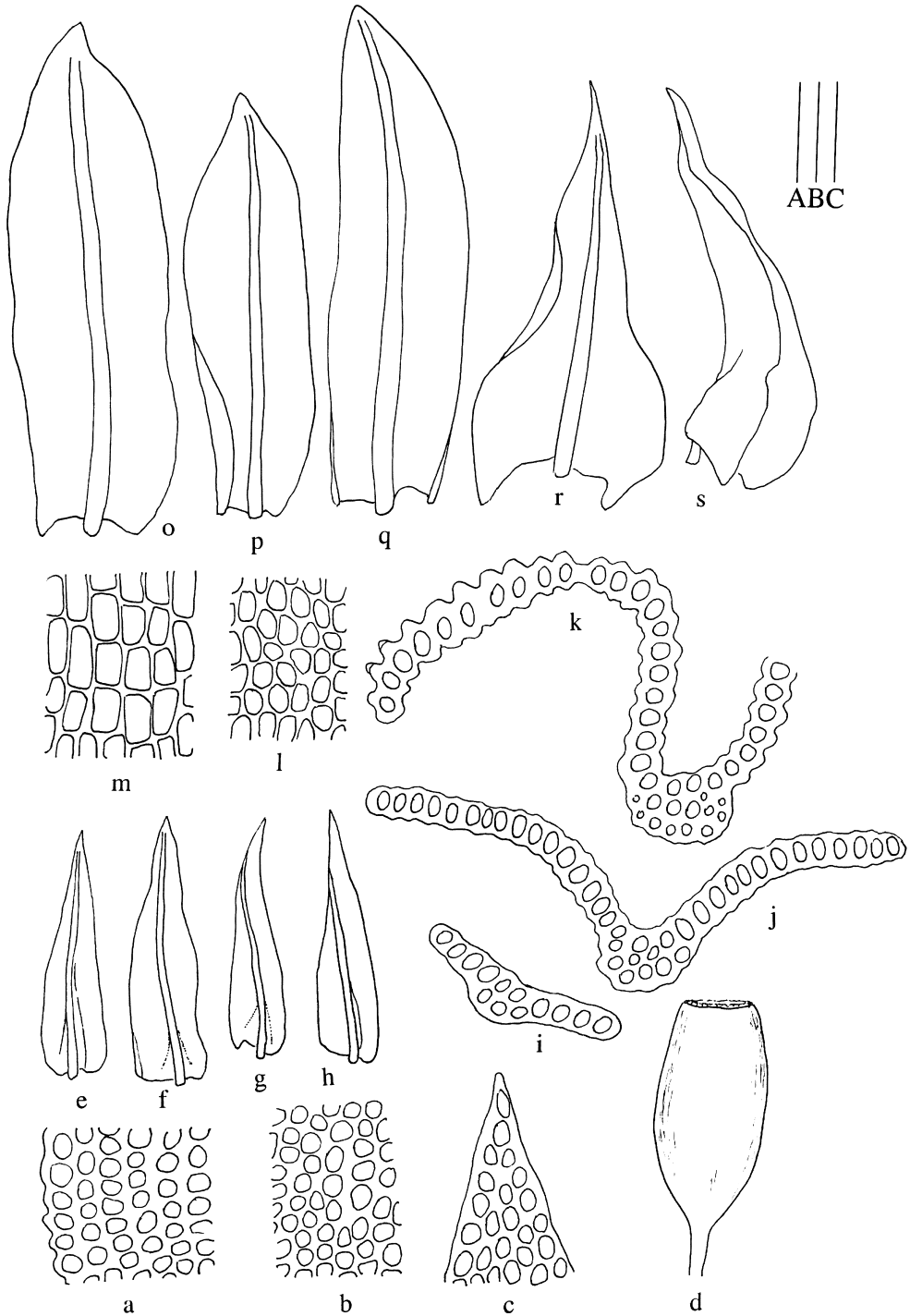
*Drummondia duthiei* Mitt. ex Müll. Hal., Nuovo Giorn. Bot. Ital. n. ser. 3: 106. 1896 (“*Duthiei*”). — LECTOTYPE (selected by Vitt 1972): India. NW Himalaya. Dhauli Valley at 2434–2734 m elevation, *Duthie 6354* (NY; isoelectotype H-BR 1401022!). — Synonymized by Vitt (1972).

*Drummondia cavaleriei* Thér., Bull. Acad. Int. Geogr. Bot. 18: 252. 1908 (“*Cavaleriei*”). — LECTOTYPE (selected by Vitt 1972): China. Kouy-Tcheou, sud de Tin-fan, XI.1904 *Cavalerie* (PC, not seen; isoelectotype H-BR 1401004!). — Synonymized by Vitt (1972).

Plants in dark green to olive green mats. Stems creeping, with numerous, erect-curved, mostly simple branches, up to 5 mm high, densely leaved. Stem leaves much different from branch leaves, about 1.2–1.5 mm long, 0.5–0.9 mm at base, often somewhat twisted when dry, triangular lanceolate, gradually acuminate. Laminal cells rounded, upper margins sometimes bistratose. Branch leaves erect-appressed, slightly twisted and keeled above when dry, oblong to ligulate-lanceolate, bluntly acuminate, acuminate-mucronate or acute, spreading to wide-spreading when wet, 1.6–1.9  $\times$  0.45–0.55 mm. Median and upper laminal cells rounded, 9–12  $\mu\text{m}$  wide, lower laminal cells larger, rounded-hexagonal, collenchymatous, basal laminal cells near leaf margins rounded-rectangular, all laminal cells flat and smooth; costa ending in leaf apex. Perichaetial leaves oblong to ovate-oblong, acute, 1.4–2.8 mm long, rectangular basal cells extending half distance up leaf. Autoecious. Setae 4.0–8.0 mm long; capsules erect, oblong-ovoid, 1.8–2  $\times$  1.2–1.5 mm, exothecial cells thin-walled, stomata few, superficial; annulus none, operculum 1–1.3 mm long, with an elongate, oblique beak; exostome teeth 32, truncate at apex, united in a ring at base, endostome absent. Spores polymorphous, rectangular, multicellular, 60–95  $\times$  40–70  $\mu\text{m}$ . Calyptra cucullate, naked.

DESCRIPTIONS AND ILLUSTRATIONS: Vitt (1972), Gao (1977), Noguchi & Iwatsuki (1989).

*Drummondia sinensis* is the largest species in the genus, with setae up to 9 mm and leaves up to 2 mm long. Only two earlier specimens, collected by H. Handel-Mazzetti (11306, 11783, H-BR), determined by Brotherus (1929) and confirmed by Vitt (1972), were known from the Hunan Province.



**Fig. 1.** *Macrocoma tenue* subsp. *sullivantii* (a–k; from Koponen *et al.* 51907). — a: Basal laminal cells near leaf margins. — b: Median laminal cells. — c: Apical laminal cells. — d: Capsule. — e–h: Leaves. — i: Transverse section through upper part of leaf. — j: Transverse section through median part of leaf. — k: Transverse section through basal part of leaf. — *Drummondia sinensis* (l–s; from Koponen *et al.* 48560). — l: Median laminal cells. — m: Basal laminal cells. — o–q: Branch leaves. — r–h, o–s: Stem leaves. Scales: A = 0.40 mm, use for e–h, o–s; B = 40  $\mu$ m, use for a–c, i–m); C = 0.80 mm, use for d.

RANGE AND HABITATS IN HUNAN: Linling (Yungtschoufu) et Sinning, *Handel-Mazzetti 11306* (H-BR 1402010). **Hupingshan.** 61. 48560, in evergreen–deciduous primeval forest, on tree trunk, at ca. 800 m. **Daweishan.** DAW4. 63572, in hotel garden, on trunk of *Liriodendron*, at 690 m. **Shunhuangshan.** Hsikwangschan, Hsinhwa, *Handel-Mazzetti 11783* (H-BR 1402011). **Wulingyuan.** 82. 58492, in mixed forest of *Pinus massoniana* and *Liquidambar formosana*, on trunk of *Liquidambar*, at ca. 725 m. Primevity index 1/1/0. Frequency in Hunan: very rare.

TOTAL RANGE: As 1: Russian Far East; As 2: China (17 provinces, Redfearn *et al.* 1996), Japan; As 3: NW India (Vitt 1972, Noguchi & Iwatsuki 1989).

### Genus *Macrocoma* (Hornsch. ex Müll. Hal.) Grout

The genus *Macrocoma* is closest to *Macromitrium* and *Groutiella*, but differs from them by the following characters: (1) leaves small ( $\pm$  1 mm long), closely erect-appressed, not contorted when dry, (2) basal leaf cells rounded, (3) calyptra covering all of the capsule; and (4) reduced to rudimentary peristome. Vitt (1973a, 1980) revised the genus worldwide.

#### *Macrocoma tenue* (Müll. Hal.) Grout subsp. *sullivantii* (Müll. Hal.) Vitt (Fig. 1a–k)

Bryologist 83: 413. 1980. — *Macromitrium sullivantii* Müll. Hal., Bot. Zeit. 20: 361. 1862 (“*Sullivantii*”). — LECTOTYPE (selected by Vitt 1980): USA. In summitate mont. Jonah Georgiae americanae ad corticem pinorum vetust, IX.1852 *Lesquereux* (FH-Sull). ISOLECTOTYPE: Sullivant & Lesquereux, Musc. Bor. Am. (ed. 1) no. 128 (NY 00345364!); ed. 2 no. 193 (H!).

*Macromitrium perrottetii* Müll. Hal., Syn. Musc. 1: 721. 1849 (“*Perrottetii*”). — LECTOTYPE (designated by Vitt 1980): India. Montes Neelgherienses, *Perrottet* (H-BR!; isolectotype BM!). — Synonymized by Vitt (1980).

*Macromitrium okamurae* Broth., Öfv. Finska Vet. Soc. Förh. 62A(9): 13. 1921 (“*Okamurae*”). — LECTOTYPE (selected by Vitt 1980): Japan. Prov. Rikuzen, Sendai, ad truncos arborum, 19.IX.1907 *E. Iishiba 269* (H-BR!). SYNTYPES: Japan. Tojima, Kinosaki, 16.VIII.1906 *G. Kono 223* (H-BR!); Prov. Kii, Mt. Koya, 3.VIII.1903 *Sh. Okamura 9* (H-BR!); Prov. Rikuzen, Sendai, 12.IV.1907 *E. Uematsu* (H-BR!), 1.XII.1907 *Uematsu 432* (H-BR!). — Synonymized by Vitt (1980).

For further synonyms, see Vitt (1980).

Plants slender, in brown to olive-green, sometimes dense mats; younger portions often light-green. Stems creeping, irregularly branched,

usually with numerous erect-ascending or sometimes horizontal branches up to 1 cm long, these often with short branchlets. Leaves erect-appressed when dry, spreading to wide-spreading when moist, keeled below, 0.9–1.1 mm long, lanceolate to ovate-lanceolate, sharply acute, or broadly acuminate, leaf margins plane and entire above, reflexed and coarse below due to bulging cells; upper cells 5–8  $\mu$ m wide, thick-walled, larger near costa, marginal cells usually smaller, rounded-quadrate, smooth and slightly inflated, basal cells strongly bulging to bulging-papillose, rounded to elliptic or rectangular and sometimes nodulose at costa, of similar size as those in median and upper parts; costa prominent, ending just below apex, sometimes rhizoids present at back. Gonioautoicous. Perichaetial leaves longer, slenderly acute; lower laminal cells longer; paraphyses numerous, persistent around base of seta. Setae 4–7 mm long; capsules oblong-cylindrical when mature, 1.8  $\times$  0.8 mm; stomata superficial, in neck and lower portion of urn; operculum conic-subulate, peristome membranaceous, upper margin irregular, pellucid, densely papillose. Spores 25–43  $\mu$ m diameter, finely papillose. Calyptrae hairy, campanulate, often deeply cleft along one ridge.

DESCRIPTION AND ILLUSTRATIONS: Vitt (1980).

*Macrocoma tenue* subsp. *sullivantii* can be separated from subsp. *tenue* by its erect or sometimes slightly recurved, acute leaf tip, and usually lanceolate to lanceolate-ovate leaf shape. This taxon is the only member of the genus in China.

HABITATS AND SUBSTRATES IN HUNAN: The primeval sites of *M. tenue* subsp. *sullivantii* are in forests on dry mountain tops and ridges, where it grows on trees such as *Quercus*. It seems to survive after forest cutting, and is especially typical in plantations of trees such as *Alniphyllum*, *Liriodendron*, and *Phellodendron*, and was also collected on *Metasequoia* trunk, at 600–1800 m. On tree trunk (7 specimens), on rotten tree (5), on fallen trunk (4), on trunk of *Alniphyllum* (2), *Camellia sinensis* (2), *Liriodendron* (4), *Metasequoia* (1), *Pyrus* (1), *Quercus* (2), on fallen branch (1), on bush (1), on soil (1). Primevity index 3/6/2. Frequency in Hunan: rare.

RANGE IN HUNAN: **Badagongshan**. 42a. 59108. 43. 48463, 54792, 54819, 54823. 55d. 58764. 86b. 65137. 90b. 61619, 64715, 64729, 64774. **Hupingshan**. 60. 53864. 61. 49927, 49930. 66. 54736. 70. 54047. **Taoyuandong**. 27. 55035, 55208, 55215, 56509, 56510, 56512, 56526. **Wulingyuan**. 18f. 53066, 53070. 19a. 52300, 52301. 19e. 51907, 51913. 84. 58552, 58555, 58556.

TOTAL RANGE: Am 1; Am 2: Mexico; As 2: China (Anhui, Fujian, Hubei, Guizhou, Shaanxi, Sichuan, and Xizang, Redfearn et al. 1996), Japan; Am 6: Argentina, Chile; Oc: Hawaii (Vitt 1994).

## Genus *Macromitrium* Brid.

Plants small to robust, in fairly dense mats. Stems creeping, densely branched; branches simple or with several branchlets, shorter towards apex of stem, densely leaved. Stem leaves shortly decurrent, keeled, ovate-oblong, ovate-lanceolate, or lingulate, apices acute, acuminate or rounded-obtuse. Margins almost entire, plane or slightly recurved. Costa stout, extending to leaf apex or near it. Branch leaves usually longer and narrower than stem leaves. Median and upper laminal cells subquadrate, rounded or rectangular, obscure or clear, walls thin or thick, smooth or with many small papillae or with a single large papilla over lumen, towards leaf base longer, rectangular to linear, hyaline, with thick walls, with or without papillae; basal laminal cells rectangular, sublinear or rhomboidal, smooth, unipapillose or tuberculate. Autoicous or phyllo-dioicous, sporophytes on branches. Perichaetial leaves slightly differentiated from branch leaves; paraphyses numerous, filiform or composed of 2–3 cell rows. Setae long or short, smooth or scabrous, capsules erect, ovate, oblong or cylindrical, stomata present, annulus none, operculum conic, beaked. Peristome present or none; when present, exostome teeth 16 in number, inserted below mouth of urn, or membranaceous, densely papillose, endostome segments lacking. Spores mostly large, but variable in size. Calyptra campanulate, often cucullate, covering entire capsule, naked or hairy. Perigonia axillary, terminal on a short branchlet, with few leaves.

The Japanese taxa of *Macromitrium* were revised by Noguchi (1967), the New Zealand and Australasian taxa by Vitt (1983) and Vitt and Ramsay (1985a, 1985b, 1986), and the Western Melanesian taxa by Vitt et al. (1995). Redfearn

et al. (1996) listed 40 taxa for China. Many of these are known from a single collection, and the Chinese taxa need to be taxonomically revised.

## *Macromitrium ferriei* Card. & Thér. (Fig. 2)

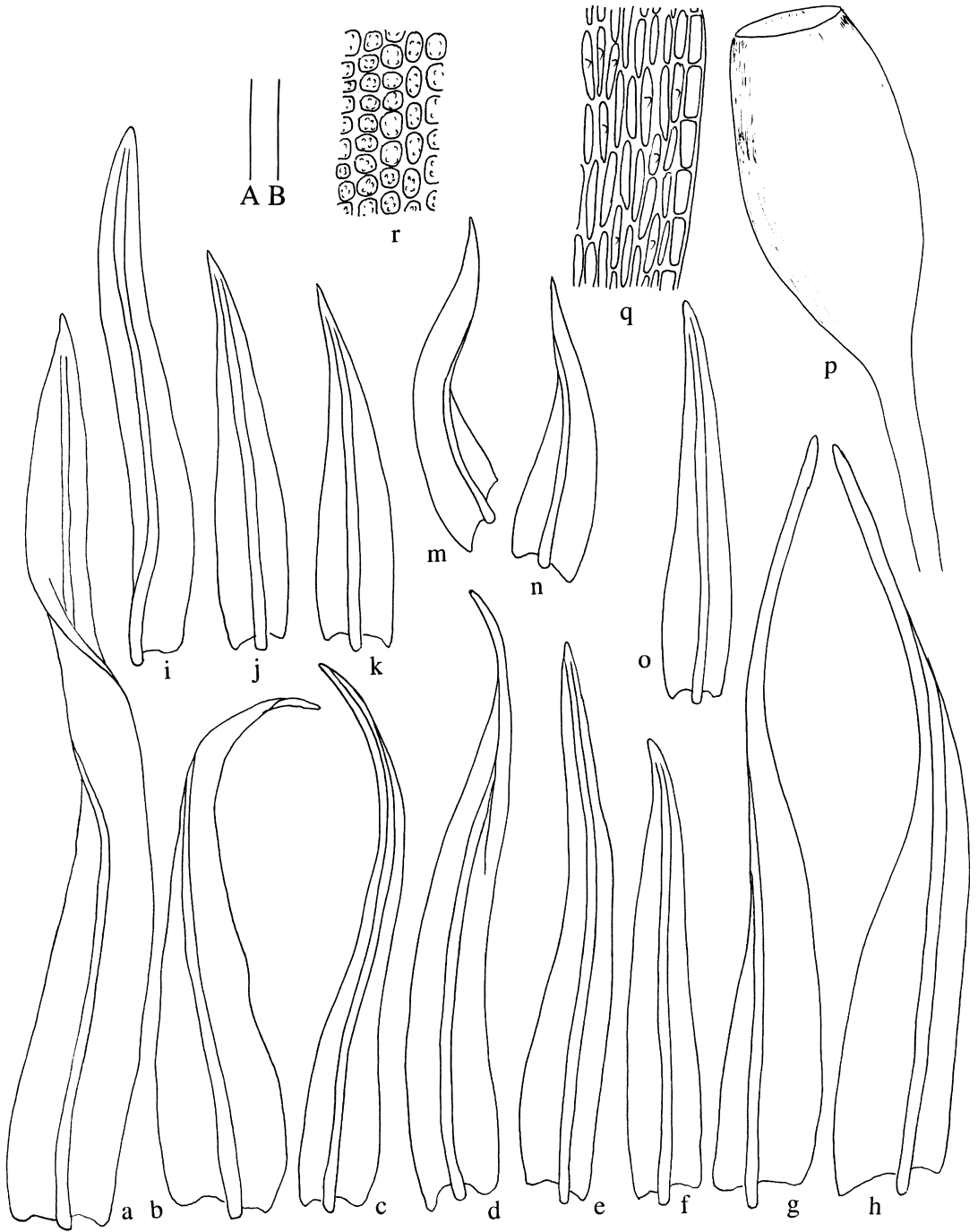
Bull. Acad. Int. Geogr. Bot. 18: 250. 1908 (“*Ferriei*”). — HOLOTYPE: Japan. Liou-Kiou: Mt. Yuwan-Dake, Isl. Amami-Oshima, X.1898 *J. B. Ferrié* (PC, not seen), isotype in herb. Noguchi (Noguchi 1967).

*Macromitrium comatulum* Broth. ex Okamura in Matsumura, Icon. Pl. Koisikavenses 3: 41, pl. 166. 1916. — LECTOTYPE (here designated): Japan. Prov. Tojima; Kimosaki, *G. Kono* 225 (NICH, not seen; isolectotype H-BR!). SYNTYPES: Shikoku: Prov. Tosa; Yanase, *Okamura 167* (H-BR!); Prov. Nagato, Ōmine (not seen). — Synonymized by Noguchi (1967).

*Macromitrium comatulum* Broth., Öfv. Finsk. Vet. Soc. Förh. 62A(9): 14. 1920, *hom. illeg.* — LECTOTYPE (here designated): *Kono 225* (H-BR!). SYNTYPES: *Okamura 167* (H-BR!); Prov. Kii, sine loco designato, 14.VIII.1915 *A. Yasuda* (H-BR!).

*Macromitrium quercicola* Broth., Sitzungsber. Akad. Wiss. Wien, Math. Nat. Kl. Abt. 1, 131: 212, 1922, *syn. nov.* — LECTOTYPE (here designated): China. Yunnan, prope vicos Hsinlung 23°54', ca. 2000 m, 10.III.1914 *Handel-Mazzetti 508* (H-BR!). SYNTYPE: Sanyingpan 26°, N of Yunnanfu, in regione calide temperata, ad truncos *Quercuum*, ca. 2400 m, 4.VII.1914 *Handel-Mazzetti 600* (H-BR!).

Plants forming dense, brownish-green mats, dark-brown below, yellowish-green to dark-green above. Branches erect, 5–25 mm long, with several short branchlets at upper part, densely leaved. Stem leaves strong deflexed to suberect when moist, yellowish, oblong-lanceolate, 0.6–1.4 × 0.2–0.3 mm. Branch leaves crisped and contorted when dry, widely spreading when wet, yellowish or green, linear- or ovate-lanceolate, to 2–3 × 0.2–0.3 mm, most acuminate or narrowly acuminate, some leaves more or less obtuse, keeled. Median and upper laminal cells subquadrate, clear or slightly obscure in some leaves, 6.5–16 × 8–10 μm, with 2–4 small, low papillae per cell or nearly smooth, lower laminal cells rhomboidal, rectangular to sublinear, 16–24 × 4–6 μm, rather clear, thicker-walled, some basal laminal cells distinctly unipapillose; costa yellowish-brown, reaching to leaf apex. Autoicous, sporophytes subterminal on branches, inner perichaetial leaves oblong-lanceolate, long and narrowly acuminate, plicate in basal part, to 2.5 mm long, all laminal cells clear and smooth, with



**Fig. 2.** *Macromitrium ferriei* (from Koponen *et al.* 59102). — a–f, i–k, and o: Branch leaves. — g and h: Perichaetial leaves. — l: Median laminal cells. — m and n: Stem leaves. — p: Capsule when wet. — q: Basal laminal cells near margins. — r: Median laminal cells. Scales: A = 0.40 mm, use for a–k and m–p; B = 40  $\mu$ m, use for l, q and r.

thick walls. Setae 3–5(–8) mm long, smooth, purple or brown. Capsules erect, ovoid-obloid, 1.4–1.8 × 0.7–0.9 mm, with slightly contracted mouth when old, some with a purplish tier of smaller exothecial cells surrounding mouth; operculum conic-rostrate, 0.7–0.8 mm long; exostome teeth short-lanceolate, with obtuse apices, up to 120 μm long, densely papillose throughout. Spores minutely papillose, 15–30 μm diameter. Calyptra mostly campanulate, occasionally cucullate, with numerous yellowish or brownish-yellow hairs.

Viktor F. Brotherus continuously received specimens from S. Okamura and returned to him the lists of identifications; there are 13 letters or post-cards to Brotherus from 1907–1915 in the Archives of the University of Helsinki (Koponen & Piippo 2002). Possibly due to the World War I, Brotherus was unaware that Okamura (1916) had described *Macromitrium comatum*, and re-described it (Brotherus 1920). The lectotype is selected based on Okamura's description and illustration, which shows a plant with "*Seta c. 5–7 mm. longa, erecta, fusca, junior laevis demum comatula. Theca [...] dense comatula*". As pointed out by Noguchi (1967), this hairiness is actually a fungal infection. Okamura's (1916) and Brotherus' (1920) descriptions are different. Brotherus, as was his habit (Koponen 2010), had sent to Okamura only the identification without a description.

*Macromitrium ferriei* is very common and variable in Japan (Noguchi & Iwatsuki 1989). In the Hunanese populations the most strongly variable characters are the leaf apex (narrowly acuminate to slightly or distinctly obtuse), papillosity of basal laminal cells (smooth or with a single large papilla), basal laminal cell shape (rhombic, rectangular or slightly elongate), and length of seta (3–8 mm).

*Macromitrium quercicola* seems to be an extreme in the morphological variation of *M. ferriei*. The former was one of the few moss species, which H. Handel-Mazzetti thought possible to identify in the field. He (in Brotherus 1929; for details, see Koponen 2010) reported many localities without citing voucher specimens, some of them from Hunan: "north of Ludu between Wukang and Hsinhwa and between Tschatang and Dschangdjatang east of Hsikwangschan"

(original in German). Cao and Koponen (2004) in their overview of taxa of *Symbolae sinicae* (Brotherus 1929) referred *M. quercicola* to the group of taxa in need of further studies.

DESCRIPTIONS AND ILLUSTRATIONS: Noguchi (1967), Noguchi & Iwatsuki (1989).

HABITATS AND SUBSTRATES IN HUNAN: *Macromitrium ferriei* is one of the typical epiphytic mosses in Hunanese forests. It is moderately common in primeval sites and thrives equally well in second-growth forests on trunks of many species of trees, even on conifers. It occurs both in warm-temperate evergreen hardwood forests and in orotemperate deciduous hardwood forests at 500–2000 m. On the basis of our substrate information this may partly be due to its ability to continue growth after forest cutting. Many specimens were collected from fallen, and even from rotten, trunks. The man-made habitats are road side trees and young plantations of various trees. It occasionally grows on stones and cliffs. On tree trunks (39 specimens), base trunk (6), rotten trunk (2), base of dead tree (1), fallen trunk (4), fallen rotten trunk or log (4), branch or twig (10), rotten branch or twig (2), fallen branch or twig (4), on bush (2), on trunk of *Ailanthus altissima* (1), *Albizia julibrissin* (1), *Betula* (1), *Celastrus* (1), *Cyclobalanopsis jenseniana* (2), *Distylium* (1), *Hydrangea paniculata* (1), *Liriodendron* (3), twig of *Meliosma oldhamii* (2), trunk of *Metasequoia* (2), *Pinus taiwanensis* (1), *Prunus* sp. (1), *P. persica* (1), *Pterostyrax psilophylla* (7), *Quercus* (2), *Rhododendron* (1), *Sassafras tzumu* (2), *Schima semiserrata* (1), *Symplocos* (3), *Taxus* (1), *Tapiscia sinensis* (2), top of rock (1), on cliff (1), on stone wall (1), on litter (1). Primevity index 19/19/7. Frequency in Hunan: rather common.

RANGE IN HUNAN: Inter urbes Linling et Sinning, 1917 *Handel-Mazzetti 11308* (H-BR, as *Macromitrium japonicum*, Brotherus 1929). **Badagongshan.** 39a. 61612. 42a. 59101 (with *Ulota crispa*), 59102. 43. 54811, 54812, 54817, 54820. 44b. 48848. 45. 50290, 55570, 55571. 47. 54540. 48. 50043, 50094. 49b. 61343, 65047, 64912, 64913, 61343, 61348. 50. 48779, 61314. 52. 54294, 54650, 54661. 55b. 54371. 55c. 58750. 55d. 58672, 58700, 58766. 86b. 61263, 65145. 87. 58906, 58923. 88a. 59074. 90b. 64677, 64755. 92. 61221. 95. 61491, 61494. **Changsha.** Yolu-schan, 1918 *Handel-Mazzetti 11451, 11502* (H-BR, as *M. japonicum* in Brotherus, 1929). **Daweishan.** DAW15. 63478, 62321. DAW22. 62283,



62286. *DAW24a*. 62075, 62083. *DAW24b*. 62090, 62223. *DAW25* 62003. *DAW26b*. 61719, 61721, 61725. *DAW27*. 61888. *DAW30*. 61918, 61920 (with *Macrocoma tenue* ssp. *sullivantii*), 61922. **Hupingshan**. 58. 53772. 59. 49737. 60. 53863, 53908. 68. 54105. 70. 54003, 54004, 54013 (with *Ulota crispa*). 72. 49898, 52208, 52223. **Mangshan**. 7a. 50951. 7c. 51068. 9b. 49534. 10a. 51019. 11b. 51099, 51153, 51282, 51306. 12a. 49221, 49222, 50653. 14b. 49275, 49478, 49479, 49481, 49482, 49489. **Shunhuangshan**. *S4*. 70496. *S12a*. 70843. *S13*. 70983, 70988. *S14*. 71034. **Taoyuandong**. 20b. 56831. 21a. 54991, 55090, 55104. 22. 50913. 23b. 55835. 27. 55216, 55029, 55030, 56479, 56481, 56508, 56514, 56567. 28. 55262, 55313, 55318 (with *Orthotrichum exiguum*, *Macrocoma tenue* subsp. *sullivantii*), 56572. 34. 57011. 37. 56687, 56723. 31. 55419, 55422. **Wulingyuan**. 17b. 52376. 18a. 58578. 18f. 53065. 19b. 52060. 84. 58557, 58553. **Yuankou**. 74c. 60045. 76b. 59990, 60019, 60023. **Yunshan**. *Y2*. 70004. *Y7a*. 70102.

TOTAL RANGE: As 2: China (18 provinces, Redfeam *et al.* 1996), Japan, Korea (Noguchi & Iwatsuki 1989).

### ***Macromitrium gymnostomum* Sull. & Lesq. (Fig. 3)**

Proc. Am. Acad. Arts Sci. 4: 278, 1859 (reprint, p. 3!). — LECTOTYPE (selected by Noguchi 1967): Japan. Shizuoka Pref., Simoda, *Wright* (FH, not seen); isolectotype: On rocks and trees, Simoda, Japan (NY!). SYNTYPE: Japan. Ousima, one of the northern Loo Choo Islands (NY!).

Plants in dense, dark or reddish-brown mats, younger parts dark-green. Stems elongate, sparsely leaved, densely covered with reddish rhizoids; branches erect, up to 5 mm long, simple, or with several short branchlets, obtuse at apex. Stem leaves oblong at base, sublinear to linear-lanceolate above. Branch leaves crisped when dry, widely spreading when moist, linear or linear-lanceolate, 1–2.5 × 0.15–0.20 mm, long; keeled, apex acute or acuminate, lower half of leaves yellowish and hyaline, upper half rather obscure; costa yellowish-brown, shortly excurrent, mid-margins slightly recurved; median and upper laminal cells obscure, rounded or rounded-hexagonal, 4–5  $\mu\text{m}$ , thin-walled, densely papillose; lower cells longer, rectangular, with or without papillae, basal cells linear, 8–25  $\mu\text{m}$  long, with thickened walls, smooth. Autoicous. Inner perichaetial leaves ovate-lanceolate, acuminate, costa extending to leaf apex, laminal cells hyaline, smooth, paraphyses numerous, slightly exerted beyond leaves; seta brown, smooth, usually 5–8 mm long; capsules obloid-

cylindric, brown, deeply plicate, constricted at mouth when dry; peristome none. Spores finely papillose, 20–25  $\mu\text{m}$  diameter. Calyptra cucullate, 1.7–2 mm long, very wide at base, somewhat lobed and plicate, naked.

DESCRIPTION AND ILLUSTRATIONS: Noguchi & Iwatsuki (1989).

The morphological characters of *Macromitrium gymnostomum* in Hunan are relatively stable and the plants are easy to separate from other members of the genus by the (1) dense, dark or reddish-brown mats, (2) widely spreading linear or linear-lanceolate leaves with a very obscure upper half and hyaline lower half when moist, and (3) gymnostomous capsules with a naked, cucullate calyptra.

HABITATS AND SUBSTRATES IN HUNAN: *Macromitrium gymnostomum* is much rarer in Hunan than *M. ferriei*, and seems to be restricted to the warm-temperate zone and lacking in man-made habitats. Primeval habitats are mixed evergreen and deciduous hardwood forests with dense bamboo undergrowth and evergreen Lauraceae-Fagaceae forests with mixture of *Pinus massoniana* and *P. kwantungensis*. Disturbed habitats are various kinds of second-growth forests and bamboo stands. Like *M. ferriei*, *M. gymnostomum* is mostly epiphytic on tree trunks, but it was occasionally collected from cliffs and boulders at 50–1550 m. On tree trunk (7 specimens), tree base (1), on *Exbucklandia tonkanensis* (1), *Distylium* (1), *Altingia chinensis* bush (1), cliff (2), boulder (1). Primevity index 4/6/0. Frequency in Hunan: rare.

RANGE IN HUNAN: **Badagongshan**. 88b. 58960. **Changsha**, Mt. Yuelu. 1. 48962. **Daweishan**. *DAW16*. 61994. **Mangshan**. 4b. 51680, 51449. 5. 51411. 7c. 50762. **Shunhuangshan**. 58. 70674. 59. 70760. **Taoyuandong**. 21a. 55092. **Wulingyuan**. 16d. 53352. 19b. 52057. 83. 58525. **Yuankou**. 79b. 59595. **Yunshan**. *Y7a*. 70130.

TOTAL RANGE: As 2: China (seven provinces, Redfeam *et al.* 1996), Japan, Korea (Noguchi & Iwatsuki 1989); As 3: Vietnam (Tan & Iwatsuki 1993).

### ***Macromitrium handelii* Broth. (Fig. 4)**

Sitzungsber. Akad. Wiss. Wien, Math. Nat. Kl. Abt. 1, 131: 212. 1922 ("*Handelii*"). — LECTOTYPE (here designated):



**Fig. 3.** *Macromitrium gymnostomum* (from Koponen et al. 58525). — a–f, i and j: Branch leaves. — g and h: Perichaetial leaves. — k and m: Capsule when dry. — l: Calyptra. — n: Capsule when wet. — o: Transverse section through basal part of leaf. — p: Transverse section through upper part of leaf. — q: Basal laminal cells near leaf margins. — r: Juxtacostal basal laminal cells. — s: Upper laminal cells. — t: Lower laminal cells. Scales: A = 0.40 mm, use for a–n; B = 40  $\mu$ m, use for o–t.

China. Prov. Yunnan: prope vicum Jöschuitang ad septentr. urbis Yunnanfu, 25°26' lat., in regione calide temperata, ad arbores frondosas, ca. 1800 m, *Handel-Mazzetti 450'* (H-BR!). SYNTYPE: China. "Prov. Hunan austro-occid: in monte Yün-Schan prope urbem Wukang, in silva elata frondosa, ad lignum putridum", ca. 1150 m, *Handel-Mazzetti 12192* (H-BR!).

Plants in dense, dark-green mats. Branches erect, short, up to 5 mm long, simple or with a few short branchlets, densely leaved. Stem leaves recurved, from a triangular-ovate base gradually tapering to an acuminate apex. Branch leaves strongly crisped and contorted when dry, spreading but often slightly incurved at apex when moist, hyaline at leaf base, linguulate-lanceolate, with subacute, obtuse apices, strongly keeled, often not plicate at base, 1.8–2.8 × 0.35–0.55 mm; costa ending just below leaf apex. Median and upper laminal cells pellucid, quadrate to hexagonal, 6.5–10 µm wide, thin-walled, with 2–4 small and low papillae; basal cells hyaline, rectangular, 20–27 × 4–6 µm, with thickened walls, distinctly unipapillose. Autoicous. Inner perichaetial leaves ovate-lanceolate or ovate-oblong, with a rather long acuminate apex, to 2.4 mm long, median laminal cells rectangular, thick-walled, smooth. Seta smooth, 3–5 mm long. Capsules obloid, peristome teeth lanceolate, obtuse, papillose throughout. Calyptra campanulate, densely hairy, lobed at base, plicate, with numerous long, yellowish hairs.

*Macromitrium handelii* is somewhat similar to *M. japonicum*, from which it can be distinguished by its distinctly unipapillose basal laminal cells and not strongly incurved leaf apices when moist.

DESCRIPTION: Brotherus (1922).

HABITATS AND SUBSTRATES IN HUNAN: *Macromitrium handelii* seems to be delimited to the warm-temperate zone in Hunan, and was collected only epiphytic. In addition to primeval *Pinus massoniana* var. *wulingensis*–*Quercus glandulifera* and *Itea*–*Daphniphyllum*–*Symplocos*–*Litsea*–*Tapiscia*–*Cyclobalanopsis*–*Pinus huangshanensis*–*Cunninghamia lanceolata* forests it was collected from disturbed habitats such as second-growth forests, cut evergreen *Cunninghamia lanceolata*–*Pinus massoniana* forest,

plantation of *Liriodendron*, *Alniphyllum*, *Metasequoia* and *Phellodendron*, bamboo cultivation, and from road side trees at 550–1400 m. On tree trunk (8 specimens), fallen tree (1), trunk of *Alniphyllum* (1), *Liriodendron* (1), *Metasequoia* (1), *Quercus glandulifera* (2). Primevity index 2/7/2. Frequency in Hunan: rare.

RANGE IN HUNAN: **Badagongshan.** 39a. 55736, 55752. 43. 54793. **Daweishan.** DAW4. 62432. **Taoyuandong.** 25a. 56884. 27. 55023. 36. 57117. **Wulingyuan.** 17b. 52098. 18d. 53019. 18f. 52539. 19a. 52328. 19b. 52064. **Yuankou.** 76b. 60024. **Yunshan.** Brotherus (1922, 1927, *Handel-Mazzetti 12192*).

TOTAL RANGE: Endemic to China. In addition to Hunan known from Sichuan and Yunnan (Redfearn *et al.* 1996).

### *Macromitrium japonicum* Dozy & Molk. (Fig. 5)

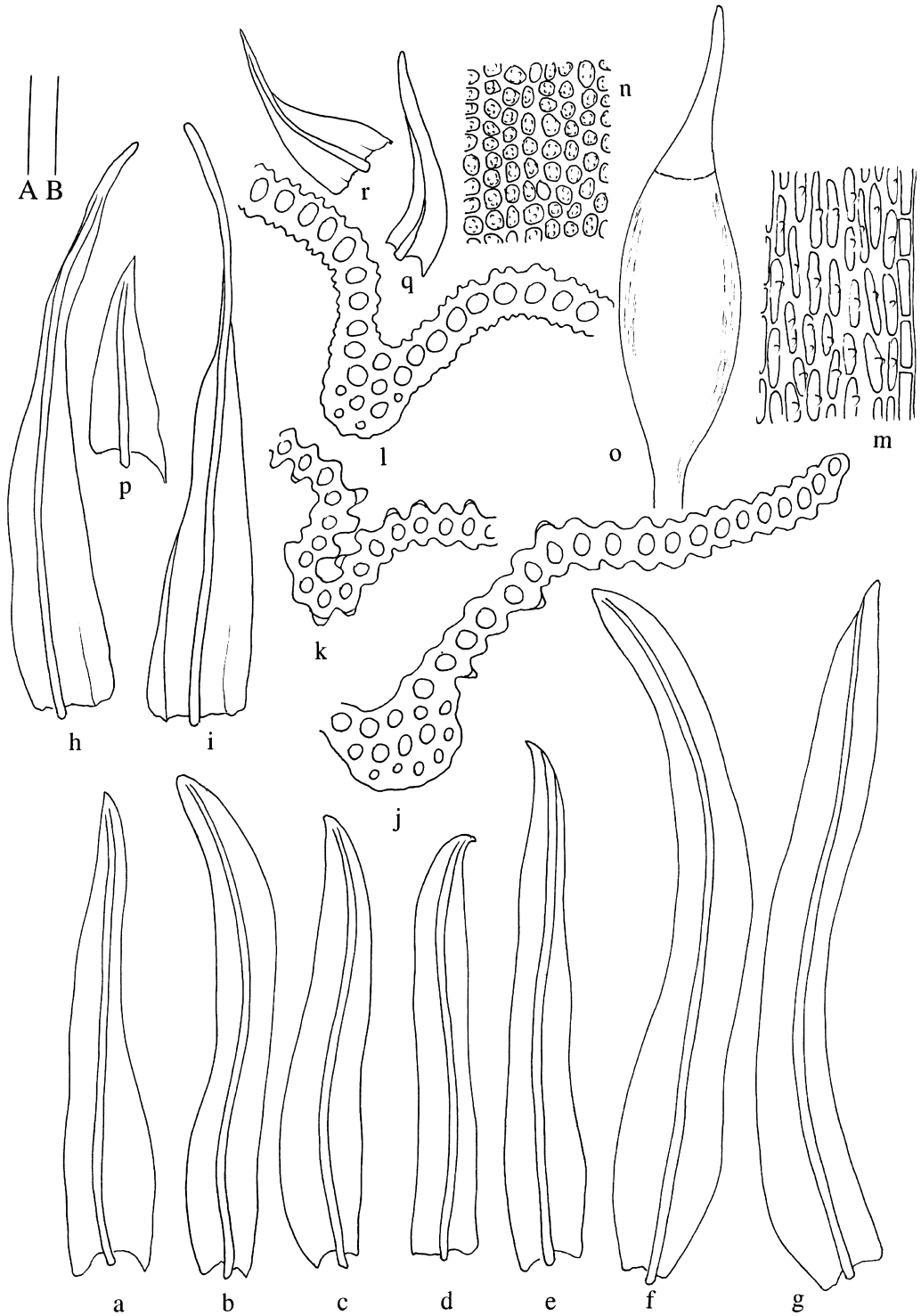
Ann. Sci. Nat. Bot. Sér. 3,2: 311 (reprint, p. 16!). 1844. — *Dasymitrium japonicum* (Dozy & Molk.) Lindb. *ex Par.*, Ind. Bryol. ed. 2, 5: 149. 1906. — LECTOTYPE (selected by Noguchi 1967): Japan. Without locality, *Siebold* (L 910, 138–1128, not seen).

*Dasymitrium incurvum* Lindb., J. Bot. 2: 285. 1864. — *Macromitrium incurvum* (Lindb.) Mitt., Trans. Linn. Soc. London Bot. ser. 2, 3: 163. 1891. — Type: "China. In saxis insulae, Tscheu-Schan (30° lat. bor.) imperii chinensis, *Hedwigie albicanti* associatum, anno 1862, legit navarchus suecicus L. *Ahlström*" (not seen). — Synonymized by Noguchi (1967).

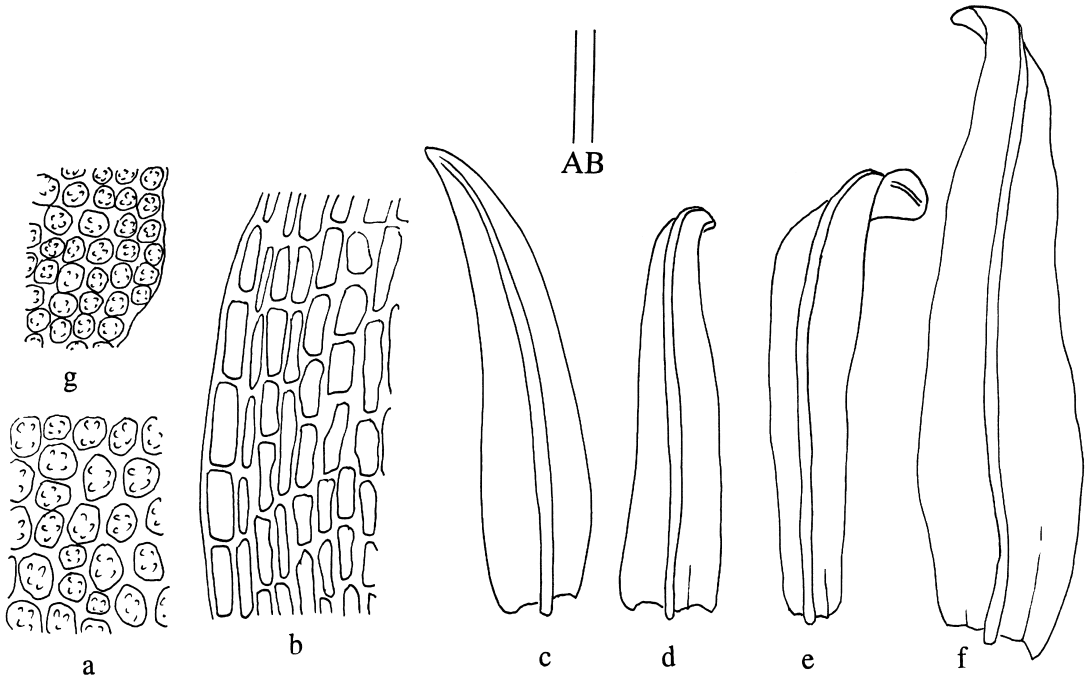
*Macromitrium giraldii* Müll. Hal., Nuov. Giorn. Bot. Ital. n. ser. 3: 106. 1896 ("Giraldii"). — China. Prov. Schen-si, in monte Tui-kio-san, VIII.1894 *Giraldi* (not seen). — Synonymized by Cardot (1905) with *Macromitrium incurvum*.

*Macromitrium bathyodontum* Card., Beih. Bot. Centralbl. 17: 13, fig. 8. 1904. — LECTOTYPE: (corrected here; selected by Noguchi 1967 as "isotype", the Code, Art. 9.8). Korea. "Corée: Ouen-San", VIII.1907 *Fauriei* 32 (KYO, not seen; isolectotype H-BR!). — Synonymized by Noguchi (1967).

Plants in dense, dark-green mats, blackish-blown below, yellowish-green at younger tips. Branches erect, short, up to 6 mm long, simple or with a few short branchlets, densely leaved. Stem leaves recurved, from a triangular-ovate base gradually tapering to an oblong-lanceolate apex. Branch leaves strongly crisped and contorted when dry, spreading but often still incurved at apex when moist, linguulate, with subacute, obtuse apices, strongly keeled, at times plicate at base, 1.3–2.5 × 0.25–0.40 mm; median



**Fig. 4.** *Macromitrium handelii* (from *Koponen et al. 60024*). — **a-g**: Branch leaves. — **h** and **i**: Perichaetial leaves. — **j-l**: Transverse sections of leaf. — **m**: Basal laminal cells near leaf margins. — **n**: Upper laminal cells near leaf margins. — **o**: Capsule when wet. — **p-r**: Stem leaves. Scales: A = 0.40 mm, use for **a-i**, **o-r**; B = 40  $\mu$ m, use for **j-n**.



**Fig. 5.** *Macromitrium japonicum* (from Koponen *et al.* 54775). — **a**: Median laminal cells. — **b**: Basal laminal cells near leaf margins. — **c–f**: Branch leaves. — **g**: Upper laminal cells. Scales: A = 0.40 mm, use for **c–f**; B = 40  $\mu$ m, use for **a**, **b** and **g**.

and upper laminal cells obscure, quadrate to hexagonal, 8–12  $\mu$ m wide, thin-walled, with 3–5 small papillae; basal cells hyaline, rectangular, 20–40  $\times$  6–8  $\mu$ m, with slightly thickened walls, smooth; costa ending just before leaf apex. Autoicous. Vaginula hairy, with many smooth hairs. Inner perichaetial leaves ovate-lanceolate or ovate-oblong, acuminate, keeled, to 1.5 mm long, costa extending to apex, median laminal cells rectangular, thick-walled, smooth. Seta smooth, 2–3 mm long. Capsules ovoid, ovoid-obloid or subglobose, constricted when dry. Exostome teeth lanceolate, obtuse, irregular in outline, densely papillose throughout, often absent in old capsules. Calyptra cucullate, somewhat lobed at base, plicate, with numerous long, yellowish hairs. Spores densely papillose, 20–30  $\mu$ m diameter.

In the Hunanese populations of *Macromitrium japonicum*, the leaf apex and the papilosity of median and upper laminal cells are variable. The leaf apices range from broadly acuminate to obtuse to broadly rounded, and the leaves from slightly to strongly incurved when

moist. The median and upper laminal cells can be slightly papillose to rather obscure and distinctly pluripapillose.

The type of *Dasymitrium incurvum* could not be located in H-SOL by us, nor is it in S-PA (Noguchi 1967). Brotherus (1925) did not see the type of *Macromitrium giraldii* but cited Cardot's synonymization of *M. incurvum* ("*M. Giraldii* Müll. Hal. nach Cardot"). In the Brotherus herbarium, seven Giralddi collections collected in 1895–1898 are kept under the name *M. giraldii*. These fit in *M. japonicum*.

DESCRIPTIONS AND ILLUSTRATIONS: Gao (1977), Noguchi & Iwatsuki (1989).

HABITATS AND SUBSTRATES IN HUNAN: The primeval habitats of *M. japonicum* were mixed evergreen and deciduous hardwood forest with dense bamboo undergrowth and low deciduous-evergreen *Euonymus–Rosa–Miscanthus–Pinus* forest or bush. Disturbed and man-made sites were second-growth forests and plantations of several species of trees. It was collected both

in temperate and warm-temperate zones only epiphytic at 690–1860 m. On tree trunk (6 specimens), dead, rotten tree (1), on *Liriodendron* (4), *Alniphyllum* (1), base of *Pinus* (1). Primevity index 2/1/2. Frequency in Hunan: rare.

RANGE IN HUNAN: Hunan austro-occid.: inter urbes Tsingschou et Wukang, alt. 600 m, *Handel-Mazzetti 11064*, diar. no. 2186 (H-BR!). **Badagongshan.** 43. 54775. 55d. 58760. 90b. 64691, 64712, 61646, 61647, 61659. **Daweishan.** DAW4. 63564. DAW27. 61931. **Hupingshan.** 70. 54025. **Shunhuangshan.** S13. 70982. **Yuankou.** 76b. 59934. 79b. 59593.

TOTAL RANGE: As 1: Russian Far East; As 2: China (22 provinces, Redfearn et al. 1996), Japan, Korea (Noguchi & Iwatsuki 1989); As 3: Sri Lanka (O'Shea 2002).

**\**Macromitrium syntrichophyllum* Thér. & P. de la Varde (Fig. 6)**

Rev. Bot. 30: 347 (reprint, p. 4!). 1918 (“*Syntrichophyllum*”). — SYNTYPES: China. “China. or., Leoufang (900 m. alt.)”, X.1910 *Courtois 332* (not seen); Tchan kia po (prov. Ngan hoi), X.1910 *Courtois 335* (not seen).

Plants forming dense dark-green mats. Branches erect, 5–10 mm high, simple or with several short branchlets in upper part, densely leaved. Stem leaves strong crisped at apex when dry, similar to branch leaves. Branch leaves strongly crisped and contorted when dry, widely spreading or slightly incurved in upper part when wet, green, lingulate or oblong, 2–2.8 × 0.3–0.5 mm, obtuse or broadly acuminate, slightly keeled. Basal parts brownish-yellow, margins entire and plane or narrowly recurved, costa reaching to leaf apex. Median and upper laminal cells quadrate or subquadrate, clear, 6–8 μm wide, with 2–4 small, low papillae per cell or nearly smooth; lower laminal cells rectangular to sublinear, 20–35 × 4–5 μm, rather clear, thicker-walled, smooth. Autoicous. Inner perichaetial leaves oblong-lanceolate, narrowly acuminate, often indistinctly notched-serrate near apex or in upper part, plicate in basal part, up to 3 mm long. Setae 5–7 mm long, smooth, Capsules erect, ovoid-obloid, 1.4–1.8 × 0.7–0.9 mm; operculum conic-rostrate, 0.7–0.8 mm long; exostome teeth short-lanceolate, with obtuse apices, densely papillose. Spores minutely papillose, 15–20 μm diameter. Calyptra large, campanulate, with

dense and long brown-yellowish hairs, enclosing whole capsule.

*Macromitrium syntrichophyllum* is similar to *M. comatum* from Japan and Korea, but can be distinguished by the perichaetial leaves, which have longer acuminae and subulae. *Macromitrium syntrichophyllum* should also be compared with *M. japonicum*, from which it differs by its (1) pellucid median and upper laminal cells with 2–4 small and low papillae, (2) longer setae, up to 7 mm long, and (3) a campanulate calyptra. From *M. sinense*, *M. syntrichophyllum* differs by its oblong or lingulate leaves with obtuse apices.

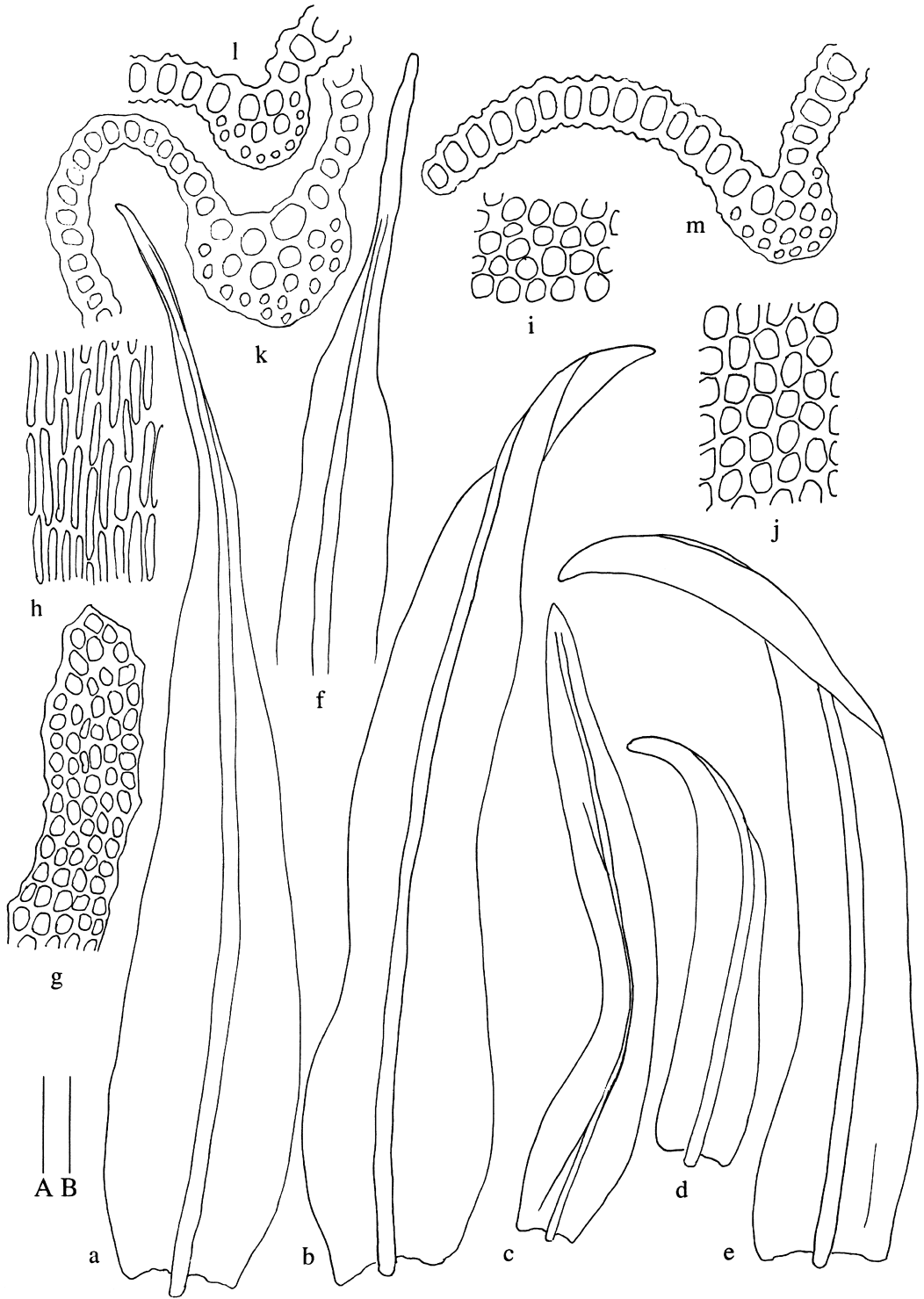
HABITATS AND SUBSTRATES IN HUNAN: *Macromitrium syntrichophyllum* was collected only once in primeval habitat, in mixed evergreen hardwood forest, and near that site in *Pinus massoniana* plantation. Other habitats were secondary evergreen hardwood forest, disturbed *Pilostegia-Quercus-Rhododendron-Schisma* elfin forest on mountain top, *Catalpa fargesii-Corylus chinensis* plantation, and *Magnolia officinalis* subsp. *biloba-Tapiscia sinensis* plantation. All collections were taken from tree trunks. On tree trunk (1), *Aesculus* (1), *Catalpa fargesii* (1), *Corylus chinensis* (1), *Evodia rutalcarpa* bush (1), *Magnietia fordiana* (1), and *Pterostyrax psilophylla* (1). Primevity index 1/3/3. Frequency in Hunan: rare.

RANGE IN HUNAN: **Badagongshan.** 42. 50503. 49b. 64888. 55d. 58695, 58726, 58741. **Mangshan.** 11b. 51104. 11c. 51318. 14b. 49255, 49321, 49322.

TOTAL RANGE: Endemic to China. First record for Hunan, previously reported from Anhui and Fujian, and as *Macromitrium syntrichophyllum* var. *longisetum* from Fujian and Guanxi (Redfearn et al. 1996).

**Genus *Orthotrichum* Hedw.**

Plants small to robust, usually in small tufts, on barks or rocks, stems short, clustered, dark-green, erect or ascending, forked or fasciculate-branched. Leaves often erect-appressed or slightly flexuose when dry, ovate-lanceolate to oblong-lanceolate, acute or blunt or rounded, often revolute at margins, generally from base nearly to apex; upper laminal cells thick-walled, incrassate, usually pluripapillose on both sur-



**Fig. 6.** *Macromitrium syntrichophyllum* (from Koponen *et al.* 49322). — **a**: Perichaetial leaf. — **b–e**: Branch leaves. — **f**: Upper part of perichaetial leaf. — **g**: Apex of perichaetial leaf. — **h**: Basal laminal cells. — **i**: Upper laminal cells — **j**: Median laminal cells. — **k–m**: Transverse sections of leaf. Scales: A = 0.40 mm, use for **a–f**; B = 40  $\mu$ m, use for **g–m**.

faces; lower laminal cells rectangular or sub-quadrate to linear, not or somewhat incrassate, hyaline or pellucid, sometimes shorter at margins but not forming a hyaline border; costa rather strong, ending near apex. Autoicous, Perichaetial leaves scarcely differentiated. Setae straight, very short to fairly long; capsule immersed to exserted, obloid-ovoid to subcylindric from a tapered neck, smooth or 8–16-ribbed, annulus none, operculum stoutly rostrate from a convex or conic base. Stomata superficial or immersed, peristome double or sometimes single, usually with 16 broadly lanceolate teeth sometimes joined in pairs, occasionally papillose, calyptra campanulate-mitrate, covering most of urn, naked or hairy.

Lewinsky (1992) revised the genus *Orthotrichum* for SE Asia, and before that for the other parts of the world (1978, 1984, 1985, 1987) and summarized her results in a synopsis (1993a). After her revisions and some later additions (Lewinsky-Haapasaari 1996, 1999a, 1999b, Redfearn et al. 1996, Allen 2002), 38 *Orthotrichum* taxa are known from China.

### ***Orthotrichum consobrinum* Card.**

Bull. Herb. Boiss. sér. 2, 8: 336. 1908. — LECTOTYPE (selected by Noguchi 1968): Japan. "Aomori Pref., Hirosaki, *Faurie 631*" (KYO, not seen). SYNTYPE: Japan. Aomori, *Faurie 2716* (H-BR!) = isotype of *Orthotrichum nipponense* Nog. (1968) = *Schistidium apocarpum* (Hedw.) Bruch & Schimp. (Noguchi & Iwatsuki 1988).

*Orthotrichum courtoisii* Broth. & Par. in Par., Rev. Bryol. 37: 2, 1910 ("*Courtoisii*"). — LECTOTYPE (designated here): China. Zika Wei, X. 1908 R. P. *Courtois 1288* (H-BR 2996016!). — Synonymized by Lewinsky (1993a).

Plants in scattered tufts, to 10 mm high, densely leaved, dark-brown to black-brown below, olive-green to dark-green above. Stems simple, rhizoids developed at base of stems. Leaves slightly appressed, erect or slightly flexuose when dry, lanceolate, acute to acuminate, 1.5–2.5 × 0.3–0.6 mm; leaf margins entire and plane or slightly recurved on one side; costa reaching leaf apex, yellowish-brown; median and upper laminal cells somewhat obscure, inflated, thin-walled, quadrate to short rectangular, somewhat irregular, 8–14 × 7–15  $\mu\text{m}$ , papillose, with 1–2 low, simple papillae

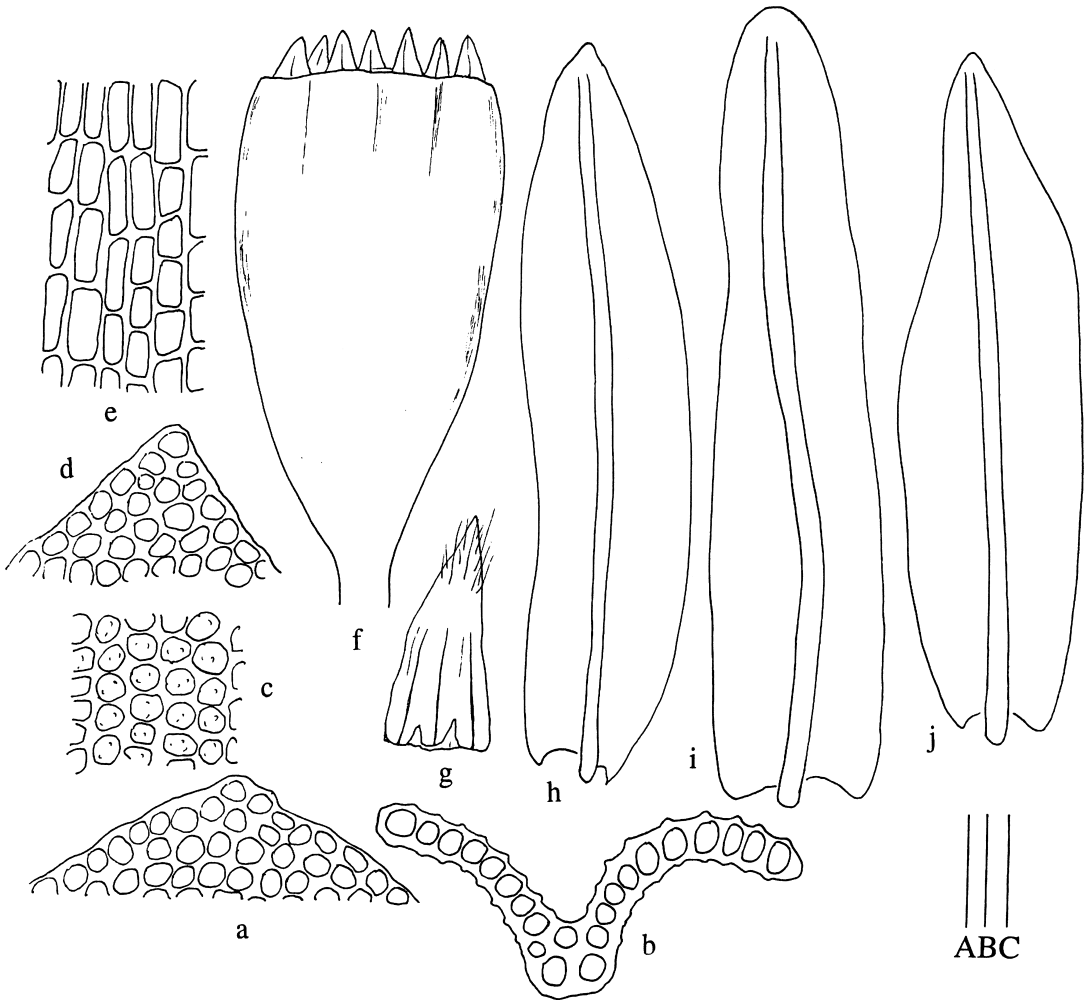
per cell; basal cells rectangular, pellucid, 18–40 × 9–14  $\mu\text{m}$ , along basal leaf margins and in leaf corner shorter, almost quadrate. Gonioautoicous. Perichaetial leaves similar to stem leaves. Capsules slightly emergent, 8-ribbed for entire length when dry, not distinctly constricted below mouth; exothecial cells differentiated in upper half of capsule into 8 yellow stripes with slightly thicker walls, separated by 8 hyaline stripes; stomata immersed, more or less covered by protruding subsidiary cells, present in lower part of capsule; operculum ca. 0.3 mm long; peristome double, exostome teeth in 8 pairs, triangular-lanceolate, yellowish, finely papillose throughout, reflexed when dry; endostome segments 8, shorter than exostome teeth, linear, hyaline, finely papillose. Spores globose, 13–17  $\mu\text{m}$ , minutely papillose. Calyptra campanulate, lobed at base, to 1.5 mm long, with 16 plicae, naked.

Brotherus (1929) reported *O. courtoisii* from Hunan from three Handel-Mazzetti specimens (11538, 12154, 11155). Specimen 11538 was collected near Changsha and 11154 from Yunshan, both of them were checked by J. Lewinsky and proved to be *O. consobrinum*. The specimen 11155 could not be located in H-BR.

*Orthotrichum courtoisii* was first described from Jiangsu Province, China (Paris 1910). It was not included in the monograph of *Orthotrichum* in SE Asia (Lewinsky 1992). Though Lewinsky made a remark on the type of *O. courtoisii* preserved in H-BR that this species is identical to *O. consobrinum*, she synonymized *O. courtoisii* formally only in Lewinsky (1993a). Redfearn et al. (1996) still recognized *O. courtoisii* as a distinct species. We confirm that *O. courtoisii* is a synonym of *O. consobrinum*. Because the former name has two authors and probably two type specimens exist, we select the specimen in H-BR seen by Lewinsky as the lectotype.

Noguchi (1968) pointed out that *O. consobrinum* in Japan varies greatly in leaf shape and size. Its naked, conic calyptra with 16 sharp, almost smooth plicae distinguish it from the Chinese congeners. The syntypes of *O. consobrinum* numbered eight specimens. Noguchi (1968) discussed two of them, number 631, which he selected as the lectotype, and 2716, which he described as *O. nipponense*.





**Fig. 7.** *Orthotrichum erubescens* (from Koponen *et al.* 49785). — **a** and **d**: Apical leaf cells. — **b**: Transverse sections of leaf. — **c**: Upper laminal cells. — **e**: Basal laminal cells. — **f**: Capsule when wet. — **g**: Calyptra. — **h–j**: Leaves. Scales: A = 0.40 mm, use for **f** and **h–j**; B = 40  $\mu$ m, use for **a–e**; C = 0.80 mm, use for **g**.

DESCRIPTIONS AND ILLUSTRATIONS: Noguchi (1968), Noguchi & Iwatsuki (1989), Lewinsky (1992).

RANGE AND HABITAT IN HUNAN: **Changsha** (“prope urbem Tschangsha”), *Handel-Mazzetti* 12538 (H-BR). **Wulingyuan**. 19a. 52534, along stream bed in second-growth evergreen hardwood forest, on tree trunk, at 620 m. **Yunshan**. Bei Wukang, 1200 m, *Handel-Mazzetti* 12154 (H-BR). Primevity index 0/1/0. Frequency in Hunan: very rare.

TOTAL RANGE: As 2: China (Anhui, Hunan, Jiangsu, and Zhejiang, as *Orthotrichum consobrinum*, and Hubei, Jiangsu, Shanghai, and Zhejiang as *O. courtoisii* in Redfearn *et al.* 1996), Japan, Korea (Lewinsky 1992).

***Orthotrichum erubescens* Müll. Hal.**  
(Fig. 7)

Nuovo Giorn. Bot. Ital. n. ser. 4: 260. 1897. — LECTOTYPE (corrected here, given as “holotype” by Lewinsky 1992, the Code, Art. 9.8): China. Prov. Schen-Si in monte Lao-y-san, III. 1896 *Giraldi*, Bryotheca E. Levier 1510 (FI, not seen).

*Orthotrichum fortunatii* Thér., Bull. Acad. Int. Geogr. Bot. 19: 18. 1909 (“*Fortunatii*”). — LECTOTYPE (designated by Lewinsky 1992): China. Kweichow, Pin-fa, *Fortunat* 2000 (PC, not seen). — Synonymized by Lewinsky (1992).

Plants in small tufts, up to 5 mm high, brown below, dark-green above. Stems simple or dichot-

omously branched above, densely leaved; rhizoids developed at base of stems. Leaves incurved-appressed and slightly flexuose when dry, ligulate, broadly acute, rounded acute or obtuse, 1.5–2.2 × 0.3–0.5 mm, plane; leaf margins entire, plane, sometimes slightly recurved in one side below; upper laminal cells rounded-quadrate, 9–16  $\mu\text{m}$ , thick-walled, sometimes irregular, with 1–2 simple papillae per cell; basal laminal cells short-rectangular to quadrate, walls solid or slightly porose, 15–45 × 9–16  $\mu\text{m}$ , becoming shorter towards leaf margins and in basal leaf corners; costa strong, reaching near leaf apex, yellowish-brown, cells inflated on dorsal surface. Gonioautoicous. Perichaetial leaves obtuse, with basal part of leaf consisting of thin-walled, hyaline, smooth cells. Capsules ovoid, 1 × 0.7 mm, immersed to emergent, strongly 8-furrowed throughout when dry, constricted at some distance below mouth, gradually or more abruptly narrowed into seta; stomata immersed, present in central and lower parts of capsules; exothecial cells differentiated into 8 yellow bands alternating with 8 paler bands; peristome double, a low preperistome at times present; exostome of 8 pairs of teeth, yellow, reflexed when dry, outer surface finely and evenly papillose; endostome segments 8, hyaline, narrow-lanceolate with broader bases, about 2/3 of tooth length, outer surface with fine vertical lines, inner smooth; opercula rounded-conic, with a short beak. Spores globose, finely papillose, yellowish-brown, 18–22  $\mu\text{m}$ . Calyptra conic-oblong or campanulate, sometimes with brown striae, with several short brown hairs at top.

Lewinsky (1992) called the specimen in FI the holotype of *O. erubescens*. Since Carl Müller's collections were destroyed in B, Lewinsky's determination must be corrected so that the specimen becomes the lectotype.

*Orthotrichum erubescens* is rather similar to *O. subpumilum*, but can be separated by its acute, rounded-acute or obtuse-apiculate stem leaves, and obtuse perichaetial leaves. It often grows mixed with other species of Orthotrichaceae, such as *O. exiguum* and *O. subpumilum*.

DESCRIPTION AND ILLUSTRATIONS: Lewinsky (1992).

HABITATS AND SUBSTRATES IN HUNAN: *Orthotrichum erubescens* was collected at a brook in

evergreen and deciduous hardwood forest (*Betula*, *Carpinus*, *Diospyros*, *Emmenopteris*, *Lonicera*, *Quercus*, *Rhamnus*, *Toona*), in a plantation of *Magnolia officinalis* subsp. *biloba* and *Tapiscia sinensis*, and on a roadside tree. All collection were from trunks of trees at 610–1370 m. Primevity index 1/0/1. Frequency in Hunan: very rare.

RANGE IN HUNAN: **Badagongshan**. 42. 50495, 55725. 42a. 61357 (mixed with *Orthotrichum jetteae*, *O. subpumilum*, and *Macromitrium japonicum*), 61374 (mixed with *Orthotrichum exiguum* and *O. subpumilum*). **Changsha**. Mts Yolu-schan, *Handel-Mazzetti 11540* (H-BR). **Huping-shan**. 65. 49785 (mixed with *O. subpumilum*). **Shunhuangshan**. 52b. 71161.

TOTAL RANGE: As 2: China (five provinces, Redfearn et al. 1996), Japan.

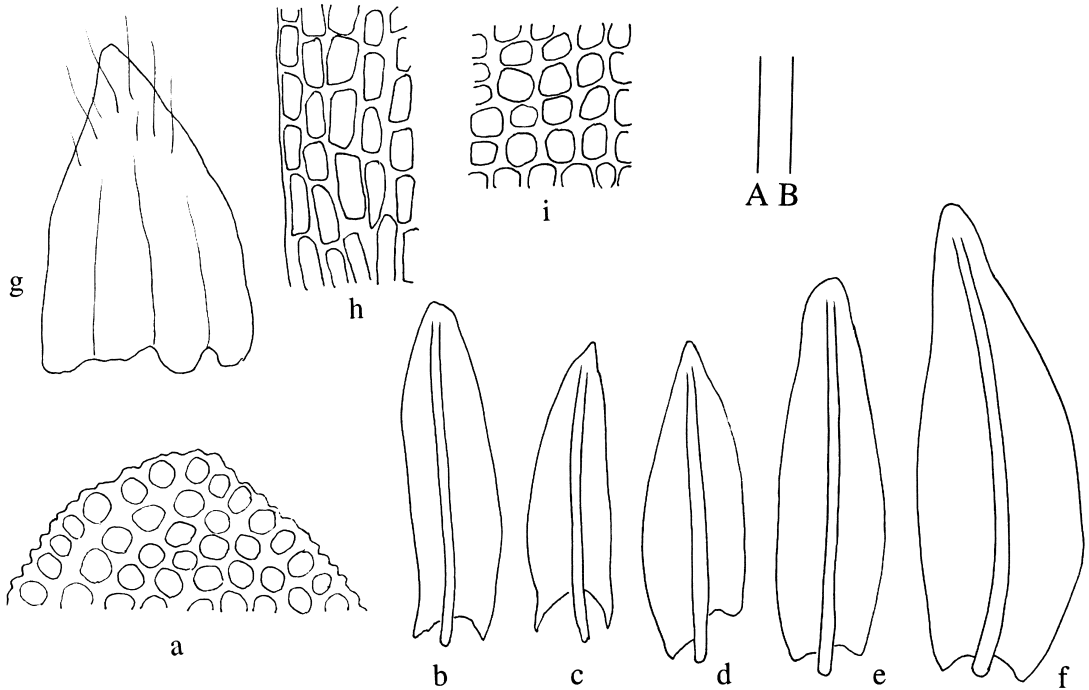
### *Orthotrichum exiguum* Sull. (Fig. 8)

Gray, Man. Bot. US, ed. 2: 633. 1858. — HOLOTYPE: USA. South Carolina, Santee Canal, *Ravenel* (FH!).

*Orthotrichum decurrens* Thér., Bull. Acad. Int. Geogr. Bot. 19: 19. 1909. — LECTOTYPE (designated by Lewinsky 1992): China. Pin-fa, sur arbres, *Cavalerie* (PC, not seen). — Synonymized by Lewinsky (1992).

*Orthotrichum szuchuanicum* Chen, Contr. Inst. Biol. Nat. Centr. Univ. Chungking 1: 7. 1943. — ISOTYPES: China. Prov. Szechuan, "Pe-pei prope Chungking, in medio monte Tsin-yun-shan, ad arborum truncos inprimis *Aleuritium Fordii*, *Pterocaryam rhoifoliarum* cum *Venturiella sinensi* associatum, fructibus maturis," 13.V.1940 P. C. Chen 5107 (JE, S-PA, not seen). — Synonymized by Lewinsky (1992).

Plants small, 3–10 mm long, dark-green, scattered or in loose tufts, clavate in appearance. Stems erect or ascending, sparsely leaved, not much branched. Stem leaves erect-appressed when dry, erect-spreading when moist, 0.6–1.2 × 0.2–0.3 mm, lower leaves much smaller than upper, upper leaves crowded, forming a clavate tip, oblong, obtuse to rounded-obtuse, decurrent, margins plane, upper half recurved; upper laminal cells somewhat obscure, thin-walled, 7–12  $\mu\text{m}$  wide; median cells hexagonal or quadrate, isodiametric, 10–13  $\mu\text{m}$  wide, strongly inflated and with 4–5 papillae over each lumen; basal cells irregularly rounded, papillose, bulging, giving margin a serrate appearance. Autoicous. Perichaetial leaves oblong, rounded-obtuse, costa prominent on dorsal side; laminal cells rectangular, thin-walled; costa ending below leaf apex, its cells mammillose or papillose on dorsal surface.



**Fig. 8.** *Orthotrichum exiguum* (from Koponen *et al.* 55708). — **a**: Apical leaf cells. — **b–f**: Leaves. — **g**: Calyptra. — **h**: Basal laminal cells near leaf margin. — **i**: Median laminal cells. Scales: A = 0.40 mm, use for **b–g**; B = 40  $\mu$ m, use for **a**, **h** and **i**.

Capsules slightly inclined, 8-furrowed when dry, globose,  $0.8 \times 0.65$  mm; stomata superficial, on apophysis. Operculum 0.35 mm long. Exostome teeth in 8 pairs, connate at apex, yellowish, lanceolate, acute, 0.2 mm long, reflexed when dry, finely papillose below, sparsely but coarsely papillose above; endostome segments 8, nearly as wide as exostome teeth, delicate, hyaline, granulate-papillose, with rounded apices. Spores 15–20  $\mu$ m, brown. Calyptra plicate, short-conic, often deeply cleft, 1 mm long, papillose on edges, with few hairs.

DESCRIPTIONS AND ILLUSTRATIONS: Vitt (1973b), Crum & Anderson (1981), Noguchi & Iwatsuki (1989), Lewinsky (1992).

*Orthotrichum exiguum* has rather unique characteristics in the genus. The plants are small and thin, not much branched, clavate in appearance, and the leaves have rectangular, thin-walled basal cells. It is especially distinct by its endostome, which is hyaline, delicate, with segments as wide as the exostome teeth, and with granulate papillae.

HABITATS AND SUBSTRATES IN HUNAN: *Orthotrichum exiguum* was found only in a single locality, in a plantation of *Magnolia officinalis* subsp. *biloba* and *Tapiscia sinensis*, at 1370 m. In 1998, a single collection was made, but in 2000, during a special study on the epiphytes on *Tapiscia sinensis*, it was found from many trunks.

RANGE IN HUNAN: **Badagongshan**. 42. 55708, on tree trunk at 1370 m. 42a. On trunk of *Tapiscia*, 61374 (mixed with *Orthotrichum erubescens* and *O. subpumilum*), 61371, 61387, 61398, 61417, 61425, 61429 (mixed with *Macromitrium japonicum*), 61435, 61456 (mixed with *O. subpumilum*), 64306, 64783, 64799 (mixed with *O. erubescens*), 64833, 64844 (mixed with *O. subpumilum*), 64982, 64987, 65000. Primevity index 0/0/1. Frequency in Hunan: very rare.

TOTAL RANGE: Am 1; As 2: China (Fujian, Guizhou, Jiangxi and Sichuan, Redfearn *et al.* 1996), Japan (Vitt 1973b, Lewinsky 1992).

### *Orthotrichum jetteae* Allen (Fig. 9)

Monogr. Syst. Bot. Missouri Bot. Garden 90: 639. 2002. — *Orthomitrium tuberculatum* Lewinsky-Haapasaari & Crosby, Novon 6: 1. 1996. (*non Orthotrichum tuberculatum* Mitt.

1869). — HOLOTYPE: China. Guizhou: Sui-yan Co., Kuan Kuo Shui Forest Reserve, Tai Yan Shan (Sun Summit) and vicinity, on tree, *Crosby 16040* (MO, not seen).

Plants in small loose tufts, up to 2 cm tall, soft, dark-brown below, olive-green above. Stems dichotomously branched, sometimes without leaves below, with a rather thick epidermis, no central strand. Rhizoids only present at extreme stem bases. Leaves loosely erect and erect-flexuose when dry, spreading when moist, varying in size, basal leaves smaller than apical ones, ovate-lanceolate or lanceolate to linear-lanceolate, acute or short acuminate, 4.5–7.2 × 0.8–1.8 mm, costa ending just below apex; leaf margins entire, plane in short leaves, somewhat undulate in longer leaves, strongly revolute almost entire length; basal cells elongate, rectangular or rhomboidal, with thick, often slightly porose walls, slightly pellucid, smooth, 26.5–70 × 6.5–11.5 μm, along basal leaf margins shorter, upper laminal cells irregularly rounded-quadrate, 10–19 μm, papillose, with 2–3 simple papillae per cell.

Gonioautoicous. Perichaetial leaves not markedly differentiated. Seta 0.7–1 mm long, smooth; vaginula hairy, with some smooth hairs. Capsules globose or ovoid when wet, 1.7 × 2.4 mm, immersed, gradually constricted to a very small mouth, smooth except mouth crinkled (or with very short furrows below mouth) when dry; exothecial cells immediately below mouth differentiated in eight stripes of thick-walled dark brown cells, usually four cells wide, alternating with eight paler stripes, often nine cells wide, further down cells are short-rectangular to quadrate, thick-walled; stomata immersed, numerous, in middle and upper part of capsule, ± 1/2 covered by subsidiary cells; exostome with 16 truncate teeth, sometimes partly united, hyaline, papillose, endostome segments not seen. Calyptra mitrate, smooth, with few smooth hairs on upper part. Spores multicellular, smooth, with a diameter up to 50 μm.

The genus *Orthomitrium* was established by Lewinsky-Haapasaari and Crosby (1996) to accommodate just one species, *O. tuberculatum*, from Guizhou, China. Shortly thereafter Tan and Jia (1997) described another species, *O. schofieldii*, from Qinghai-Tibetan plateau, China.

Allen (2002), however, synonymized *Orthomitrium* with *Orthotrichum* and gave *Orthomitrium tuberculatum* a new name due to an older blocking name in *Orthotrichum*.

The specimen of *Orthotrichum jetteae* cited below was reported previously in Guo et al. (2004) as *Orthomitrium tuberculatum*. It was mixed with *Orthotrichum erubescens*, *O. subpumlum*, and *Macromitrium japonicum*.

DESCRIPTIONS AND ILLUSTRATIONS: Lewinsky-Haapasaari & Crosby (1996, as *Orthomitrium tuberculatum*).

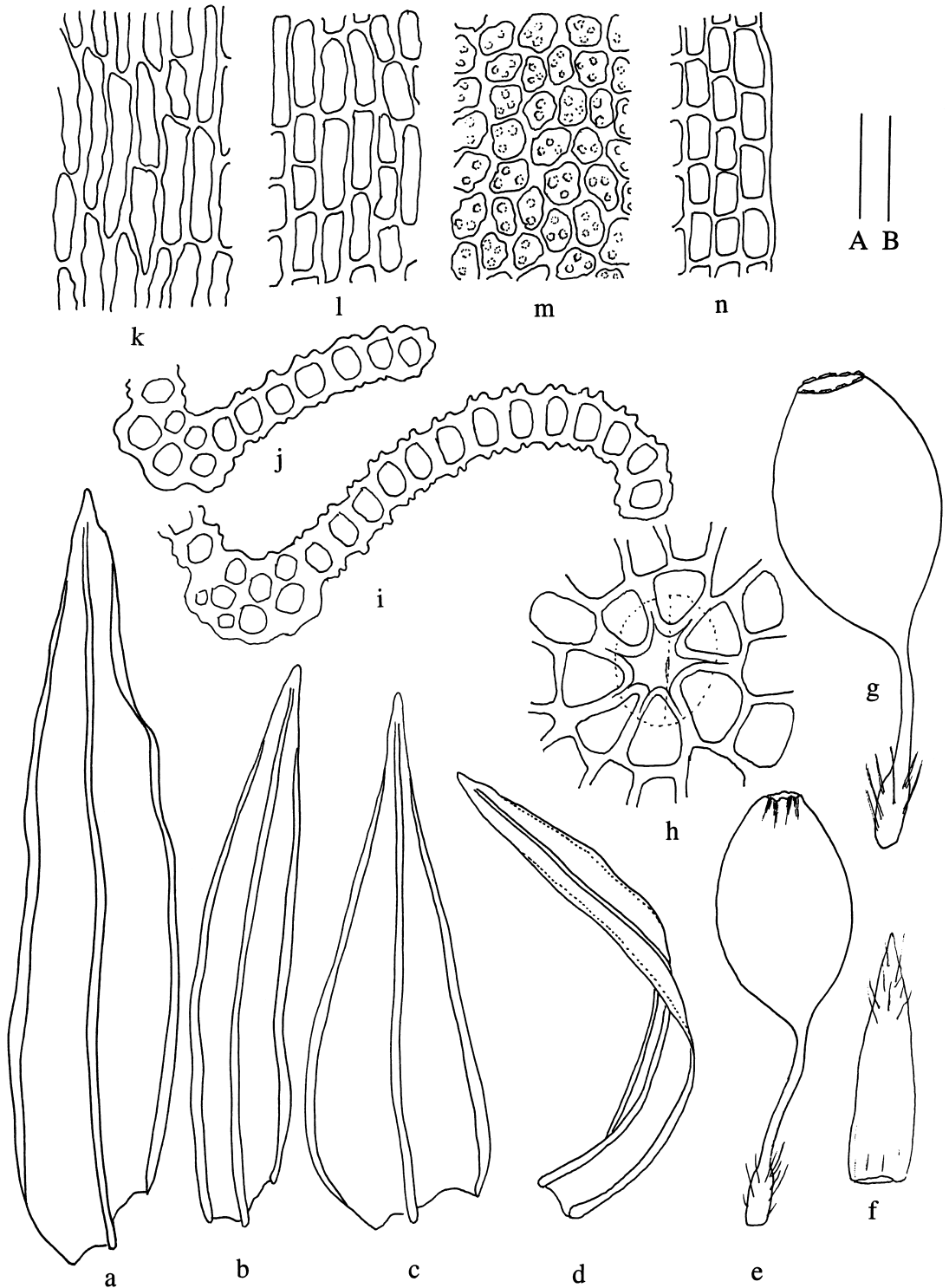
RANGE AND HABITAT IN HUNAN: **Badagongshan**. 42a. 61357, plantations of *Phellodendron chinense*, *Prerostyrax psillophyllum*, *Magnolia officinalis* subsp. *biloba*, and *Tapiscia sinensis*, on trunk of *Tapiscia sinensis*, at 1370 m. Primivity index 0/0/1. Frequency in Hunan: very rare.

TOTAL RANGE: Endemic to China, known from Guizhou and Hunan.

**\**Orthotrichum rupestre* Schleich. ex Schwaegr.**

Spec. Musc. Suppl. 1(2): 27, tab. 53. 1816. — LECTOTYPE (designated by Lewinsky 1983): Austria. "Pasterze in Carinthia alpibus, *Schwägrichen* s. n." (G, not seen).

Plants robust, up to 25 mm high, dark-brown to black below, dark-green above, stems branched, in loose tufts. Leaves stiff, erect-appressed when dry, spreading when moist, 2.2–3.5 mm long, elongate-lanceolate, lanceolate or ovate-lanceolate, acute; costa ending just below apex, margins entire, recurved-revolute to near apex, smooth; basal laminal cells yellowish, rectangular to elongate rhomboidal, with thick and porose walls, smooth, 20–60 × 5–12 μm, along leaf margins shorter, quadrate to short rectangular; upper leaf cells rounded quadrate to short elongate, ca. 8–9 μm wide, thick-walled, with 1–2 distinct simple papillae per cell. Gonioautoicous. Perichaetial leaves not differentiated. Capsules ovoid to ellipsoid with a wide mouth, immersed, furrowed in the upper half when dry, exothecial cells in the upper part differentiated into 8 darker yellow stripes, separated by 8 stripes of a paler colour. Stomata superficial in central parts of capsule. Peristome double, exostome of 8 pairs of teeth splitting to 16 when old, erect or spreading when dry, endostome 8 lanceolate segments, smooth. Spores globose,



**Fig. 9.** *Orthotrichum jetteae* (from Virtanen 61357). — a–d: Leaves. — e: Dry capsule. — f: Immature calyptra. — g: Wet capsule. — h: Immersed stoma. — i and j: Transverse sections through upper parts of leaf. — k: Juxtacostal basal laminal cells. — l: Basal laminal cells near leaf margins. — m: Upper laminal cells. — n: Basal laminal cells along leaf margins. Scales: A = 0.4 mm, use for a–g; B = 40  $\mu$ m, use for h–n.

roughly papillose, 20–25  $\mu\text{m}$ . Calyptra oblong-conic to conic, plicate, with yellowish hairs reaching over the top.

This is the first record of *O. rupestre* for Hunan. In China it has previously been reported from Inner Mongolia, Shaanxi, and Xizang (Redfearn et al. 1996). Two specimens of *O. rupestre* were collected from Hunan, but only 54814 has capsules and calyptrae. This is a variable species, the typical form, as Vitt (1973b) described, is characterized as follows: (1) plants much branched, in loose tufts, (2) leaves lanceolate, apex narrowly and bluntly acute, (3) basal laminar cells elongate, thick-walled, and nodose, yellowish in older leaves, (4) capsules immersed to emergent, 8-ribbed one-half the length when old and dry, (5) exostome of 16, coarsely papillose teeth, and (6) calyptrae with numerous papillose hairs. Though the specimen 54814 has immersed capsules, it still falls into the variation range of *O. rupestre*, as described by Vitt (1973b) and Lewinsky (1992).

*Orthotrichum rupestre* grows mostly on granitic rocks and boulders, but has been reported as epiphytic on trees and shrubs in Africa and Australasia (Lewinsky 1978, 1984), on several species of trees in South America (Lewinsky 1987), and from old trunks of *Sophora chrysophylla* in Hawaii (Lewinsky 1993b).

DESCRIPTIONS AND ILLUSTRATIONS: Lewinsky (1992), Vitt (1973b), Crum & Anderson (1981).

RANGE IN HUNAN: **Badagongshan**. 43. 54814, at trail in second-growth forest, on trunk of *Tapiscia sinensis*, at 1400 m. 54814. **Shunhuangshan**. S2b. 71159, on tree trunk by road, at 610 m. Primevity index 0/1/0. Frequency in Hunan: very rare.

TOTAL RANGE: Widely distributed in Europe, in America from Greenland and Alaska in north to Tierra del Fuego, northern Africa, Himalayas and China in Asia, Australia and New Zealand. Distribution map in Lewinsky (1993a).

### \**Orthotrichum subpumilum* Bartr. ex Lewinsky

J. Hattori Bot. Lab. 72: 59. 1992. — HOLOTYPE: China. Jiangxi Province, Kuling, Chang-Ko, *Chung 4038a* (FH!).

Plants small, densely tufted, up to 8 mm tall, brownish below, dark green above; stems scarcely branched, rhizoids abundant at base

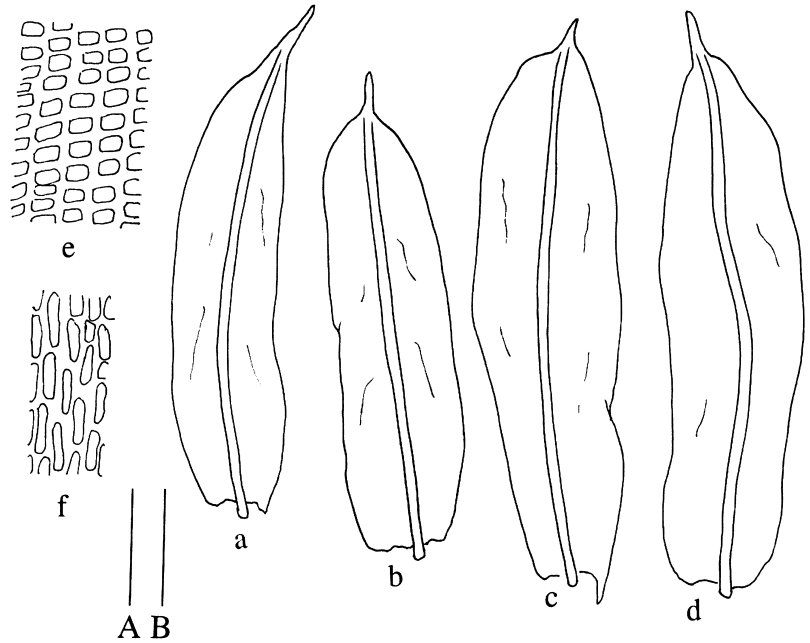
of stems; leaves erect and appressed when dry, lanceolate, narrow-lanceolate, acute or short-acuminate, 1.3–2.5  $\times$  0.25–0.50 mm, plane; costa ending below apex; margins entire, plane or slightly undulate; basal laminar cells short-rectangular or rhomboidal, thin-walled, smooth, 20–75  $\times$  7–15  $\mu\text{m}$ ; upper laminar cells rounded-quadrate to short-rectangular, 6–18  $\times$  6–15  $\mu\text{m}$ , with 1–2 simple, low papillae per cell. Gonioautoicous. Some perichaetial leaves different from stem leaves by their obtuse leaf apex. Capsule obloid-cylindric, emergent, strongly 8-furrowed in upper half and constricted beneath mouth when dry; exothecial cells differentiated into 8 yellow bands alternating with 8 pale bands; stomata immersed, slightly covered by subsidiary cells, in lower part of capsule; peristome double, exostome of 8 pairs of teeth, not splitting to 16 when dry, densely papillose near base, becoming striate near apex, endostome segments 8, hyaline, with a smooth outer layer. Spores globose, finely papillose, golden-brown, 17–22  $\mu\text{m}$  diameter. Calyptra conic-oblong, with numerous papillose hairs.

DESCRIPTION AND ILLUSTRATIONS: Lewinsky (1992).

*Orthotrichum subpumilum* has previously been reported from Jiangxi and Anhui Provinces in China. It is often mixed with *O. erubescens*, but can be separated by its acute or acuminate leaves. A special study on the epiphytes of *Tapiscia sinensis* showed that it may be locally common on trunks in primeval, disturbed, and man-made habitats at 610–1500 m.

RANGE AND SUBSTRATES IN HUNAN: **Badagongshan**. 42a 61357, plantation of *Magnolia officinalis* subsp. *biloba* and *Tapiscia sinensis*, on trunk of *Tapiscia*, at 1370 m, (mixed with *Orthotrichum jetteae*, *O. erubescens* and *Macromitrium japonicum*), 61358, 61374 (mixed with *Orthotrichum erubescens* and *O. exiguum*), 61456 (mixed with *O. exiguum*), 64844 (mixed with *O. exiguum*). 54. 54616, at peat bog, on trunk of *Liriodendron*, 1500 m. **Hupingshan**. 65. 49785, at brook in evergreen and deciduous hardwood forest (*Betula*, *Carpinus*, *Diospyros*, *Emmenopteris*, *Lonicera*, *Quercus*, *Rhamnus*, *Toona*), on tree trunk, at 1150 m (mixed with *Orthotrichum erubescens*). **Shunhuangshan**. S2b. 71162, on tree trunk by road, at 610 m. Primevity index 1/1/1. Frequency in Hunan: rare.

TOTAL RANGE: Endemic to China, known from Anhui, Hunan (new) and Jiangsi (Redfearn et al. 1996).



**Fig. 10.** *Schlotheimia grevilleana* (from Koponen *et al.* 53373). — **a–d**: Branch leaves. — **e**: Median laminal cells. — **f**: Basal laminal cells. Scales: A = 0.40 mm, use for **a–d**; B = 20  $\mu$ m, use for **e** and **f**.

### \*Genus *Schlotheimia* Brid.

*Schlotheimia* can be recognized by the chestnut-brown color of the plants, well-developed peristome, and long-campanulate, non-plicate calyptrae that have 4–5 broad basal lobes (cf. Vitt *et al.* 1992).

Vitt (1989) revised the genus for Australia and New Zealand, and Vitt *et al.* (1992) for Western Melanesia. Koponen and Enroth (1992) revised the genus for China, recognizing three species. However, they omitted a fourth species, *Schlotheimia rubiginosa* (Müll. Hal.) D.H. Vitt (1972), *hom. illeg.* One species occurs in Hunan province.

### \**Schlotheimia grevilleana* Mitt. (Fig. 10)

J. Proc. Linn. Soc. Bot. Suppl. 1: 53. 1859 (“*Grevilleana*”). — LECTOTYPE (designated by D. H. Vitt in herb. and Koponen & Enroth 1992): India. “In mont. Nilghiri, *Gardner 32*” (NY!). SYNTYPE: India. “In mont. Khasian. In sylvis Myrung ad terram”, *Griffith* (not seen).

*Schlotheimia fauriei* Card., Bot. Centralbl. 19(2): 106, fig. 9. 1905 (“*Fauriei*”). — ISOTYPE: China (Taiwan). Formosa: Kelung, 1903 *Faurie 95*, *in parte* (H-BR!). — Synonymized by Koponen & Enroth (1992).

*Schlotheimia calycina* Broth. & Par., Rev. Bryol. 34:

30. 1907. — LECTOTYPE (here designated): Vietnam. Annam: Langbian, ad *Pinus* u. *Dipterocarpus*, 1906 *Eberhardt 432* (H-BR!). — Synonymized by Koponen & Enroth (1992).

*Schlotheimia latifolia* Card. & Thér. in Thér., Bull. Acad. Int. Geogr. Bot. 18: 250. 1908. — SYNTYPE: Japan. Iles Liu Kiu, Naze, 1899 *Ferrié* (H-BR!). — Synonymized by Koponen & Enroth (1992).

*Schlotheimia japonica* Besch. & Card. in Card., Bull. Herb. Boiss. sér. 2, 8: 336. 1908. — SYNTYPES: Japan. Fusi-yama”, *Faurie 339*; Komagatake, rochers, a 1000 m, *Faurie 3400*; Koyasan, *Faurie 3663, 3668, 3689* (H-BR!); Tosa: Yanase, 1905 *Okamura 177, 180* (H-BR!). — Synonymized by Koponen & Enroth (1992).

Plants in dense tufts, reddish-brown below, dark-brown to lustrous above. Stems elongate creeping, sparsely leaved; branches numerous, erect, simple, rarely with few branchlets, densely leaved, obtuse at apex. Stem leaves appressed, yellowish-brown, lanceolate, to 1 mm long, costa stout. Branch leaves crowded, spirally twisted when dry, widely spreading when moist, oblong or oblong-ovate, 1.8–2.2  $\times$  0.5–0.7 mm, mostly obtuse and short-cuspidate, with percurrent to short excurrent costae, cusps ca. 80(–160)  $\mu$ m long; margins plane and entire. Median laminal cells rectangular, with strongly incrassate walls, 9–12  $\mu$ m long, towards leaf margins and apex somewhat shorter, in diagonal rows; apical cells

elliptic, in diagonal rows, basal cells elongate, rectangular or sublinear, walls porose; alar cells not differentiated. Inner perichaetial leaves similar to upper branch leaves, to 2.5 mm long. Seta 2.5–7 mm long. Capsules erect, cylindric, dark-brown, distinctly sulcate when dry, 1.5–2.3 mm long. Exostome teeth 16, not paired, recurved when dry, lingulate, rounded-obtuse, to 0.35 mm long, densely papillose; basal membrane of endostome low, segments linear, as long as exostome teeth. Spores 23–30  $\mu\text{m}$  diameter, densely papillose. Calyptra elongate-mitrate, lobate at base, naked, smooth, scabrous at apex.

DESCRIPTION AND ILLUSTRATIONS: Noguchi & Iwatsuki (1989, as *Schlotheimia japonica*), Koponen & Enroth (1992).

Since *Schlotheimia calycina* Broth. & Par. has two authors and supposedly two type specimens exist, we designate the lectotype here.

The genus *Schlotheimia* is new to Hunan. The Hunan specimens of *S. grevilleana* have a slightly longer leaf awn than reported in the literature, some being up to 160  $\mu\text{m}$  long, but the leaf apices are obtuse.

HABITATS AND SUBSTRATES IN HUNAN: *Schlotheimia grevilleana* was collected both in primeval mixed hardwood forests and disturbed forests and it can survive in man-made habitats. All collections came from warm-temperate habitats, at 330–1250 m. On tree trunks (8 specimens), *Altingia chinensis* (1), *Microlepis* (1), cliffs or cock outcrops (6). Primevity index 3/5/2. Frequency in Hunan: rare.

RANGE IN HUNAN: **Mangshan.** 4b. 51145, 51450, 51531, 51685, 51686. 6. 51465. 7b. 50728, 50729. 7d. 50717. 9a. 49530. 10c. 51035. **Wulingyuan.** 16d. 53373. **Yuankou.** 74d. 59871, 59862. 75a. 59372, 59386. 78a. 59651.

TOTAL RANGE: As 2: China (11 provinces, Redfearn *et al.* 1996), Japan; As 3: Sri Lanka, South India, Assam; As 4: Indonesia (Java), Philippines; Afr 2 (O'Shea 1995).

## Genus *Ulota* Mohr

The genus *Ulota* differs from the other genera of the Orthotrichaceae by erect tufts, crisped leaves, differentiated basal leaf margin cells, smooth or slightly papillose leaf cells, and the calyptra, which is densely hairy throughout.

Five species of *Ulota* have been reported from China (Redfearn *et al.* 1996). Among them, *Ulota bellissima* and *U. eurystoma* have almost round or triangular capsules, and *U. gymnostoma* has gymnostomous capsules, so capsule-bearing *U. crispa* can be easily separated from these three species. *Ulota morrisonensis* is known only from Taiwan (Redfearn *et al.* 1996).

The genus was revised for Western Melanesia by Vitt *et al.* (1992). Two species of *Ulota* occur in Hunan.

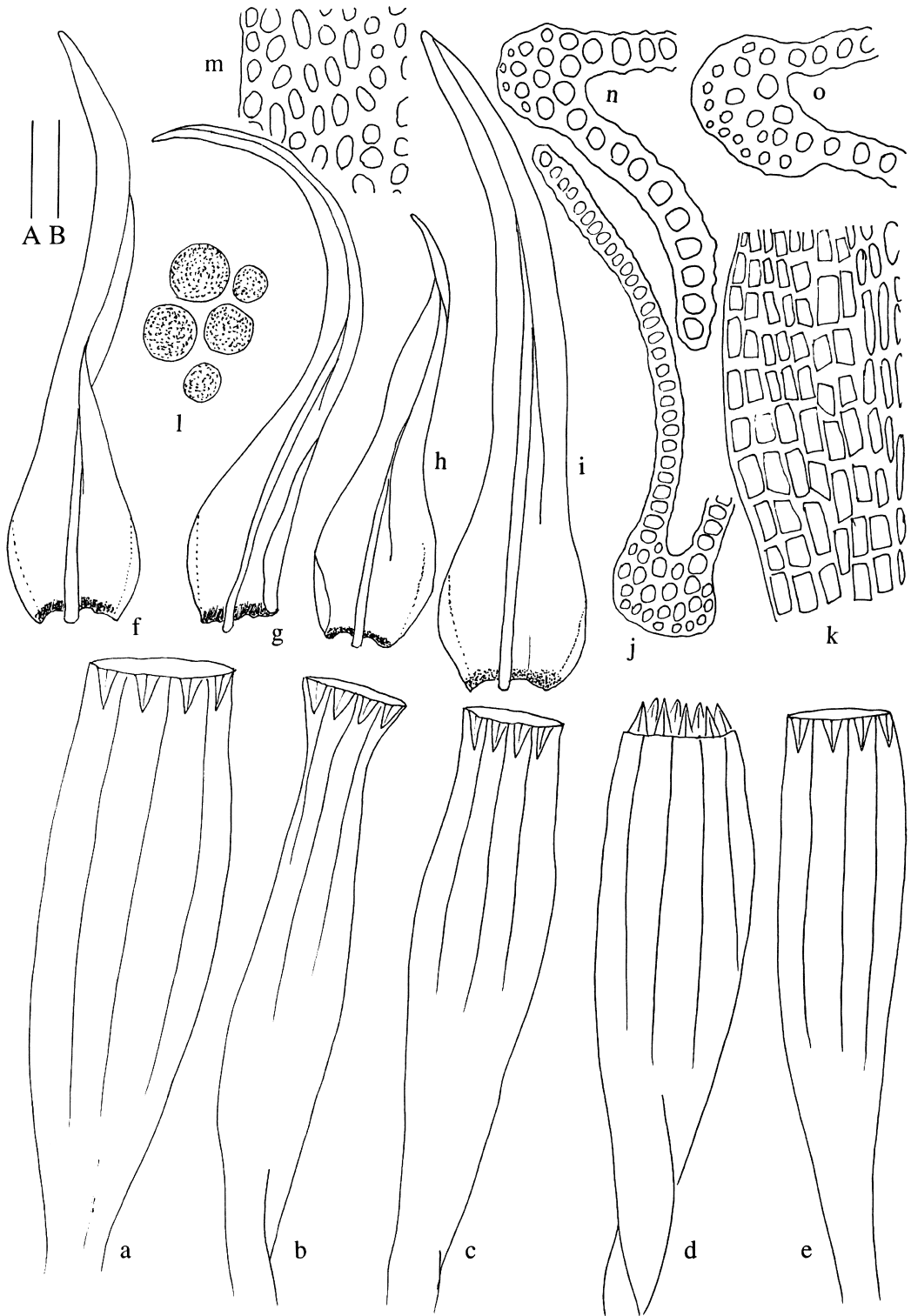
## *Ulota crispa* (Hedw.) Brid. (Fig. 11)

Musc. Recent. Suppl. 4: 112. 1819. — *Orthotrichum crispum* Hedw., Spec. Musc.: 162. 1801. — Type material in G (not seen; cf. Price 2005).

*Ulota macrocarpa* Broth., Symb. Sin. 4: 70. 1929, *syn. nov.* — LECTOTYPE (designated by Guo *et al.* 2004): China. Hunan: Prope urbem Wukang, in silva frondosa elata umbrosa montis Yün-Schan, ad arbores, 1200–1300 m, 8.VIII.1917 *Handel-Mazzetti* 11191 (H-BR!).

Plants small, up to 10–15 mm high, green, yellow-green. Leaves strongly crisped when dry, erect-spreading when moist, 2–8.5  $\times$  0.4–0.6 mm, linear-lanceolate from an ovate or rounded, concave base, contracted above shoulder, margins entire, plane or sometimes slightly and irregularly recurved above, incurved below. Median laminal cells pellucid, rounded or rounded-hexagonal, 5–7  $\mu\text{m}$  wide, 1–2 papillae per cell, toward leaf margins becoming smaller; inner basal laminal cells sublinear to narrowly rectangular, often orange, 35–45  $\times$  5–7  $\mu\text{m}$ , cell walls thick, slightly sinuous; laminal cells at basal angles in 3–10 rows differentiated, often hyaline, with thin longitudinal walls; in some leaves basal differentiated border not easily observed due to incurved leaf margin. Perichaetial leaves shorter than stem leaves. Setae 1–1.5 mm long. Capsules 2.5–3  $\times$  0.7–1.2 mm including apophysis, yellow or yellow-brown, obloid-cylindric from a long, tapered neck, strongly contracted to not contracted beneath mouth, gradually to abruptly constricted to neck when dry, often strongly 8-ribbed; exostome teeth yellowish, united in 8 pairs, erect to reflexed when dry; endostome segments 8, shorter than exostome teeth. Spores 18–32  $\mu\text{m}$  diameter, finely to coarsely papillose.





**Fig. 11.** *Uloa crispera* (a from lectotype of *Uloa macrocarpa*, b–m from Virtanen 61351). — a–e: Capsules when dry. — f–i: Leaves when wet. — j, n and o: Transverse sections of leaf. — k: Basal laminal cells near leaf margins. — l: Spores. — m: Median laminal cells. Scales: A = 0.40 mm, use for a–i; B = 40  $\mu$ m, use for j–o.

Calyptra mitrate, densely covered by yellowish hairs.

Brotherus (1929) gave a detailed description in the protologue of *U. macrocarpa* and pointed out that *U. macrocarpa* was similar to *U. robusta*. Gametophytically, *U. macrocarpa* is characterized by its slightly differentiated basal marginal cells, but they are often very similar in *U. crispa*. The capsules of *U. macrocarpa* are slightly larger, bulgy and strongly 8-ribbed, not contracted at or beneath the mouth. Having checked 54 *Ulot*a specimens collected from Hunan, we found that the capsules of *U. crispa* vary much, from pale-yellow to brown, from being strongly contracted under the mouth to only slightly so or not contracted at all, from distinctly 8-ribbed to slightly or nearly not ribbed. Also, the spores vary from 18 to 32  $\mu\text{m}$  in diameter. Much variation also exists during the different development stages of the capsules. A comparatively high degree of variation was found also in the European populations of *U. crispa* by Hill and Smith (1976). *Ulot*a *macrocarpa* has short, somewhat urn-shaped capsules, which are similar to those present in North American *U. crispa*. We conclude that *U. macrocarpa* is a taxonomic synonym of *U. crispa*.

*Ulot*a *crispa* varies greatly in capsule shape, median and upper laminal cells, and the leaf basal hyaline bands. Its capsules vary from oblong-cylindric, fusiform, oblong to urn-shaped (Crum & Anderson 1981), but the Hunanese specimens usually have oblong-cylindric capsules. The median and upper laminal cells are often papillose, but the Hunanese and some Japanese specimens have smooth laminal cells. Iwatsuki (1959) noted that the wide basal hyaline bands in the leaves are distinct in Japanese species of *Ulot*a, but the Hunan specimens vary greatly in this character, the basal hyaline bands being usually wide in the leaves with plane basal margins, and narrow in the leaves with slightly recurved basal margins.

DESCRIPTIONS AND ILLUSTRATIONS: Crum & Anderson (1981), Noguchi & Iwatsuki (1989).

HABITATS AND SUBSTRATES IN HUNAN: Two of the primeval sites of *Ulot*a *crispa* were evergreen hardwood forests with species of Lauraceae and Fagaceae and the third locality was mixed ever-

green and deciduous (*Acer*, *Populus*, *Tilia*) forest on the peak area of Mt. Hupingshan. Disturbed sites were second-growth forests and old plantation forests. Man-made sites were young plantations of trees such as *Phellodendron chinensis*, *Tapiscia sinensis* and *Metasequoia*, and road side trees. It grows at 745–1800 m. Special study on the epiphytes of plantations showed *Ulot*a *crispa* to be locally common in such sites. It is exclusively epiphytic: tree trunk (5 specimens), on branch (2), fallen trunk (2), on stump (1), on *Albizzia* (1), *Alniphyllum* (1), *Liriodendron* (2), *Metasequoia* (6), *Phellodendron chinensis* (9) *Prunus wilsonii* (1), *Pterostyrax psilophylla* (17), and *Tapiscia* (3). Primevity index 4/8/3. Frequency in Hunan: rather rare.

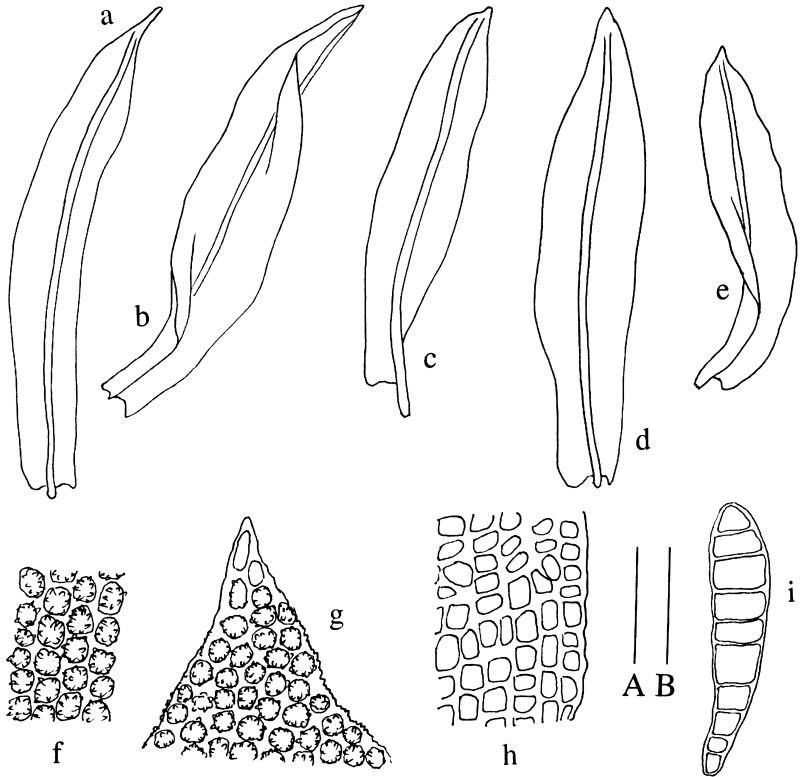
RANGE IN HUNAN: **Badagongshan**. 42. 50495, 55711. 42a. 59088, 59091, 59106, 61434 (mixed with *Macrocoma tenue* ssp. *sullivanii* and others), 61419, 61383. 43. 54782. 47. 54537. 48. 50035. 49b. 64888, 64897, 64898, 64902, 64905, 64909, 64920, 64921, 64925, 64926, 64934, 65054 (mixed with *U. gymnostoma*), 61312, 61322, 61329, 61340, 61351. 51. 50385 (mixed with *U. gymnostoma*), 54. 54616. 55d. 58719, 58766 (mixed with *Glyphomitrium* sp.). 86b. 58630, 65024, 65034, 65135, 61268, 61285, 61292. 87. 58929, 61236, 61250, 61254, 61259, 64611, 64625. 90b. 64714, 64731. 92. 61538, 61552, 61557. **Daweishan**. DAW23. 61673. **Hupingshan**. 69. 54087. **Mangshan**. 14b. 49488. **Taoyuandong**. 21a. 55104. 27. 55238 (mixed with *U. gymnostoma*). 32. 57173. **Yunshan**. Y1. 70268. Y2. 70007. *Handel-Mazzetti 11191* (H-BR 4335 024).

TOTAL RANGE: Am 1, Eur, As 2: China (seven provinces, Redfearn et al. 1996), Japan (Noguchi & Iwatsuki 1989).

### *Ulot*a *gymnostoma* S.L. Guo, Enroth & Virtanen

Ann. Bot. Fennici 41: 459, figs. 1–2. 2004. — HOLOTYPE: China. Hunan, Changsha Area, Liu Yang Co., Daweishan National Forest Park, along road from Lu-Yuan hotel towards Tian-Xing Hu, 25°25'N, 114°07'30"E, ca. 1400 m, on trunk of *Prunus persica*, mixed with *Giraldiella levieri* and *Ulot*a *crispa*, 20.IX.2000 62091 (H1)

*Ulot*a *gymnostoma* is rather similar to *U. crispa* both in gametophyte characters and in the ecological distribution. Gametophytically *U. gymnostoma* is somewhat different from *U. crispa* by its recurved or broadly recurved leaf base with narrow hyaline differentiated band. The major difference between the species is the lack of peristome in *U. gymnostoma*.



**Fig. 12.** *Zygodon rupestris* (from Koponen *et al.* 55612). — **a–e**: Leaves. — **f**: Upper laminal cells. — **g**: Leaf apex. — **h**: Basal laminal cells near leaf margins. — **i**: Gemma. Scales: A = 0.40 mm, use for **a–e**; B = 40  $\mu$ m, use for **f–i**.

**HABITATS AND SUBSTRATES IN HUNAN:** *Ulota gymnostoma* was collected in second-growth evergreen hardwood forests and in plantations of *Alniphyllum*, *Liriodendron*, *Metasequoia*, and *Phellodendron*, and *Magnolia officinalis* subsp. *biloba* and *Tapiscia sinensis* both in temperate and warm-temperate zones. It is epiphytic on trees: tree trunk (3 specimens), *Alniphyllum* (1), *Liriodendron* (3), *Metasequoia* (1), *Prunus persica* (1), and *Pterostyrax psilophylla* (3), at 1350–1450 m. Primevity index 0/2/3. Frequency in Hunan: rare.

**RANGE IN HUNAN:** **Badagongshan.** 42. 55711. 43. 54771. 49. 48788. 49b. 64910, 64915, 65045. 55d. 58746. 86b. 65085. 90b. 64679, 64718, 61658. **Daweishan.** DAW24b. 62091. **Yunshan.** *Handel-Mazzetti* 12162 (H-BR 4335 028).

**TOTAL RANGE:** Endemic to China, known only from Hunan Province.

### \*Genus *Zygodon* Hook. & Tayl.

The genus *Zygodon* was revised worldwide by Malta (1926). It is separated from the other genera of the family Orthotrichaceae by the

combination of erect to ascending stems, presence of septate gemmae in leaf axils (not on leaves), and a cucullate, non-plicate calyptra (Vitt 1982). Five species have been reported from China (Redfearn *et al.* 1996), one of which was found in Hunan.

### \**Zygodon rupestris* Schimp. ex Lor. (Fig. 12)

Bryol. Notizb. 32. 1865. — **LECTOTYPE** (designated by Karttunen 1984): Austria. “Tirolis silvatica alpina pr. Windismatrej, rupes valde adumbratae 34–3600’S”, 1862 *Molendo* = Rabenhorst, Bryoth. Eur. 626 (M 103-83/14, Herb. P. G. Lorentz; not seen)

*Zygodon viridissimus* (Dicks.) Brid. var. *rupestris* Lindb. ex C. Hartm., Handb. Skand. Fl., ed. 8: 382. 1861. — **LECTOTYPE** (designated by Karttunen 1984): Sweden. Dalsland, Lilla Strand i Fröskog, I.1858 *N. C. Kindberg* (H-SOL!).

Plants minute, up to 7–8 mm high, bright-green, with little tomentum, in dense tufts, stems simple. Gemmae axillary, fusiform, brownish, horizontally septate, 3–6-celled. Leaves loosely appressed or somewhat contorted when dry, wide-

spreading and plane when moist,  $1-2 \times 0.15-0.30$  mm, oblong to oblong-lanceolate, apices acute to acuminate, ending in a rather long, clear cell. Distal leaves larger than proximal, margins entire. Costa stout, extending to below leaf apex, prominent at back, papillose. Upper and median laminal cells rounded or rounded-hexagonal,  $10-12 \mu\text{m}$ , more or less obscure, rather coarsely pluripapillose on both surfaces, papillae 5–8 per cell, marginal cells smaller. Basal laminal cells rectangular or subquadrate,  $10-48 \times 6.5-10 \mu\text{m}$ , thin-walled, smooth, hyaline. Dioicous. Sporophytes not seen.

DESCRIPTION AND ILLUSTRATIONS: Crum & Anderson (1981).

*Zygodon rupestris* is new to China. It has been treated as a species, subspecies, or variety by different authors (for details, see Karttunen 1984). *Zygodon viridissimus* differs from *Z. rupestris* by its leaves ending in a longer apiculus, and gemmae with horizontal rather than vertical divisions. The former has been reported from Inner Mongolia, Sichuan and Taiwan.

RANGE AND HABITAT IN HUNAN: **Badagongshan**. 40a. 55612, dry deciduous-evergreen forest (*Acer davidii*, *Cyclobalanopsis multinervis*, *Dendrobenthamia japonica*, *Liquidambar acalycina*, *Tetracentron sinense*) on slope, on cliff, 1230–1340 m. Primevity index: 1/0/0. Frequency in Hunan: Very rare.

TOTAL RANGE: Eur; As 2: China (Hunan); Am 1 (Crum & Anderson 1981).

## Doubtful record

### *Macromitrium prolongatum* Mitt.

Trans. Linn. Soc. Bot. London ser. 2(3): 162. 1891. — HOLOTYPE: Japan. Kanagawa Pref., Mt. Kintoki, Bisset (NY, not seen).

*Macromitrium brachycladulum* Broth. & Par. ex Broth. in Engler & Prantl, Nat. Pflanzenfam. 1(3): 1202. 1909. — SYNTYPES: Japan. Ins. Shikoku, Tsurugizan, 1400 m alt., VI.1900 *Faurie 1024* (H-BR, ex Herb. E. G. Paris!); Hondo merid., Fusiyaama, 10.VI.1900 *Faurie 313* (H-BR, ex Herb. E. G. Paris!). — Synonymized by Noguchi (1958).

Brotherus (1929) recorded *Macromitrium brachycladulum* for China as follows: “SW-Y.: An *Lithocarpus*-Stämmen in der wtp. St. des

Yün-schan bei Wukang. 1190 m, c. sp. (12261, H-BR).” The information “SW-Y” (southwest Yunnan) is editor’s (H. Handel-Mazzetti) error, because the locality is actually Mt. Yunshan near Wukang in Hunan Province. Redfearn *et al.* (1996) placed Brotherus’ (1929) record in Yunnan, and the error was not noticed by Rao *et al.* (1997). The label of the specimen gives the province correctly “Hunan austro-occ.”.

Noguchi (1958) thought *Macromitrium brachycladulum* is a *nomen nudum*, and after studying authentic specimens determined by Brotherus he synonymized it with *M. prolongatum*. However, he did not cite the specimens he saw. We can confirm Noguchi’s synonymization. The specimen *Handel-Mazzetti 12261* has no sporophytes and cannot be identified with certainty. Most probably it is *Macromitrium ferriei*.

## New combination

*Schlotheimia vittii* S.L. Guo, Enroth & T.J. Kop., *nom. nov.*

*Schlotheimia rubiginosa* (Müll. Hal.) D.H. Vitt, Canadian J. Bot. 50: 1193. 1972, *hom. illeg.*, non *S. rubiginosa* Wright in Staph., Trans. Linn. Soc. London Bot. Ser. 2(4): 257. 1894. — *Drummondia rubiginosa* Müll. Hal., Nuovo Giorn. Bot. Ital. n. ser. 3: 106. 1896. — TYPE: China. “Prov. Schen-si, in medio monte Kuan-tou-san, XII. Inter alios muscos perpauca frustula”, *Giraldi* (not seen).

## Discussion

### Distribution groups

We group the Hunanese taxa of the Orthotrichaceae into distribution elements according to their altitudinal distribution in Hunan (Figs. 13–15) and general distribution. The rationale for these groups was explained in our previous papers (Koponen *et al.* 2004, Potemkin *et al.* 2004, Ignatov *et al.* 2005, Váña *et al.* 2005).

Holarctic, continuously or discontinuously boreal to temperate element

*Ulota crispa*

*Zygodon rupestris*

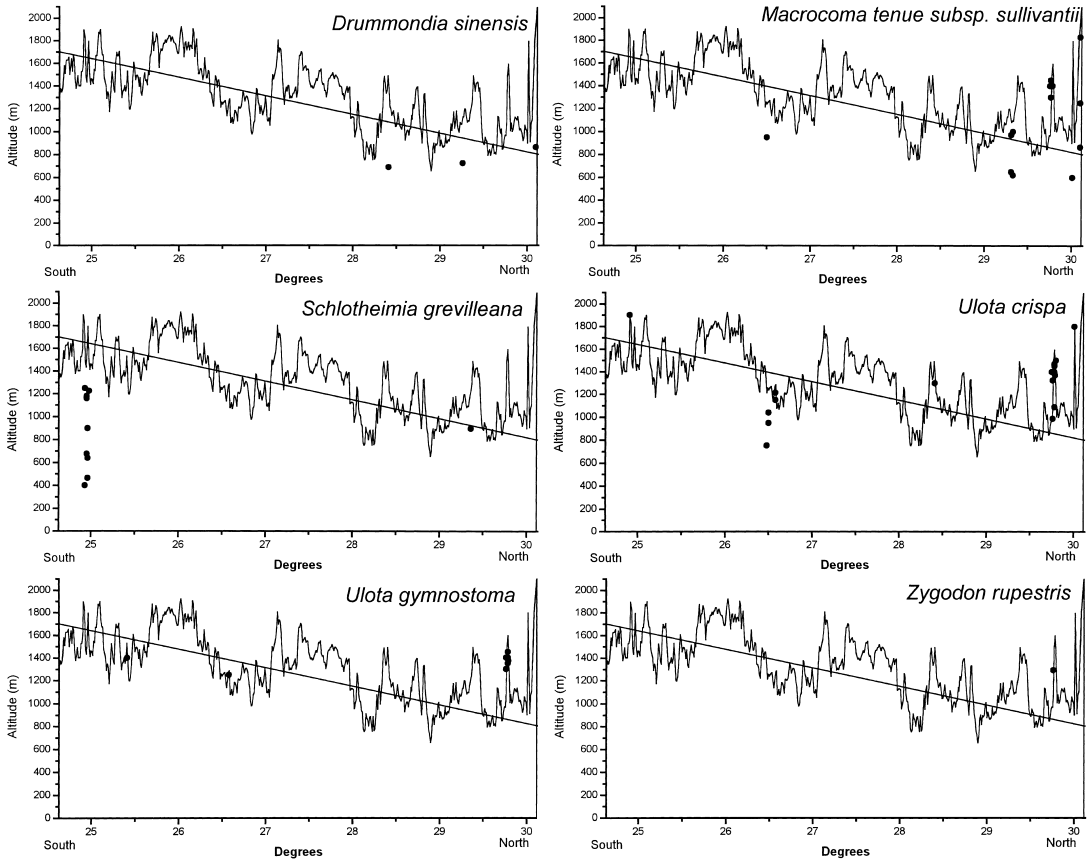


Fig. 13. The altitudinal distribution in Hunan of the species in the genera *Drummondia*, *Macrocoma*, *Schlotheimia*, *Uloa* and *Zygodon*.

Temperate–bipolar element  
*Orthotrichum rupestre*

Temperate–pan-subtropical element  
*Macromitrium tenue* subsp. *sullivantii*

Southeast Asian temperate to warm-temperate element

*Drummondia sinensis*  
*Orthotrichum consobrinum*  
*O. erubescens*  
*Macromitrium ferriei*  
*M. gymnostomum*  
*M. japonicum*

Endemic to China

*Orthotrichum jetteae*  
*O. subpumilum*  
*Macromitrium handelii*  
*M. syntrichophyllum*

*Uloa gymnostoma*

East Asia–eastern North America disjunction  
*Orthotrichum exiguum*

East Asia–Africa disjunction  
*Schlotheimia grevilleana*

### Frequency and human influence

In Table 1, the Orthotrichaceae taxa are grouped according to their occurrence in three site classes — primeval, disturbed and man-made sites — and according to their frequencies. Seven species are very rare (Group 1). Four of them were not collected in man-made habitats, but two of them only in habitats of this site class. The eight species of Group 2 are rare in Hunan. Two of them were not recorded in man-made habitats,

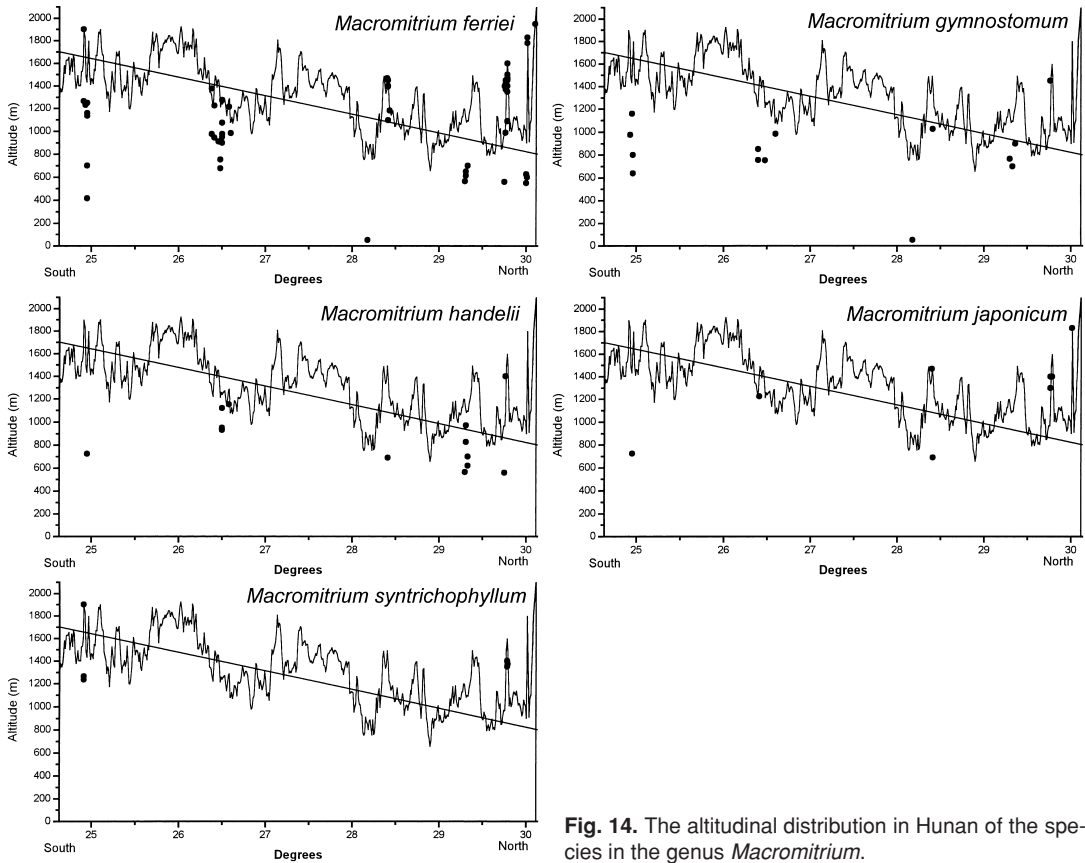


Fig. 14. The altitudinal distribution in Hunan of the species in the genus *Macromitrium*.

but nearly all of them are variously present in primeval and disturbed sites. *Macromitrium ferriei* (Group 3) is the single moderately common species in Hunan, and it is rather common in primeval sites.

Although the Orthotrichaceae taxa are rare in the present sampling, they seem to inhabit primeval forests as well as disturbed sites, and many of them survive in man-made habitats, such as plantations of trees in garden areas and on road-side trees.

### Conservation of bryophytes in Hunan

In our previous studies (Koponen *et al.* 2004, Potemkin *et al.* 2004, Ignatov *et al.* 2005) we showed that part of the taxa were lacking in man-made habitats, and many taxa were rarer in disturbed sites than in primeval sites. The spe-

cies of Orthotrichaceae seem to be similar to the soil-inhabiting small-sized plants of the hepatic families Jungermanniaceae and Gymnomitriaceae (Váňa *et al.* 2005), which are approximately equally present in all three site classes. This is probably due to their substrate ecology. The Orthotrichaceae are epiphytic on trunks of trees. Only three of the taxa were found also on cliffs. It seems not to matter whether the phorophyte grows in primeval forest, in second-growth forest, in plantation or by road side. Some of the taxa grow on rather young trunks of planted trees, such as on *Tapiscia sinensis*. However, we emphasize that only few of these taxa can survive in habitats where their main substrate, trunks of trees, are absent.

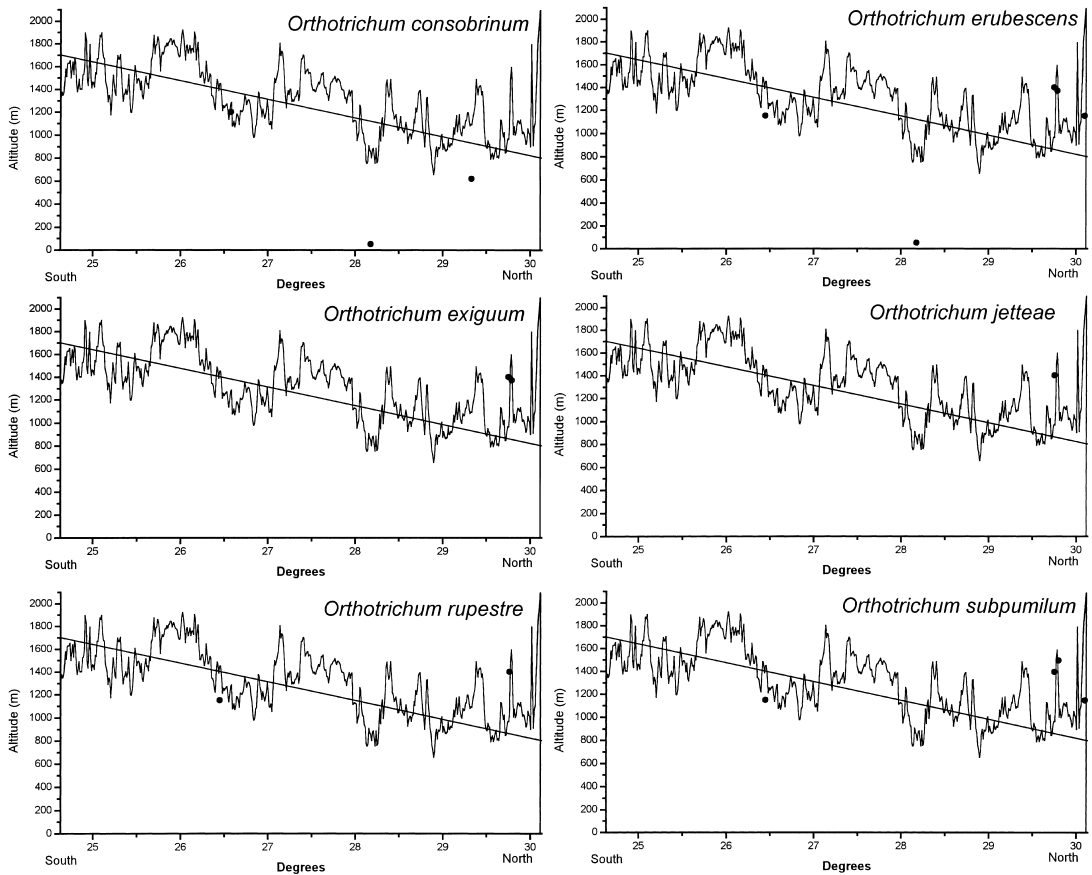


Fig. 15. The altitudinal distribution in Hunan of the species in the genus *Orthotrichum*.

**Table 1.** The Orthotrichaceae taxa arranged according to their frequency and the human influence of the habitats. 1 = ± primeval forests (45 sites). 2 = disturbed or secondary forest (66 sites). 3 = man made habitats (36 sites). The frequency is counted for each of these habitats. 4 = total frequency in Hunan (146 sites). Frequency classes: rr = very rare, r = rare, st r = rather rare, p = moderately common, st fq = rather common. Substrates. c = cliff, stone. e = epiphyte. w = rotten wood. s = soil. i = indifferent.

	1	2	3	4	Substrates
<i>Zygodon viridissimus</i> subsp. <i>rupestris</i>	r	—	—	rr	c
<i>Orthotrichum rupestre</i>	—	rr	—	rr	e
<i>O. consobrinum</i>	—	rr	—	rr	e
<i>Drummondia sinensis</i>	r	rr	—	rr	e
<i>Orthotrichum jetteae</i>	—	—	r	rr	e
<i>O. erubescens</i>	r	—	r	rr	e
<i>O. exicum</i>	—	—	r	rr	e
<i>Schlotheimia grevilleana</i>	r	r	r	r	e, c
<i>Macromitrium gymnostomum</i>	r	st r	—	r	e, c
<i>Uloa gymnostoma</i>	—	r	r	r	e
<i>Orthotrichum subpumilum</i>	r	rr	r	r	e
<i>Macromitrium japonicum</i>	r	rr	r	r	e
<i>M. syntrichophyllum</i>	r	r	r	r	e
<i>M. handelii</i>	r	st r	r	r	e
<i>Macrocma tenue</i> subsp. <i>sullivantii</i>	r	st r	r	r	e
<i>Uloa crispa</i>	r	st r	r	st r	e
<i>Macromitrium ferriei</i>	st fq	st fq	st r	p	e, c

## Acknowledgements

This research on the bryoflora of Hunan is being done in cooperation with the Forest Department of Hunan Province and its Forest Botanical Garden, and the Division of Systematic Biology, Department of Biological and Environmental Sciences, and the Botanical Museum, University of Helsinki. The project was a part of the project “The biodiversity of tropical southeast Asiatic bryoflora”, lead by Timo Koponen, which was one of the projects of the Finnish Biodiversity Research Programme 1997-2000 (2002) (FIBRE). The Academy of Finland Fellowships nos. 34229, 40867, 10134229, and 153706 are cordially acknowledged. The first author gratefully acknowledges the support from the State Scholarship Fund of China for his visit to the University of Helsinki in 2003–2004, a scholarship from the Finnish-Chinese Botanical Foundation, the National Nature Science Foundation of China (no. 30570121), and the Scientific Research Foundation for the Returned Overseas Chinese Scholars, State Education Ministry, and also thanks Teuvo Ahti, Xiao-lan He, Juhani Heino, Sanna Huttunen, Jaakko Hyvönen, Sirkka Sällinen and Viivi Virtanen at the Herbarium of The Natural History Museum of The University of Helsinki, for their hospitality and help during his visit. The Curators in BM, FH, NY, and S-PA are thanked for sending specimens on loan.

## References

- Allen, B. 2002: Moss flora of Central America. Part 2. Encalyptaceae–Orthotrichaceae. — *Monogr. Syst. Bot. Missouri Bot. Garden* 90: 1–699.
- Brotherus, V. F. 1920: Musci novi japonici. — *Öfvers. Finska Vet.-Soc. Förhandl.* 62 A(9): 1–55.
- Brotherus, V. F. 1922: Musci novi sinenses, collecti a Dre. Her. Handel-Mazzetti. — *Sitzungsber. Akad. Wiss. Wien Math. Naturw. Klasse Abt. 1*, 131: 209–220.
- Brotherus, V. F. 1925: Musci (Laubmoose) 2. — In: Engler, A. & Prantl, K. (eds.), *Die natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten insbesondere den Nutzpflanzen* 11: 1–542, 1925.
- Brotherus, V. F. 1929: IV. Musci. — In: Handel-Mazzetti, H. (ed.), *Symbolae Sinicae. Botanische Ergebnisse der Expedition der Akademie der Wissenschaften in Wien nach Südwest-China 1914/1918*: 1–74. Julius Springer Verlag, Wien.
- Cao, T. & Koponen, T. 2004: Musci in “Symbolae Sinicae”; an annotated checklist of mosses collected by H. Handel-Mazzetti in China in 1914–1918, and described by V. F. Brotherus in 1922–1929. — *Bryobrothera* 8: 1–34.
- Cardot, J. 1905: Mousses de l’île Formose. — *Beih. Bot. Centralbl.* 19: 85–148.
- Crum, H. A. & Anderson, L. E. 1981: *Mosses of eastern North America*, vol. 2: 665–1328. — Columbia Univ. Press, New York.
- Enroth, J. & Koponen, T. 2003: Bryophyte flora of Hunan Province, China. 8. Additions to the checklist. — *Hikobia* 14: 79–86.
- Gao, C. 1977: *Flora muscorum China boreali-orientalis*. — Sci. Press, Beijing.
- Guo, S.-L., Enroth, J. & Virtanen, V. 2004: Bryophyte flora of Hunan Province, China. 9. *Ulota gymnostoma sp. nova* (Orthotrichaceae, Musci). — *Ann. Bot. Fennici* 41: 459–463.
- Hill, M. O. & Smith, A. J. E. 1976: Principal component analysis of taxonomic data with multi-state discrete characters. — *Taxon* 25: 249–255.
- Ignatov, M. S., Huttunen, S. & Koponen, T. 2005: Bryophyte flora of Hunan Province, China. 5. Brachytheciaceae (Musci), with an overview of *Eurhynchiadelphus* and *Rhynchostegiella* in SE Asia. — *Acta Bot. Fennica* 178: 1–56.
- Iwatsuki, Z. 1959: A revision of the Japanese species of the genus *Ulota*. — *J. Hattori Bot. Lab.* 21: 138–156.
- Karttunen, K. 1984: *Zygodon gracilis*, *Z. rupestris* and *Z. dentatus*, *comb. nova* (Musci, Orthotrichaceae). — *Ann. Bot. Fennici* 21: 343–348.
- Koponen, T. 2010: Compilation of “Musci” in “Symbolae Sinicae” in the light of H. Handel-Mazzetti’s letters to V. F. Brotherus. — *Bryobrothera*. [In print].
- Koponen, T., Cao, T., Huttunen, S., Juslén, A., Peng, C., Piippo, S., Rao, P., Váňa, J. & Virtanen, V. 2004: Bryophyte flora of Hunan Province, China. 3. Bryophytes from Taoyuandong and Yankou Nature Reserves, and Badagonshan and Hupingshan National Nature Reserves, with additions to floras of Mang-shan Nature Reserve and Wulingyuan Global Cultural Heritage Area. — *Acta Bot. Fennica* 177: 1–47.
- Koponen, T. & Enroth, J. 1992: Notes on the genus *Schlotheimia* (Orthotrichaceae, Musci) in China. — *Bryobrothera* 1: 277–282.
- Koponen, T., Enroth, J., Fang, Y.-M., Huttunen, S., Hyvönen, J., Ignatov, M., Juslén, A., Lai, M.-J., Piippo, S., Potemkin, A. & Rao, P. 2000: Bryophyte flora of Hunan Province, China. 1. Bryophytes from Mangshan Nature Reserve and Wulingyuan Global Cultural Heritage Area. — *Ann. Bot. Fennici* 37: 11–39.
- Koponen, T. & Piippo, S. 2002: Viktor Ferdinand Brotherus and his collection of letters. — *Bryobrotherella* 5: 1–29.
- Lewinsky, J. 1978: The genus *Orthotrichum* Hedw. (Musci) in Africa south of the tropic of Cancer. — *Bot. Tidsskr.* 72: 61–85.
- Lewinsky, J. 1983: Lectotypification of *Orthotrichum rupestre* Schleich. ex Schwaegr. — *Lindbergia* 9: 53–56.
- Lewinsky, J. 1984: The genus *Orthotrichum* Hedw. (Musci) in Australasia. A taxonomic revision. — *J. Hattori Bot. Lab.* 56: 369–460.
- Lewinsky, J. 1985: *Orthotrichum* in South America 1. Introduction and taxonomic revision of taxa with immersed stomata. — *Lindbergia* 10: 65–94.
- Lewinsky, J. 1987: *Orthotrichum* (Orthotrichaceae) in South America 2. Taxonomic revision of taxa with superficial stomata. — *Mem. New York Bot. Garden* 45: 326–370.
- Lewinsky, J. 1992: The genus *Orthotrichum* Hedw. (Orthotrichaceae, Musci) in Southeast Asia. A taxonomic revision. — *J. Hattori Bot. Lab.* 72: 1–88.
- Lewinsky, J. 1993a: A synopsis of the genus *Orthotrichum* Hedw. (Musci, Orthotrichaceae). — *Bryobrothera* 2: 1–59.



- Lewinsky, J. 1993b: The genus *Orthotrichum* Hedw. (Musci) in Hawaii. — *Bryobrothera* 2: 61–69.
- Lewinsky-Haapasaari, J. 1996: *Orthotrichum notabile* Lewinsky-Haapasaari, a new moss species from Sichuan, China. — *Lindbergia* 20: 102–105.
- Lewinsky-Haapasaari, J. 1999a: *Orthotrichum laxum* Lewinsky-Haapasaari, a new species from the Qinghai Province, China. — *Lindbergia* 24: 29–32.
- Lewinsky-Haapasaari, J. 1999b: *Orthotrichum vermiferum* Lewinsky-Haapasaari, a new species from the Qinghai province of China, together with comments on *Orthomitrium schofieldii*. — *Lindbergia* 24: 33–37.
- Lewinsky-Haapasaari, J. & Crosby, M. R. 1996: *Orthomitrium tuberculatum* (Orthotrichaceae), a new genus and species from Guizhou, China. — *Novon* 6: 1–5.
- Malta, N. 1926: Die Gattung *Zygodon* Hook. et Tayl. Eine monographische Studie. — *Latvijas Univ. Bot. Dārza Darbi* 1: 1–183.
- Noguchi, A. 1958: A list of mosses from Mt. Ontake, central Japan. — *J. Hattori Bot. Lab.* 20: 272–288.
- Noguchi, A. 1967: Musci Japonici. VII. The genus *Macromitrium*. — *J. Hattori Bot. Lab.* 30: 205–230.
- Noguchi, A. 1968: Musci Japonici. VIII. The genus *Orthotrichum*. — *J. Hattori Bot. Lab.* 31: 113–129.
- Noguchi, A. (supplemented by Z. Iwatsuki) 1988: *An illustrated moss flora of Japan*. Part 2. — Hattori Bot. Lab., Nichinan.
- Noguchi, A. (supplemented by Z. Iwatsuki) 1989: *An illustrated moss flora of Japan*. Part 3. — Hattori Bot. Lab., Nichinan.
- Okamura, S. 1916: *Macromitrium comatulum*, Broth. (Orthotrichaceae). — In: Matsumura, J. (ed.), *Icones plantarum koisikavenses* 3: 41–42, pl. 166.
- O'Shea, B. J. 1995: Checklist of the mosses of sub-Saharan Africa. — *Trop. Bryol.* 10: 91–198.
- O'Shea B. J. 2002: Checklist of the mosses of Sri Lanka. — *J. Hattori Bot. Lab.* 92: 125–164.
- Paris, E. G. 1910: Muscinées de l'Asie orientale. — *Rev. Bryol.* 32: 1–4.
- Potemkin, A. D., Piippo, S. & Koponen, T. 2004: Bryophyte flora of the Hunan Province, China 4. Diplophyllaceae and Scapaniaceae (Hepaticae). — *Ann. Bot. Fennici* 41: 415–427.
- Price, M. J. 2005: Catalogue of the Hedwig-Schwägrichen Herbarium (G). Part 1. Type material and a review of typifications for the Hedwig moss names. — *Boissiera* 61: 1–388.
- Rao, P. C., Enroth, J., Piippo, S. & Koponen, T. 1997: The bryophytes of Hunan Province, China: An annotated checklist. — *Hikobia* 12: 181–203.
- Redfeare, P. J. Jr., Tan, B. C. & He, S. 1996: A newly updated and annotated checklist of Chinese mosses. — *J. Hattori Bot. Lab.* 79: 163–357.
- Tan, B. C. & Iwatsuki, Z. 1993: A checklist of Indochinese mosses. — *J. Hattori Bot. Lab.* 74: 325–405.
- Tan, B. C. & Jia, Y. 1997: Mosses of Qinghai-Tibetan plateau, China. — *J. Hattori Bot. Lab.* 82: 305–320.
- Vaña, J., Piippo, S. & Koponen, T. 2003: Bryophyte flora of the Hunan Province. 6. Jungermanniaceae and Gymnomitriaceae (Hepaticae). — *Acta Bot. Fennica* 178: 57–78.
- Vitt, D. H. 1972: A monograph of the genus *Drummondia*. — *Can. J. Bot.* 50: 1191–1208.
- Vitt, D. H. 1973a: A revisionary study of the genus *Macrocoma*. — *Rev. Bryol. Lichénol.* 39: 205–220.
- Vitt, D. H. 1973b: A revisionary study of the genus *Orthotrichum* in North America, north of Mexico. — *Bryophyt. Biblioth.* 1: 1–208.
- Vitt, D. H. 1980: The genus *Macrocoma* I. Typification of names and taxonomy of the species. — *Bryologist* 83: 405–436.
- Vitt, D. H. 1982: The genera of Orthotrichaceae. — *Beih. Nova Hedwigia* 71: 261–268.
- Vitt, D. H. 1983: The New Zealand species of the pantropical genus *Macromitrium* (Orthotrichaceae: Musci): Taxonomy, phylogeny and phytogeography. — *J. Hattori Bot. Lab.* 54: 1–94.
- Vitt, D. H. 1989: The genus *Schlotheimia* (Orthotrichaceae: Bryopsida) in Australia and New Zealand. — *Bryologist* 92: 282–289.
- Vitt, D. H. 1994: Orthotrichaceae. — *Mem. New York Bot. Garden* 69: 590–657.
- Vitt, D. H., Koponen, T. & Norris, D. H. 1992: Bryophyte flora of the Huon Peninsula, Papua New Guinea. LIII. *Ulota* and *Schlotheimia* (Orthotrichaceae, Musci). — *Acta Bot. Fennica* 148: 5–25.
- Vitt, D. H., Koponen, T. & Norris, D. H. 1995: Bryophyte flora of the Huon Peninsula, Papua New Guinea. LV. *Desmotheca*, *Groutiella*, *Macrocoma* and *Macromitrium* (Orthotrichaceae, Musci). — *Acta Bot. Fennica* 154: 1–94.
- Vitt, D. H. & Ramsay, H. P. 1985a: The *Macromitrium* complex in Australasia (Orthotrichaceae: Bryopsida). Part I. Taxonomy and phylogenetic relationships. — *J. Hattori Bot. Lab.* 59: 325–451.
- Vitt, D. H. & Ramsay, H. P. 1985b: The *Macromitrium* complex in Australasia (Orthotrichaceae: Bryopsida). Part II. Distribution, ecology, and paleogeography. — *J. Hattori Bot. Lab.* 59: 453–468.
- Vitt, D. H. & Ramsay, H. P. 1986: The *Macromitrium* complex in Australasia (Orthotrichaceae: Bryopsida). Part III. Cytotaxonomy. — *J. Hattori Bot. Lab.* 61: 1–43.

## Index of names formally treated in this paper

Accepted names are in **boldface**. An asterisk means that a lectotype is proposed or corrected in this paper. Names proposed as new synonyms are marked *syn. nov.*

<i>Dasymitrium incurvum</i> .....	11	<b><i>Orthotrichum consobrinum</i></b> .....	16
<i>Dasymitrium japonicum</i> .....	11	* <i>Orthotrichum courtoisii</i> .....	16
<b><i>Drummondia</i></b> .....	4	<i>Orthotrichum crispum</i> .....	24
<i>Drummondia cavaleriei</i> .....	4	<i>Orthotrichum decurrens</i> .....	18
<i>Drummondia duthiei</i> .....	4	* <b><i>Orthotrichum erubescens</i></b> .....	17
<i>Drummondia rubiginosa</i> .....	28	<b><i>Orthotrichum exiguum</i></b> .....	18
<b><i>Drummondia sinensis</i></b> .....	4	<i>Orthotrichum fortunatii</i> .....	17
<b><i>Macrocoma</i></b> .....	5	<b><i>Orthotrichum jetteae</i></b> .....	19
<b><i>Macrocoma tenue</i></b> var. <i>sullivantii</i> .....	5	<i>Orthotrichum nipponense</i> .....	16
<b><i>Macromitrium</i></b> .....	6	<b><i>Orthotrichum rupestre</i></b> .....	20
* <i>Macromitrium bathyodontum</i> .....	11	<b><i>Orthotrichum subpumilum</i></b> .....	22
<i>Macromitrium brachycladulum</i> .....	28	<i>Orthotrichum szuchuanicum</i> .....	18
* <i>Macromitrium comatulum</i> .....	6	<b><i>Schlotheimia</i></b> .....	23
* <i>Macromitrium comatulum, hom. illeg.</i> .....	6	* <i>Schlotheimia calycina</i> .....	23
<b><i>Macromitrium ferriei</i></b> .....	6	<i>Schlotheimia fauriei</i> .....	23
<i>Macromitrium giraldii</i> .....	11	<b><i>Schlotheimia grevilleana</i></b> .....	23
<b><i>Macromitrium gymnostomum</i></b> .....	9	<i>Schlotheimia japonica</i> .....	23
* <b><i>Macromitrium handelii</i></b> .....	9	<i>Schlotheimia latifolia</i> .....	23
<i>Macromitrium incurvum</i> .....	11	<i>Schlotheimia rubiginosa, hom. illeg.</i> .....	28
<b><i>Macromitrium japonicum</i></b> .....	11	<b><i>Schlotheimia vittii, nom. nov.</i></b> .....	28
<i>Macromitrium okamurae</i> .....	5	<b><i>Ulota</i></b> .....	24
<i>Macromitrium perrottetii</i> .....	5	<b><i>Ulota crispa</i></b> .....	24
<i>Macromitrium prolongatum</i> .....	28	<b><i>Ulota gymnostoma</i></b> .....	26
* <i>Macromitrium quercicola, syn. nov.</i> .....	6	<i>Ulota macrocarpa, syn. nov.</i> .....	24
<i>Macromitrium sullivantii</i> .....	5	<b><i>Zygodon</i></b> .....	27
<b><i>Macromitrium syntrichophyllum</i></b> .....	14	<b><i>Zygodon rupestris</i></b> .....	27
<i>Orthomitrium tuberculatum</i> .....	19	<i>Zygodon viridissimus</i> var. <i>rupestris</i> .....	27
<b><i>Orthotrichum</i></b> .....	14		