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A world revisionary study of the genus
Groutiella Steere (Orthotrichaceae, Bryopsida)

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A world revisionary study of the genus *Groustiella* Steere (Orthotrichaceae, Bryopsida)

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ABSTRACT

The genus *Groustiella* Steere is revised on a worldwide basis. Nine species are accepted: *G. apiculata* (Hook.) H.A. Crum & Steere, *G. chimborazensis* (Spruce ex Mitt.) Florsch., *G. husnotii* (Schimp. ex Besch.) H.A. Crum & Steere, *G. macrorrhyncha* (Mitt. ex Bosch & Sande Lac.) Wijk & Margad., *G. obtusa* (Mitt.) Florsch., *G. reesei* (Vitt) B.H. Allen, *G. tomentosa* (Hornsch.) Wijk & Margad., *G. tuberculata* B.H. Allen & I.H. Holz and *G. tumidula* (Mitt.) Vitt. Four species are reduced to synonymy, *Groustiella subgoniorrhyncha* (Broth.) Wijk & Margad. and *G. thraustophylla* (Müll. Hal. ex Broth.) Wijk & Margad. under *G. tomentosa*, *G. maracaibensis* (Broth.) B.H. Allen & Goffinet under *G. macrorrhyncha*, and *G. wagneriana* (Müll. Hal.) H.A. Crum & Steere under *G. apiculata*. A key, illustrations and diagnostic features to the recognized species are provided.

KEY WORDS
Bryophytes,
Groustiella,
new synonyms.

RÉSUMÉ

Révision mondiale du genre Groustiella Steere (Orthotrichaceae, Bryopsida).

La révision mondiale du genre *Groustiella* Steere est proposée ici. Neuf espèces sont acceptées : *G. apiculata* (Hook.) H.A. Crum & Steere, *G. chimborazensis* (Spruce ex Mitt.) Florsch., *G. husnotii* (Schimp. ex Besch.) H.A. Crum & Steere, *G. macrorrhyncha* (Mitt. ex Bosch & Sande Lac.) Wijk & Margad., *G. obtusa* (Mitt.) Florsch., *G. reesei* (Vitt) B.H. Allen, *G. tomentosa* (Hornsch.) Wijk & Margad., *G. tuberculata* B.H. Allen & I.H. Holz et *G. tumidula* (Mitt.) Vitt. Quatre espèces sont réduites en synonymie, *Groustiella subgoniorrhyncha* (Broth.) Wijk & Margad. et *G. thraustophylla* (Müll. Hal. ex Broth.) Wijk & Margad. sous *G. tomentosa*, *G. maracaibensis* (Broth.) B.H. Allen & Goffinet sous *G. macrorrhyncha*, et *G. wagneriana* (Müll. Hal.) H.A. Crum & Steere sous *G. apiculata*. Pour permettre la reconnaissance des espèces, une clé, des illustrations et les caractères diagnostiques des espèces reconnues sont fournis.

MOTS CLÉS
Bryophytes,
Groustiella,
synonymes nouveaux.

INTRODUCTION

Groutiella Steere, a member of Orthotrichaceae, is distributed in pantropical areas, with the majority of species concentrated in Central and South America. Before our study, 13 species were accepted (Crosby *et al.* 2000; Allen 2002; Yu *et al.* 2011).

Groutiella's taxonomic history is rather complicated. Mitten (1869) considered the group with short calyptrae to be section *Micromitrium* (Mitt.) Schimp. ex Besch. of *Macromitrium* Brid. This section was elevated to a subgenus by Brotherus (1902), but also elevated to the genus *Micromitrium* by Schimper (Bescherelle 1872). Unfortunately, *Micromitrium* was a later homonym for a genus used by Austin in 1870 (Austin 1870). In 1946, Grout proposed a new name, *Craspedophyllum*. However, *Craspedophyllum* was also a later homonym for a genus of ferns used by Copeland in 1938. Steere (in Crum & Steere 1950) proposed *Groutiella* to replace *Craspedophyllum*.

Grout (1944) furthermore pointed out that short calyptrae were not useful as a distinguishing character for the genus, because it was very difficult to find in some specimens. He instead emphasized the limbidity of leaves to be an important taxonomic character of the genus, which is still followed today. Two species of *Groutiella* have been studied at the molecular phylogenetic level by Goffinet *et al.* (1998) and Goffinet & Vitt (1998). Based on the molecular data and morphological characters, *Groutiella* has been recognized as a natural and monophyletic group.

Prior to this work, *Groutiella* had been revised in several regional floras (Table 1). Many bryologists have made important work on it. After Grout's study of *Groutiella*, Vitt did some revisions in North America. During the works, Vitt (1979) and Vitt & Crum (1970) clarified many species' concepts and relationships. Allen (2002) made a great contribution to *Groutiella* in Central America, which is a diversity center of *Groutiella*. Apart from North America and Central America, studies of *Groutiella* are insufficient in other regions.

A formal worldwide revision of *Groutiella* was initiated with the aim of clarifying the concepts and delimitation of every species.

MATERIAL AND METHODS

For the purpose of a worldwide revision, type and non-type specimens of *Groutiella* (a total of 265 specimens, including 24 type specimens) were examined from the following herbaria: BM, E, F, G, H, HBG, MO, NSW, NY, PC, PE, and W (acronyms of the herbaria follow Thiers (2015)). The peristome and spores were studied using Hitachi S-4800 scanning electron microscope. All species were illustrated by the authors.

RESULTS AND DISCUSSION

Plants of *Groutiella* are medium-sized, usually growing on the bark of trees, uncommonly on rocks (Fig. 1A). Primary

stems creeping, secondary stems erect-ascending (Fig. 1A, D). Cross-section of the stem of all species in *Groutiella* lacks a central strand (Fig. 1B). Leaves are contorted, or spirally twisted when dry and obviously keeled (Fig. 1C-E, G). Generally, the upper leaves are spirally twisted with a little scattered contorted at top (Fig. 1H). As diagnostic characters, leaves are erect to wide spreading when moist (Fig. 1F). The shape of leaves, leaf's costa and cell differentiation are different at the species level (Fig. 2).

Capsules are often found in specimens, the length of setae and capsules are slightly different among species. Capsules are variable in shape and color with age, usually become darker and larger, and constricted at the mouth when mature (Fig. 3A, B). Allen (2002) divided *Groutiella* into two groups based on capsule shape: the *apiculata*-group with oblong-cylindrical capsules and the *mucronifolia*-group with obovate capsules. But in some specimens, the two types of capsules can be observed together (Fig. 3C). Peristome is reduced, only consisting of a low and papillose basal membrane with 2-3 layers of pre-peristomes. The height of the membrane is *c.* 100 µm and the ornamentation is irregularly papillose in *G. husnotii*, having high papillose arranging in line (Fig. 3D, E). Spores are globose with finely papillose ornamentation (Fig. 3F, H), in *G. obtusa* (Mitt.) Florsch. and *G. tumidula* (Mitt.) Vitt. they are polygonal concave-constricted, which is similar to *Macromitrium ferriei* Cardot & Thér. (Fig. 3G).

Family ORTHOTRICHACEAE Arn.

Genus *Groutiella* Steere

The Bryologist 53: 145 (Crum & Steere 1950). — *Macromitrium* sect. *Micromitrium* Mitt., *Journal of the Linnean Society, Botany* 12: 218 (Mitten 1869). — *Micromitrium* (Mitt.) Schimp. ex Besch., *Mémoires de la Société des Sciences naturelles de Cherbourg* 16: 190 (Bescherelle 1872), illeg. hom. non. *Micromitrium* Austin, 1870. — *Macromitrium* subg. *Micromitrium* (Mitt.) Broth., *Die Natürlichen Pflanzenfamilien* I (3): 479 (Brotherus 1902). — *Craspedophyllum* Grout, *North American Flora* 15A: 38 (Grout 1946), illeg. hom. non. *Craspedophyllum* Copeland, 1938.

TYPE SPECIES. — *Groutiella fragilis* (Mitt.) Grout.

Groutiella apiculata (Hook.) H.A. Crum & Steere (Figs 4; 5)

The Bryologist 53: 146 (Crum & Steere 1950).

Macromitrium wagnerianum Müll. Hal., *Synopsis Muscorum Frondosorum omnium hucusque Cognitorum* 2: 642 (Müller 1851). — *Craspedophyllum wagnerianum* (Müll. Hal.) Grout, *North American Flora* 15A: 41 (Grout 1946). — *Groutiella wagneriana* (Müll. Hal.) H.A. Crum & Steere, *The Bryologist* 53: 146 (Crum & Steere 1950). — Type: Venezuela. Galipan, ad arbores in 4000 m alt., VIII.1849, *Wagner s.n.* (syn-, NY!), **syn. nov.**

SPECIMENS EXAMINED. — **Belize.** Belize, Tropical Education Center, Allen 17979 (MO); Cayo, Southern Maya Mountains, *Gradstein & Weber M-157*, Allen 15537, 15054, 15454, 15136 (MO).

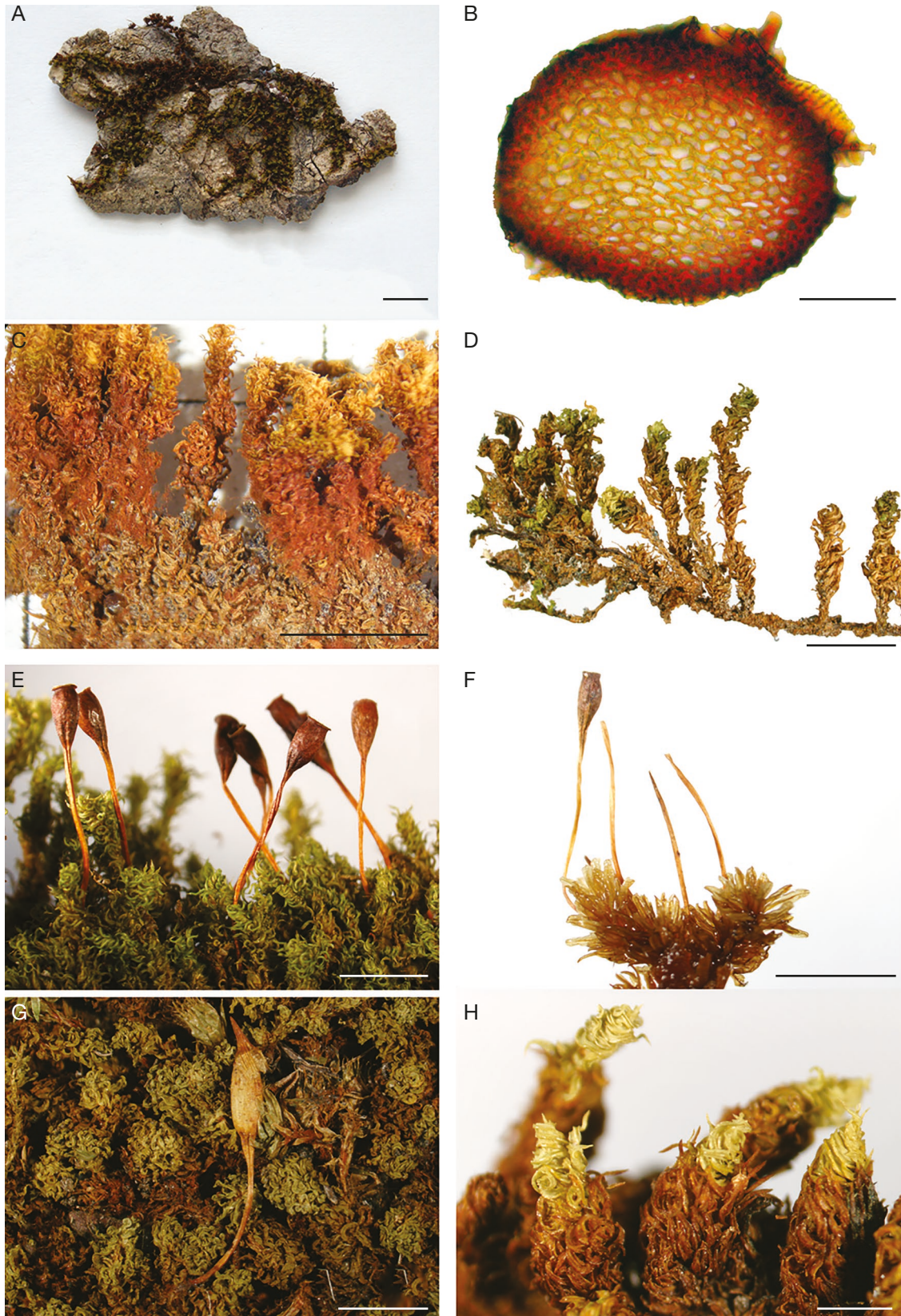


FIG. 1. — Habits and plants of *Groutiella* Steere: **A**, *G. apiculata* (Hook.) H.A. Crum & Steere; **B**, *G. macrorrhyncha* (Mitt. ex Bosch & Sande Lac.) Wijk & Margad., showing stem cross section; **C**, *G. tomentosa* (Hornsch.) Wijk & Margad., showing rhizoids; **D**, *G. reesei* (Vitt) B.H. Allen, showing the primary stem; **E**, *G. husnotii* (Schimp. ex Besch.) H.A. Crum & Steere, plant when dry; **F**, *G. obtusa* (Mitt.) Florsch., plant when wet; **G**, *G. chimborazensis* (Spruce ex Mitt.) Florsch., plant when dry; **H**, *G. tomentosa*, plant when dry. **A** from Price 920 (MO); **B** from Pamplin s.n. (NY); **C** from Sebert 1545 (NSW); **D** from Reese 4450 (MO); **E** from Allen 14033B (MO); **F** from Liesner 16772a (NSW); **G** from Pringle 10560 (MO); **H** from Larsen et al. 2362 (MO). Scale bars: A, 1 cm; B, 75 µm; C, 5 mm; D-G, 3 mm; H, 1 mm.

KEY TO THE SPECIES OF *GROUTIELLA* STEERE

1. Upper branch leaves gradually narrowed to a long subula and usually broken off *Groutiella tomentosa* (Hornsch.) Wijk & Margad.
 — Upper branch leaves obtuse, acute to acuminate, never forming a subula 2
2. Branch leaves ligulate to lingulate, apices obtuse to abruptly acuminate 3
 — Branch leaves lanceolate to ovate-lanceolate, apices acute to acuminate 5
3. Branch leaves rugose above *G. obtusa* (Mitt.) Florsch.
 — Branch leaves smooth or undulate 4
4. Length-width ratio of median branch leaves less than 3.5:1; branch leaves oblong to lingulate, often widest at or above the middle, ending in a short mucro; costa subpercurrent, in most leaves not filling the entire mucro *G. tumidula* (Mitt.) Vitt.
 — Length-width ratio of median branch leaves more than 3.5:1; branch leaves ligulate to oblong, as wide above as below, ending in a long apiculus or cusp; costa excurrent and usually stoutly filling the apiculus *G. apiculata* (Hook.) H.A. Crum & Steere
5. Branch leaf apices usually acute; costa ending below the apex, subpercurrent, percurrent or shortly and weakly excurrent 6
 — Branch leaf apices acuminate and apiculate; costa stoutly excurrent 7
6. Upper branch leaf apices fragile, often broken; branch leaves bordered in lower ¼ or less by short rectangular cells; leaf mid-lower cells thin-walled, strong bulging *G. reesei* (Vitt) B.H. Allen
 — Upper branch leaf apices not fragile, usually intact; branch leaves bordered in the lower ⅓ to ½ by elongate linear cells; leaf mid-lower cells thick-walled, flat to bulging-tuberculate *G. chimborazensis* (Spruce ex Mitt.) Florsch.
7. Basal leaf cells tuberculate *G. tuberculata* B.H. Allen & I.H. Holz
 — Basal leaf cells smooth 8
8. Branch leaves bordered up to ⅔ or more of the leaf length *G. husnotii* (Schimp. ex Besch.) H.A. Crum & Steere
 — Branch leaves bordered up to ⅓ or less of the leaf length *G. macrorrhyncha* (Mitt. ex Bosch & Sande Lac.) Wijk & Margad.

Toledo. Bladen Nature Reserve, *Whittemore et al. 6414* (MO); Columbia River Forest Reserve, *Whittemore et al. 6475* (MO).
Brazil. Bahia, Itabuna, *Vital 8682* (MO); “Estado de Rio Janeiro,” *E. ULE. 2183* (HBG).
Colombia. Magdalena, Santa Marta Municipio, *Steere 4582* (MO); Nariño, Río Guisa, *Ramírez et al. 8.868* (MO).
Costa Rica. Alajuela, *Wasum 9322, Holz CR 99-1436* (MO); Guanacaste, Parque Nacional Guanacaste Estación Cacao, *Chávez 466, Chávez 254* (MO).
Cuba. Autilles, Adjuntas, 1886, *Sintenio s.n.* (NSW); *s.l.*, from herb. W. Mönkemeyer, *Wright s.n.* (HBG); Santiago, Gran Pieder, 1980, *T. Pócs & M. Aluff 9197/E* (F).
Dominica. El Seibo, Cordillera Oriental, *Reese 15542* (MO); St. Paul, *Hegewald 9543* (MO).
Ecuador. Galapagos, Santa Cruz Gantón, *Weber B-13672* (MO).
Guadeloupe. Sur un muret, St-Claude, *Gallo 828* (MO).
French Guiana. St-Laurent-du-Maroni, Eaux Claires, *Buck 18576* (MO).
Honduras. Copán, Copán Ruinas, *Allen 17717* (MO).
Jamaica. Manchester, near Banana Ground, *Crosby 1343* (MO); Portland, 7 mi NW of Muirton on road to Ecclesdown, *Crosby 13717* (MO); St. Ann, along road between Alderton and Alexandria, *Crosby 2902* (MO); Moneague, *Crosby 2870* (MO); St. Thomas, Winchester Peak, *Crosby 3343* (MO).
Mexico. Prope Xalapam in Regno Mexicano, regione temperata, *Humboldt & Bonpland s.n.* (iso-lecto-, E).
Nicaragua. Matagalpa, Hamonia, *I. Granzow de la Cerda 11611* (MO); Chiriqui, Fortuna dam site, *Folsom et al. 5615* (MO); Colon, Santa Rita Ridge, *Crosby 10366* (MO).

Panamá. Cerro Campana, *Crosby 4507* (MO).
Puerto Rico. Barranquitas, La Torricilla, *Steere 4582* (MO); Cayey, Guavata Purchase Unit, *Steere 4760* (MO); Coamo, Río de la Mina, *Steere 4059* (MO); Las Piedras, Luquillo Mountains, *Price 826* (MO); *Schwaneke s.n.* (HBG); Maricao, Reserva Forestal Maricao, *Reese 14523, Steere 5561* (MO); Naguabo, Barrio De Maizales, *Britton 3052* (MO); Río Grande, *Price 920* (MO); San Lorenzo, *Steere 6792* (MO); El Verde, *Steere 6282* (MO); Villalba, Cordillera Central, *Steere 5996* (MO); “Plantae Portoricenses”, *P. Sintenis F131, F90* (HBG).
Saint Vincent and the Grenadines. St. Vincent, Mount St. Andrew, *Rev. Lansdown Guilding s.n.* (isotype of *G. mucronifolia*, E).
Suriname. Brokopondo, Brownsweag, *Allen 19386* (MO); Paramaribo, Paramaribo, *Price 371* (MO, NSW); *s.l.*, *Weigelt 1827* (HBG).
Trinidad and Tobago. St. Andrew, Manzanilla, *Crosby 2059* (MO); Trinidad, *Sieber s.n.* (holotype of *Macromitrium brevipes*, G).
Venezuela. Galipan, ad arbores in 4000 m alt., VIII.1849, *Wagner s.n.* (syntype of *G. wagneriana*, NY!).

DISTRIBUTION AND HABITAT. — The tropical region of America, north to Mexico, south to Brazil. On bark of tree trunks and branches, rotten logs and rocks; 250-1400 m.

DESCRIPTION

For description, see Hooker 1818; Schwägrichen 1826; Grout 1946; Bartram 1949; Florschütz-de 1964; Vitt 1994; Allen 2002.

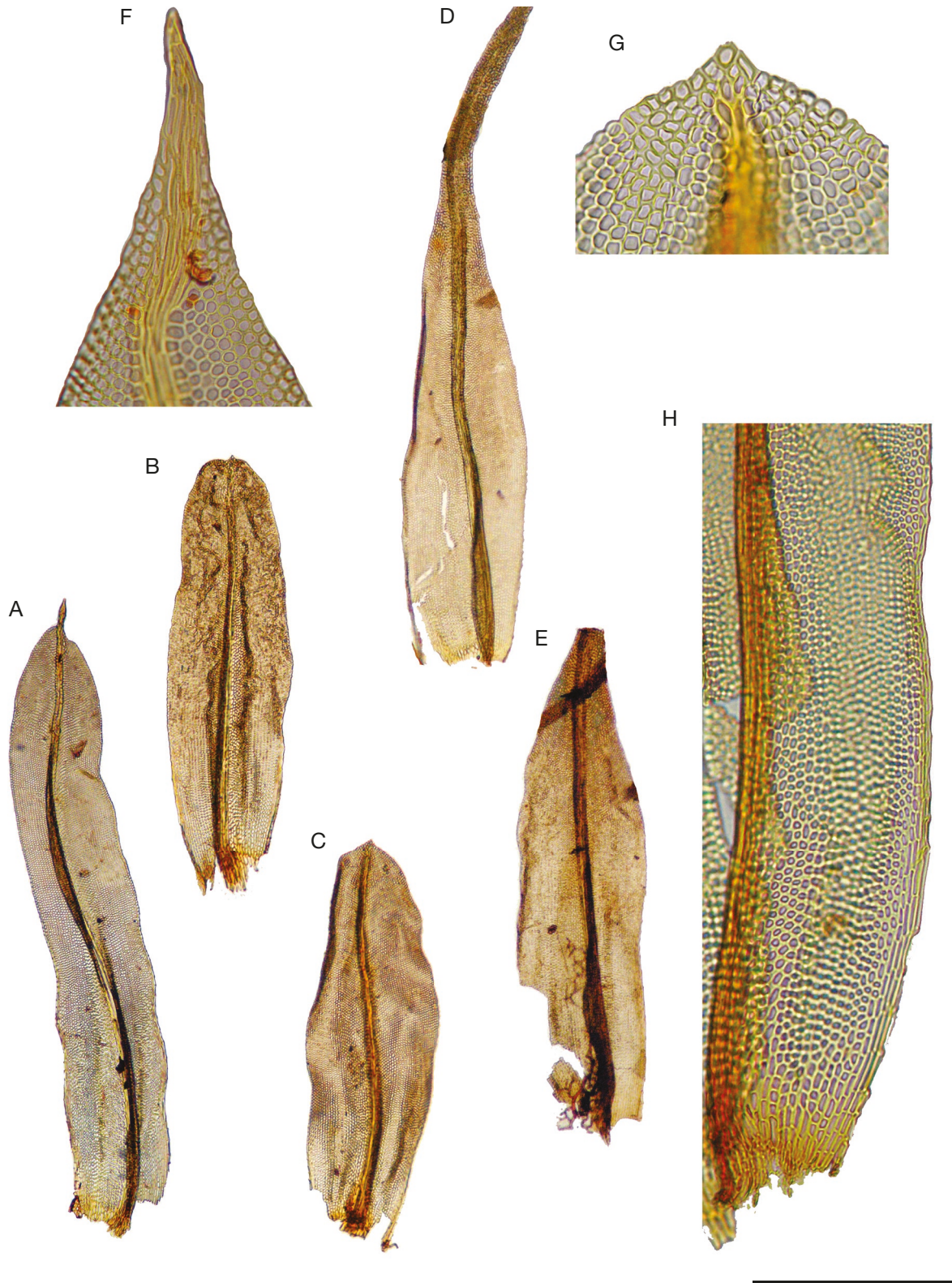


FIG. 2. — Leaves, apices and border of *Groutiella* Steere: **A, H**, *G. apiculata* (Hook.) H.A. Crum & Steere; **B**, *G. obtusa* (Mitt.) Florsch.; **C, G**, *G. tumidula* (Mitt.) Vitt.; **D, E**, *G. tomentosa* (Hornsch.) Wijk & Margad.; **F**, *G. macrorrhyncha* (Mitt. ex Bosch & Sande Lac.) Wijk & Margad. **A** from *Allen 15136* (MO); **B** from *Spruce 111* (NY); **C, G** from *Spruce 101* (NY); **D, E** from *Allen 25041* (MO); **F** from *Allen 5349* (MO); **H** from *Wagner s.n.* (NY). Scale bar: A–E, 600 μ m; F, G, 100 μ m; H, 210 μ m.

TABLE 1. — Regional studies of *Groutiella* Steere.

Regions	Species of <i>Groutiella</i> Steere
Central America (Allen 2002)	<i>G. apiculata</i> , <i>G. chimborazensis</i> , <i>G. husnotii</i> , <i>G. maracaibensis</i> , <i>G. mucronifolia</i> , <i>G. obtusa</i> , <i>G. reesei</i> , <i>G. tomentosa</i> , <i>G. tuberculata</i> , <i>G. tumidula</i>
Colombia (Churchill & Linares 1995)	<i>G. apiculata</i> , <i>G. chimborazensis</i> , <i>G. husnotii</i> , <i>G. obtusa</i> , <i>G. tomentosa</i> , <i>G. tumidula</i>
Guatemala (Bartram 1949)	<i>G. apiculata</i> , <i>G. fragilis</i> (accepted name: <i>G. tomentosa</i>), <i>G. mucronifolia</i> (accepted name: <i>G. apiculata</i>), <i>G. undosa</i> (accepted name: <i>G. chimborazensis</i>), <i>G. wagneriana</i> (accepted name: <i>G. apiculata</i>)
Eastern India and Adjacent Regions (Gangulee 1976)	<i>G. tomentosa</i>
Eastern North America (Crum & Anderson 1981)	<i>G. tomentosa</i> , <i>G. tumidula</i>
Mexico (Vitt 1994)	<i>G. apiculata</i> , <i>G. chimborazensis</i> , <i>G. tomentosa</i> , <i>G. tumidula</i>
Huon Peninsula, Papua New Guinea (Vitt <i>et al.</i> 1995)	<i>G. tomentosa</i>
North America (Vitt 2003)	<i>G. tomentosa</i> , <i>G. tumidula</i>

COMMENTS

The relationship of *Groutiella apiculata* (Hook.) H.A. Crum & Steere and *G. mucronifolia* (Hook. & Grev.) H.A. Crum & Steere had been discussed many times. Grout (1944, 1946) stated the apex and the height of marginal border were the main distinctions between them. Florschütz-de (1964) mentioned the shape of the apex was rather variable. The longer branches (1-3 cm) and stronger, more distinct marginal border were the only differentiating characters of the two species. Crosby (1970) stated the populations which usually referred to two species could not be separated based on the variability in length of branches, leaf apex morphology and height of marginal borders. He concluded that all the specimens studied were *G. mucronifolia*, while the type specimen of *G. apiculata* is beyond the variation of other specimens and treated as a separate species. Based on the examination of type specimens of *G. apiculata*, according to the characters of leaf shape, costa, leaf apex and habit in dry conditions, Vitt (1979) considered them to be synonymous. Allen (2002) confirmed the similarity of the two species on gametophyte grounds, while he separated them by sporophytic characters, such as the length of setae, the feature of the peristome and spores.

Having examined type specimens and more than 50 non-type specimens, we have concluded that it is difficult to separate the two species by characters of gametophyte, as well as the sporophyte. The length of setae overlaps, and the length and shape of capsules change due to different period of maturity and environmental conditions. In addition, sometimes the two kinds of capsules are observed on the same specimen. The SEM observation also shows that the spores of *G. mucronifolia* are consistent with the feature of *G. apiculata*. In summary, we accept Vitt's treatment regarding these two species that *G. mucronifolia* is a synonym of *G. apiculata*.

Groutiella wagneriana, a South American species, was synonymized with *G. chimborazensis* (Spruce ex Mitt.) Florsch. by Grout (1946), followed by Bartram (1949) and Crum & Bartram (1958). Florschütz-de (1964) presumed that the specimens checked by Grout might not be the original material of *G. wagneriana*, and he considered that the type specimen was somewhat obtuse, mucronate-apiculate, rugose leaves, more similar to *G. obtusa* than to *G. chimborazensis*. Vitt (1994) considered *G. wagneriana* close to *G. apiculata*, based on the shape of leaves, apex morphology and features of the sporophyte.

The type specimens of *G. wagneriana* (Wagner *s.n.*, syn-, NY) are indistinguishable from *G. apiculata*. The lingulate leaves, obtuse apices with excurrent costa and the height of basal marginal border are all consistent to *G. apiculata*. Some of the leaves are rugose as mentioned in Florschütz-de (1964). However, the leaves are lightly rugose, quite similar to the leaves of a few *G. apiculata* specimens (e.g. *T. Pócs & M. Aluff* 9197/E, *P. Sintenis* F131). It is noteworthy that the basal branch leaves with acute apices are similar to *G. chimborazensis*. Examining the middle and upper branch leaves are essential to identify specimens properly.

The diagnostic characters of *Groutiella apiculata* are lingulate leaves with obtuse leaf apices and stoutly excurrent costa. The ratio of leaf length and width could be from 3.5 (e.g. *Griffin* 334, *Allen* 17717) to 6 (e.g. *Crosby* 4507a, *Britton* 3052). The apiculus made by the stoutly excurrent costa could be much longer, up to 130 µm (e.g. *C. Le Gallo* 828, *Carlos Chávos* 466), or very short to 40 µm (e.g. *Crosby* 3343, *Vital* 8682).

Groutiella tumidula and *G. obtusa* are the only other species with lingulate leaves and obtuse apices in the genus. The leaves of *G. obtusa* are rugose above, which is easy to distinguish. While the leaves of *G. tumidula* (the ratio of leaf length and width is from 2.2 to 3.4) are much broader and shorter than *G. apiculata* (the ratio of leaf length and width is above 3.5), and the costa ends below the tip or percurrent, not extending into the apiculus, which is different from the stoutly excurrent costa of *G. apiculata*. Meanwhile, *G. tumidula* has a much shorter apiculus (always less than 30 µm) than *G. apiculata* (apiculus 40-120 µm).

Groutiella chimborazensis (Spruce ex Mitt.) Florsch. (Fig. 6)

Flora of Suriname 4: 215 (Florschütz-de 1964).

SPECIMENS EXAMINED. — **Belize.** Cayo, Southern Maya Mountains, *Allen* 15133 (MO).

Bolivia. Santa Cruz, Velasco, *Fuentes* 1049 (MO).

Brazil. Rondônia, Serra dos Pacaás Novos, *Reese* 13734A (MO); Pará, Rio Jamaxím, *Reese* 16683 (MO).

Colombia. Magdalena, Santa Marta Municipio, *Churchill & Linares* 18411 (MO).

Costa Rica. San José, Cordillera Talamanca, *Holz* CR 99-0960 (MO); Puntarenas, *Crosby* 2499B (MO); Heredia, Volcan Barba, *Crosby* 9934 (MO); Chm-cewh? forch-Ou Barba, 1890, *Louduz s.n.* (NSW).

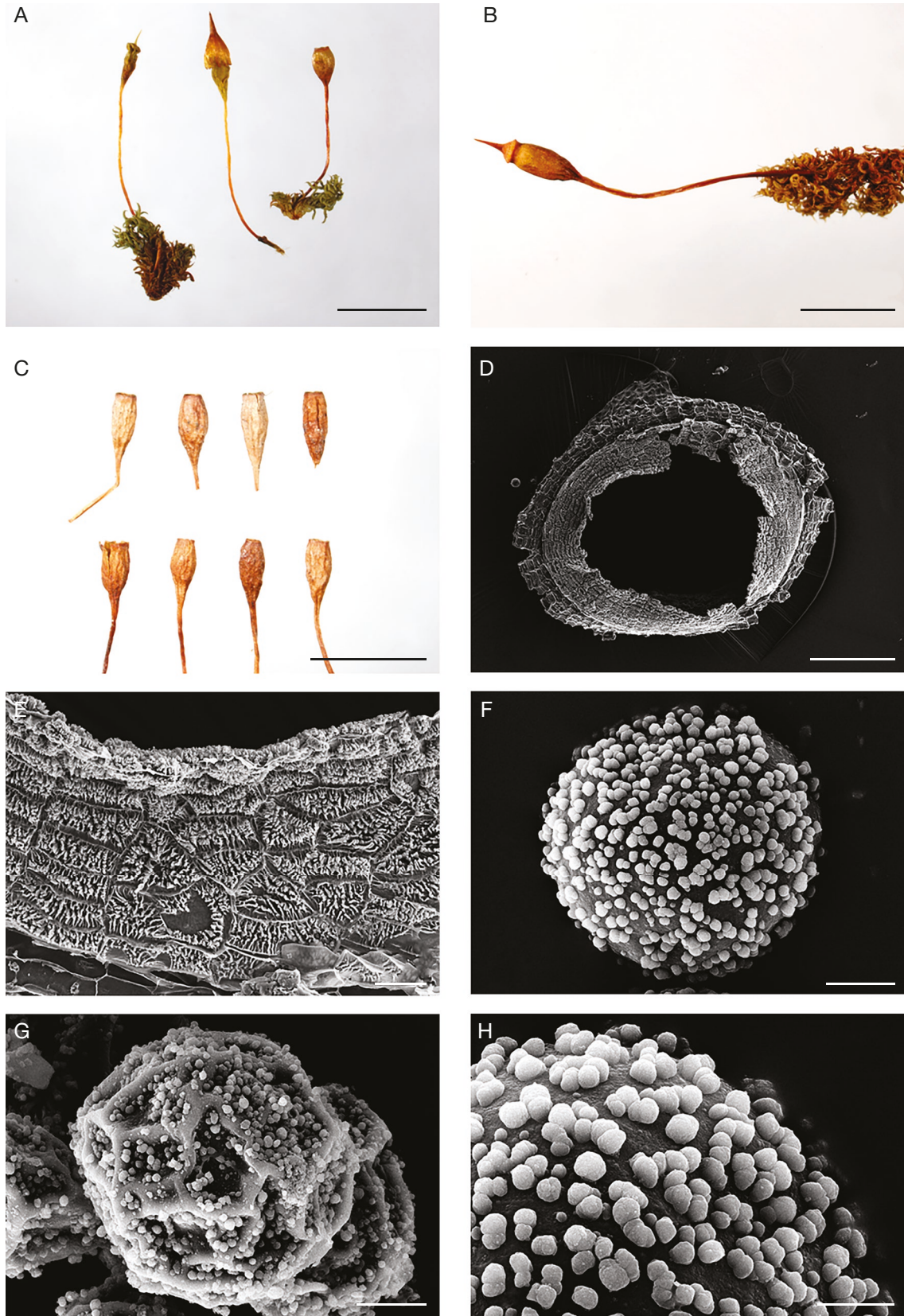


FIG. 3. — Capsules, peristome and spores of *Groustiella* Steere: **A**, *G. apiculata* (Hook.) H.A. Crum & Steere; **B, D, E**, *G. husnotii* (Schimp. ex Besch.) H.A. Crum & Steere; **C**, *G. tumidula* (Mitt.) Vitt.; **F, H**, *G. wagneriana* (Müll. Hal.) H.A. Crum & Steere; **G**, *G. obtusa* (Mitt.) Florsch. **A** from Allen 15136 (MO); **B, D, E** from Steere 7180 (MO); **C** from Vital 2319 (MO); **F, H** from Pringle 10560 (MO); **G** from Liesner 16772A (NSW). Scale bars: A–C, 3 mm; D, 250 μ m; E, 25 μ m; F, G, 5 μ m; H, 2.5 μ m.

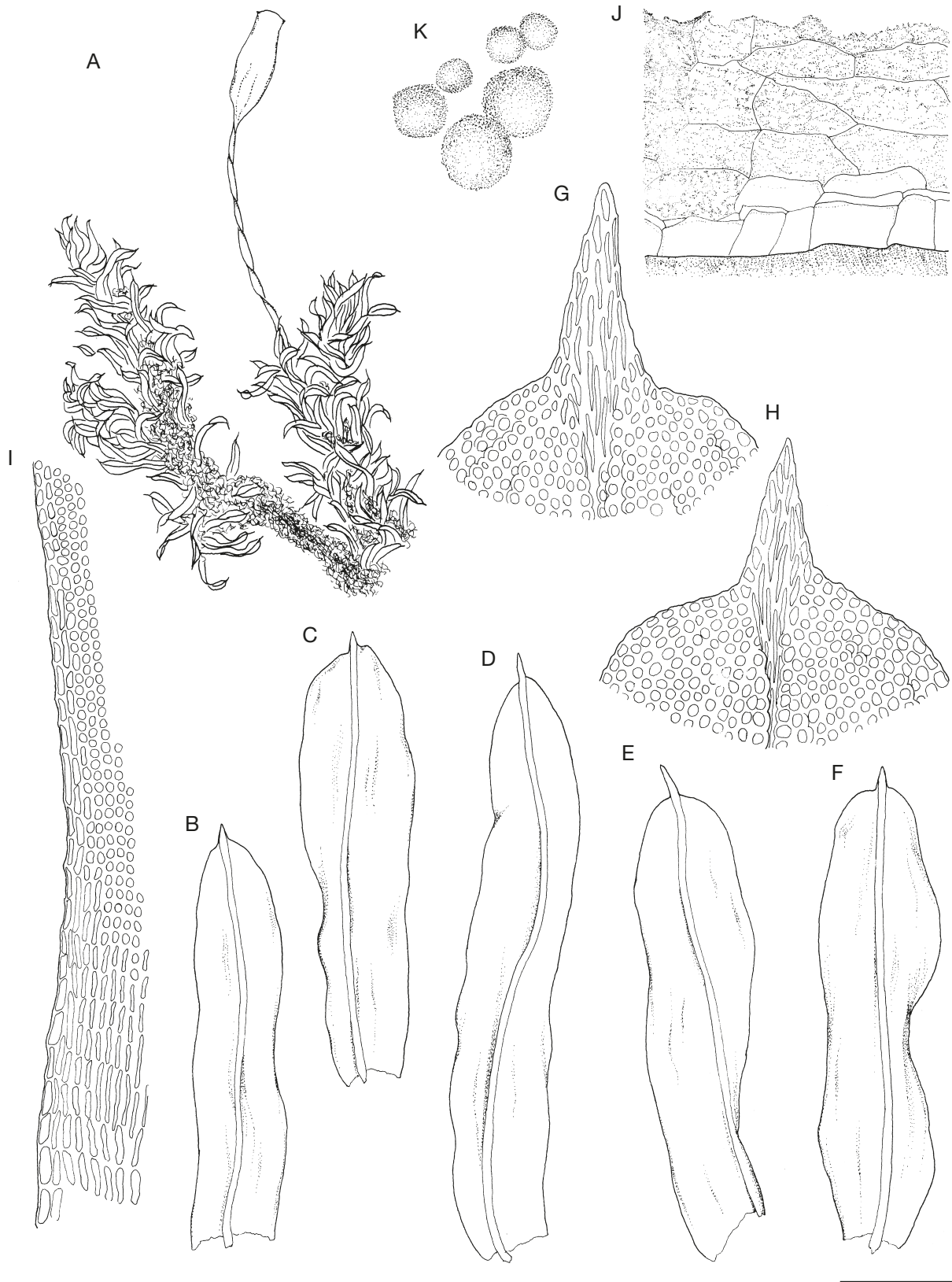


FIG. 4. — *Groutiella apiculata* (Hook.) H.A. Crum & Steere: **A**, habit; **B-F**, leaves; **G-H**, apical leaf cells; **I**, medial and basal leaf cells with margin; **J**, portion of peristome; **K**, spores. **A** from *Allen 14033B* (MO); **B, D** from *Allen 15136* (MO); **C** from *Allen 17979* (MO); **E, G** from *Chávez 254* (MO); **F, H, I** from *Allen 19386* (MO); **K** from *Steere 6792* (MO). Scale bar: A, 2 mm; B-F, 0.5 mm; G, H, 80 μ m; I, 100 μ m; J, K, 50 μ m. Credits: Yu N.-N.

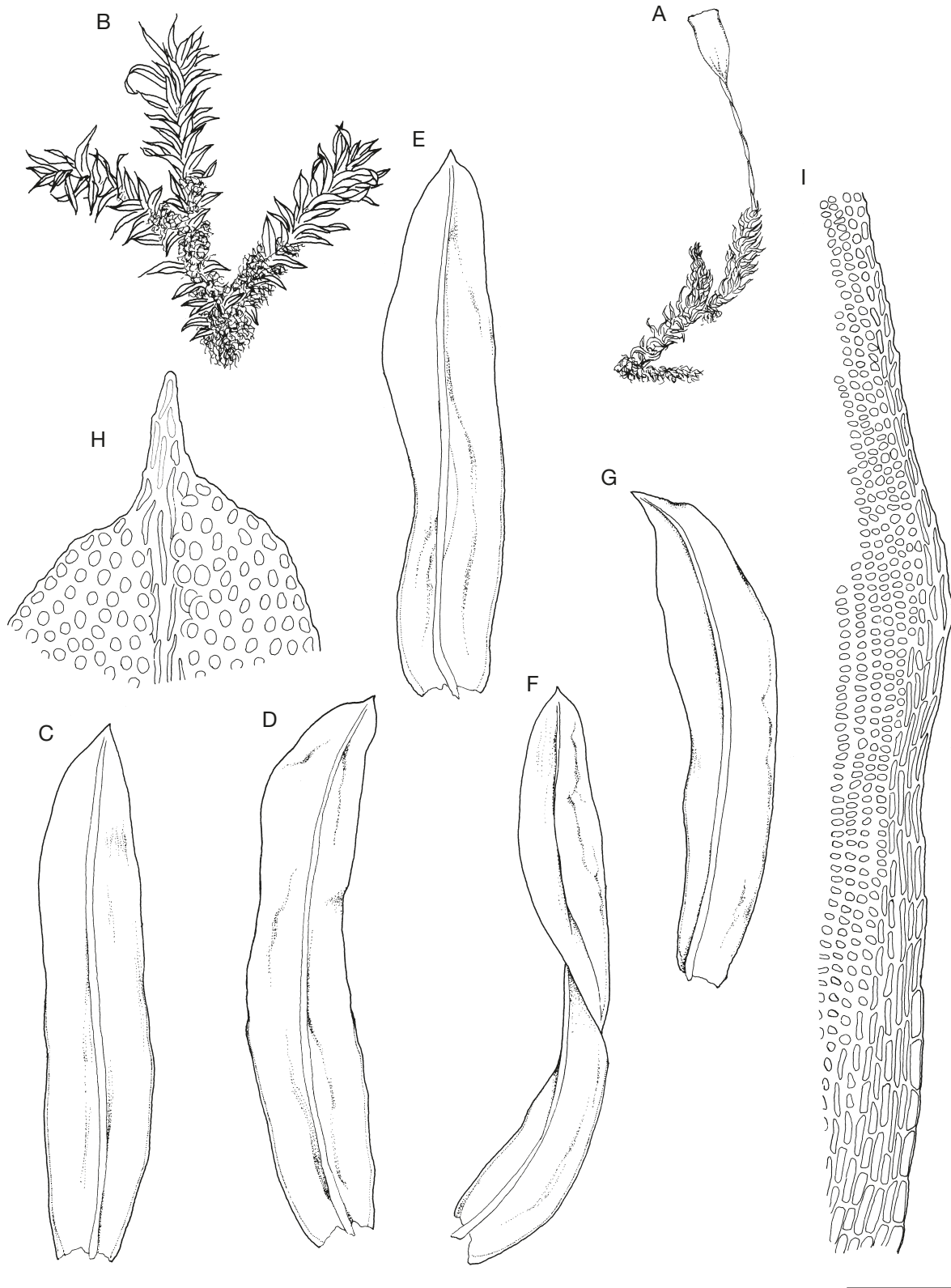


FIG. 5. — *Groutiella apiculata* (Hook.) H.A. Crum & Steere: **A**, plant when dry; **B**, plant when wet; **C-G**, leaves; **H**, apical leaf cells; **I**, marginal leaf cells. All from *Wagner s.n.* (NY), syntype of *G. wagneriana* (Müll. Hal.) H.A. Crum & Steere. Scale bar: A, 0.6 cm; B, 4.5 mm; C-G, 0.7 mm; H, 53 μ m; I, 105 μ m. Credits: Yu N.-N.

Ecuador. Andes Quitenses, ad radices occidentalis montis Chimborazo (3500 ped.), *Spruce n. 110* (syn-, NY); Cotopaxi, Rio Pilaló, *L. Holm-Nielsen et al. 3144* (MO).

Guatemala. Laguna del Pino, *Bernoulli & Cario 47* (syntype of *Macromitrium semimarginatum*, HBG); Jalapa, Jalapa, *Clover 10206* (MO).

Guyana. Rupununi, Kanuku Mts, *Maas & Westra 3880* (MO).

Honduras. Lempira, Gracias, *Allen 11845* (MO).

Mexico. Jalisco, Rio Blanco, *Pringle 10560* (isotype of *G. undosa*, MO); Michoacán, Uruapan Municipio, *Landry 23.6* (MO); Querétaro, *Landry 15.6* (MO); San Luis Potosi, Antiguo Morelos, *R.A. Pursell 5422* (MO); Sinaloa, Panuco, *Pursell s.n.* (MO); Tamaulipas, Rancho del Cielo, *M.G. Manuel 169* (MO).

Nicaragua. Matagalpa, Esquipulas, *Stevens 11909* (MO).

Panama. Chiriquí, Boquete, *Crosby 3972* (MO); *Croat 67935* (MO); Cerro Horqueta, *D'Arcy 6481* (MO).

DISTRIBUTION AND HABITAT. — The tropical region of America, north to Mexico, south to Bolivia (Santa Cruz). On bark of tree trunks and upper branches, rarely on soil; 880-2600 m.

DESCRIPTION

For description, see Grout 1946; Bartram 1949; Vitt 1994; Churchill & Linares 1995; Allen 2002.

COMMENTS

The leaves of *G. chimborazensis* are lanceolate, and the costa are excurrent, end below or in the apex. There is a variation in the apex and lamina. The apex could be acute to sharply acuminate, which can be found in one specimen. The lamina is usually plane, but also can be undulate.

G. macrorrhyncha is very similar to *G. chimborazensis* in having lanceolate leaves. It differs from *G. chimborazensis* in having a stoutly excurrent costa.

Groustiella husnotii (Besch.) H.A. Crum & Steere (Fig. 7)

The Bryologist 53: 147 (Crum & Steere 1950).

SPECIMENS EXAMINED. — **Brazil.** *S.l., Tello s.n.* (HBG[2189-4]).

Colombia. Cundinamarca, Villeta Municipio, *Linares & Churchill 4138* (MO); Magdalena, Filo Cartagena, *Churchill & Linares 18419* (MO).

Dominica. St. George, *Hegewald 9430* (MO).

Honduras. Comayagua, from Agua Amarilla to San José Del Los Planes, *Allen 14033B* (MO).

Martinique. St. Pierre, *Husnot 145* (holo-, PC, NY); *s.l., s.n.* (HBG [2189-8]).

Puerto Rico. Barranquitas, *Steere 4605* (MO); Jayuya, 29.III.1929, *Laubengayer s.n.* (MO); 30.III.1929, *Laubengayer s.n.* (MO); Villalba, *Steere 6852* (MO); Cayey, *Steere 5101* (MO); *Steere 5245* (MO); Adjuntas, *Steere 7180* (MO).

Venezuela. Lara, Seirra de Portuguesa, *Griffin 334* (MO); Mérida, Distrito Libertador, *Griffin et al. 017508* (MO); Monagas, Caripe, *Pursell 8479* (MO); Santa Inés, *Pursell 8955* (MO).

DISTRIBUTION AND HABITAT. — The tropical region of America. On bark, or on rocks; (140-) 900-1800 m.

DESCRIPTION

For description, see Grout 1946; Churchill & Linares 1995; Allen 2002.

COMMENTS

The extraordinary character of *Groustiella husnotii* is that the height of leaf marginal border is the tallest in *Groustiella*, which usually extends to $\frac{2}{3}$ of the leaf, and even can reach into the apex. The length of the stout apiculus which is formed by the excurrent costa varies in length from 90 μm (e.g. *Hegewald 9430*) to 240 μm (e.g. *Steere 7180*).

Crosby (1970) pointed out that *G. apiculata* was similar to *G. husnotii* since they both have a stout apicula and excurrent costa, therefore, *G. apiculata* and *G. husnotii* could be confused by each other (e.g. HBG[2189-4] identified to *G. apiculata*). However, *G. husnotii* can be easily identified by its longer limbidia ($\frac{2}{3}$ of leaf, Fig. 7G-H) and a lanceolate leaf with acute to acuminate apex, at the same time, *G. apiculata* differs in much shorter limbidia ($\frac{1}{3}$ of leaf) and a lingulate leaf with obtuse apex (Figs 4G-H; 7F).

Groustiella macrorrhyncha

(Mitt. ex Bosch & Sande Lac.) Wijk & Margad.
(Fig. 8)

Taxon 9: 51 (Wijk & Margadant 1960).

Micromitrium maracaibense Broth., *Mitteilungen aus dem Institut für allgemeine Botanik in Hamburg* 8: 403 (Brotherus 1931). — *Groustiella maracaibensis* (Broth.) B.H. Allen & Goffinet, *Monographs in Systematic Botany from the Missouri Botanical Garden* 90: 544 (Allen 2002). — Type: Venezuela. Maracaibo, *E. von Jess s.n.* (syn-, H!), **syn. nov.**

SPECIMENS EXAMINED. — **Costa Rica.** Alajuela, Monte Verde, *McQueen 5048A* (MO); Cartago, Tapantí Forest Reserve, *Griffin & Eakin 019960* (MO).

Indonesia. Java, 1906, *Pamplin s.n.* (syn-, NY).

Nicaragua. Matagalpa, Hamonia, *I. Granzow de la Cerda 11611* (MO).

Panama. Cerro Colorado, *Allen 5349* (MO).

Venezuela. Maracaibo, *E. von Jess s.n.* (syn-, H).

DISTRIBUTION AND HABITAT. — The tropical region of America; Indonesia Islands (Java). On bark of tree trunks, upper branches, and twigs; 1000-1500 m.

DESCRIPTION

For description, see Mitten 1860; Brotherus 1931; Allen 2002.

COMMENTS

G. maracaibensis was published by Brotherus in 1931, as *Micromitrium maracaibense* Broth. and transferred to *Groustiella* by Allen and Goffinet in 2002. Mitten published *Macromitrium macrorrhynchum* Mitt. ex Bosch & Sande Lac. (accepted name: *Groustiella macrorrhyncha*, *fide* Wijk & Margadant 1960) in 1860 based on the “oblongo-lingulata” leaves and the excurrent costa. The characters of the type specimen from NY display *Groustiella macrorrhyncha* leaves as oblong-lanceolate with excurrent costa, with gradually acute to acuminate apices, which are identical to *G. maracaibensis*. In this paper, *Groustiella maracaibensis* is synonymised under *G. macrorrhyncha*. After this treatment, *G. macrorrhyncha* distributes in both New and Old world continents. *G. tomentosa* (Hornsch.) Wijk & Margad. is another species in this genus distributed pantropically.

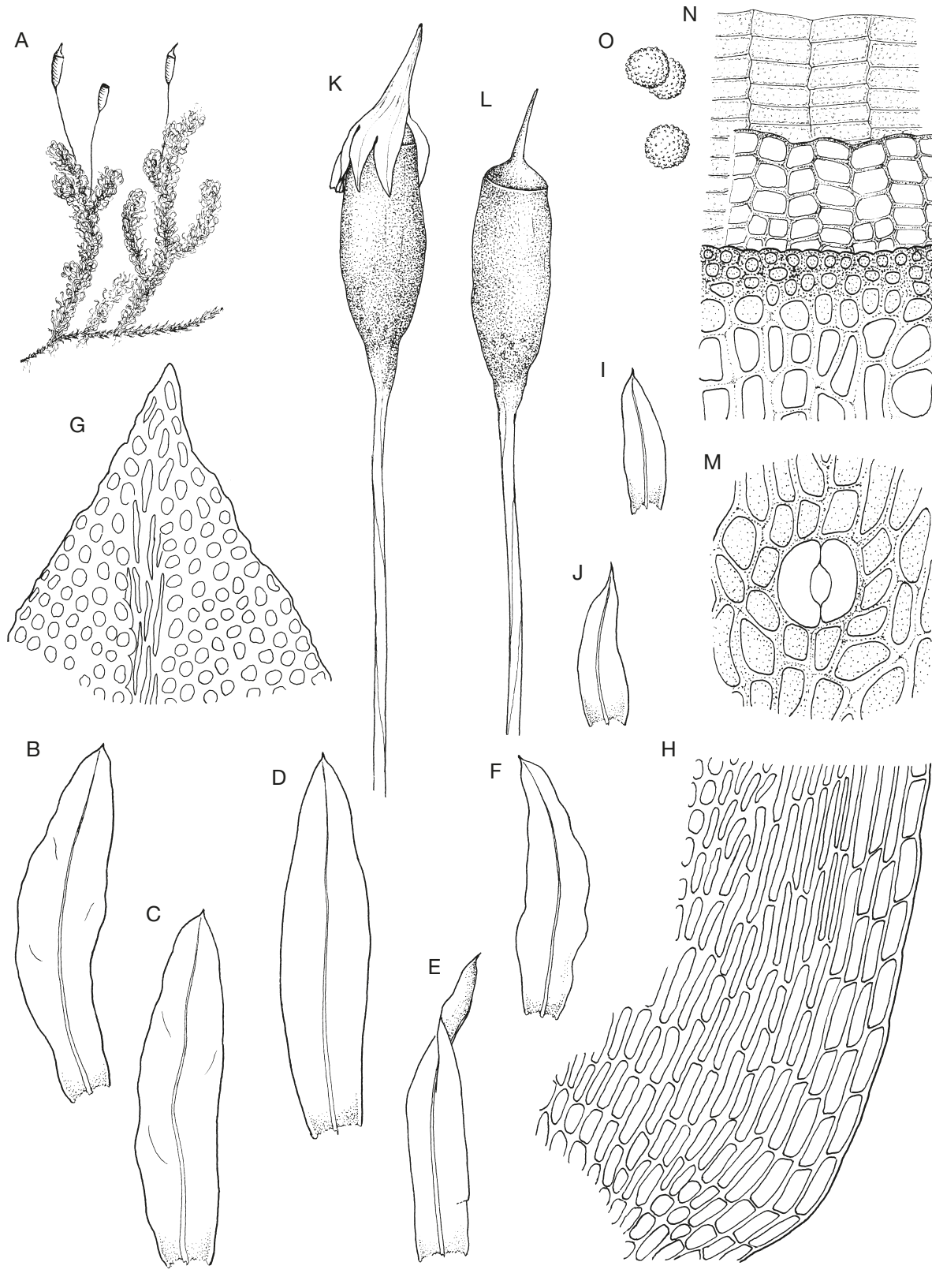


FIG. 6. — *Groustiella chimborazensis* (Spruce ex Mitt.) Florsch.: **A**, plant; **B-D**, median leaves; **E, F**, basal leaves; **G**, apical leaf cells; **H**, basal leaf cells; **I, J**, perichaetial bract; **K, L**, capsule; **M**, phaneropore; **N**, portion of peristome; **O**, spores. All from *Pringle 10560* (MO), isotype of *Macromitrium undosum* Card. Scale bar: A, 1 cm; B-F, I, J, 1.15 mm; G, H, 55 μ m; K, L, 1.8 mm; M-O, 232 μ m. Credits: Yu N.-N. & Guo M. S.

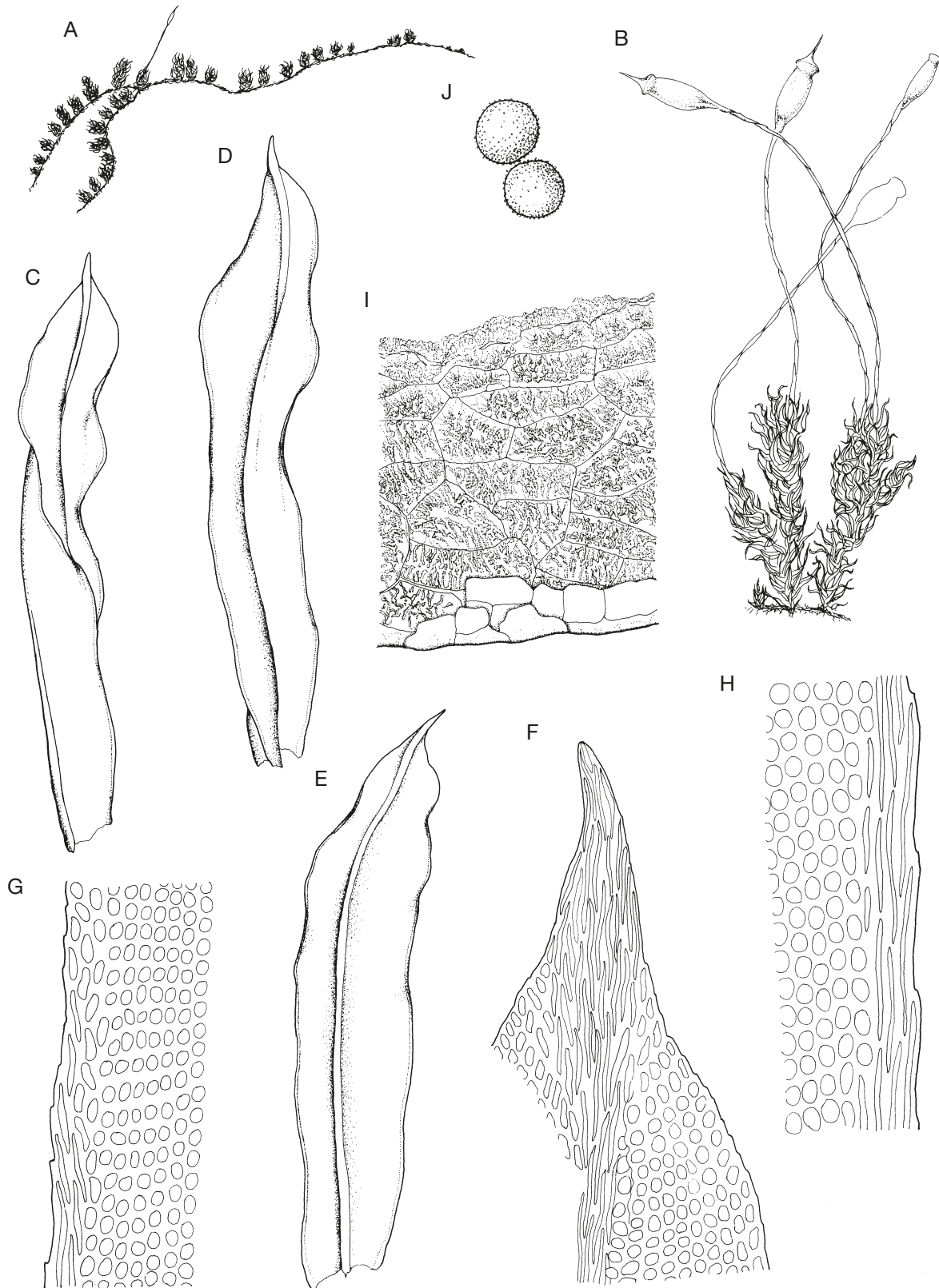


FIG. 7. — *Groutiella husnotii* (Besch.) H.A. Crum & Steere: **A**, plant; **B**, branches with capsules; **C-E**, leaves; **F**, apical leaf cells; **G**, upper marginal leaf cells; **H**, median marginal leaf cells; **I**, portion of peristome; **J**, spores. **A**, **C-H** from Husnot Exsicc. 145 (syntype of *G. husnotii*, PC); **B**, **I**, **J** from Steere 7180 (MO). Scale bar: A, 1.9 cm; B, 3.5 mm; C-E, 0.6 mm; F-H, J, 60 μ m; I, 58 μ m. Credits: Yu N.-N.

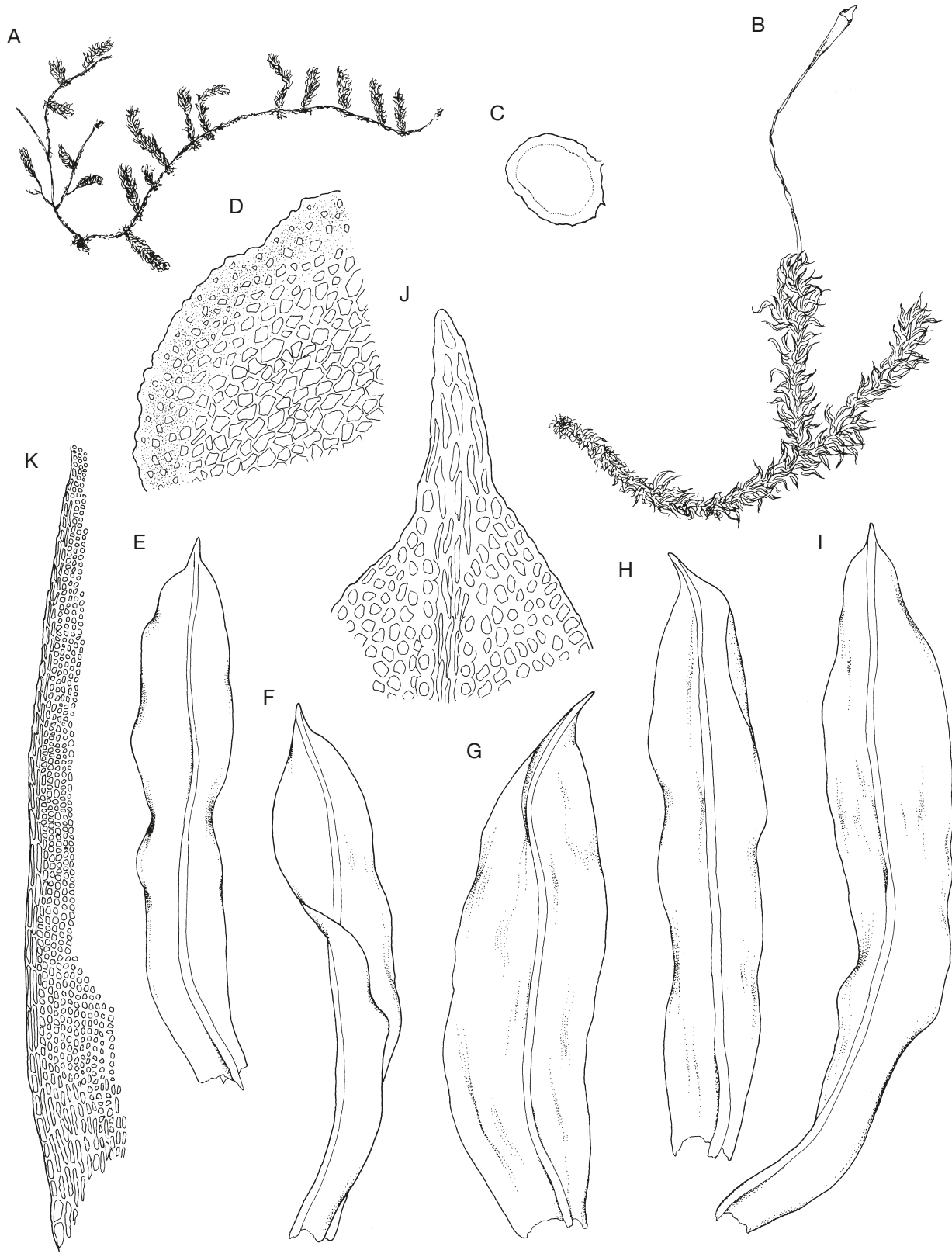


FIG. 8. — *Groutiella macrorrhyncha* (Mitt. ex Bosch & Sande Lac.) Wijk & Margad.: **A**, plant; **B**, branches with capsule; **C**, cross section of stem; **D**, portion of cross section of stem; **E-I**, leaves; **J**, apical leaf cells; **K**, marginal leaf cells. All from *Pamplin s.n.*, syntype of *G. macrorrhyncha*, NY. Scale bar: **A**, 1.7 cm; **B**, 5 mm; **C**, **E-I**, 0.4 mm; **D**, 100 μ m; **J**, 53 μ m; **K**, 160 μ m. Credits: Yu N.-N.

Groutiella macrorrhyncha has lanceolate leaves with stoutly excurrent costae, and are clearly crispate when dry. There is a variation in the apices of *G. macrorrhyncha* where the apices are only gradually acute (e.g. *Griffin et al. 19960, D'Acay 6481*), or acuminate (e.g. *Allen 5349*).

Groutiella chimborazensis has lanceolate leaves with short acuminate apices and crispate when dry, so it is difficult to distinguish it from *G. macrorrhyncha* in habit. However, *G. chimborazensis* differs from *G. macrorrhyncha* in the percurrent costa or costa almost ending below the apex (Fig. 6G), while *G. macrorrhyncha* has an excurrent costa (Fig. 8J).

Groutiella obtusa (Mitt.) Florsch.
(Fig. 9)

Flora of Suriname 6 (1): 210 (Florschütz-de 1964).

SPECIMENS EXAMINED. — **Bahamas**. Archipelago, Marsh Harbor Site, *Lassiter & Saulea* 2078 (MO).

Belize. Cayo, Las Cuevas Field Station, *Allen 18067* (MO).

Brazil. Amazon, Caripi & Para, *Spruce 111* (lecto-, NY); Pará, Vigia, *Davidse et al. 17600* (MO).

Colombia. Risaralda, Soratama, *Schultes & Cabrera 12857* (MO).

Dominica. Puerto Plata, Pico El Murazo, *Reese 15453* (MO).

Ecuador. Morona Santiago, Carretera Macas-Limón, *Ortega U. 504* (MO).

Guyana. Cuyuni-Mazaruni, Matope Falls, *Graham 351* (MO); Guiana, *Richard s.n.*

Peru. Loreto, Maynas, *Hegewald 6327* (MO).

Suriname. Brokopondo, *Allen 19351* (MO); Sipaliwini, Tafelberg, *Allen 23579* (MO); El Dorado Falls, *Allen 19246* (MO).

Venezuela. Amazonas, Río Negro, *Liesner 16772A* (MO, NSW).

DISTRIBUTION AND HABITAT. — The tropical region of America, north to Belize, south to Peru (Loreto). On bark of tree trunks and branches, and on rotten logs; 50-1200 m.

DESCRIPTION

For description, see Grout 1946; Florschütz-de 1964; Churchill & Linares 1995; Allen 2002.

COMMENTS

Groutiella obtusa is distinguished from all other species of *Groutiella* by its remarkably rugose leaves with raised streaks on the upper lamina, like the leaves of *Macromitrium contextum* Hampe. The length of leaves has some variation, from 1.3 to 2.0 mm, but all are typically lingulate (Fig. 9B-E).

Another special character of *G. obtusa* is the spores, which are polygonal concave-constricted (Figs 3G; 9H). The only other *Groutiella* species with polygonal concave-constricted spores is *G. tumidula*. This character is documented to occur in *Groutiella* for the first time.

Groutiella reesei (Vitt) B.H. Allen
(Fig. 10)

Monographs in Systematic Botany from the Missouri Botanical Garden 90: 551 (Allen 2002).

SPECIMENS EXAMINED. — **Mexico**. Veracruz, Huatusco Municipio, *Reese 4450* (MO); *Reese 4451* (para-, MO).

DISTRIBUTION AND HABITAT. — Mexico; Central America (Allen 2002). On bark of tree trunks and branches; 545-1250 m.

DESCRIPTION

For description, see Vitt 1979, 1994; Allen 2002.

COMMENTS

Groutiella reesei was published as a subspecies of *G. chimborazensis* by Vitt (1979), but later promoted to the rank of species by Allen (2002) based on two leaf features: the bulging quadrate cells on the upper dorsal surface of the costa, and the thickened (Fig. 10K), fragile and frequently broken leaf apices (Fig. 10D, G, J). Including these two characters, the species further differs from *G. chimborazensis* by having much lower leaf marginal border that consists of two rows of short-rectangular to rectangular cells (Fig. 10L). *Groutiella tomentosa* also has fragile apices, but differs in its longer leaf limbidia consisting of elongated cells.

Groutiella tomentosa (Hornsch.) Wijk & Margad.
(Fig. 11)

Taxon 9: 51 (Wijk & Margadant 1960).

Macromitrium thraustophyllum Müll. Hal. ex Broth., *Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie* 24: 242 (Brotherus 1897). — *Micromitrium thraustophyllum* (Müll. Hal. ex Broth.) Paris, *Index Bryologicus* 3: 241 (Paris 1905). — *Groutiella thraustophylla* (Müll. Hal. ex Broth.) Wijk & Margad., *Taxon* 9: 51 (Wijk & Margadant 1960). — Type: **Cameroon**. An Bäumen und Ästen bei Bibundi, Tokko und Buea, *Dusén s.n.* (isosyn-, PC!), **syn. nov.**

Macromitrium subgoniorrhynchum Broth., *Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch-naturwissenschaftliche Klasse* 84: 391 (Brotherus 1908). — *Micromitrium subgoniorrhynchum* (Broth.) Broth., *Die natürlichen Pflanzenfamilien, Zweite Auflage* 11: 45 (Brotherus 1925). — *Groutiella subgoniorrhyncha* (Broth.) Wijk & Margad., *Taxon* 9: 51 (Wijk & Margadant 1960). — Type: **Samoa**. Savai'i Island, "Insel Savaii. Krater Maungaafi.", **syn. nov.**

SPECIMENS EXAMINED. — **Angola**. Cuarza River, 1937, *Boss s.n.* (MO). **Australia**. Queensland, Cook, *Norris 43540, 40897, 43099, 43108* (NSW).

Belize. Cayo, Las Cuevas Field Station, *Allen 18062* (MO); Toledo, Columbia River Forest Reserve, *Allen 18613* (MO).

Bolivia. La Paz, Franz Tamayo, *Fuentes et al. 4060* (MO); Santa Cruz, Prov. Ichilo, *Churchill & Arroyo P. 21527-B* (MO).

Brazil. Amazonas, "ibidem loco Tanaú," *Spruce 110c* (syntype of *G. fragilis*, NY); "in campis montecidensibus," *s.d.*, *F. Sellow s.n.* (lecto-, H); Pará, Serra do Cachimbo, *Reese 16161* (MO); Base Aérea do Cachimbo & vic., *Reese 16128* (MO); Sergipe, Rio Tabora, *Vital 2874* (MO).

Cameroon. Bipinde, Urwaldgebiet, *Zenker 2186* (HBG); "an Baumstämmen und Baumästen bei Etome, Lifenja, Bonge, Itoki und Ekumba-Liongo", *Dusen s.n.* (type of *G. sarcotricha*, PC).

China. Yunnan, Simao Co., *Xu 6959, 11337* (MO, PE).

Colombia. Putumayo, Carretera between Mocoa and Puerto Asis, *Giraldo-Cañas 2163* (MO).

Comoros. Anjouan (Ndzuwani), W of Gegi, *Magill & Pócs 11432* (MO); Grande Comore (Ngazidja), N of Massif du Kartala, *Magill & Pócs 10947* (MO); along road between Koimbani & Salimani,

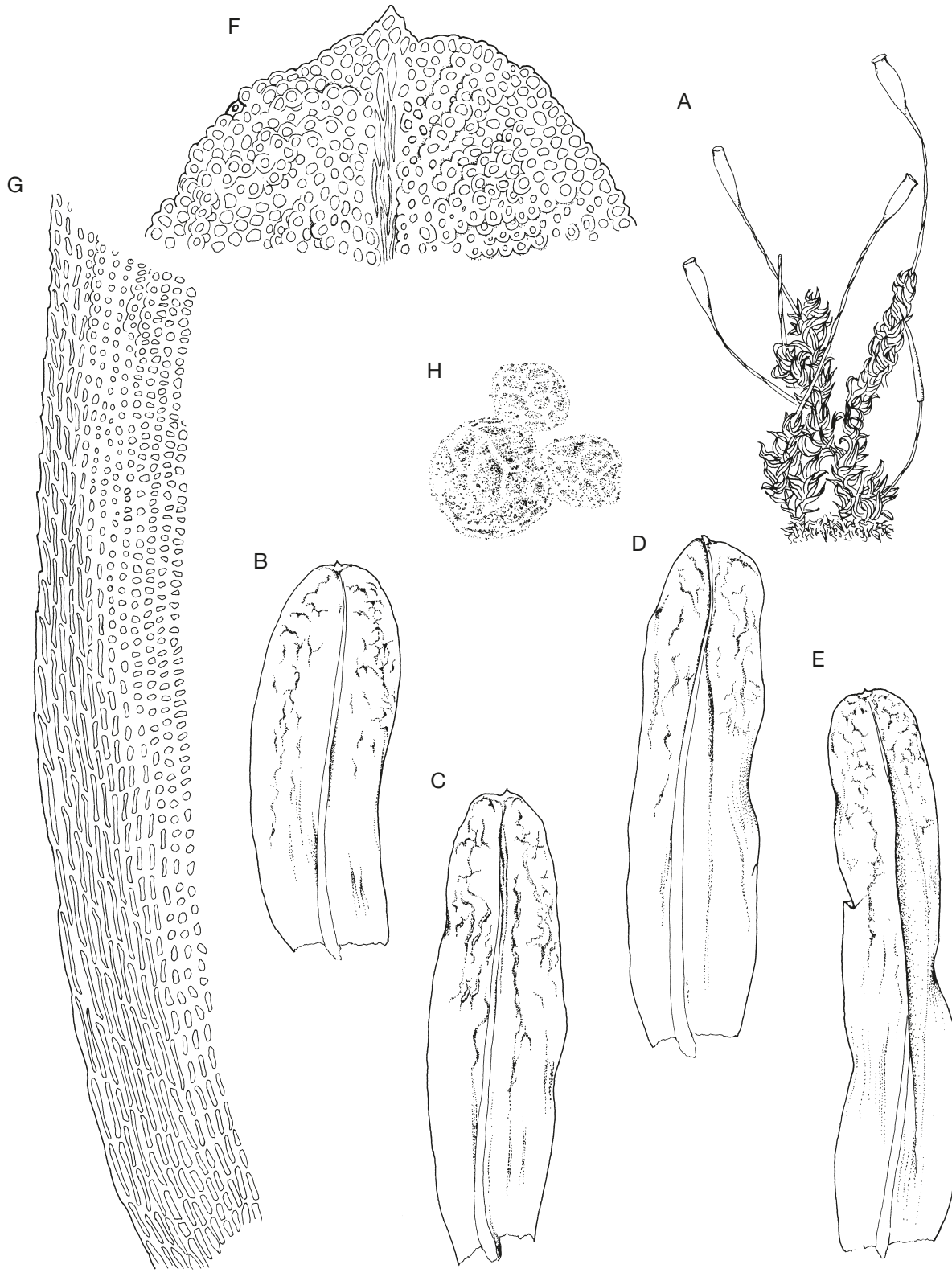


FIG. 9. — *Groutiella obtusa* (Mitt.) Florsch.: **A**, branches with capsules; **B-E**, leaves; **F**, apical leaf cells; **G**, marginal leaf cells; **H**, spores. **A**, **H** from *Liesner 16772* (MO, NSW); **B-G** from *Spruce 111*, lectotype of *G. obtusa*, NY. Scale bar: **A**, 2.6 mm; **B-E**, 0.5 mm; **F**, 125 μ m; **G**, 170 μ m; **H**, 20 μ m. Credits: Yu N.-N.

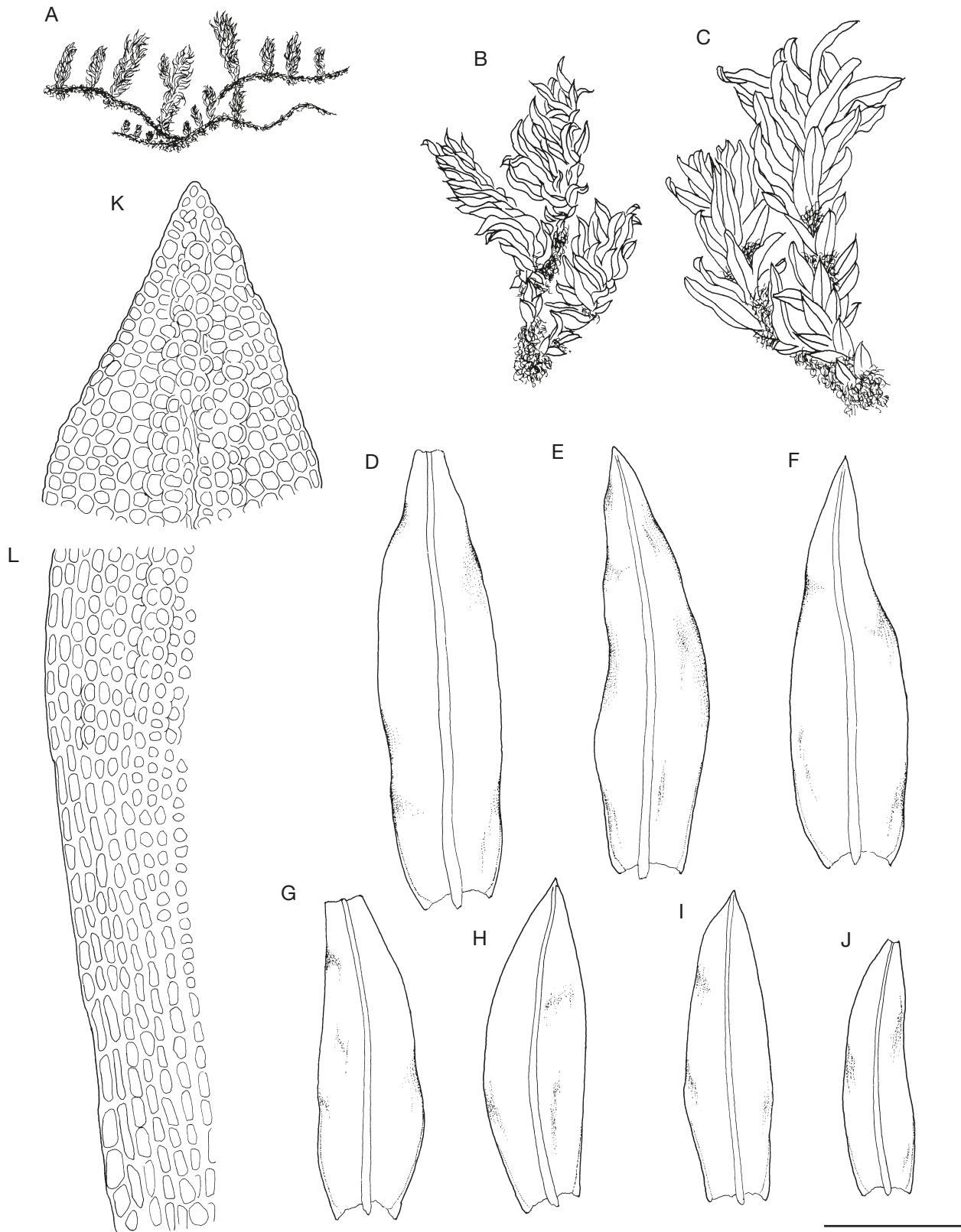


FIG. 10. — *Groutiella reesei* (Vitt) B.H. Allen: **A**, plant; **B**, branches when dry; **C**, branches when wet; **D–J**, leaves; **K**, apical leaf cells; **L**, basal marginal leaf cells. All from Reese 4451, paratype of *G. reesei*, MO. Scale bar: A, 5.6 mm; B, 1.9 mm; C, 2.1 mm; D–J, 0.7 mm; K, 73 μ m; L, 76 μ m. Credits: Yu N.-N.

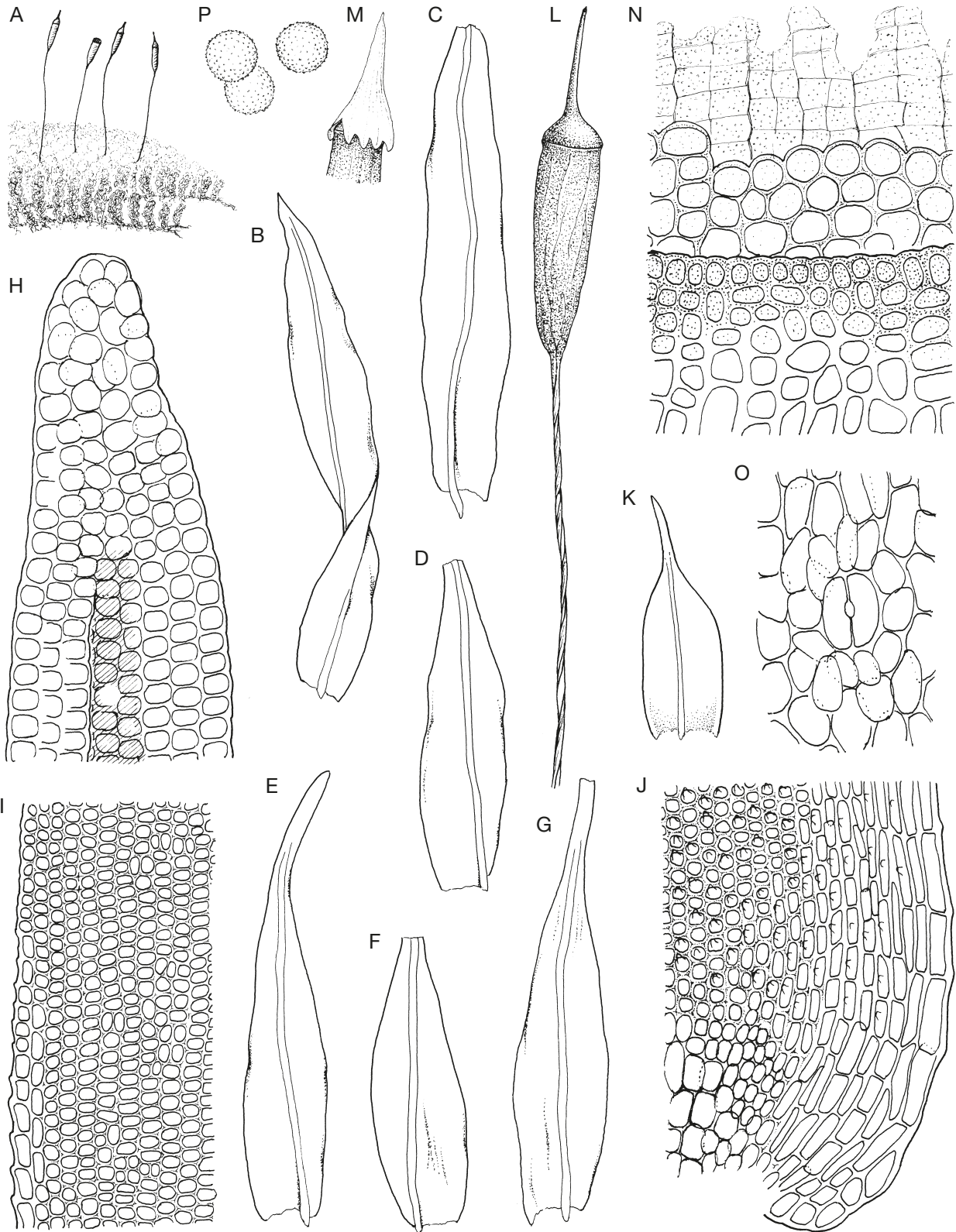


FIG. 11. — *Groustiella tomentosa* (Hornsch.) Wijk & Margad.: **A**, plant; **B–G**, leaves; **H**, apical leaf cells; **I**, median marginal leaf cells; **J**, basal leaf cells; **K**, perichaetial bract; **L**, capsule; **M**, calyptra; **N**, portion of peristome; **O**, phaneropore; **P**, spores. **A, K–P** from *Larsen et al.* 2362 (MO); **B, C** from *de Robillard s.n.*, lectotype of *G. laxotorquata* (Müll. Hal. ex Besch.) Wijk & Margad.; **D–G** from *Allen* 25041 (MO); **H–J** from *Sellow s.n.*, lectotype of *G. tomentosa*, H. Scale bar: **A**, 1.2 cm; **B–J**, 90 μ m; **K**, 0.9 mm; **L, M**, 3 mm; **N–P**, 130 μ m. Credits: Yu N.-N. & Guo M. S.

Magill & Pócs 10960 (MO).

Costa Rica. Guanacaste, along secondary road 150 between Tilarán & Tronadora, *Crosby 3740* (MO); San José, Meseta Central, *Holz CR 99-1344* (MO).

Ecuador. Galápagos, Isla Santa Cruz, *Weber B-13523* (MO).

Gabon. Gabon, Bamba, *Leits 6149* (HBG).

Ghana. Eastern, Ahuri Bot. Garden near Accra, *Richards 6302, 6966* (MO).

Guinea. “Arbres pres de Bourouhadjo, Apr. 1901”, *Norman s.n.* (syntype of *G. limbatula*, PC); “Arbres pres Dango, Mar. 1901”, *Norman s.n.* (syntype of *G. pleurosignoidea*, PC); Kankan, Kouroussa, “ad ramnlos editiores arborum viae, 1903”, *H. Pobeguini s.n.* (syntype of *G. pobeguini*, PC).

Honduras. Atlántida, Pico Bonito Natl. Park, *Allen 17285* (MO); Comayagua, trail from San José Del Los Planes to El Plan, *Allen 13755* (MO); Copán, along rd. to Agua Caliente at El Zapote, *Allen 17733* (MO); Yoro, Cordillera Nombre de Dios, *Allen 13513* (MO).

Indonesia. Java, Samarang prope Medini, monte Ungaran, s. coll. (syntype of *G. goniorrhyncha*, NY); Tjibodas, *Winkler 176* (HBG); Lombok, Mt. Rinjani, *Sebert 1545* (NSW); Sumatra, s.l., *Teymann s.n.* (NY).

Ivory Coast. Dix-Huit Montagnes, Mt. Toukovi Bei Man, *Frahm 802971* (MO).

Jamaica. St. James Parish, Montego Bay, *Hegewald 8219* (MO); St. Thomas Parish, W of Arntully & May Hall, *Crosby 3350* (MO).

Mauritius. S.l., 1876, *Monkemeyer s.n.* (HBG).

Mexico. México, 22-24 mi. WSW of Mexico City, *Reese 4447* (MO); Veracruz, Sierra de la Cruz, *Mueller 2261a* (syntype of *G. schlumbergeri*, NY); s.l., V. de Robillard (lectotype of *G. laxtoquata*, H).

Nicaragua. Estelí, N slope of Cerro Tomabú, *Stevens 15016* (MO); Jinotega, c. 2 km NW of San Rafael del Norte on rd., *Stevens & Grijalva 15070* (MO); s.l., *Schiede s.n.* (HBG).

Nigeria. Bendel, Benin Prov., Okomu Forest Reserve, *Richards 3936* (MO); Minna, Abuja Distr., Garki Kuimi, *Jones 887* (MO); Ogoja, Ikom, Afi River Forest Reserve, *Jones 18947* (MO); Obudu division, Sonkwala area, *Savory & Keay 25141* (MO).

Panama. Panamá, along rd. around Goofy Lake, *Crosby 4346* (MO).

Papua New Guinea. Morobe, Yabim, 1903, *J. Kaulfuss s.n.* (HBG, NSW).

Philippines. St-Andre-des-Arts, *Paris s.n.* (HBG); Luzon Island, Rizal Prov., *Ramos 12550* (NSW); Sablang Prov., *Fénix 12806* (NSW); Benguet Prov., *Elmer 8345* (NSW).

Sierra Leone. Western, Leicester Peak, 1948, *Brenan s.n.* (MO).

Suriname. Brokopondo, Brownsberg Nat. Reserve, *Magombo 5325* (MO); Para, Joden Savanne, *Allen 19459* (MO); Paramaribo, s.l., *Price 370* (NSW); Sipaliwini, Kayserberg Airstrip, *Allen 25041* (MO).

Tanzania. Tanga, Korogwe Distr., *Brenan 1621* (MO).

Thailand. Northern, Ban Mae Pang 30 km N of Mae Sariang, *Larsen et al. 2362* (MO); 30 km S of Bo Luang along Om Koi trail, *Larsen et al. 2060* (MO); Doi Pha Dam between Hang Dong & Bo Luang, *Larsen et al. 2197* (MO); Peninsular, Yala, *Charoenphol et al. 4140* (MO); Prachinburi, Khao Yai Natl. Park, Khao Khieo, *Larsen et al. 137, 224* (MO).

Trinidad and Tobago. St. George, Northern Range, near summit of Lalaja Rd., *Crosby 2145* (MO).

Unknown country. Longbiou, *Uerhawk? s.n.* (HBG); Menigsea[?], Vecas Caiccy?, *Sumichrash s.n.* (NSW).

DISTRIBUTION AND HABITAT. — The tropical region of the world. On bark of tree trunks and branches, rotten logs, and rocks; 5-1880 m.

DESCRIPTION

For description, see Brotherus 1908, 1897; Grout 1946; Florschütz-de 1964; Vitt & Crum 1970; Gangulee 1976; Crum & Anderson 1981; Vitt & Ramsay 1985; Vitt 1994; Wu 1994; Churchill & Linares 1995; Vitt *et al.* 1995; Allen 2002.

COMMENTS

In Africa, Bizot (1965, 1973) and Yu *et al.* (2011) treated five species as synonyms of *G. tomentosa*. *G. thraustophylla*, an old Cameroon species, was described by Müller (in Brotherus 1897), noted that “speciei praecedenti *M. sarcotrichum* Müll. Hal. (accepted name: *Groutiella tomentosa*) quoad foliorum structura omuino conveniens”. The differences between *G. thraustophylla* and *G. sarcotrichum* (accepted name: *G. tomentosa*) were “sed statura multo giaciliore; ramulis laxius dispositis, foliis crispulo-imbricatis, summo apice ramuli tantum indistincte spiraliter contortis, dorso rugulosis dignoscenda” (Müller in Brotherus 1897). The variation of the characteristics mentioned is all within the concept of *G. tomentosa*. Here we treat *G. thraustophylla* as a synonym of *G. tomentosa*.

Brotherus described the leaves of *Groutiella subgoniorrhyncha* as being “oblongo-lanceolata, sensim auguste acuminate, acumine saepe diffracto”, the characters of leaf shape, apex are all identical to the ones of *G. tomentosa*. We confirmed Brotherus’ description based on the type specimen; therefore, we treat it as a synonym of *G. tomentosa*.

The diagnostic characters for *Groutiella tomentosa* are the fragile, cuspidate to stoutly subulate leaves and the papillose basal leaf cells. The long, fragile subulae of the upper leaves are usually wider and fewer in the specimens from Africa than from other places (e.g. *Magill 11432, Magill & Pócs 10960*). *G. reesei* is the only other species with fragile leaf apex in the genus, the differences between them can be found in discussion of *G. reesei*. *G. tuberculata* B.H. Allen & I.H. Holz another species in the genus with papillose basal leaf cells, but the papilla of it is much more obvious than *G. tomentosa*, meanwhile it never has a fragile apex.

There are some differences between the upper and lower leaves in *G. tomentosa*. The upper leaves are narrowed to a long, fragile subula (to 1 mm long). While the lower leaves usually have acute, non-fragile tips, which are similar to the leaves of *G. chimborazensis*, but *G. chimborazensis* never has a long, fragile leaf apex.

Groutiella tuberculata B.H. Allen & I.H. Holz (Fig. 12)

Monographs in Systematic Botany from the Missouri Botanical Garden 90: 555 (Allen 2002).

SPECIMENS EXAMINED. — **Costa Rica.** San José, Cordillera de Talamanca, 4 km N San Gerardo de Dota and 1 km W of Jaboncillo, *Holz CR 99-981* (iso-, MO).

DISTRIBUTION AND HABITAT. — Central America. On bark of branches, 2900 m.

DESCRIPTION

For description, see Allen (2002).

COMMENTS

Groutiella tuberculata is easy to be recognized for its consistently papillose basal leaf cells. *Groutiella tomentosa* is the other species of the genus with papillose basal leaf cells.

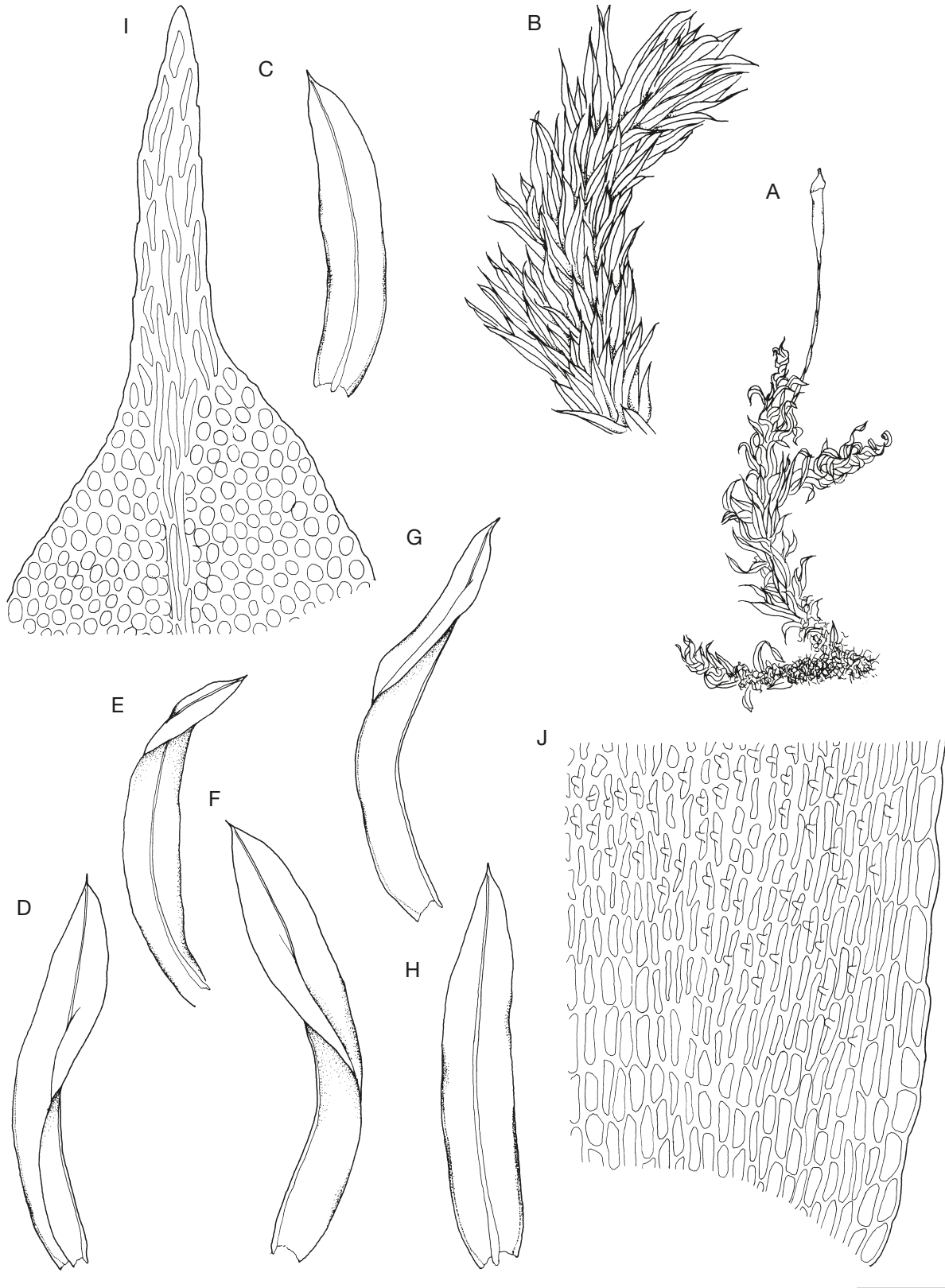


FIG. 12. — *Groutiella tuberculata* B.H. Allen & I.H. Holz: **A**, branches with capsule; **B**, branch when wet; **C-H**, leaves; **I**, apical leaf cells; **J**, basal leaf cells. All from Holz CR99-0981, isotype of *G. tuberculata*, MO. Scale bar: A, 3 mm; B, 2 mm; C-H, 156 μ m; I, J, 42 μ m. Credits: Yu N.-N.

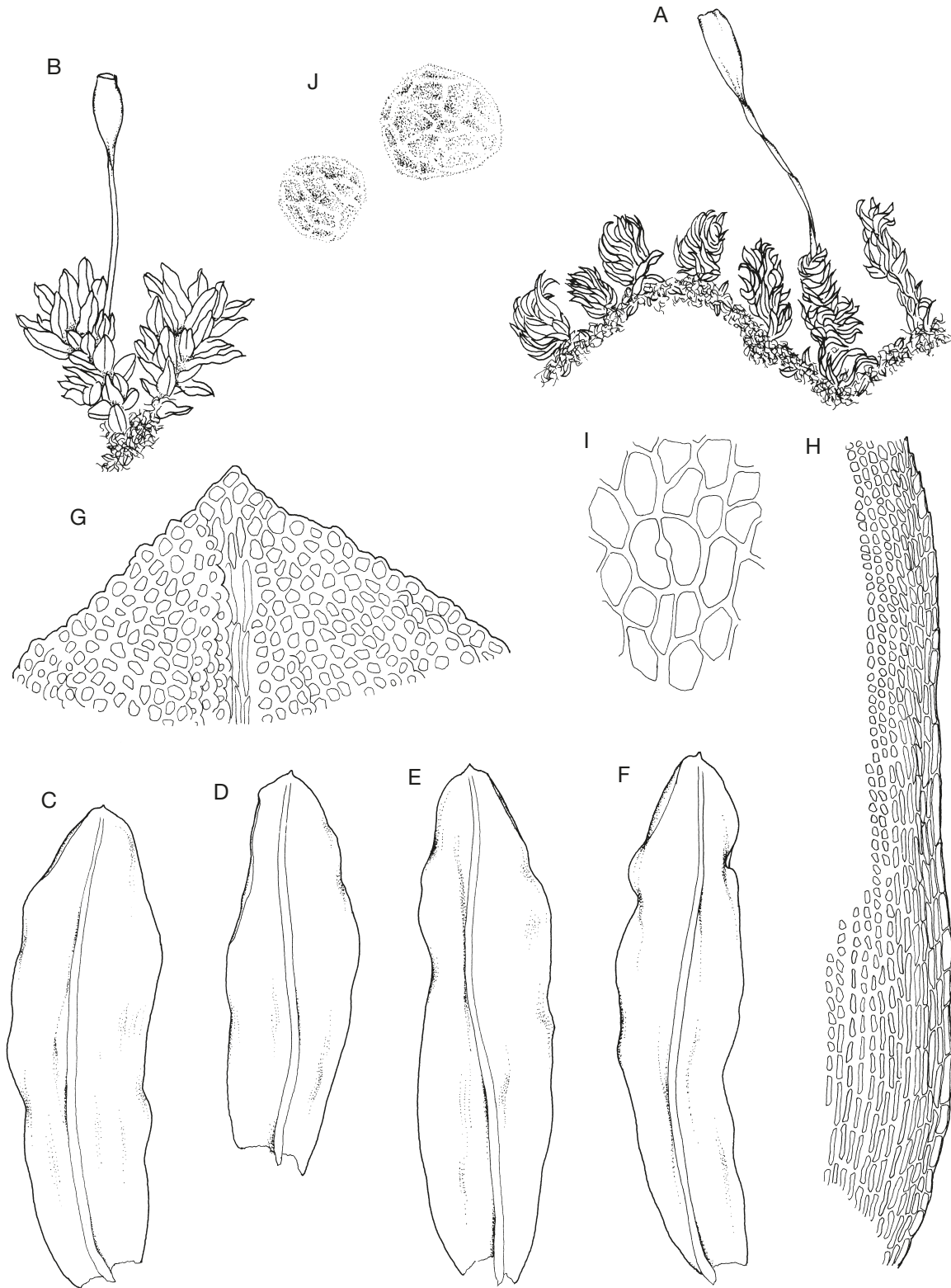


FIG. 13. — *Groutiella tumidula* (Mitt.) Vitt. **A**, plant; **B**, branches when wet with capsule; **C-F**, leaves; **G**, apical leaf cells; **H**, marginal leaf cells; **I**, phaneropore; **J**, spores. **A, B, J** from Hegewald 8525 (MO); **C-I** from *Spruce 101*, isotype of *G. tumidula*, NY. Scale bar: **A**, 3 mm; **B**, 2.8 mm; **C-F**, 0.5 mm; **G**, 59 μ m; **H**, 110 μ m; **I**, 73 μ m; **J**, 30 μ m. Credits: Yu N.-N.

The differences between them provided in the discussion of *G. tomentosa*. *G. husnotii* and *G. macrorrhyncha* are similar to *G. tuberculata* in having lanceolate and cripate leaves, however, they have smooth basal leaf cells, while, *G. husnotii* differs in a longer limbidia extending to $\frac{2}{3}$ or more of leaf length, and *G. macrorrhyncha* differs in stoutly excurrent costa.

Groustiella tumidula (Mitt.) Vitt
(Fig. 13)

The Bryologist 82: 9 (Vitt 1979).

SPECIMENS EXAMINED. — **Belize.** Belize, Sibum River, *Allen 19093* (MO); Cayo, along the Raspaculo Branch and Macal River, *Allen 18489* (MO); Orange Walk, Lamanai, *Townsend 94/102* (MO).

Bolivia. Cochabamba, Carrasco, *Linneo 453* (MO); Santa Cruz, Ichilo Prov., *Churchill & Arroyo 21527-A* (MO); Elías Meneses, *Churchill & Arroyo 21508* (MO).

Brazil. Mato Grosso do Sul, Município de Miranada, *Vital 2319* (MO); “Estado de Rio de Janeiro,” *E. ULE. 2182* (HBG).

Ecuador. Sucumbíos, Res. Faunística Cuyabeno, *R. RH 1990-332c* (MO).

Jamaica. 1909, *Maxwell s.n.* (NSW).

Mexico. Veracruz, 1.2 mi S of Rio Tecolutla on road to Nautla, *Reese 4636* (MO); 1.2 mi S of Rio Tecolutla, *Pursell 5033* (MO).

Panama. Canal Area, George Green Forest, *Tyson 1177F* (MO).

Peru. Amazonas, Bagua, *Hegewald 7146* (MO); Cuzco, Quilabamba, *Lowy PBR 205* (MO); Junín, Tarma, *Hegewald 8525* (MO); Loreto, Coronel Portillo, *Hegewald 8229* (MO); Tarapoto, *Spruce 101* (iso-, NY).

United States. Florida, Collier Co., *Reese 1277* (MO); Miami, *Small 59* (MO).

Venezuela. Monagas, Jusepin, *Pursell 8501* (MO).

DISTRIBUTION AND HABITAT. — The tropical region of America, north to United States (Florida), south to Bolivia. On tree trunks and roots of orchids; 610-1320 m.

DESCRIPTION

For description, see Vitt 1979; Crum & Anderson 1981; Vitt 1994; Allen 2002.

COMMENTS

The remarkable character of *Groustiella tumidula* is the lingulate leaf with acute apex and percurrent costa. *G. tumidula* is similar to *G. apiculata* and *G. obtusa* in having lingulate and rounded-obtuse leaves. The differences between *G. tumidula* and *G. apiculata* are discussed in comments of *G. apiculata*. *G. obtusa* differs from it in having rugose leaves.

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