A REVISION OF *GRIMMIA* (MUSCI, GRIMMIACEAE) IN THE AMERICAS. 1: LATIN AMERICA[1]

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ABSTRACT

Grimmia comprises 29 (plus 2 probable) species in Latin America. The centers of highest species diversity are the Mexican Volcanic Belt and the Andean Range between central Peru and southern Patagonia. All taxa are keyed and described, and they are typified if it has not been done previously. Each species is illustrated and its distribution mapped. *Grimmia molesta* is described as new from Peru. Previous records of *G. tergestina* from Mexico correspond to *G. involucrata*. *Grimmia kidderi*, *G. ochyriana*, and *G. tergestina* are reported for the first time from the Americas.

Grimmia comprises about 100 species worldwide (Muñoz, in prep.), and its taxonomy is reputedly difficult. Most of this difficulty arises because hundreds of names were published without proper evaluation of existing taxa, and because currently there are only a few updated regional treatments available. For example, at this time there is no complete survey for Latin America, a region rich in described taxa according to *Index Muscorum* (van der Wijk et al. 1962, 1969). Papers on Patagonian and Peruvian taxa by Deguchi (1984, 1987) do not cover all the species known from those areas, in spite of which they are of great value and the only source of reliable information for South American *Grimmia*. The only other treatment available is by Crum (1994), which covers the Mexican species. My results, however, differ in several ways from his, mostly in terms of accepted species.

Species of *Grimmia* are typical members of plant communities above the tree line, growing on rocks and fed by thawed snow, withstanding extremely harsh enviromental conditions. In the geographic area covered for this study, only a few widespread species are present outside the main mountain ranges, mainly associated with man-made habitats.

Some 1500 herbarium specimens were studied to determine the geographical distribution and morphological variation of the species. Types of many taxa described from areas not covered in this revision were also studied in order to determine the correct names for the taxa; these names are listed in the appropiate nomenclatural sections. World distributions follow the Hollis and Brummitt (1992) scheme. All distributions are based on specimens actually studied by the author.

GEOGRAPHICAL DISTRIBUTION OF *GRIMMIA* IN LATIN AMERICA

Figure 1 plots the number of species per country, clearly showing that *Grimmia* is more species-rich in temperate regions. Conversely, in the Neotropics the genus is found only in montane to alpine habitats, mainly above tree line.

Mexico has the highest number of species, reflecting its larger variety of habitats suitable for the establishment of *Grimmia*. Species with a temperate distribution (*G. americana*, *G. laevigata*, *G. lisae*, *G. montana*, *G. ochyriana*, *G. ovalis*, *G. pilifera*, *G. poecilostoma*, *G. pulvinata*, and *G. ungeri*) reach their southernmost limit in the Mexican Volcanic Belt (or north of it). Two species, *G. ochyriana* (Fig. 29) and *G. ovalis* (Fig. 31), have outlying populations in the highest peaks of northern Guatemala.

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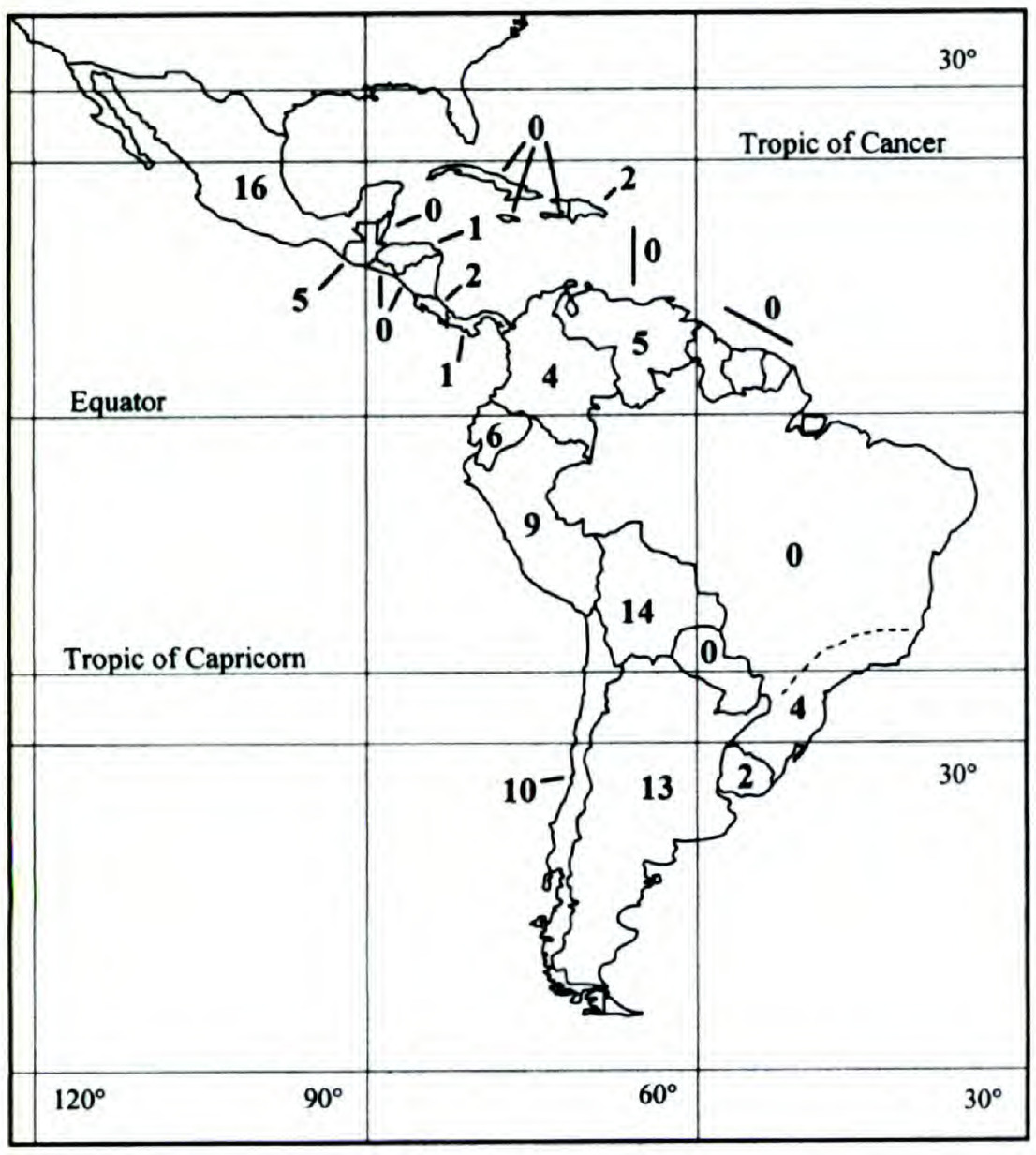

Figure 1. Number of *Grimmia* species per country in Latin America.

Noteworthy is the bipolar temperate distribution of *G. laevigata* (Fig. 12) and *G. pulvinata* (Fig. 40), species not occurring in the intervening Neotropics. Two endemic species, *G. involucrata* (Fig. 6) and *G. pulla* (Fig. 34), increase the number of taxa known from Mexico. The number of *Grimmia* species decreases south of the Mexican Volcanic Belt. The predominance of tropical lowland to montane vegetation in Central America and the Caribbean seems to be responsible for the paucity of *Grimmia* taxa in the area (Fig. 1).

Grimmia anodon, *G. atrata*, *G. donniana*, *G. elongata*, *G. fuscolutea*, *G. longirostris*, *G. plagiopodia*, *G. reflexidens*, *G. tergestina*, and *G. trichophylla* are widespread species following the main South American Andean chain. Two of these, *G. elongata* and *G. longirostris*, have disjunct populations in the mountains of southeastern Brazil (Itatiaia and Santa Catarina). Figure 1 shows that the diversity is low in the northern countries of South America, but increases southward, especially around the Bolivia–Peru border. Indeed, there are several species almost restricted to this area: *G. bicolor* (Fig. 10), *G. molesta* (Fig. 10), *G. pseudoanodon* (Fig. 34), and *G. trinervis* (Fig. 29). This may be an artifact since much of this area is better collected than other sites in Argentina and Chile similarly suitable for *Grimmia* establishment.

Two more species can be considered endemic to areas covered by this study. *Grimmia navicularis* (Fig. 26) grows in the Andean range, and *G. tortuosa* (Fig. 40) is known only from the type collection in the Falkland Islands.

Taxonomic Characters

The taxonomic characters of *Grimmia* have been surveyed in depth by Deguchi (1978). Variability in taxonomic characters was considered by Muñoz (1998d) in his revision of *Grimmia* subg. *Orthogrimmia*, with four Latin American species. Some taxonomic characters, however, deserve further comment here.

Hair-points. Features associated with hair-points should be used with extreme caution due to their variability. In this study, only *G. atrata* and *G. ochyriana* constantly lack hair-points. *Grimmia pulla* has short hair-points that are strongly dentate and usually brownish, at least proximally, features only observed in this taxon. *Grimmia elongata* usually has short hair-points, which are absent in many leaves, but some Bolivian specimens of this species have long hair-points. Hair-point length and structure in remaining species show high infraspecific variability, from lacking to more than 1 mm, and from entire to dentate. I discard any taxonomic entity based solely on this structure.

Costae. The structure of the costae and its relative differentation from the lamina are considered of major taxonomic importance in this study, and can be easily ascertained in transverse sections. Kawai (1965, 1968) wrote the best survey of costae structure and ontogeny in Grimmiaceae.

Three types of costae (as seen in cross section) can be distinguished in *Grimmia*: (1) undifferentiated or weakly differentiated from the lamina, not or only scarcely prominent on the dorsal side of the leaf (Figs. 2C, 18C, D, 20E, F, 30B, C, 35B, 42B, C); (2) reniform, consisting of 2 to 6 cells in the ventral epidermis, differentiated from the lamina and prominent (occasionally weakly) on the dorsal side of the leaf (Figs. 5B–D, 21B, C, 22B, C, 28B–D); and (3) terete, consisting of 2 cells in the ventral epidermis, differentiated from the lamina and prominent on the dorsal side of the leaf (e.g., Figs. 4B, C, 7B–D, 9G–I, 13B–D, 43B, C).

Propagula. The main source of information about vegetative propagation in mosses is still Correns (1899), who recognized three main modes of gemma formation in *Grimmia*: (1) complete modification of the leaf apex into massive gemmae, causing the destruction of the leaf (*G. anomala* Schimp. and *G. hartmanii* Schimp., both alien); (2) gemmae generated at the tips of stalks, branched or not,

developed on the dorsal axillary side of leaves, causing minor leaf damage, if any (*G. austrofunalis*, *G. lisae*, and the alien *G. muehlenbeckii* Schimp. and *G. torquata* Drumm.); and (3) modification of the laminal cells into propagula, destroying the leaf (*G. trichophylla*).

Features associated with the development of gemmae are critical to distinguish the closely related *G. austrofunalis* and *G. trichophylla* and are treated in detail under these species.

Perichaetial leaves. Perichaetial leaves are convolute and larger than other leaves except for *G. atrata*, in which they are convolute but otherwise undifferentiated. Five species in the area (*G. americana*, *G. involucrata*, *G. poecilostoma*, *G. tergestina*, and *G. trinervis*) have perichaetial leaves strongly modified, hyaline and filmy except for a patch of green cells at the apex. Except for *G. trinervis*, with strongly plicate leaves, these taxa are identical in gametophyte morphology and anatomy, differing either in sexuality or sporophyte characteristics.

Annulus. Deguchi (1978, fig. 7) described three types of annulus: (1) *Schistidium* type: simple and persistent, composed of undifferentiated cells (*G. montana*, *G. plagiopodia*, and *G. ungeri*); (2) *elongata* type: compound and revoluble, composed of 1 to 2 rows of inflated, isodiametric cells (e.g., *G. atrata*, *G. elongata*, *G. ochyriana*, and *G. pseudoanodon*); and (3) *affinis* type: compound and revoluble, composed of (2)3 to 4 rows of inflated, rectangular cells becoming larger from the lower to the upper rows (e.g., *G. involucrata*, *G. longirostris*, *G. poecilostoma*, and *G. trichophylla*).

The annulus of all the species studied can be assigned to one of Deguchi's three types except for *G. anodon* and *G. trinervis*. Discrepancies are apparent in the interpretation of the annulus morphology in *G. anodon*. It has been defined as "narrow, persistent. . ." (Deguchi, 1987: 22), "wanting" (Cao & Vitt, 1986: 205), "simple" (Jones, 1933: 22), "persistent, of 1 layer of cells" (Crum, 1994: 395), or as "1(2)reihig, bleibend, gewölbt, stumpf genabelt, gleichfarbig [in 1(2) layers, persistent, arched, bluntly umbilicate, concolorous]" (Limpricht, 1890: 727). In *G. trinervis*, the annulus was characterized as "imperfectly developed, of quadrate, thick-walled, translucent cells" (Deguchi, 1987: 32). In fact, *Grimmia anodon* and *G. trinervis* share a similar annulus: 1 to 2 layers of inflated cells, differentiated from both the exothecial and operculum cells, and persisting for a long time on the capsule mouth. These annular cells are identical to those of the *elongata* type, but the annulus in these two gymnostomous species persists longer on the capsule mouth, and can be termed "tardily deciduous."

In this treatment, laminal length excludes hair-point, laminal width has been measured at the broadest part of the leaf, and fractions (e.g., "margin recurved in the proximal ½") always refer to laminal length. Cellular measurements include the wall, except when otherwise stated. Proximal juxtacostal and marginal cells refer to the two or three rows of cells closest to the costa and margin, respectively. The size of the perichaetial leaves refers to the area of the rectangle defined by their length and width. Finally, setae length includes the vaginula.

Taxonomic Treatment

Grimmia Hedw., Sp. Musc. Frond. 75. 1801. TYPE: *Grimmia plagiopodia* Hedw. (lectotype, designated by Mårtensson (1956: 106–107)).

Cladautoicous, *gonioautoicous*, or *dioicous*. *Plants* in dense cushions or compact to loose tufts, glaucous, green, greenish yellow, or olive-green. *Stems* erect or ascending, with or without a central strand. *Leaves* erect, appressed or flexuous, occasionally with homomallous tips when dry, erect to spreading when moist, linear, ovate, lanceolate, ligulate, oblong to triangular, obtuse to acuminate, concave, canaliculate or keeled, plane or plicate; *margins* entire, plane, recurved or incurved; *costa* single, percurrent, terete, semi-terete, semi-elliptic or almost indistinct in cross section; *lamina* 1–4-stratose in the distal half; *distal cells* isodiametric to rectangular or oblate, bulging or plane, with straight or sinuous walls; *proximal cells* quadrate to rectangular or oblate, the walls straight or sinuous, uniformly thickened or the transverse walls thicker than the longitudinal walls; with or without *hyaline hair-points*. *Perichaetial leaves* convolute and larger or similar in shape but slightly larger than vegetative leaves. *Androecia* axillary or terminal. *Setae* straight or curved, longer or shorter than capsules. *Capsules* immersed, emergent or exserted, subglobose, ovoid, ellipsoid or fusiform, symmetric or asymmetric and ventricose at the base, smooth or ribbed, stramineous or castaneous, with stomata at the urn base or lacking stomata; *exothecial cells* isodiametric or rectangular, thin- or thick-walled; *annulus* simple and persistent, compound and revoluble, or compound and tardily deciduous; *peristome teeth* 16, triangular, entire, perforate in the distal half or cribrose throughout and irregularly cleft at apex, orange to brown; *opercula* conic to long-rostrate; *calyptrae* cucullate or mitrate,

smooth, covering to the capsule mouth; *columella* persistent; *spores* smooth to coarsely granulose.

Key to Species of *Grimmia* in America South of the U.S.A.

Notes for using the key:

Leaf length is *without* hair-points.

Cross sections: They are essential to correctly identify a specimen. Superficial examination, as indicated by Sayre (1952: 255–256), can result in errors. Cross sections are made between ½ and ⅔ of laminal length above base.

Capsules: Some species have immersed capsules hidden by the perichaetial leaves that are often overlooked. Immersed capsules can be found when looking carefully under the dissecting microscope for inflated distal stem parts, where leaves have longer hair-points. It is surprising how many specimens with immersed capsules are considered sterile even though some sporophytes can be easily found in the packet.

Propagula: If the specimen has propagula, go directly to couplet 36, but check also *G. lisae* (European specimens of this taxon sometimes have propagula). Although it is commonly stated that fertile specimens of *G. trichophylla* have no propagula, this is not correct. Propagula are most likely detected around perichaetial buds, even on the perichaetial leaves themselves. Propagula may be first sought on the youngest innovations and perichaetial buds. If not located, propagules may be found in older stem bifurcations, among decayed perichaetia. It is important to note where the propagula are generated on the leaves, whether on the back of the costa or directly over the lamina (see couplet 36 in the key). *Grimmia austrofunalis* and *G. trichophylla* can be difficult, if not impossible, to separate without propagula.

1a. Leaves strongly plicate on both sides of costa.
- 2a. Setae curved; capsules asymmetric and ventricose at base, gymnostomous; calyptrae mitrate, not exceeding further down than capsule mouth, not plicate ..... 30. *G. trinervis*
- 2b. Setae straight; capsules symmetric with seta centrally placed at base, species in the area with peristomes; calyptrae campanulate, extending below capsule mouth, plicate ..... *[Coscinodon]*

1b. Leaves not plicate or only weakly so.
- 3a. Capsules asymmetric and ventricose at base; seta eccentrically attached to the capsule, curved, shorter than the capsule.
  - 4a. Peristome lacking; leaves keeled ..... 2. *G. anodon*
  - 4b. Peristome present; leaves concave ..... 21. *G. plagiopodia*
- 3b. Sterile specimens, or capsules symmetric; seta centrally attached to the capsule and, if curved, longer than the capsule.
  - 5a. Proximal marginal cells of leaves oblate ..... 12. *G. laevigata*
  - 5b. Proximal marginal cells of leaves quadrate to rectangular.
    - 6a. Proximal marginal cells of leaves with all walls similar, thin.
      - 7a. Margins plane throughout or incurved above, no trace of recurvation.
        - 8a. Leaves crisped when dry; exothecial cells strongly incrassate, lumen almost obliterated ..... 28. *G. tortuosa*
        - 8b. Leaves erect and appressed to weakly flexuous when dry, but never crisped; exothecial cells thin-walled ..... 6. *G. donniana*
      - 7b. At least one margin recurved for part of its length.
        - 9a. Longest hair-points longer than 0.3 mm, most of the leaves piliferous; autoicous, male buds small and lateral, hidden just below perichaetia; setae curved (the species is always found with sporophytes) ..... 8. *G. fuscolutea*
        - 9b. Longest hair-points to 0.3 mm long, most of the leaves muticous; dioicous, male buds terminal; setae straight ..... 7. *G. elongata*
    - 6b. Proximal marginal cells of leaves with transverse walls thicker than longitudinal walls.
      - 10a. All leaves constantly muticous.
        - 11a. Dry plants with leaves flexuous and crisped; 1 to 2 basal marginal cell rows inflated, usually reddish, forming 2-stratose alar areas; perichaetial leaves virtually identical to vegetative leaves (2.3–3.2 mm vs. 1.5–3.2 mm long); seta 3–10 mm; capsule completely exserted ..... 3. *G. atrata*
        - 11b. Dry plants with leaves erect, only flexuous at apical part; basal marginal cell rows not inflated, not colored, similar to adjacent inner rows, 1-stratose; perichaetial leaves longer than vegetative leaves (4.0–5.5 mm vs. 2–3 mm long); seta 1.5–2.1 mm; capsule immersed ..... 18. *G. ochyriana*
      - 10b. At least perichaetial leaves with a trace of a hyaline hair-point.
        - 12a. Margins plane or incurved.
          - 13a. Distal half of lamina unistratose, only 1 or 2 marginal rows 2-stratose.
            - 14a. Hyaline hair-points terete; seta more than 1 mm, curved; capsules exserted, with peristome ..... 9. *G. humilis*
            - 14b. Hyaline hair-points flat at base; seta less than 1 mm, straight; capsules immersed, gymnostomous ..... 23. *G. pseudoanodon*
          - 13b. Distal half of lamina 2 to 3(4)-stratose.
            - 15a. Costae semicircular (cross section), prominent on dorsal surface.
              - 16a. Lamina concave to U-shaped (cross section) in the proximal part

of leaf; perichaetial leaves 5–15 times larger in area than the other leaves; capsules immersed ..... 11. *G. kidderi*

16b. Lamina V-shaped (cross section) in the proximal part of leaf; perichaetial leaves 2–3 times larger in area than the other leaves; capsules exserted.

17a. Laminar cells bulging (cross section) ..... 26. *G. reflexidens*

17b. Laminar cells not bulging (cross section).

(NOTE: Sterile or poor specimens of the following three taxa can be impossible to name.)

18a. Blades of lamina in cross section (distal half) forming a $< 30°$ angle, parallel at the junction with the costa, furrow very narrow; stomata present at the urn base ..... 26. *G. reflexidens*

18b. Blades of lamina in cross section (distal half) forming a $> 45°$ angle, divergent at base, furrow more open; stomata lacking.

19a. Operculae long-rostrate; setae 2–4 mm long; peristome teeth 50–90 μm wide at mouth, irregularly splitting above and ± cribrose; proximal juxtacostal leaf cells mostly long-rectangular, to 4.5 : 1; dioicous ..... 16. *G. montana*

19b. Operculae obtuse to rostellate; setae to 2 mm long; peristome teeth 40–50 μm wide at mouth, entire or slightly cribrose at apex; proximal juxtacostal leaf cells isodiametric to rectangular, to 3 : 1; autoicous ..... 31. *G. ungeri*

15b. Costae elliptical (cross section), scarcely prominent on dorsal surface, occasionally of the same thickness as lamina, scarcely differentiated.

20a. Proximal juxtacostal cells long-rectangular (4–8 : 1), walls nodulose; perichaetial leaves of mature sporophytes green and firm, neither hyaline nor filmy; setae 3–7 mm long; capsules exserted ..... 19. *G. ovalis*

20b. Proximal juxtacostal cells shorter (1–4 : 1), walls straight; perichaetial leaves of mature sporophytes almost entirely hyaline and filmy (look carefully around capsules: inner perichaetial leaves are almost invisible except under high contrast in the compound microscope); setae to 1 mm; capsules immersed.

(NOTE: Sterile specimens of the following four taxa are gametophytically identical and impossible to name with confidence.)

21a. Setae curved; capsules ventricose and asymmetric at base.

22a. Autoicous, male buds small and hidden just below perichaetia ..... 1. *G. americana*

22b. Dioicous, male buds terminal ..... 22. *G. poecilostoma*

21b. Setae straight; capsules symmetric at base.

23a. Autoicous, male buds small and hidden just below perichaetia ..... 10. *G. involucrata*

23b. Dioicous, male buds terminal ..... 27. *G. tergestina*

12b. Margin recurved, at least on one side for part of its length.

24a. Ventral layer of costae 2 to 6 cells wide, cross section of costae reniform.

25a. Proximal juxtacostal cells of leaves with nodulose walls; setae straight; capsules cylindrical ..... 14. *G. longirostris*

25b. Proximal juxtacostal cells of leaves with uniformly thickened walls; setae curved; capsules ovoid ..... 13. *G. lisae*

24b. Ventral layer of costae 2 cells wide, cross section of costae semicircular, never reniform.

26a. Leaves lingulate to elliptic, widest near middle or sides parallel, of equal width ± from base to little above middle.

27a. Hyaline hair-points sharply dentate, to 0.6 mm long; dioicous ..... 24. *G. pulla*

27b. Hyaline hair-points smooth or weakly denticulate, to 2 mm long; autoicous, perigonia below perichaetia ..... 25. *G. pulvinata*

26b. Leaves ovate to lanceolate, widest near base and conspicuously tapering upward from there.

28a. Laminar cells bulging (cross section) ..... 26. *G. reflexidens*

28b. Laminar cells not bulging (cross section).

29a. Lamina 2 to 3(4)-stratose for most of its upper ⅔.

30a. Leaves ovate, broad proximally, ± suddenly nar-

rowed into an upper subulate part, forming shoulders; leaves 2–3 mm long ..... 20. *G. pilifera*

30b. Leaf base not forming shoulders; leaves shorter than 1.9 mm.

31a. Blades of lamina in cross section forming a < 30° angle, parallel at the junction with the costa, furrow very narrow.

32a. Leaves lanceolate to narrowly lanceolate; plants commonly reddish; setae curved ..... 17. *G. navicularis*

32b. Leaves ovate-lanceolate to lanceolate; plants never reddish; setae straight ..... 26. *G. reflexidens*

31b. Blades of lamina in cross section forming a > 50° angle, divergent at base, furrow open.

33a. Leaves appressed, straight; setae straight; capsules immersed; autoicous ..... 15. *G. molesta*

33b. Leaves flexuous; setae curved; capsules exserted; dioicous ..... 5. *G. bicolor*

29b. Lamina mostly unistratose in its upper ⅔, with bistratose margins and/or occasional and small 2-stratose patches.

34a. Leaves ovate ..... 9. *G. humilis*

34b. Leaves narrowly lanceolate to lanceolate.

35a. Blades of lamina in cross section forming a < 30° angle, parallel at the junction with the costa, furrow very narrow ..... 17. *G. navicularis*

35b. Blades of lamina in cross section forming a > 45° angle, divergent at base, furrow more open.

36a. Propagula sessile on lamina, seldom on the costa, no stalk remaining after propagula liberation, which causes leaf destruction; lamina bistratose at margins and in streaks; plants less than 3 cm; spores minutely granulose, apparently smooth under light microscope ..... 29. *G. trichophylla*

36b. Propagula on stalks at dorsal base of costa, the stalk 1(2) cells long remaining attached to the costa after propagula liberation, which does not affect the leaf; lamina unistratose except the sometimes 2-stratose 1 or 2 marginal rows; plants to 8 cm; spores coarsely and distinctly granulose under compound microscope ..... 4. *G. austrofunalis*

1. Grimmia americana E. B. Bartram, Bryologist 32: 8, pl. 1. 1929. TYPE: U.S.A. Texas: Jeff Davis Co., Fort Davis, *Orcutt 7082* (lectotype, here designated, FH; isolectotype, NY).

Gonioautoicous. Plants olive-green. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 1.1–1.6 × 0.4–0.7 mm, triangular to ovate, obtuse to acute, concave, not plicate; *margins* plane; *costa* semi-elliptical, undifferentiated, ventral epidermis 3–7 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 7–12 μm long, isodiametric, rectangular and oblate, not bulging, walls sinuous; *proximal juxtacostal cells* 20–60 × 10–14 μm, rectangular (2–5 : 1), walls medium-thick and straight; *proximal marginal cells* 7–20 × 10–18 μm, oblate to rectangular (0.5–1.5 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete distally and flat proximally, somewhat decurrent, straight, to 2 mm, denticulate. *Perichaetial leaves* 1.8–2.5 × 0.8–1.3 mm, convolute, hyaline and filmy, scarcely discernible, larger than vegetative leaves (3–3.5 : 1). *Androecia* below perichaetia. *Setae* curved, 0.4–0.6 mm long. *Capsules* immersed, ovoid, ventricose, smooth, castaneous, with stomata at the base; *exothecial cells* 35–70 × 20–35 μm, rectangular (1.5–2.5 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 80–120 μm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose

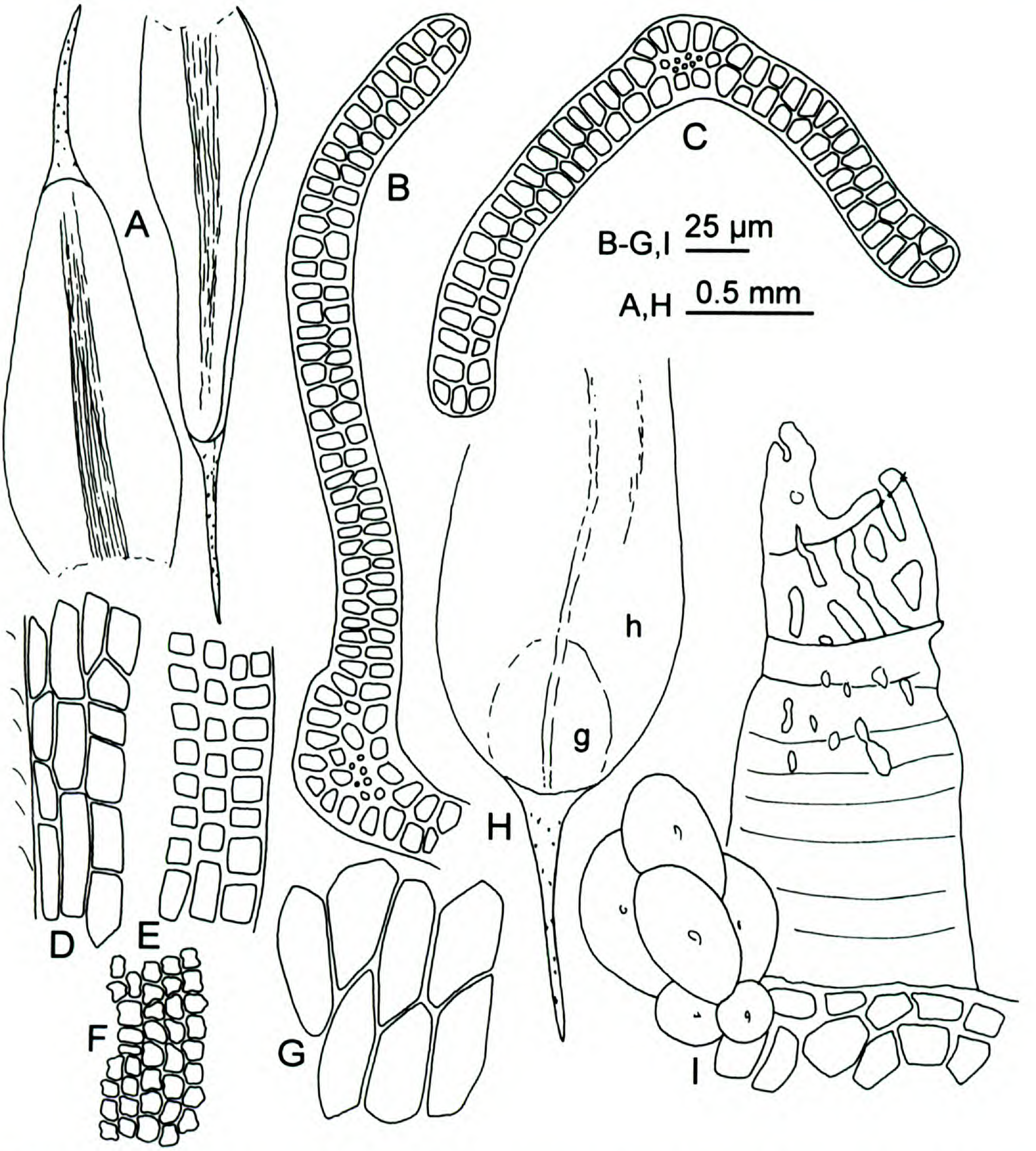

Figure 2. *Grimmia americana*. —A. Leaves. —B, C. Transverse sections at proximal and medial parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. —H. Perichaetial leaf (h = hyaline area; g = green area). —I. Peristome tooth and annulus (only contour shown, not papillosity). (*Orcutt 7082*, FH.)

throughout, orange-brown, concolorous with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 14–18 µm, smooth.

Illustrations. Figure 2; Bartram (1929: pl. 1); Crum and Anderson (1981: fig. 195 A–G); Jones (1933: pl. 6).

Distribution (Fig. 3). Northern America. *Grimmia americana* is known only from the southwestern and south-central U.S.A. It grows in Arizona and Texas close to the Mexican border, and it should be expected in suitable places in northern Mexico.

Grimmia americana has concave leaves with an undifferentiated costa in the distal part; it is gonioautoicous and has immersed capsules on curved setae. It is a member of the complex of taxa with strongly modified perichaetial leaves, which are hyaline and filmy except for a small patch of green cells in the distalmost part of the leaf. Species in

Figure 3. Distribution of: ● *Grimmia americana*; ▲ *Grimmia anodon.*

this group cannot be distinguished from sterile specimens, as discussed under *G. poecilostoma.*

Additional specimens examined. U.S.A. **Arizona**: Pima Co., near Agua Caliente, *Bartram 189* (FH). **Texas**: Jeff Davis Co., Fort Davis, *Orcutt 7082* (FH, NY).

2. Grimmia anodon Bruch & Schimp., Bryol. Europ. (fasc. 25–28) 3: 110, tab. 236. 1845. *Schistidium anodon* (Bruch & Schimp.) Loeske, Laubm. Eur. Part I: 49. 1913. TYPE: Germany. Heidelberg, *Braun s.n.* (lectotype, designated by Cao & Vitt (1986), BM not seen).

Grimmia alpina Kindb., Christiania Vidensk.-Selsk. Forh. 1888(6): 30. 1888 [1889]. TYPE: Norway. Dovre, Drivstuen, *Kindberg s.n.* (lectotype, here designated, S; isolectotype, S).

Grimmia anodon var. *anomala* E. B. Bartram, Bryologist 27: 59. 1924. *Grimmia anodon* f. *anomala* (E. B. Bartram) G. N. Jones, in Grout, Moss Fl. N. Amer. 2(1): 22. 1933. TYPE: U.S.A. Arizona: Pima Co., steep shaded banks of dry washes in Tuscon Mountains, *Bartram s.n.* (lectotype, here designated, FH; isolectotype, H-BR).

Gonioautoicous. Plants yellowish green to olive-green. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 0.9–1.6 × 0.35–0.70 mm, oblong or ovate to lanceolate, obtuse to acute, keeled (seldom rather flat distally), not plicate; *margins* recurved proximally or in middle part of one side; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose, 2-stratose at margins and in streaks in the distal ⅔; *distal cells* 7–16 μm long, mostly rectangular, not bulging, walls straight to sinuous; *proximal juxtacostal cells* 20–40 × 9–12 μm, rectangular (2–4 : 1), walls medium-thick and straight; *proximal marginal cells* 14–25 × 10–12 μm, rectangular (1.5–2 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* sometimes lacking, terete, straight, to 1.5 mm, denticulate. *Perichaetial leaves* 1.6–2.0 × 0.8–1.2 mm, convolute and larger than vegetative leaves (2–3×). *Androecia* below perichaetia. *Setae* curved, 0.3–0.5 mm long. *Capsules* immersed, subglobose, ventricose, smooth, stramineous, with stomata at the base; *exothecial cells* 40–80 × 14–25 μm, rectangular (2–3 : 1), thin-walled; *annulus* compound and tardily deciduous, *elongata* type; *peristome* lacking; *opercula* plano-convex, bluntly mammillate; *calyptrae* mitrate; *spores* 8–11 μm, minutely granulose.

Illustrations. Figure 4; Braithwaite (1888: tab. 46 fig. E); Chałubiński (1882: tab. 4 fig. 3); Deguchi (1984: fig. 1; 1987: pl. 1); Ignatov and Cao (1994: fig. 18); Lawton (1971: pl. 57 fig. 15–24); Maier and Geissler (1995: abb. 2); Petrov (1975: tab. 62 fig. 6); Smith (1978: fig. 147 16–18); Vaněk (1940: figs. 12–20).

Distribution (Fig. 3). Europe, northern Africa, temperate and tropical Asia, northern and southern America; Mexico, Peru, and Bolivia. On crevices and surfaces of calcareous rocks in open areas between 100 and 4000 m elevation.

Grimmia anodon has ovate leaves and immersed, subglobose, and ventricose eperistomate capsules on a curved seta. Although its gametophytes resemble several other species such as *G. humilis*, *G. molesta*, or *G. pseudoanodon*, the sporophyte is unmistakable. In areas in which they cohabit (e.g., Europe, North America), *G. anodon* can be also misidentified as *Schistidium flaccidum* (De Not.) Ochyra, but the seta in *Schistidium* is straight, and the study of this feature precludes any confusion.

Hair-point presence and length, as well as the number of cell layers in leaf cross section, are variable in *G. anodon.* Several taxa have been described based on muticous specimens (e.g., *G. alpina* Kindb. and *G. limprichtii* Kern, both described from European materials) or supposed differences in leaf lamina stratification (e.g., *G. anodon* var. *anomala* E. B. Bartram from Arizona). Random variation in laminal characters occurs across the entire distributional range of *G. anodon.* No correlation can be seen to other characters, and *G. alpina* and *G. anodon* var. *anomala* are herein reduced to synonymy.

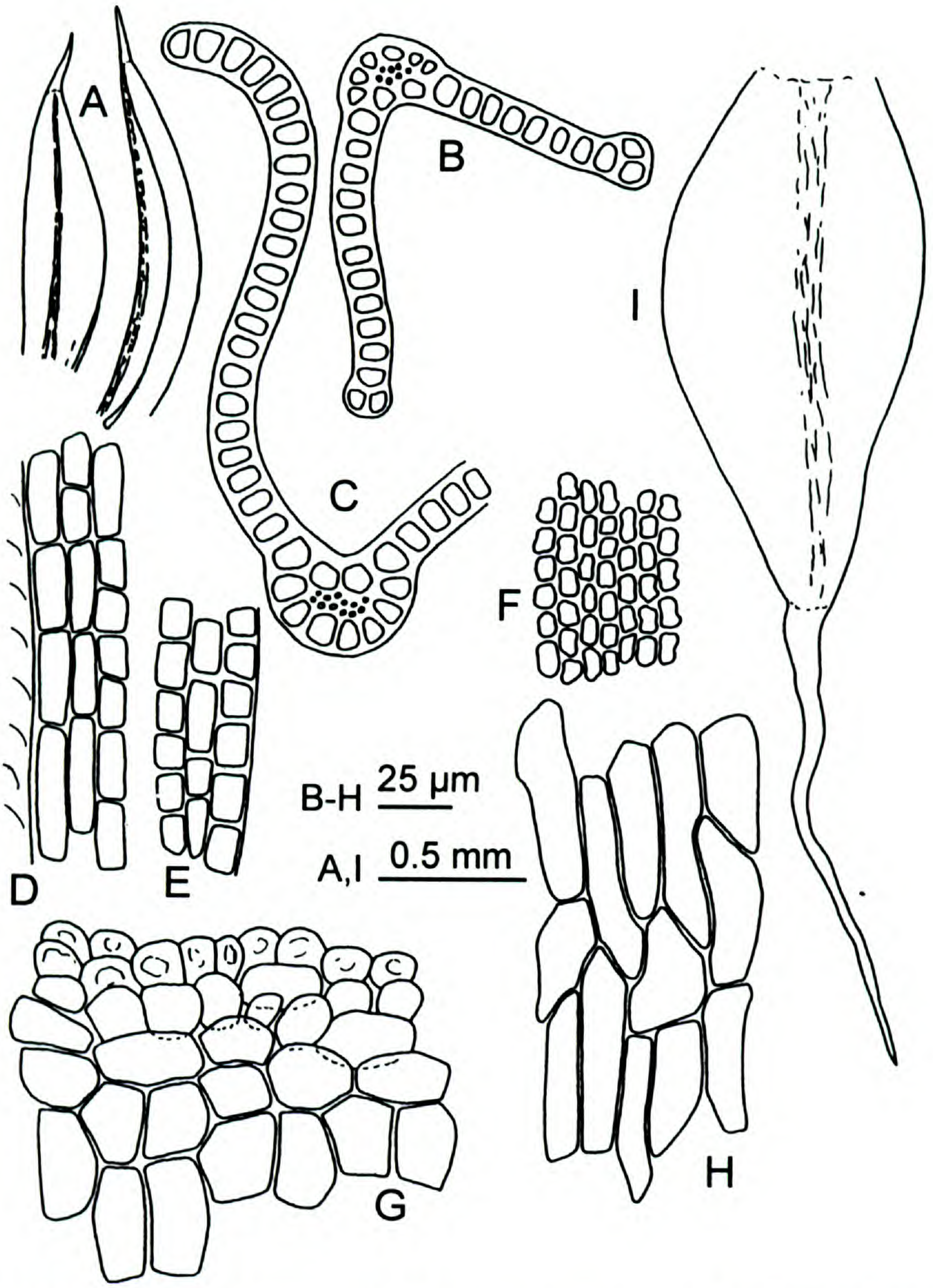

Figure 4. *Grimmia anodon*. —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Basal juxtacostal leaf cells. —E. Basal marginal leaf cells. —F. Distal leaf cells. —G. Mouth of capsule showing the annulus. —H. Medial exothecial cells. —I. Perichaetial leaf. (*Delgadillo 2414*, TENN.)

Specimens examined. MEXICO. **Nuevo León**: summit of Cerro Potosí, *Delgadillo 2361* (TENN), *2414* (TENN), *2429* (TENN); Cerro Potosí near Galeano, *Sharp 3912* (TENN).

BOLIVIA. **Oruro**: Atahuallpa, Cerro Pumiri, near Sabaya, NW of Laguna Coipasa, *Lewis 79–1947* (F); Pallallkkollu, SE of Pagador, W of Laguna Coipasa, near Chilean border, *Lewis 79–2008B* (F). CHILE. **Magallanes**: Parque Nacional Torres del Paine, *Deguchi 26028* (HIRO), *26070* (HIRO), *26074* (HIRO), *26102* (HIRO). PERU. **Arequipa**: Arequipa, laguna Las Salinas, *Hegewald & Hegewald 5483b* (HIRO). **Puno**: prov. Azángaro, around laguna Ascanocha, about 5 km SW of Asillo, *Deguchi 29980* (HIRO), *29983* (HIRO), *29996* (HIRO).

3. Grimmia atrata Miel. ex Hornsch., Flora 2: 85. 1819. *Grimmia alpestris* var. *brevipila* Bruch ex Mont., Arch. Bot. 1: 219. 1833, nom. inval. in synon. *Dryptodon atratus* (Miel ex Hornsch.) Hartm., Handb. Skand. Fl. ed. 3: 271. 1838. TYPE: Austria. Grosarl, *Hornschuch s.n.* (lectotype, designated by Deguchi (1978), B).

Grimmia strictifolia Mitt., J. Linn. Soc., Bot. Suppl. 1: 44. 1859. *Racomitrium strictifolium* (Mitt.) A. Jaeger, Ber. Tätigk. St. Gallischen Naturwiss. Ges. 1872–73:

89 (Gen. Sp. Musc. 1: 371). 1874. TYPE: India. Sikkim: Jongri, *Hooker 295* (lectotype, here designated, NY).

Grimmia tristicha Herzog, Biblioth. Bot. 87: 58. 1916, nom. illeg., non Schwaegr., 1811. *Grimmia tristichoides* Margad., Lindbergia 1: 128. 1972. TYPE: Bolivia. Hochtal von Viloco, *Herzog 3152* (lectotype, here designated, JE; isolectotype, PC).

Grimmia tristicha var. *comosa* Herzog, Biblioth. Bot. 87: 59. 1916. *Grimmia tristichoides* f. *comosa* (Herzog) Margad., Lindbergia 1: 128. 1972. TYPE: Bolivia. Hochtal von Viloco, *Herzog 3188* (lectotype, here designated, JE; isolectotype, PC).

Dioicous. *Plants* dark green, reddish, or blackish. *Stems* erect, to 5.5 cm, central strand lacking or weakly developed. *Leaves* flexuous and crisped when dry, erect to patent when moist, 1.5–3.2 × 0.30–0.75 mm, lingulate-lanceolate, obtuse, canaliculate, not plicate; *margins* recurved proximally, to ⅓ the leaf length on one side; *costa* reniform, differentiated, ventral epidermis 4–6 cells wide in cross section; *lamina* 2-stratose at margins and in streaks in the distal ⅔; *distal cells* 7–20 μm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 30–50 × 7–12 μm, rectangular (3–5:1), walls thick and nodulose; *proximal marginal cells* 14–34 × 8–10 μm, rectangular (1.5–4.0:1), inflated and forming bistratose alar parts, the transverse walls thicker than the longitudinal walls; *hyaline hair-points* lacking. *Perichaetial leaves* 2.3–3.2 × 0.6–0.8 mm, similar to vegetative leaves but convolute proximally. *Androecia* terminal. *Setae* straight, 3–10 mm long. *Capsules* exserted, ovoid to ellipsoid, with attenuate base, symmetric, smooth, castaneous, with stomata at the base; *exothecial cells* 25–55 × 20–35 μm, isodiametric to rectangular (1–2:1), thick-walled; *annulus* compound and revoluble, *elongata* type; *peristome teeth* 60–90 μm wide at the mouth, entire to cribrose and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, castaneous, concolorous with the urn; *opercula* mammillate to rostrate; *calyptrae* cucullate or mitrate; *spores* 13.5–17.5 μm, coarsely granulose.

Illustrations. Figure 5; Cao and Churchill (1995a: pl. 2 figs. 1–7); Herzog (1916: fig. 20, as *G. tristicha*); Maier and Geissler (1995: abb. 5); Noguchi (1988: fig. 145A); Smith (1978: fig. 154 8–11).

Distribution (Fig. 6). Europe, temperate and tropical Asia, southern America. In Latin America *Grimmia atrata* is known only from a few Bolivian collections. It grows on moist acidic rocks in open areas above tree line, between 4350 and 4800 m elevation.

Grimmia atrata has muticous, flexuous, more or less curled leaves that are bistratose marginally and at the alar areas. The lamina is usually unistratose, with the margins and occasional streaks bistratose. However, the type of *Grimmia tristicha* has leaves almost entirely bistratose. *Grimmia atrata* is similar to *G. ochyriana,* another taxon with muticous leaves. However, alar cells in *G. ochyriana* are similar to other basal cells, the perichaetial leaves are strongly differentiated from vegetative leaves, and the capsules are immersed.

Grimmia atrata shows little morphological variability, except for sporophyte dimensions. Throughout its world range specimens occur with longer sporophytes. Seta length can reach to 10 mm, and longer setae are usually correlated with longer capsules.

Additional specimens examined. BOLIVIA. **La Paz**: Chojñacota, *Herzog 2979* (JE, PC); prov. Inquisivi, Mina Poldi, *Lewis 87–884* (MO), *87–901* (MO), *87–914* (MO), *87–926* (MO); Loayza, im Hochtal von Viloco, *Herzog 3170* (JE, NY).

4. Grimmia austrofunalis Müll. Hal., Hedwigia 37: 165. 1898. TYPE: [Australia. Victoria:] Mt. William, Mar. 1883, *Sullivan s.n.* (holotype, MEL).

Grimmia pansa R. S. Williams, Bull. New York Bot. Gard. 3: 125. 1903 [19 Oct.]. TYPE: Bolivia. Pelechuco, *Williams 2823* (lectotype, here designated, NY; isolectotypes, FH, JE).

Racomitrium austrosudeticum Broth., in Herzog, Biblioth. Bot. 87: 60. 1916. TYPE: [Bolivia. Cochabamba:] Tablas, *Herzog 2859* (lectotype, here designated, H; syntypes, *Herzog 3179*, H; *Herzog 4366*, H; *Herzog 4807*, H).

Grimmia crassiretis Cardot & Broth., Kongl. Svenska Vetenskapsakad. Handl. 63(10): 27, tab. 2 fig. 7. 1923. TYPE: [Argentina. Santa Cruz:] Patagonie: lac San Martín, *Skottsberg 380* (lectotype, here designated, PC; isolectotypes, H-BR, UPS; syntype, [Valle Frías. . .] PC).

Grimmia benoistii Thér., Rev. Bryol. Lichénol. 9: 10. 1936. TYPE: [Ecuador.] Pichincha: Massif du Pichincha, en face de Condorguachana, *Benoist 3116* (lectotype, here designated, PC; isolectotypes, F, PC; syntypes, [*Benoist 3117*] F, PC).

Dioicous. *Plants* olive-green to reddish or blackish, strongly glossy. *Stems* ascending, to 8 cm, central strand lacking on sterile stems. *Leaves* erect and appressed or somewhat flexuous apically when dry, patent when moist, 2.0–2.8 × 0.5–0.8 mm, lanceolate, acuminate, keeled, not plicate; *margins* recurved proximally, to ½–⅔ the leaf length on one side and flat or more narrowly recurved proximally, to ⅓–½ the leaf length on the other side, occasionally both margins plane; *costa* semi-terete, differ-

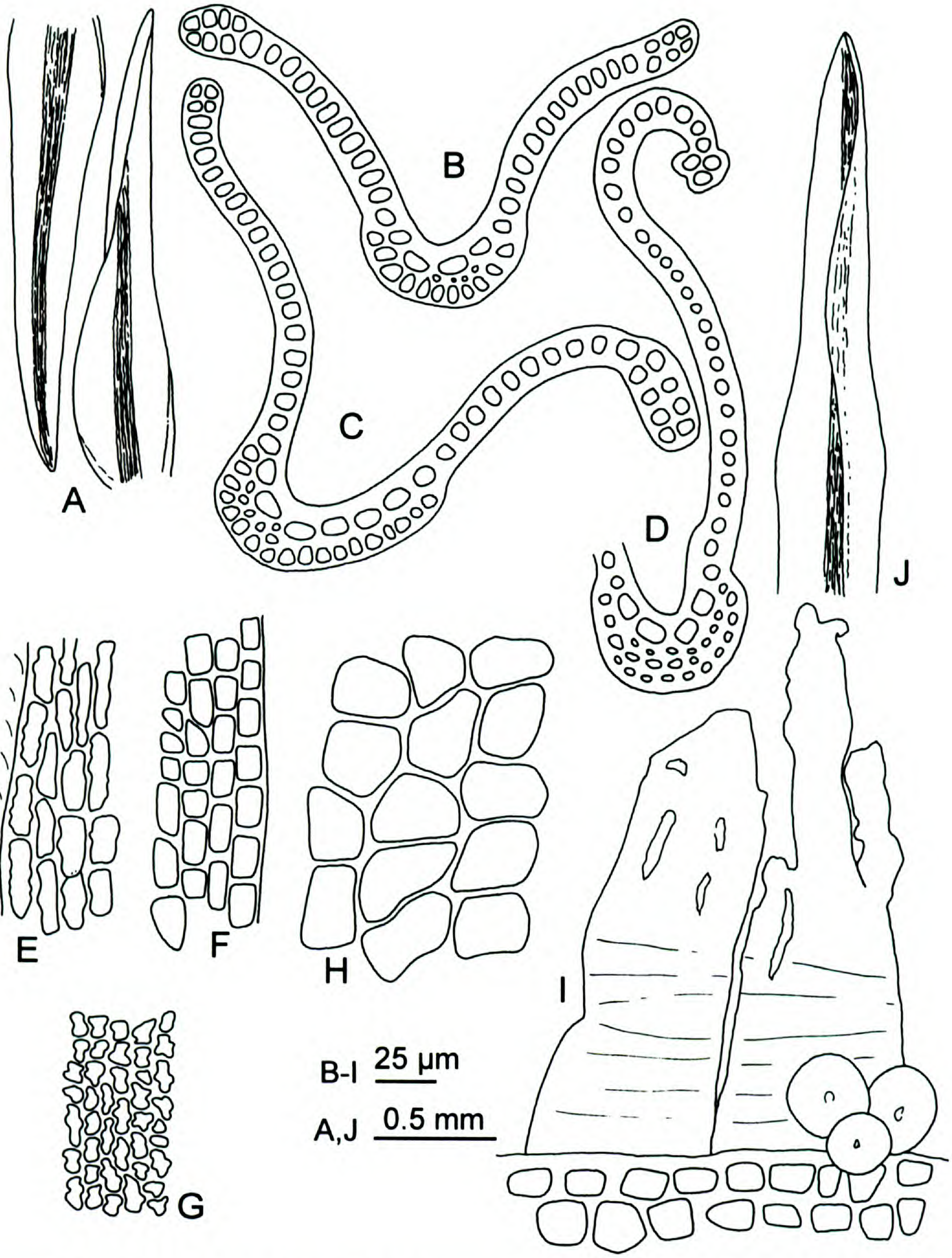

Figure 5. *Grimmia atrata.* —A. Leaves. —B–D. Transverse sections at distal, medial and proximal parts of leaf, the latter showing bistratose alar areas. —E. Proximal juxtacostal leaf cells. —F. Proximal marginal leaf cells. —G. Distal leaf cells. —H. Medial exothecial cells. —I. Peristome teeth and annulus (only contour shown, not papillosity). —J. Perichaetial leaf. (*Lewis 87-914*, MO.)

Figure 6. Distribution of: ● *Grimmia atrata*; ▲ *Grimmia humilis*; ■ *Grimmia involucrata*; ★ *Grimmia lisae*.

entiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose, seldom 2-stratose at one or two marginal rows in the distal ⅔; *distal cells* 6–18 μm long, isodiametric and rectangular, some oblate intermingled, not bulging, walls sinuous; *proximal juxtacostal cells* 45–85 × 8–18 μm, rectangular (2–10 : 1), walls thin and straight to medium-thick and nodulose; *proximal marginal cells* 13–30 × 9–12 μm, rectangular (1.5–3.0 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 0.4 mm, smooth to denticulate. *Propagula* 100–200 × 50–130 μm, ellipsoid, composed of several multicellular clusters, on branched stalks at dorsal basal part of costa, brownish with brown to reddish walls. *Perichaetial leaves* 3–4 × 0.7–0.9 mm, convolute proximally and prolonged in a very narrow acuminate distal half, larger than vegetative leaves (1.5 ×). *Androecia* terminal. *Setae* curved, 4.0–5.5 mm long. *Capsules* exserted, ellipsoid, symmetric, ribbed, stramineous, with stomata at the base; *exothecial cells* 22–65 × 14–24 μm, isodiametric to rectangular (1–2 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 45–65 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 10–16 μm, minute to coarsely granulose.

Illustrations. Figures 7, 8; Deguchi (1984: figs. 12, 13; 1987: pl. 12–14, all as *G. trichophylla*).

Distribution (Fig. 31). Australasia, southern America; Andean Range from Venezuela to Patagonia. *Grimmia austrofunalis* grows on dry to seepy rocks, seldom on bark of *Polylepis* sp., in every kind of habitat, from open sunny grassland to shaded forests in deep ravines, between 160 (Patagonia) and 5180 (Bolivia) m elevation.

Grimmia austrofunalis is the largest South American species within the genus, with the stems sometimes reaching 8 cm. Most specimens are strongly glossy, with brownish to reddish tints. Leaves are tightly appressed to the stem and not or weakly flexuous, and unistratose (seldom 1 or 2 marginal rows are bistratose). In *G. austrofunalis*, gemmae arise on stalks from the proximal dorsal costae. In one strongly propaguliferous collection stalks on the laminar cells occur at both sides of the costa. After the release of the gemmae, both costa and leaf remain undamaged. This represents the best character differentiating *G. austrofunalis* from *G. trichophylla*. Gemmae in *G. trichophylla* are sessile on the lamina, leading to the destruction of underlying cells. Gemmae formation in *G. trichophylla* is described specifically under that taxon (Fig. 44). The developmental formation of propagula in *G. austrofunalis* is illustrated in Figure 8.

Gemma formation starts with the development of hyaline filaments at the basal dorsal side of the costa. These filaments are uniseriate, 4- to 8-celled, and hyaline. They subsequently ramify at the distal extremes. Cells in each filament branch undergo several consecutive perpendicular divisions to form a more or less spherical to ellipsoid body. These multicellular bodies remain attached to the main filament, which functions like a hilum. Finally, just prior to the release of propagula, the cell walls of the propagula become thickened and pigmented. When a gemma detaches, the basal cell of the stalk, strongly reddish or brownish in color, remains on the costa. Propagula so formed compose a large cluster of gemmae resembling those found in *G. trichophylla*, but are obviously much larger in *G. austrofunalis*.

Names included here under *Grimmia austrofunalis* have usually been considered synonyms of *G. trichophylla* (Deguchi, 1987: 30, *G. pansa*; Deguchi, 1984: 25, *G. crassiretis*; and Churchill, 1994: 2, *G. benoistii*).

Selected specimens examined. ARGENTINA. **Chubut**: vallée Frías, *Skottsberg 381* (PC). **Santa Cruz**: Lac San Martín, *Skottsberg 380* (PC). BOLIVIA. **Cochabamba**: prov. Arani, 14 km S of Tiraque, *Lewis 85-115* (F, IBA);

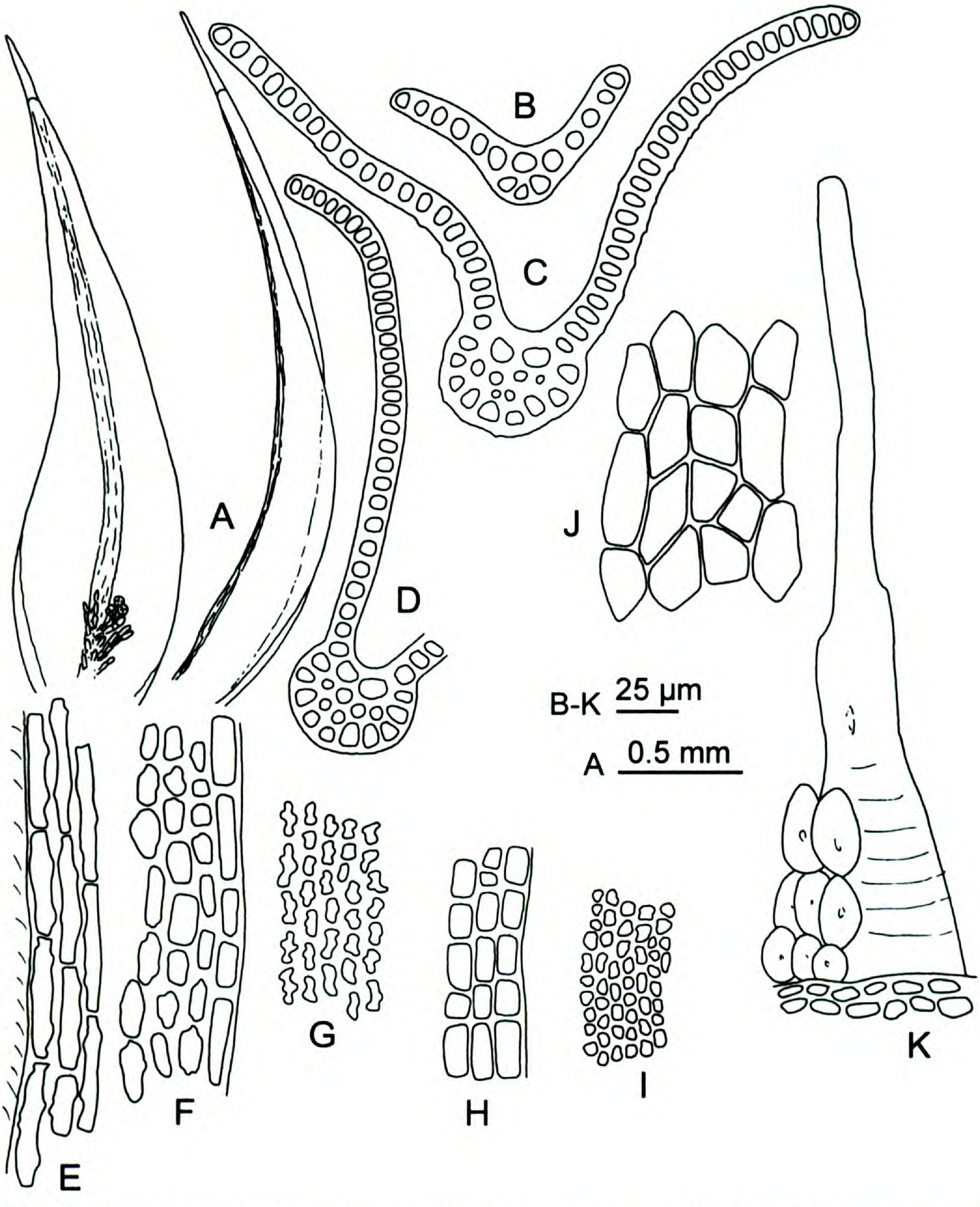

Figure 7. *Grimmia austrofunalis.* —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E. Proximal juxtacostal leaf cells. —F & H. Proximal marginal leaf cells. —G & I. Distal leaf cells. —J. Medial exothecial cells. —K. Peristome tooth and annulus (only contour shown, not papillosity). (A–D, H, I: *Lewis 87–1882,* MO; E–G, I, K: *Williams s.n.,* UBC.)

prov. Carrasco, río Monte Puncu, *Lewis 83-1826* (F, IBA); prov Chapare, río Espíritu Santo, *Lewis 85-1649* (F, IBA); prov. Quillacollo, *Lewis 79-2568* (MO). **La Paz**: prov. Camacho, 1 km below Escoma–Charasani road, *Lewis 79-793* (F, IBA); prov. Inquisivi, Cumbre Sayaquira, *Lewis 87321* (PC); prov. Larecaja, Pelechuco, 5 May 1902, *Williams s.n.* (UBC); prov. Loayza, río Acoroma Chuma, *Lewis 87-1789B* (MO); prov. Los Andes, Cerro Jankho Karka, *Lewis 84-145A* (F, IBA); prov. Murillo, head of río Zongo at SW slope of Cerro Chekhara, N of La Paz, *Lewis 79-1809* (F); prov. Sur Yungas, Bolsa Negra, *Lewis 83-2229* (F, MO). CHILE. **La Araucanía**: Cautín, Dep. Villarrica, Pucón, Halbinsel, *Hosseus 394* (FH). **Libertador General Bernardo O'Higgins**: Las Palmas, 60 km W of Rancagua, *Bartlett 19123* (NY). **Los Lagos**: Llanquihue, Lago Todos los Santos, *Seki 1/70-72* (H). COLOMBIA.

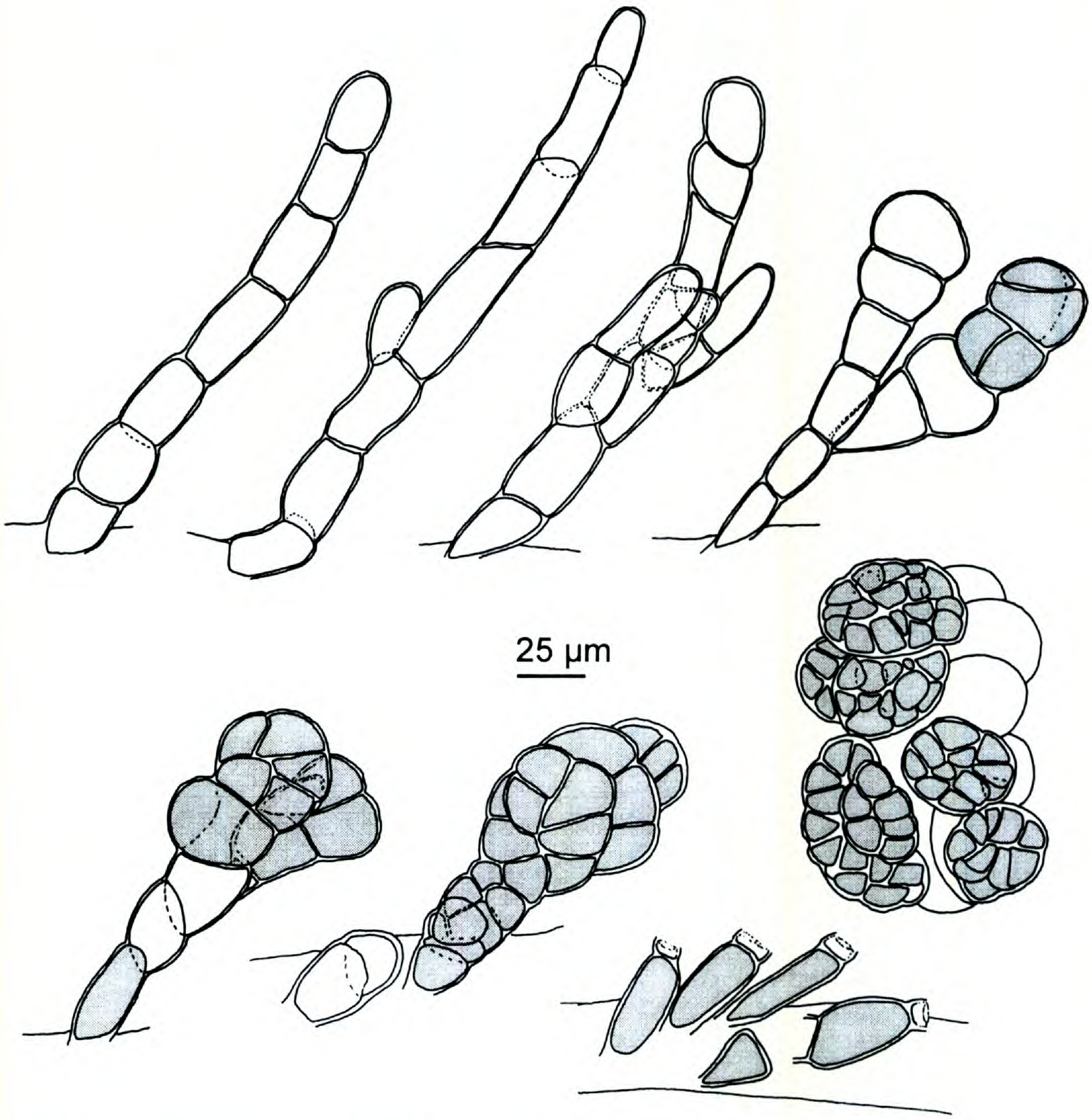

Figure 8. *Grimmia austrofunalis*. Sequence of gemmae formation.

Arauca: Sierra Nevada del Cocuy, quebrada El Playón, *Cleef 8855* (COL). **Boyacá**: páramo de la Rusia, *Cleef 7006c* (COL). **Caldas**: Villamaría, carretera Manizales–Bogotá, sobre la carretera que conduce al Nevado del Ruiz (km 213), *Churchill et al. 16307A* (IBA). ECUADOR. **Pichincha**: Pichincha, *Bell 375* (FH). PERU. **Ancash**: Huari, an der Ostseite des Tunnel Cahuish, *Hegewald & Hegewald 7698* (IBA, MO). **Ayacucho**: an der Strasse Huanta–San Francisco, Pass zwischen Tambo und Quinoa, *Frahm 824021* (IBA). VENEZUELA. **Mérida**: en el cañón justamente al S de Gavidia, *Griffin III et al. PV-1170* (CAS).

5. Grimmia bicolor Herzog, Beih. Bot. Centralbl. 26: 66. 1909. TYPE: Bolivia. Cochabamba: Llavethal, Jan. 1908, *Herzog s.n.* (lectotype, here designated, JE; isolectotype, PC).

Grimmia subquatricruris Broth., in Herzog, Biblioth. Bot. 87: 57. 1916. TYPE: Bolivia. Huaillattanisee, *Herzog 2973* (lectotype, here designated, H-BR; isolectotype, JE).

Dioicous. Plants glaucous-green to blackish, occasionally rusty-brownish. *Stems* erect, to 2 cm, with central strand. *Leaves* strongly flexuous, creased along the costa, twisted and incurved at apex, sigmoid in lateral view when dry, erect to patent when moist, 1–2 × 0.5–0.9 mm, ovate to lanceolate, acute, keeled, not plicate; *margins* recurved proximally, to ½ the leaf length on one side; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2(3)-stratose in the distal ⅔; *distal cells* 5–12 µm long, isodia-

metric, rectangular and oblate, not bulging, walls sinuous; *proximal juxtacostal cells* 20–50 × 8–12 μm, mostly rectangular ([1]2–6:1), walls medium-thick and straight; *proximal marginal cells* 10–20 × 7–12 μm, isodiametric to rectangular (1–2:1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, flexuous, to 0.9 mm, entire or with few denticulations. *Perichaetial leaves* 2–3 × 0.8–1.0 mm, convolute and larger than vegetative leaves (2 ×). *Androecia* terminal. *Setae* curved, 2.0–2.6 mm long. *Capsules* exserted, ovoid to ellipsoid, symmetric, smooth, stramineous to light brown, with stomata at the base; *exothecial cells* 30–50 × 14–25 μm, mostly rectangular (2:1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 70–130 μm wide at the mouth, entire or moderately cribrose, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic to mammillate; *calyptrae* not seen; *spores* 9–12 μm, minutely granulose.

Illustrations. Figure 9; Herzog (1916: fig. 19).

Distribution (Fig. 10). Southern America. *Grimmia bicolor* is rare, known only from scattered collections in Bolivia. It was collected on rocks between 3600 and 5180 m.

Grimmia bicolor has bistratose, keeled, ovate to lanceolate flexuous leaves and curved setae. Noteworthy in dry plants are the leaves with wide bases clasping most of the stem circumference. They are folded distally along the costa, and are also flexuous (Fig. 9A).

Only two fertile collections are known (*Herzog 4772*, JE; *Lewis 87-1879*, MO). Sporophytes are very old in the Herzog specimen, and thus exostome characters are difficult to see. This could account for his observation (Herzog, 1916: 58) of "stomatibus deficientibus." However, stomata do appear at the urn bases.

I have identified *Lewis 87-1879* as *G. bicolor*, although it is quite different from the other collections known. Most of the stems in this specimen are sprouts with strongly differentiated, small and muticous leaves that are well developed only at the very apex of the shoots. Furthermore, the apical leaves of these sprouts are lanceolate and less flexuous than in the other specimens of *G. bicolor* I know. Nonetheless, there are several more or less typical stems scattered in the cushion, some of them fertile. Similar stem and deviant leaf morphology in plants subject to extreme conditions is known in other genera (e.g., *Bryum*, *Philonotis*). This is especially true from high-altitude locations where the plants receive water from melting snow or, as in this case, plants are subject to freezing conditions at night and extremely high insolation during the day.

Additional specimens examined. BOLIVIA. **Cochabamba**: bei der Saittulaguna, *Herzog 2680* (JE); oberen Chocayatal, *Herzog 3587* (PC); Llavetal, *Herzog 308* (JE, PC); prov. Quillacollo, near summit of Cerro Tunari, *Lewis 79-2581* (F), *79-2585* (F, IBA), *Herzog 4772* (JE). **La Paz**: prov. Loayza, (Glacier Camp) alongside the glaciers of Cerro Jankho Loma, 11 km SE of Viloco, *Lewis 87-1879* (MO); prov. Los Andes, Cerro Jankho Karka, *Lewis 84-209a* (F, IBA); prov. Murillo, 5 km NE of Milluni, *Lewis 79-1727* (F, IBA).

6. Grimmia donniana Sm., Engl. Bot. 18: 1259. 1804. TYPE: United Kingdom. North Wales, pales at Beddgelart, July 1802, *Turner s.n.* (lectotype, designated by Muñoz (1998d), BM).

For a list of synonyms, see Muñoz (1998d).

Cladautoicous or goniautoicous. Plants greenish yellow above, dark green to blackish below. *Stems* erect, to 1.5 cm, with central strand. *Leaves* erect and appressed, occasionally flexuous when dry, patent when moist, 1.3–2.2 × 0.25–0.60 mm, lanceolate, acute, keeled, not plicate; *margins* plane; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2-stratose at margins and in streaks in the distal ⅔; *distal cells* 7–11 μm long, isodiametric to rectangular (1–1.5:1), not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 38–80 × 5.5–15.0 μm, narrowly rectangular (4–9:1), walls thin and straight to thick and slightly sinuous; *proximal marginal cells* 35–95 × 8–25 μm, narrowly rectangular (4–9:1), the walls thin and straight, all alike, scarcely discernible; *hyaline hair-points* terete or flat when long, slightly flexuous, to 2.2 mm, entire to weakly denticulate. *Perichaetial leaves* 2.0–2.5 × ca. 0.8 mm, convolute and larger than vegetative leaves (2.0–2.5 ×). *Androecia* axillary or terminal. *Setae* erect and straight, 3.5 mm long. *Capsules* exserted, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 35–55 × 24–46 μm, isodiametric to rectangular (1–2:1), thin-walled; *annulus* compound and revoluble, *elongata* type; *peristome teeth* 50–70 μm wide at the mouth, entire or irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic or mammillate; *calyptrae* mitrate (only one specimen known with some cucullate calyptrae; see Muñoz, 1998d); *spores* 7–11 μm, minutely granulose.

Illustrations. Figure 11; Bruch and Schimper

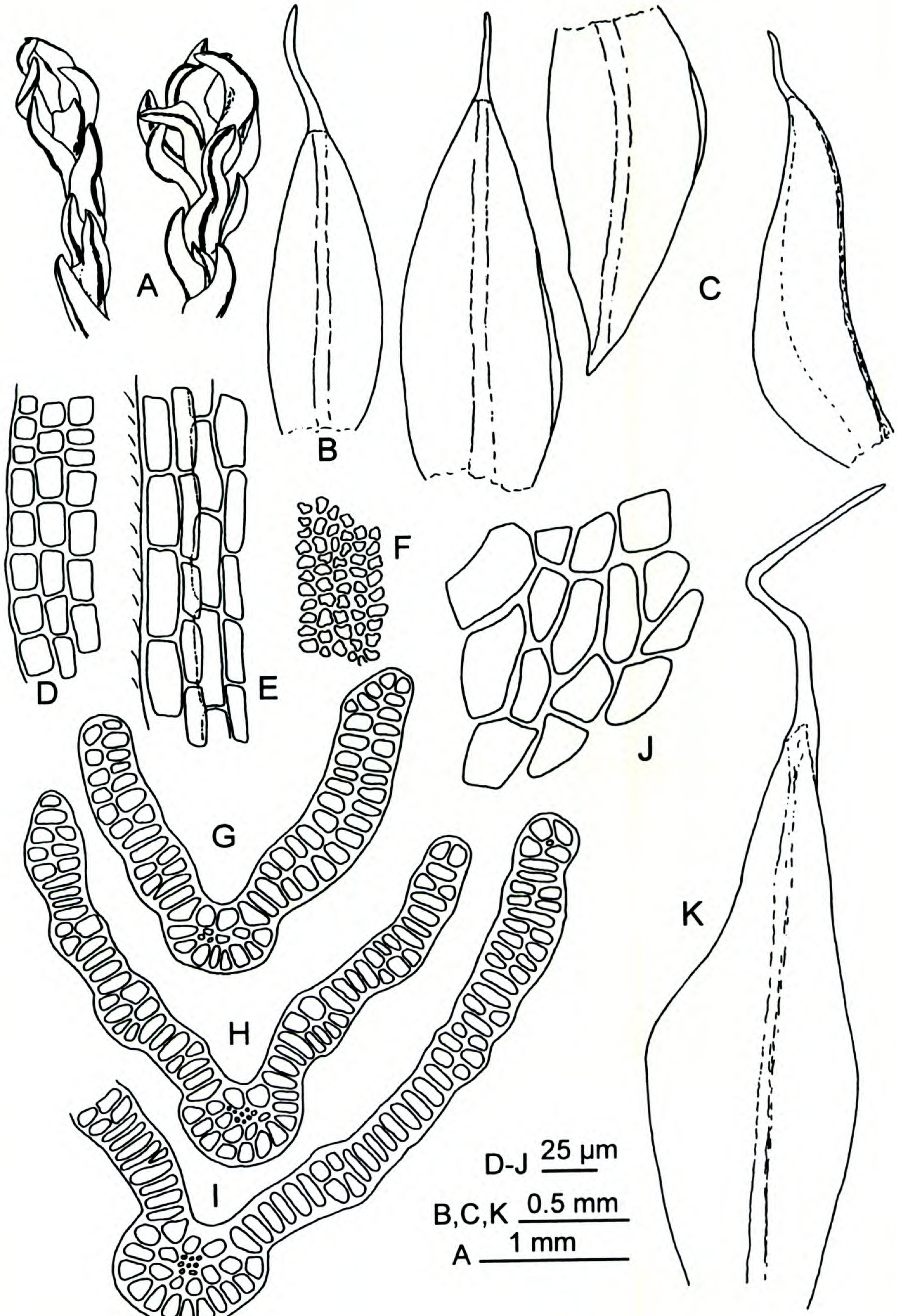

Figure 9. *Grimmia bicolor.* —A. Dry plants. —B, C. Leaves. —D. Proximal marginal leaf cells. —E. Proximal juxtacostal leaf cells. —F. Distal leaf cells. —G–I. Transverse sections at distal, medial, and proximal parts of leaf. —J. Medial exothecial cells. —K. Perichaetial leaf. (A, C–I: *Herzog s.n.*, JE; B, J, K: *Herzog 4772*, JE.)

Figure 10. Distribution of: ● *Grimmia bicolor*; ▲ *Grimmia kidderi*; ■ *Grimmia molesta*; ★ *Grimmia pilifera*.

(1845: tab. 249, as *G. obtusa*); Cao and Vitt (1986: figs. 15, 16a–c); Chałubiński (1882: tab. 7 fig. 11); Deguchi (1978: fig. 27); Ignatov and Cao (1994: fig. 10, but not figs. 8, 9); Jóhannsson (1993: fig. 32); Limpricht (1890: fig. 198); Muñoz (1998d: fig. 4); Noguchi (1988: fig. 140B); Nyholm (1956: fig. 69F).

Distribution (Fig. 12). Europe, temperate Asia, northern and southern America. *Grimmia donniana* is fairly common in temperate regions of the Northern Hemisphere. However, in Latin America it is rare, known only from scattered localities in Mexico, Ecuador, and Bolivia. It grows on igneous rocks in open areas between 3560 and 4670 m elevation.

The leaves of *G. donniana* are characterized by more or less homogeneous, hyaline, and thin-walled cells extending from the costa to margins in the proximal quarter of the leaves. The setae are straight, the capsules are exserted, pale yellowish or stramineous with thin-walled exothecial cells, and the peristome teeth are entire and rather narrow below. The specimen from Popocatépetl (*Sharp 4761 p.p.*, TENN) has very short setae for the species (1 mm), and the capsules are mostly immersed. It could be confused with the Eurosiberian *G. triformis* Carestia & De Not. because that species is identical in gametophyte features and has immersed sporophytes. However, *G. triformis* has thick-walled exothecial cells, and broader (70–100 μm rather than 50–70 μm), cribrose peristome teeth (Muñoz, 1998d).

In the area of the Nevado Sajama (Oruro, Bolivia), *G. donniana* grows closely intermingled in the same cushions with *G. pseudoanodon* and *G. longirostris*. The three species are autoicous and have abundant sporophytes, and identification is therefore easy. *Grimmia pseudoanodon* has immersed, stramineous, gymnostomous capsules, and the leaf margins are plane. *Grimmia longirostris* has exserted, brownish capsules with peristome of the same color, and leaves with recurved margins. In these two species the proximal marginal cells of the leaves have transverse walls thicker than longitudinal walls. *Grimmia donniana* has exserted, pale-yellowish to stramineous capsules topped by orange-reddish peristomes contrasting in color with the capsule. The leaf margins are plane, with the proximal cells being hyaline and more or less inflated and homogeneous from margins to costa.

Additional specimens examined. MEXICO. **México**: Popocatépetl, *Sharp 4761A* (TENN). **Veracruz**: monte Orizaba, *Galeotti s.n.* (PC).

BOLIVIA. **La Paz**: prov. Inquisivi, Cerro Naranuani, *Lewis 83-3243* (F). **Oruro**: Nevado Sajama, *Lewis 84-293* (F, IBA), *308A* (F). ECUADOR. **Napo**: Cerro Antisana in moraine S of W glacier, *Grubb 2501B* (FH).

7. Grimmia elongata Kaulf., in Sturm, Deutschl. Fl. Abtheilung II, Cryptogamie 4(13): 24. 1812. *Dryptodon elongatus* (Kaulf.) Hartm., Handb. Skand. Fl. ed. 3: 271. 1838. TYPE: [Austria. Steyermark:] Styria, *Kaulfuss s.n.* (lectotype, designated by Geissler & Maier (1995), B not seen).

Grimmia fuliginosa Schimp. ex Müll. Hal., Syn. Musc. Frond. 1: 778. 1849. *Schistidium fuliginosum* (Müll. Hal.) Ochyra, Fragm. Florist. Geobot. 43: 105. 1998. TYPE: Mexico. [Veracruz:] Pic d'Orizaba, *Liebmann s.n.* (lectotype, here designated, BM).

Grimmia andreaeacea Müll. Hal., Linnaea 43: 453. 1882. TYPE: Argentina. Cuesta de Caldeira, 27 May 1873, *Lorentz s.n.* (lectotype, here designated, BM; isolectotype, PC).

Grimmia montana var. *epilosa* Grav. ex Delogne, Ann. Soc. Belge Microscop. 9: 21. 1885. *Grimmia montana* f. *epilosa* (Delogne) Podp., Consp. Musc. Eur: 281. 1954. TYPE: Belgique. Namur: Willerzie, 14 Sep. 1882, *Gravet s.n.* (lectotype, here designated, PC; isolectotype, PC).

Grimmia tolucensis Cardot, Rev. Bryol. 38: 1. 1911. TYPE: Mexico. México: volcano of Toluca, *Pringle s.n.* Plantae mexicanae, n° 27a (lectotype, here designated, PC; isolectotypes, FH, JE, PC 2 replicates, TENN).

Dioicous. Plants olive-green to reddish, blackish at high-elevation or exposed habitats. *Stems* erect, to 4 cm, with a central strand. *Leaves* erect and appressed, occasionally flexuous when dry, erect when moist, 1.6–2.4 × 0.3–0.4 mm, lanceolate, acuminate, keeled, not plicate; *margins* re-

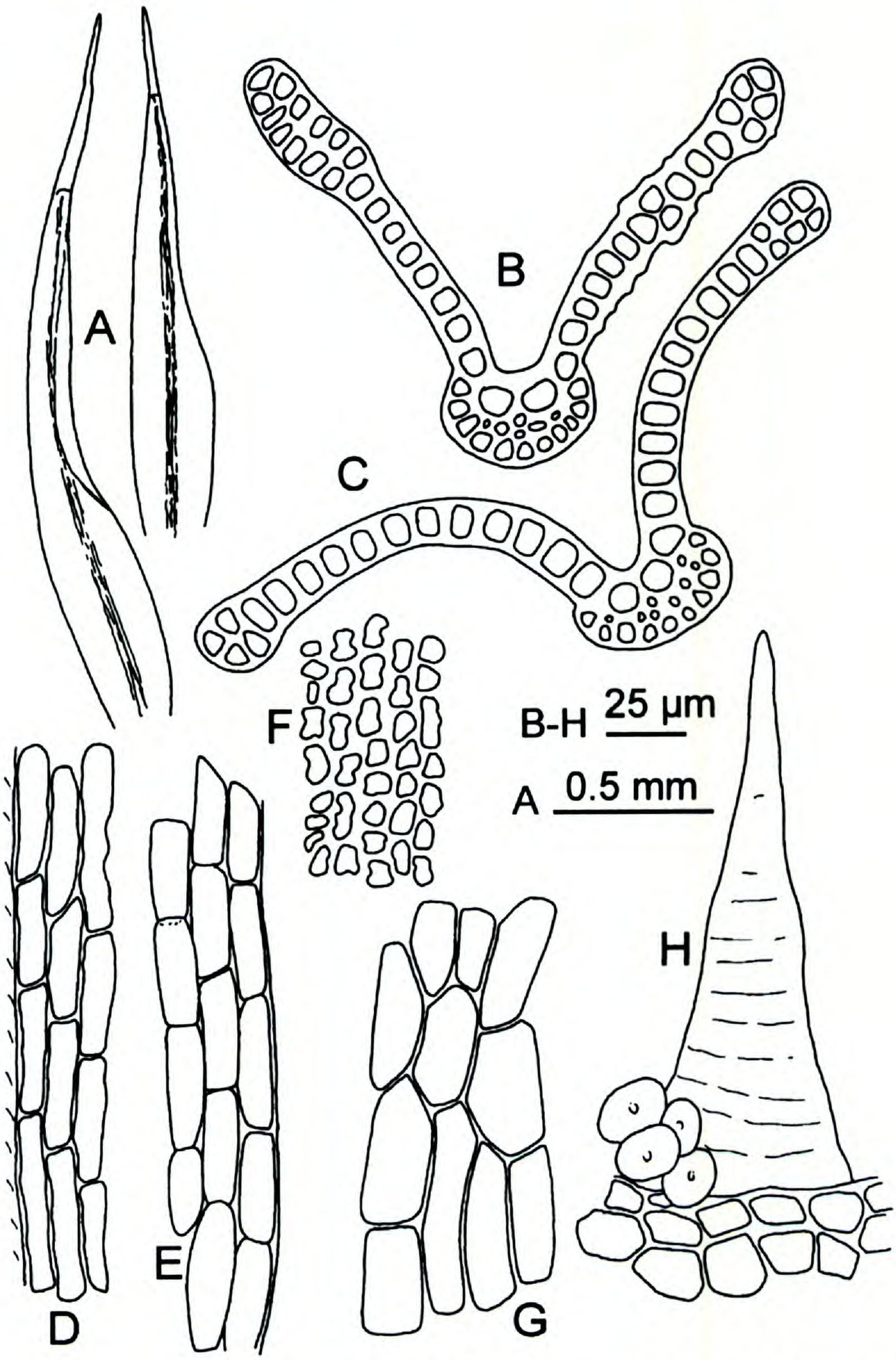

Figure 11. *Grimmia donniana.* —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. —H. Peristome tooth and annulus (only contour shown, not papillosity). (A–F: *Galeotti s.n.*, PC; G, H: *Sharp 4761 p.p.*, TENN.)

curved proximally, to ½ the leaf length on one side and flat or more narrowly recurved proximally, to ⅓ the leaf length on the other side; *costa* semiterete to nearly terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1–2-stratose, 2-stratose at margins in the distal ⅔; *distal cells* 6–9 µm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 30–50 × 6–10 µm, rectangular (3–5 : 1), walls thin and straight; *proximal marginal cells* 40–65 × 6–10 µm, rectangular (4–10 : 1), the walls thin and straight, all alike; *hyaline hair-points* sometimes lacking, terete, straight, to 0.3 mm, entire. *Perichaetial leaves* 3.25 × 0.7 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* terminal. *Setae* erect and straight, 1.0–2.5 mm long. *Capsules* emergent to exserted, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 20–50 × 12–30 µm, mostly isodiametric (1[2] : 1), thin-walled; *annulus* compound

Figure 12. Distribution of: ● *Grimmia donniana*; ▲ *Grimmia laevigata*.

and revoluble, *elongata* type; *peristome teeth* 50–60 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic to rostrate; *calyptrae* mitrate, seldom cucullate; *spores* 9–14 μm, minutely granulose.

Illustrations. Figure 13; Chałubiński (1882: tab. 10 fig. 18); Jóhannsson (1993: fig. 23); Lawton (1971: pl. 59 figs. 11–18); Maier and Geissler (1995: abb. 12); Noguchi (1988: fig. 139 B); Petrov (1975: tab. 64 fig 3); Smith (1978: fig. 149 6–8).

Distribution (Fig. 14). Europe, Reunion, temperate and tropical Asia, southern America; Mexico, Guatemala, Bolivia, Argentina, southeastern Brazil. On sandstone and igneous, either granite or basalt, rocks in open areas, mainly in places with water available from melt, between 2100 and 4600 m elevation.

Plants of *G. elongata* are usually red-tinged. The leaves have recurved margins, short hair-points, and basal marginal cells with thin, uniformly thickened walls. The setae are straight, and the capsules exserted. It is likely to be confused only with *Grimmia navicularis*, a species with curved setae, but rarely fertile. *Grimmia navicularis* has also a red tint and narrow leaves strongly keeled. However, its leaves have basal marginal cells with transverse walls thicker than the longitudinal walls.

Usually quite stenotypic, the only feature that really varies is the length and sinuousity of the distal cells. These are commonly rectangular and strongly sinuous, but short isodiametric cells are also seen. The calyptrae are seldom cucullate instead of mitrate, e.g., PC isolectotypes of *G. tolucensis.*

Additional specimens examined. GUATEMALA. **San Marcos**: between San Sebastián and summit of Volcán Tajamulco, *Steyermark 35547A* (FH), *35548* (FH), *35549A* (FH); near summit of Tajamulco, *Sharp 5429* (TENN). MEXICO. **México**: Mt. Popocatépetl, *Kiener 18554* (FH, TENN), *18591A* (FH), *18591B* (FH), *18592B* (FH), *Vitt 17469* (ALTA), *17486* (ALTA); Nevado del Toluca, *Balls 4100* (FH), *Dunn et al. 21901* (TENN), *Hahn s.n.* (TENN), *Horton 7859* (TENN), *Iltis & Iltis 3221* (TENN), *3228* (TENN), *3229* (TENN), *Patrick 292* (FH), *Pringle s.n.* (FH, JE, PC, UC), *Saint-Pierre 1781A* (PC), *1795* (PC), *1797A* (PC), *1797B* (PC), *1899* (PC), *Sharp et al. 1506B* (TENN), *1514* (TENN), *Vitt 17887* (ALTA), *17902* (ALTA, TENN). **Puebla**: ladera NW del Pico de Orizaba, *Delgadillo 4081* (ALTA), *Purpus 4277A* (UC). **Veracruz**: road from Perote to Cofre, *Sharp et al. 7175B* (TENN).

ARGENTINA. **Salta**: Cuesta de Caldeira, 27 May 1873, *Lorentz s.n.* (BM, PC). BOLIVIA. **Chuquisaca**: prov. Sur Cinti, 6 km E of Salitre, *Lewis 84-1827* (F, IBA), *84-1868* (F, IBA). **Cochabamba**: prov. Cercado, laguna Taquiña, *Lewis 83-2051* (F, IBA); prov. Tapacari, 3 km NE of Challa, *Lewis 83-3938a* (F, IBA), *83-3945* (F, IBA), *83-3961* (F, IBA), *83-3971* (F, IBA). **La Paz**: prov. Inquisivi, Cerro Colque Mata, *Lewis 83-3291* (F, IBA), *83-3301* (F, IBA), *83-3306A* (F, MO), *83-3314* (F, IBA), *83-3317* (F, MO); prov. Sur Yungas, Taquesi Pass, *Lewis 83-2129A* (F, IBA); prov. Sur Yungas, between Tres Ríos and Empresa Minera Bolsa Negra, *Lewis 83-2232* (F, IBA), *83-2235* (F, IBA), *83-2138* (F, IBA). BRAZIL: **Minas Gerais**: Serra do Itatiaia, May 1902, *Dusén s.n.* (PC), *611* (H-BR).

8. Grimmia fuscolutea Hook., Musci Exot. 1: 63. 1818. TYPE: [Mexico.] In frigidis Tobeccae et Islahuacae, *Humboldt & Bonpland s.n.* (syntype, BM not seen).

Grimmia affinis Hornsch., Flora 2: 85. 1819 [non *G. affinis* Hornsch. Flora 2: 442 = *G. longirostris* Hook.].
Grimmia apiculata Hornsch., Flora 1: 329. 1818, nom. nud. *Grimmia apiculata* Hornsch., Flora 2: 442. 1819, nom. illeg. incl. sp. prior. *Grimmia pulvinata* var. *apiculata* (Hornsch.) Huebener, Muscol. Germ: 710. 1833, nom. nud. err. cit. *Dryptodon apiculatus* (Hornsch.) Hartm., Handb. Skand. Fl. ed. 3: 270. 1838. TYPE: [Austria.] Windischmattreyer Tauern, *Hornschuch s.n.* (lectotype, designated by Deguchi (1978), B; isolectotype, H-SOL).
Grimmia flexicaulis Müll. Hal., Linnaea 43: 454. 1882. TYPE: Argentina. Cuesta de Pinos, 27 Mar. 1873, *Lorentz s.n.* (lectotype, designated by Deguchi (1987), JE; isolectotype, BM).
Grimmia quatricruris Müll. Hal., Linnaea 43: 462. 1882. TYPE: Argentina. Cuesta de Pinos in descensu ab alta Puna in convallem Tarija Boliviae, 27 Mar. 1873, *Lorentz s.n.* (lectotype, here designated, BM; isolectotype, PC).
Grimmia unicruris Müll. Hal., Linnaea 43: 463. 1882. TYPE: Argentina. Cuesta de Pinos, 27 Mar. 1873,

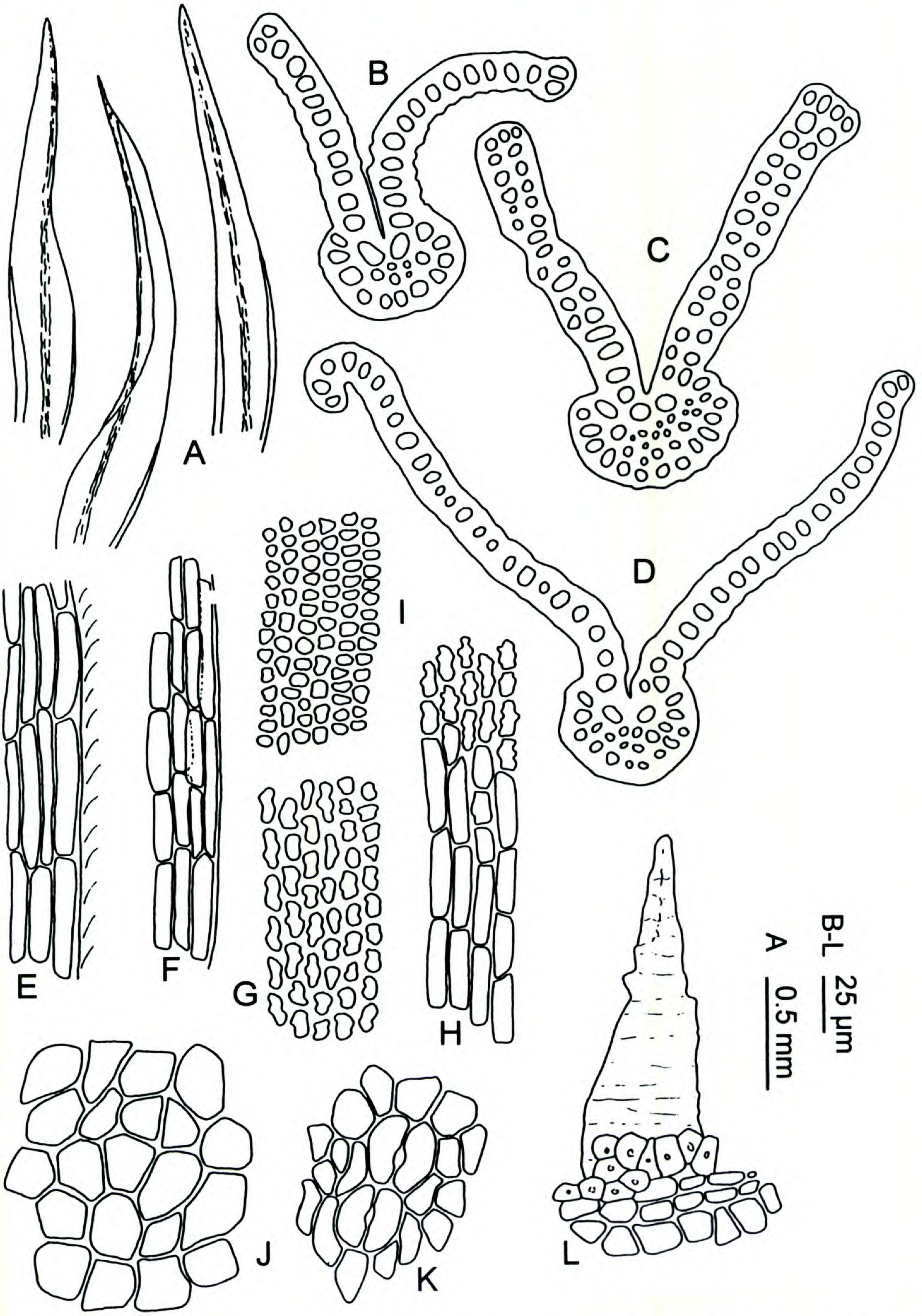

Figure 13. *Grimmia elongata.* —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E. Proximal juxtacostal leaf cells. —F. Proximal marginal leaf cells. —G & I. Distal leaf cells. —H. Transition proximal-medial leaf cells. —J. Medial exothecial cells. —K. Proximal exothecial cells and stomata. —L. Peristome tooth and annulus (only contour shown, not papillosity). (A, B, D–H: *Steyermark 35547a*, FH; C: *Saint-Pierre s.n.*, 1889, PC; J-L: *Saint-Pierre s.n.*, 1887, PC.)

Figure 14. Distribution of *Grimmia elongata*.

Lorentz s.n. (lectotype, here designated, BM [N.B. 3 isotypes in JE are all *G. longirostris* Hook.]).

Grimmia trichophylloidea Schimp. ex Müll. Hal., Nuovo Giorn. Bot. Ital., n.s. 4: 127. 1897. TYPE: Bolivia. Larecaja: vicinitis Sorata, prope Vancuiri, *Mandon 1633* (lectotype, here designated, NY; isolectotypes, F, PC).

Grimmia fastigiata Cardot, Bull. Herb. Boissier, sér. 2, 5: 1003. 1905. TYPE: Argentina. Tierra del Fuego: Ushuaia, mt. Martial, *Skottsberg 70* (lectotype, here designated, PC; isolectotype, H-BR).

Grimmia sanii Greven, Bryologist 99: 429, fig. 2. 1996. TYPE: South Africa. Natal: Drakensberg, Crow's Nest, Mount aux Sources, *Schelpe 2115* (holotype, PRE not seen; isotypes, MO 2 replicates).

Gonioautoicous. Plants green, yellowish green to golden brown. *Stems* erect, to 6 cm, with central strand. *Leaves* erect and flexuous when dry, erect when moist, 1.5–3.0 × 0.3–0.6 mm, lanceolate, acuminate, keeled, not plicate; *margins* recurved proximally, to ⅔ the leaf length on one side and more narrowly recurved proximally, to ⅓–½ the leaf length on the other side, sometimes only shortly and narrowly recurved proximally, in the middle on one side; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose, 2-stratose at margins and in streaks, seldom 2-stratose throughout the distal half in the distal ⅔; *distal cells* 10–30 × 7–11 μm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 40–110 × 8–12 μm, rectangular (3.5–13 : 1), walls medium-thick and straight or nodulose; *proximal marginal cells* 35–80 × 8–12 μm, rectangular (3–10 : 1), the walls thin and straight, all alike, scarcely discernible; *hyaline hair-points* terete, flexuous, to 2 mm, entire. *Perichaetial leaves* 3–4 × 0.6 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* below perichaetia. *Setae* curved, 1.5–3.0 mm long. *Capsules* emergent to exserted, ovoid, symmetric, smooth or ribbed, stramineous, with stomata at the base; *exothecial cells* 30–60 × 10–20 μm, rectangular (2.5–5.0 : 1), thin-walled, but incrassate at the corners; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 70–90 μm wide at the mouth, entire or moderately cribrose, both surfaces papillose throughout, orange, contrasting with the urn; *opercula* mammillate to rostellate; *calyptrae* mitrate; *spores* 10–16 μm, minutely granulose.

Illustrations. Figure 15; Chałubiński (1882: tab. 4 fig. 5, as *G. apiculata*); Deguchi (1978: figs. 17–19, as *G. apiculata*; 1987: pl. 2, 3, as *G. flexicaulis*); Maier and Geissler (1995: abb. 4, as *G. apiculata*); Noguchi (1988: fig. 139B, as *G. apiculata*).

Distribution (Fig. 16). Europe, Africa, temperate and tropical Asia, Antarctic, northern and southern America; Mexico, Andean Range from Venezuela to northern Argentina and Tierra del Fuego. On granite, slate, quartzite, and basalt in forested and open areas, also on strongly compacted earth in grass tussocks and shrub bases in open areas above the tree line, mainly in places with water available from melt, between 3900 and 4700 m elevation.

Grimmia fuscolutea varies in both gametophytic and sporophytic features (Deguchi, 1978: 169, figs. 18, 19). Plants from drier habitats have longer and more incrassate laminal cells, a modification common in many other species in the genus. Capsule shape and surface vary independently of the habitat conditions. Despite this variability, *G. fuscolutea* can be recognized under the dissecting microscope by the combination of the yellowish-shiny bases of the leaves, the recurved margin, and the perigonia located just below the perichaetia. The plant is autoicous and fruits abundantly, making it easy to find male buds. The yellowish shine of the leaf bases is due to the long cells with mostly thin walls, especially toward the margins.

Two specimens (Ecuador. Pichincha: *Bell 153*, FH; Argentina. Tucumán: Cumbre de Calehuaqui, *Kühn s.n.*, JE) have proximal marginal cells with transverse walls slightly thicker than the longitudinal walls. Both are sterile and morphologically deviant from normal *G. fuscolutea* and could prove to be a different taxon. I include them in *G. fuscolutea*, but fertile specimens would be necessary to definitively place them.

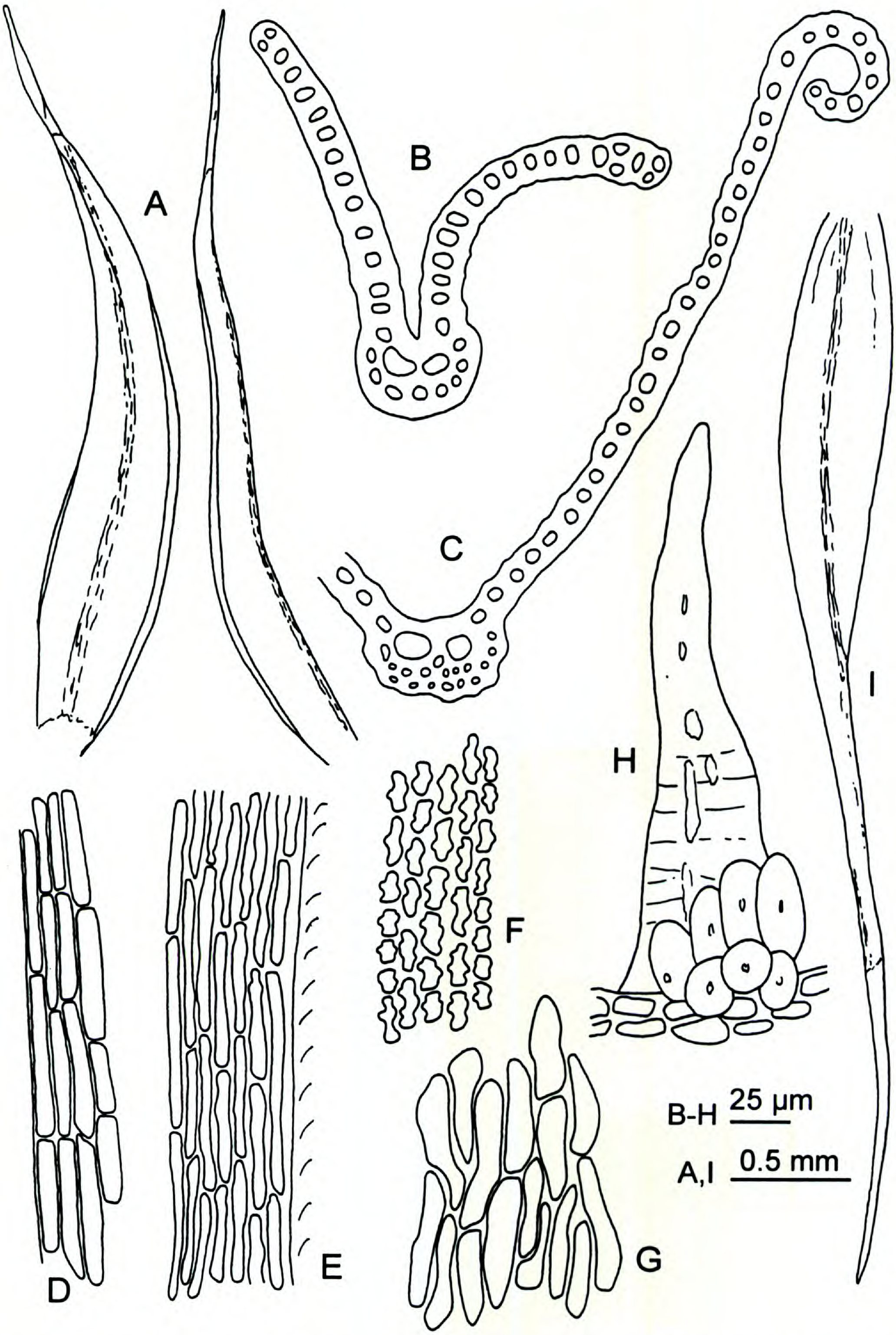

Figure 15. *Grimmia fuscolutea.* —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Proximal marginal leaf cells. —E. Proximal juxtacostal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. —H. Peristome tooth and annulus (only contour shown, not papillosity). —I. Perichaetial leaf. (*Vitt 17921*, TENN.)

Figure 16. Distribution of *Grimmia fuscolutea.*

Selected specimens examined. MEXICO. **México**: Nevado de Toluca, *Cárdenas 3512* (ALTA). **Puebla**: ladera NW del Pico de Orizaba, *Cárdenas 647* (ALTA). **Veracruz**: cima del Cofre de Perote, *Delgadillo 3057* (ALTA); Orizaba, *Schiede 1070B* (PC).

ARGENTINA. **Catamarca**: Yakatula, Grandillas [sic] et Vayas, Feb. 1872, *Lorentz s.n.* (JE). **Salta**: Cuesta de Pinos, in descensu ab alta Puna inconvallem Tarija Boliviae, 27 Mar. 1873, *Lorentz s.n.* (BM, JE, PC). **Tucumán**: depto. Tafi, Infiernillo, *Glummer 1976* (FH). **Tierra del Fuego**: Ushuaia, Mt. Martial, *Skottsberg 70* (PC). BOLIVIA. **Cochabamba**: prov. Ayopaya, laguna Cayuntani, *Lewis 83-4354B* (F, MO); prov. Quillacollo, head of río Suturi, S of Serranías Tarucani, *Lewis 79-2427* (F, FH); prov. Tapacari, Vicuña, *Lewis 83-3932* (F, IBA). **La Paz**: La Cumbre, *Raeymaekers 550* (FLAS); Mururata, *Jaffuel 247* (PC, FH); prov. Camacho, 1 km below Escoma–Charasani road, about 3 km S of Amarate turnoff, NNW of Chuma, *Lewis 79-824* (F, MO, UBC); prov. Inquisivi, cumbre Sayaquira, ca. 2.5 km S of Estancia Huaña Hkota, *Lewis 87414* (FLAS); prov. Larecaja, vicinitis Sorata, prope Vancuiri, *Mandon 1633* (F, NY, PC); prov. Los Andes, Cerro Jankho Karka, *Lewis 84-205A* (F, IBA); prov. Murillo, upper río Chuquiaguillo, *Lewis 88-417* (FLAS); prov. Sur Yungas, between Abra and Estancia Taquesi, *Lewis 83-2183* (F, IBA). **Oruro**: prov. Dalence, 3 km S of Ñaquela, *Lewis 84-1540* (F, IBA). **Potosí**: prov. Tomás Frías, cerro Kari Kari, *Lewis 79-206* (F). ECUADOR. **Pichincha**: Rucu Pichincha, *Benoist 3457* (PC), *3458* (F, PC). PERU. **Lima**: Oroya–Bahn, Hacienda Arana bei Yauli, *Weberbauer 373* (H-BR, PC). VENEZUELA. **Mérida**: Rangel, páramo de Piedras Blancas, *Griffin, III et al. 1498* (ALTA, F, MO).

9. Grimmia humilis Mitt., J. Linn. Soc., Bot. 12: 100. 1869. TYPE: [Chile. Magallanes:] Sandy Point [Punta Arenas], *Lechler s.n.* (lectotype, here designated, NY; isolectotypes, BM, PC).

Gonioautoicous. Plants green, yellowish green to rusty. *Stems* erect, to 1 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 0.7–1.2 × 0.3–0.5 mm, ovate, acute, keeled, not plicate; *margins* plane, occasionally weakly recurved distally; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose except for the 2-stratose two marginal rows in the distal ⅔; *distal cells* 10–18 μm long, isodiametric, rectangular and oblate, not bulging, walls sinuous; *proximal juxtacostal cells* 24–37 × 10–13 μm, rectangular (2–3 : 1), walls thin and straight; *proximal marginal cells* 12–25 × 10–13 μm, isodiametric to rectangular (1–2 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 1.1 mm, denticulate. *Perichaetial leaves* 1.0–1.4 × 0.5–0.7 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* below perichaetia. *Setae* curved, 1.6 mm long. *Capsules* exserted, ovoid, symmetric, smooth to weakly ribbed, stramineous, with stomata at the base; *exothecial cells* 25–55 × 12–27 μm, rectangular (2–3 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–75 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic; *calyptrae* cucullate; *spores* 10–15 μm, minutely granulose.

Illustrations. Figure 17; Deguchi (1984: figs. 3, 4).

Distribution (Fig. 6). Southern America. *Grimmia humilis* is known from Argentina and Chile. It has been collected on dry rocks between 100 and 800 m elevation.

Grimmia humilis has small, ovate and unistratose leaves with flat margins, and curved setae. The only species with similar leaf shape and sporophyte morphology is *G. bicolor,* but this taxon has bistratose, larger leaves.

Additional specimens examined. ARGENTINA. **Río Negro**: Parque Nacional Argentino Nahuel Huapi, Valle Limay, *Donat 110* (JE, PC). **Santa Cruz**: lac Buenos Aires, *Skottsberg 377* (PC); Lago San Martín, Nana, *Donat 28* (JE); Cañadón de las Cuevas, Jan. 1905, *Dusén s.n.* (PC); estancia Güer Aike, río Gallegos, *Santesson M542* (FH). CHILE. Feria, *Gay s.n.* (BM). **Aisén**: en route from Coihaique to Coihaique Alto, *Deguchi 26528* (HIRO). **Magallanes**: Sierra Carmen Silva, *Roivainen 326* (FH); Natales, *Siple 391.3* (FH); Patagonia, 1912, *Cormack s.n.* (BM); río San Martín, *Dusén 141* (FH, NY, PC); Morro Chico, *Deguchi 26407* (HIRO); Parque Nacional Torres del Paine, *Deguchi 26027* (HIRO).

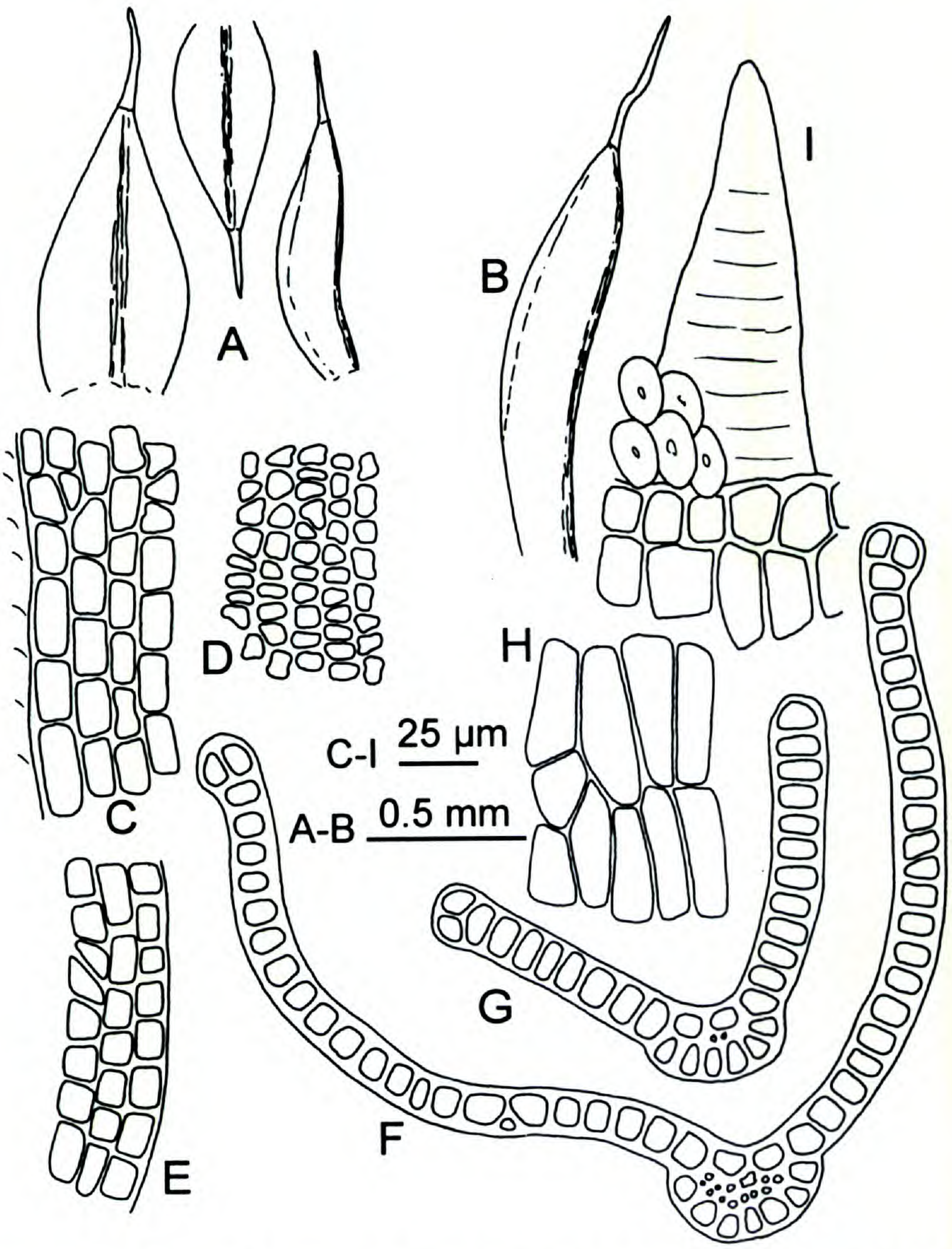

Figure 17. *Grimmia humilis.* —A. Leaves. —B. Perichaetial leaf. —C. Proximal juxtacostal leaf cells. —D. Distal leaf cells. —E. Proximal marginal leaf cells. —F, G. Transverse sections at proximal and medial parts of leaf. —H. Medial exothecial cells. —I. Peristome tooth and annulus (only contour shown, not papillosity). (*Donat 110*, PC.)

10. Grimmia involucrata Cardot, Rev. Bryol. 36: 105. 1909. TYPE: Mexico. Cuyamaloya, 17 Sep. 1908, *Pringle s.n.*, Plantae mexicanae n° 10598 p.p. (lectotype, here designated, PC; isolectotype, PC).

Gonioautoicous. Plants olive-green to blackish. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 0.9–1.5 × 0.35–0.60 mm, triangular to ovate, obtuse to acute, concave, not plicate; *margins* plane; *costa* semi-elliptical, undifferentiated, ventral epidermis 2–6 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 5–14 µm long, mostly isodiametric, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 20–50 × 10–15 µm, rectangular (1.5–4.0 : 1), walls medium-thick and straight; *proximal marginal cells* 10–22 × 10–18 µm, isodiametric, rectangular or oblate (0.7–2.0 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hairpoints* terete distally and flat proximally, somewhat decurrent, straight, to 2 mm, denticulate. *Perichaetial leaves* 1.7–2.2 × 0.9–1.2 mm, convolute, hyaline and filmy, scarcely discernible, larger than vegetative leaves (3.0–3.5 : 1). *Androecia* below perichaetia. *Setae* erect and straight, 1 mm long. *Capsules* immersed, ovoid, ventricose, smooth, straminеous, with stomata at the base; *exothecial cells* 30–70 × 15–35 µm, rectangular (2–4 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peri-*

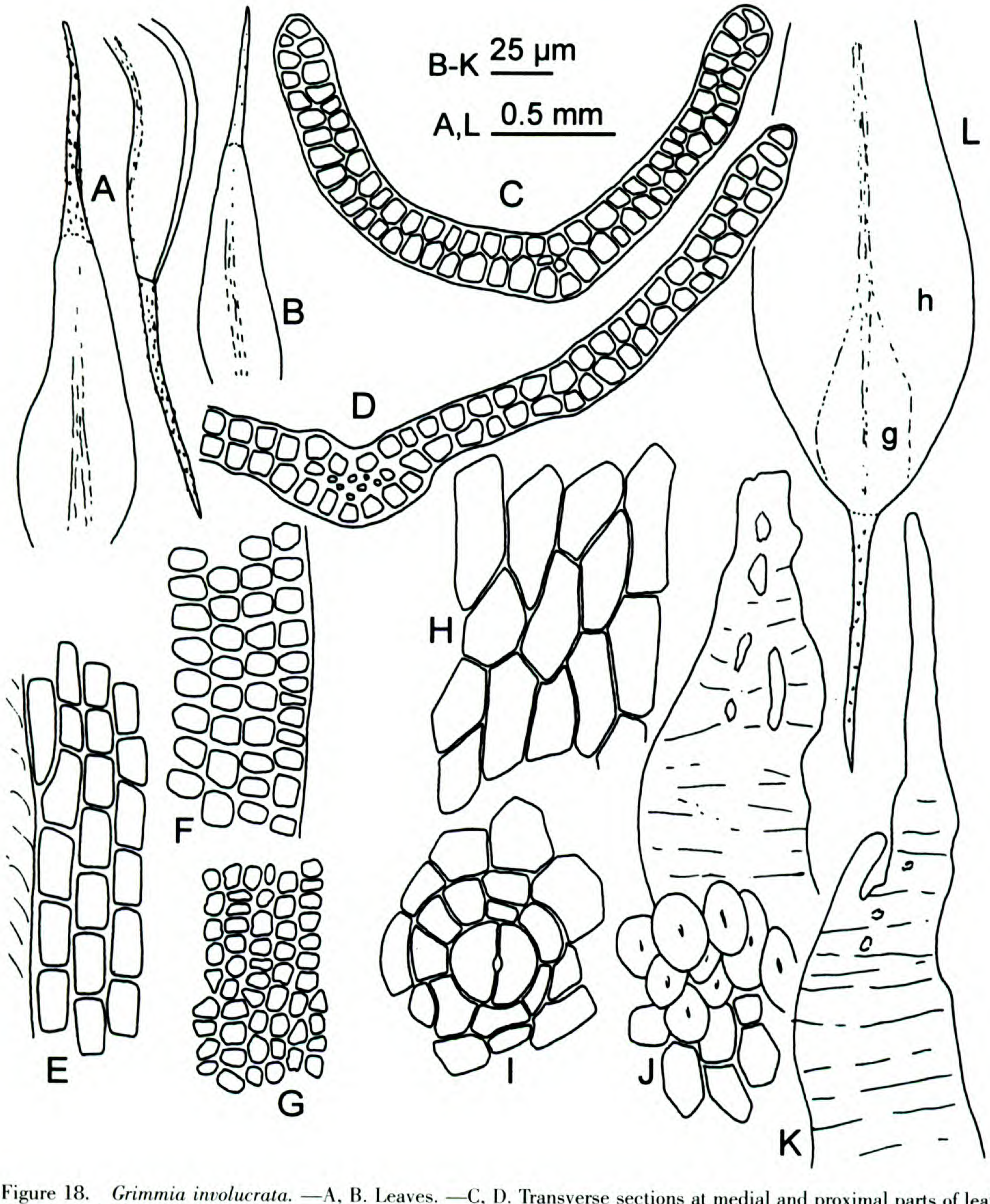

Figure 18. *Grimmia involucrata.* —A, B. Leaves. —C, D. Transverse sections at medial and proximal parts of leaf. —E. Proximal juxtacostal leaf cells. —F. Proximal marginal leaf cells. —G. Distal leaf cells. —H. Medial exothecial cells. —I. Proximal exothecial cells and stoma. —J. Peristome tooth and annulus (only contour shown, not papillosity). —K. Peristome tooth (only contour shown, not papillosity). —L. Perichaetial leaf (h = hyaline area; g = green area). (A, H, I, K: *Pringle 10598*, TENN; B–G, J, L: *Amable 1448*, TENN.)

stome teeth 55–80 µm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange-brown, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 12–16 µm, minutely granulose.

Illustrations. Figure 18; Delgadillo (1999: fig. 1).

Distribution (Fig. 6). Northern America. *Grimmia involucrata* is known only from a few localities in Mexico, where it grows on rocks of unspecified nature around 2500 m elevation.

Grimmia involucrata is characterized by the bi-

stratose concave leaves, undifferentiated costa, the gonioautoicous sexual condition, the strongly modified perichaetial leaves, and the straight setae. For differences between this taxon and the closely related *Grimmia americana*, *G. poecilostoma*, and *G. tergestina*, see the discussion under *G. poecilostoma*.

Crum (1994) considered *Grimmia involucrata* synonymous with *G. affinis* and included the specimens of *G. involucrata* under *G. tergestina*. *Grimmia longirostris* (= *G. affinis*) is a totally different taxon, but some type collections of *G. involucrata* have stems of *G. longirostris* intermingled. This, combined with the similarity of *G. involucrata* and *G. tergestina*, may explain Crum's mistake.

A description and illustration of *Grimmia involucrata* appears in Delgadillo (1999).

Additional specimens examined. MEXICO. **Hidalgo**: Cuyamaloya, Sierra de Pachuca, *Pringle 10599* (ALTA, TENN). **México**: Tlalpan, *Amable 1448* (PC).

11. Grimmia kidderi James, Bull. Torrey Bot. Club 6: 54. 1875. TYPE: Kerguelen Island, 1874, *Kidder s.n.* (lectotype, here designated, FH; isolectotype, FH).

Grimmia frondosa James, Bull. Torrey Bot. Club 6: 54. 1875. TYPE: Kerguelen Island, *Kidder s.n.* (lectotype, here designated, FH; isolectotypes, FH 2 replicates, NY, PC).

For additional synonyms, see Ochyra and Hertel (1990) and Bell (1984).

Dioicous. Plants olive-green, yellowish brown or blackish. *Stems* erect, to 3 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, (0.75)1.0–1.5 × 0.2–0.4 mm, lanceolate, acuminate, concave to keeled distally, not plicate; *margins* plane; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1–2-stratose in the distal ⅔; *distal cells* 7–16 μm long, isodiametric and rectangular, some oblate intermingled, bulging on the dorsal surface, walls straight to sinuous; *proximal juxtacostal cells* 30–60 × 8–12 μm, rectangular (3–8:1), walls thin and straight to thick and nodulose; *proximal marginal cells* 20–35 × 6–8 μm, rectangular (3–6:1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete distally or when short, flat proximally or when long, straight to flexuous, to 1.5 mm, smooth to denticulate. *Perichaetial leaves* 3.0–4.5 × 0.7–0.9 mm, convolute and larger than vegetative leaves (5–15 ×). *Androecia* terminal. *Setae* straight, 0.6–1.4 mm long. *Capsules* immersed, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 35–60 × 15–25 μm, rectangular (1.5–3.0:1), thin-walled, but incrassate at the corners; *annulus* compound and tardily deciduous, *elongata* type; *peristome teeth* 100–130 μm wide at the mouth, entire to cribrose and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic to rostrate; *calyptrae* not seen; *spores* 10–12 μm, minutely granulose.

Illustrations. Figure 19; Bell (1984: fig. 3 as *G. immerso-leucophaea*); Cardot (1908: 52 as *G. nordensjoldii*); van Zanten (1971: fig. 11–1 as *G. kerguelensis*).

Distribution (Fig. 10). Antarctic, middle Atlantic (Ascension), Subantarctic islands (Kerguelen, Marion-Prince Edward, South Georgia, Tristan de Cunha), southern America. In Latin America *G. kidderi* is known only from two Patagonian collections. Nevertheless, it is one of the commonest *Grimmia* species in the Southern Hemisphere archipelagos. The South American specimens lack habitat information, but collections from other areas grow on rocks in open and exposed areas, between sea level in South Georgian islands to 1800 m in Tristan de Cunha.

Grimmia kidderi is rarely fertile, yet despite this it is not difficult to recognize. The leaves are narrowly lanceolate and concave for most of their length; a few distal cross sections can appear V-shaped. The proximal cells are long-rectangular, and often somewhat nodulose in the juxtacostal rows. If fertile, the species can be immediately recognized by the immersed capsules surrounded by disproportionately large perichaetial leaves, 5–15 times larger in area than the normal vegetative leaves (Fig. 19K). It is interesting to note that the vast majority of species of *Grimmia* have large perichaetial leaves, commonly 2–5 times larger than other leaves. Nevertheless, the genera *Grimmia* and *Schistidium* have been distinguished historically by the larger, strongly differentiated perichaetial leaves of *Schistidium* as opposed to the largely undifferentiated perichaetial leaves of *Grimmia* (cf. the keys in Crum, 1994; Crum & Anderson, 1981).

In a previous work (Muñoz, 1998d), I cited the specimen *Gunckel 1768* as *Grimmia reflexidens*, but, on reexamination, it clearly has the characteristics of *G. kidderi*.

Additional specimens examined. ARGENTINA. **Santa Cruz**: à l'ouest du lac Azara, *Skottsberg 371* (H-BR). CHILE. **La Araucanía**: Lonquimay, *Gunckel 1768* (PC).

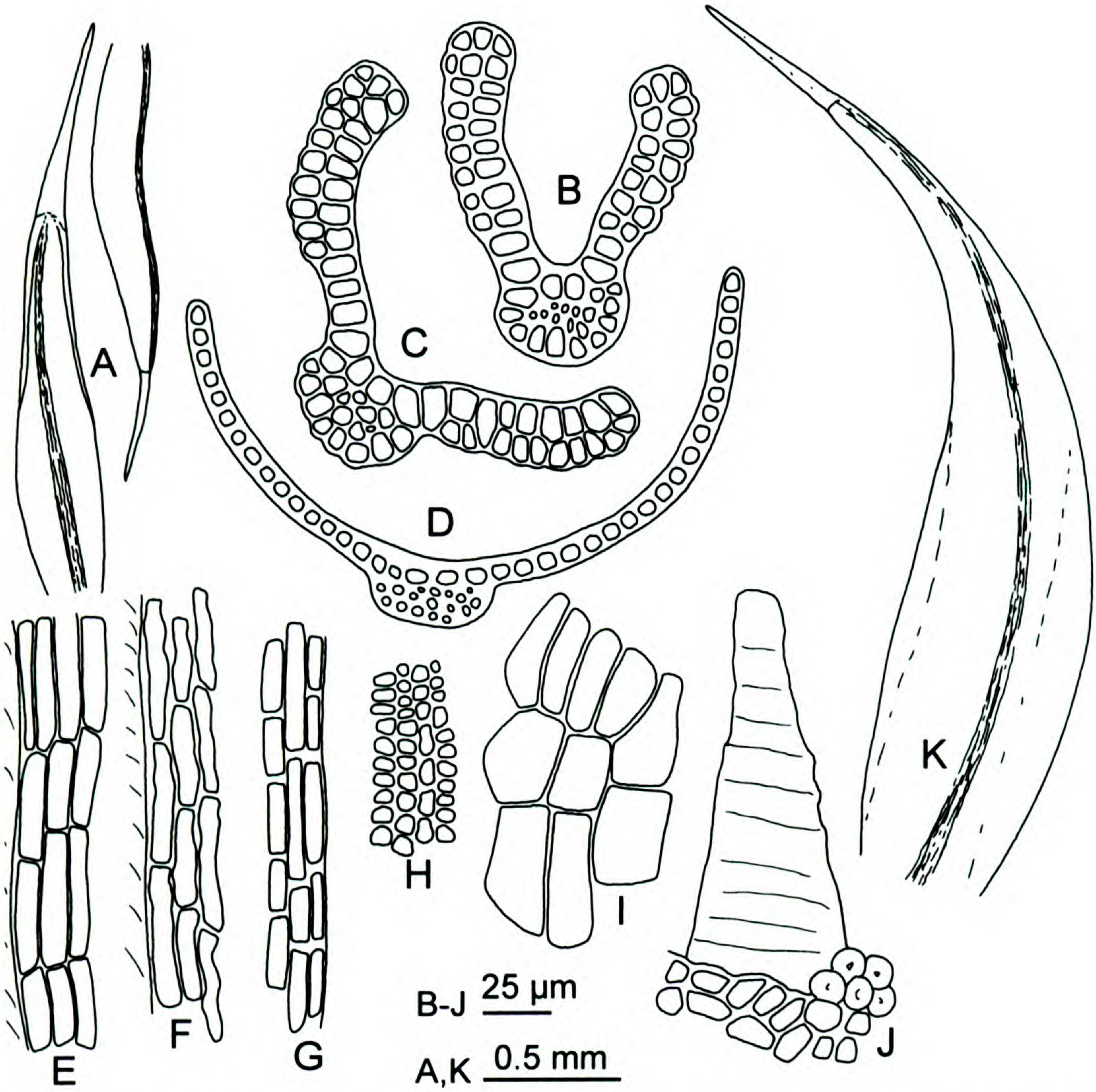

Figure 19. *Grimmia kidderi*. —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E, F. Proximal juxtacostal leaf cells. —G. Proximal marginal leaf cells. —H. Distal leaf cells. —I. Medial exothecial cells. —J. Peristome tooth and annulus (only contour shown, not papillosity). —K. Perichaetial leaf. (A–H: *Gunckel 1768*, PC; I–K: *Skottsberg*, H-BR.)

12. Grimmia laevigata (Brid.) Brid., Bryol. Univ. 1: 183. 1826. *Campylopus laevigatus* Brid., Muscol. Recent. Suppl. 4: 76. 1819. TYPE: Italy. *Anonymous s.n.* (lectotype, designated by Cao & Vitt (1986), B).

Grimmia leucophaea Grev., Mem. Wern. Nat. Hist. Soc. 4: 87, pl. 6. 1822. *Dryptodon leucophaeus* (Grev.) Brid., Bryol. Univ. 1: 773. 1827. TYPE: United Kingdom. Edinburgh, King's Park, *Greville s.n.* (lectotype, here designated, BM; isolectotypes, FH, NY 3 replicates).

Dryptodon brevifolius Brid., Bryol. Univ. 1: 775. 1827. TYPE: no data, labeled: "Dryptodon brevifolius N. Schleich. Herb. De Cand." (lectotype, here designated, B).

Grimmia leiocarpa Taylor, London J. Bot. 5: 44. 1846. TYPE: Australia. Swan River, 1843, *Drummond s.n.* (lectotype, here designated, FH; isolectotypes, H-SOL, NY 2 replicates).

Grimmia calotricha Müll. Hal., Linnaea 43: 454. 1882. TYPE: Argentina. Sierra de Córdoba, Las Peñas, 1871, *Lorentz s.n.* (lectotype, here designated, BM; isolectotype, PC).

Grimmia leucophaea var. *latifolia* Limpr., Laubm. Deutschl. 1: 742. 1889. *Grimmia leucophaea* var. *latifolia* Limpr., Bryoth. Siles. n° 163. 1867, nom. nud. *Grimmia campestris* var. *latifolia* (Limpr.) Paris, Index Bryol. ed. 2: 269. 1904. *Grimmia campestris* f. *latifolia* (Limpr.) Mönk., Laubm. Eur. 356. 1927. *Grimmia laevigata* f. *latifolia* (Limpr.) Podp., Consp. Musc. Eur. 276. 1954. TYPE: [Poland. Silesia:] Spitzberg bei Hirschberg, 1867, *Limpricht s.n.* (lectotype, here designated, FH).

Grimmia sarcocalyx Kindb., in Macoun, Cat. Canad. pl., Musci: 66. 1892. *Grimmia sarcocalyx* Kindb., in Macoun, Bull. Torrey Bot. Club 17: 271. 1890, nom. nud. *Grimmia campestris* subsp. *sarcocalyx* (Kindb.) Kindb., Eur. N. Amer. Bryin. 2: 219. 1898. TYPE: Canada. British Columbia: Spence's Bridge, 28 May 1889, *Macoun s.n.* (lectotype, here designated, S; isolectotype, CANM-198098).

Grimmia murina Müll. Hal., Hedwigia 36: 105. 1897. TYPE: [Argentina. Buenos Aires:] Sierra de la Ventana, 1881, *Lorentz s.n.* (lectotype, here designated, JE; isolectotypes, JE, PC).

Dioicous. *Plants* olive-green to blackish. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, spreading when moist, 0.8–1.4 × 0.3–0.8 mm, triangular or cordate to ovate, obtuse to acuminate, concave, not plicate; *margins* plane; *costa* semi-elliptical, undifferentiated, ventral epidermis 2–6 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 5–10 μm long, isodiametric, rectangular and oblate, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 20–30 × 12–16 μm, rectangular (1.5–2.5 : 1), walls thick and straight; *proximal marginal cells* 6–10 × 10–16 μm, oblate (0.4–0.7 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 2 mm, dentate, seldom nearly smooth. *Perichaetial leaves* ca. 2 × 0.8–1.3 mm, convolute and larger than vegetative leaves (2–4 ×). *Androecia* terminal. *Setae* erect and straight, 1–3 mm long. *Capsules* exserted, ovoid, symmetric, smooth, castaneous, with stomata at the base; *exothecial cells* 30–65 × 15–30 μm, rectangular (1.5–2.5 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–60 μm wide at the mouth, entire or weakly cribrose, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, castaneous, concolorous with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 12–16 μm, minutely granulose.

Illustrations. Figure 20; Deguchi (1984: fig. 5); Dirkse (1982: figs. 1–12); Lawton (1971: pl. 61 figs. 1–9); Maier and Geissler (1995: abb. 16); Orbán and Vajda (1983: fig. 328a–c); Petrov (1975: tab. 62 fig. 7); Smith (1978: fig. 148 1–4).

Distribution (Fig. 12). Europe, Africa, temperate and tropical Asia, Australasia, northern and southern America; central and eastern Argentina, south Brazil, central Chile. On acidic and slightly basic rocks on cliffs, outcrops, and other exposed, open places usually dry and sunny between 180 and 2000 m elevation.

Grimmia laevigata is readily recognized by the basal marginal cells oblate and the undifferentiated costae in the distal part of leaves. It is macroscopically similar to *Grimmia americana, G. involucrata, G. poecilostoma, G. tergestina,* and populations of *G. ovalis* with short acumina. For example, all reports of *G. laevigata* from Chihuahua, Durango, and Tlaxcala (Mexico; Crum, 1994: 391) are *G. ovalis* with short leaves. All previous species have basal marginal cells that are isodiametric to rectangular, and are not oblate as in *G. laevigata.* Some authors have stressed that *G. laevigata* has more strongly dentate hair-points. This is usually correct, but some populations of *G. laevigata* have almost smooth hair-points, and *G. tergestina* can have strongly dentate hair-points, leading to misidentifications. Basal leaf areolation is the best diagnostic character in *G. laevigata* because sporophytes are rarely produced.

Additional specimens examined. MEXICO. **Baja California**: 75 km S of Tijuana on Ensenada Rd., 6 Sep. 1962, *Sharp s.n.* (TENN); below Melting Ranch, E of Colenett, Sierra de San Pedro Mártir, *Sharp et al. 6086* (TENN), *6090* (TENN), *6097a* (TENN); Sonorabampo Canyon near La Misión, *Mulroy 8* (TENN); ca. 12 km W de Tecate, *Meyer 33* (TENN); 3.5 km S of Tecate, *Meyer 34A* (TENN); 1 km W of Tijuana, Presa de Rodríguez, *Meyer 32A* (TENN).

ARGENTINA. **Buenos Aires**: Sierra Ventana, *Kühnemann 4137* (TENN). **Córdoba**: Depto. Punilla, Weg von Tanti nach Cerro Los Gigantes, unterhalb La Hoyada, *Hosseus & Weihmüller 2216* (FH), *2217* (FH), *2218* (FH), *2227* (FH), *2309* (FH), *2372* (FH); Weg von Tanti nach Cosquín bei der Cueva de los Pajaritos, *Hosseus & Weihmüller 886* (FH), *887* (FH), *888* (FH), *889* (FH); Sierra Chica, Weg von Río Ceballos nach La Falda, *Hosseus & Weihmüller 1487* (FH); Río Juspe, Weg nach La Candelaria, *Hosseus 910* (FH); bei der Estafeta Casa Nueva (Pedernera), *Hosseus 1856* (FH); Depto. Colón, Los Quebrachitos, 10 km oberhalb Unquillo, *Hosseus 761* (FH). BRAZIL. **Rio Grande do Sul**: Lavras do Sul, *Vital 9196* (FLAS). CHILE. **Bio-Bio**: Los Ángeles, *Dusén 366* (FH, JE, NY, PC). **Maule**: Caurico, *Barros 6877* (FH). **Región Metropolitana**: prope Santiago urbem, *Dusén 136* (FH, NY, PC); San Cristóbal, *Bertho 100* (FH, PC). URUGUAY. **Montevideo**: Montevideo, *Gibert 1243* (PC).

13. Grimmia lisae De Not., Muscol. Ital. Spic: 15. 1837. *Grimmia muehlenbeckii* var. *lisae* (De Not.) Bott., in Venturi & Bott., Atti Soc. Crittog. Ital. 3: 217. 1884. *Grimmia trichophylla* subsp. *lisae* (De Not.) Boulay, Musc. France 1: 378. 1884. *Dryptodon lisae* (De Not.) Loeske, Stud. Morph. Syst. Laubm. 111. 1910. *Grimmia trichophylla* var. *lisae* (De Not.) Bott., in Luisier, Brotéria, Sér. Bot. 14: 32. 1916. TYPE: Italia. In collibus taurinensibus, 1836, *Lisa s.n.* (lectotype, here designated, RO; isolectotypes, H-SOL, NY, RO).

Grimmia sardoa Müll. Hal., Syn. Musc. Frond. 1: 786. 1849. *Grimmia trichophylla* var. *sardoa* (Müll. Hal.)

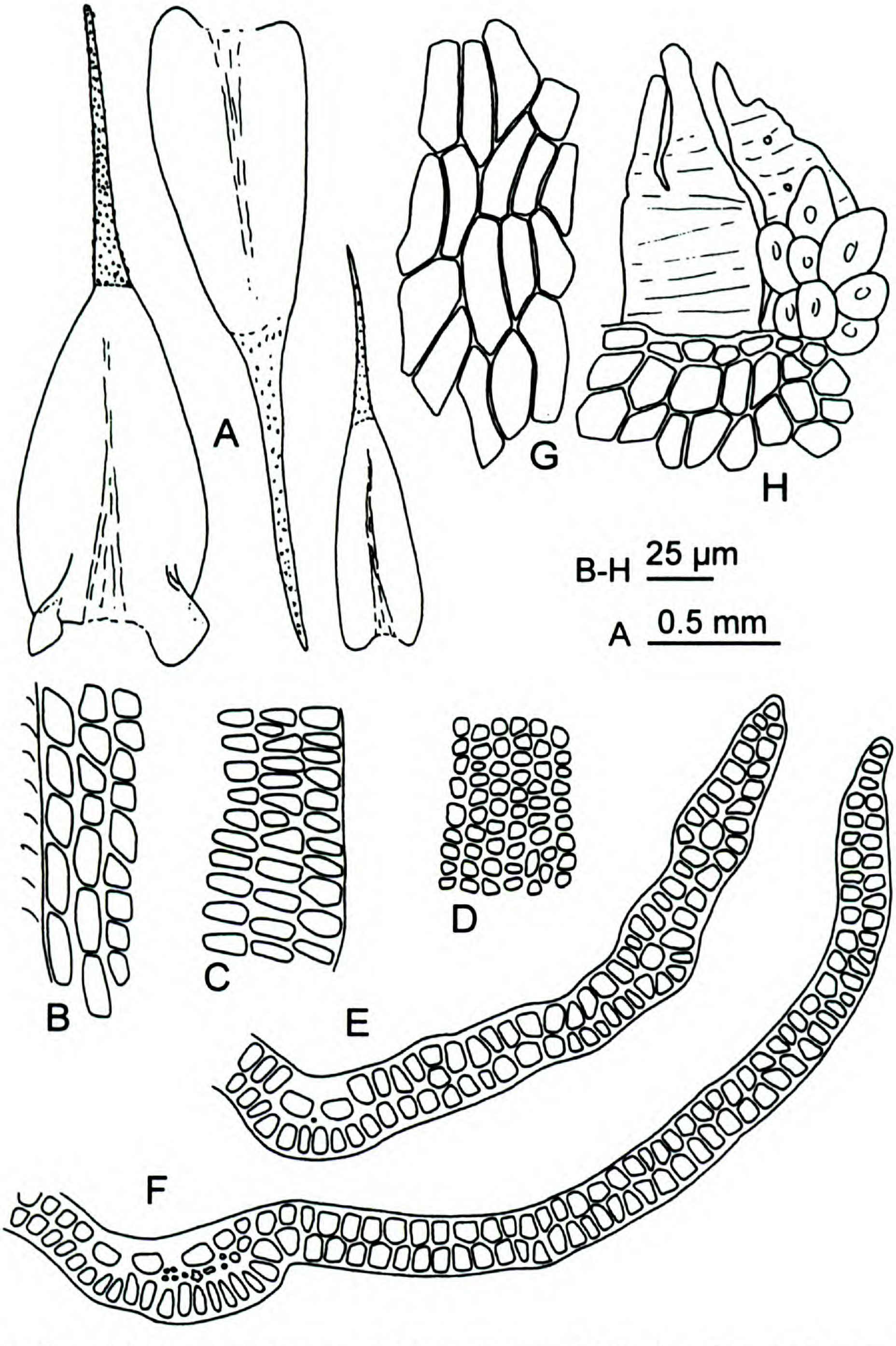

Figure 20. *Grimmia laevigata.* —A. Leaves. —B. Proximal juxtacostal leaf cells. —C. Proximal marginal leaf cells. —D. Distal leaf cells. —E, F. Transverse sections at medial and proximal parts of leaf. —G. Medial exothecial cells. —H. Peristome teeth and annulus (only contour shown, not papillosity). (*Mulroy 8*, TENN.)

Boulay, Musc. France 1: 379. 1884. *Grimmia muehlenbeckii* var. *sardoa* (Müll. Hal.) M. Fleisch., Malpighia 7: 329. 1893, nom. inval. pro synon. *Grimmia lisae* subsp. *sardoa* (Müll. Hal.) Kindb., Eur. N. Amer. Bryin. 2: 223. 1898. *Dryptodon sardoa* (Müll. Hal.) Loeske, Stud. Morph. Syst. Laubm. 111. 1910. *Grimmia trichophylla* subsp. *sardoa* (Müll. Hal.) Bott., in Loeske, Laubm. Eur. Part I: 133. 1913. TYPE: Italia. Sardinia, *De Notaris s.n.* (lectotype, here designated, RO).

Grimmia californica Sull., Expl. Railroad Mississippi Pacific, Descr. Moss. Liverw: 187, pl. 4. 1857 "1856." TYPE: U.S.A. California: near Oakland, *Bigelow 2.b* (lectotype, here designated, FH).

Grimmia canadensis Kindb., Eur. N. Amer. Bryin. 2: 226. 1898. TYPE: Canada. British Columbia: Vancouver Isl., 26 May 1893, *Macoun s.n.* (lectotype, here designated, S; isolectotypes, CANM-198079, CANM-198080).

Grimmia azorica Renauld & Cardot, Bull. Soc. Roy. Bot. Belgique 41: 58. 1905. *Grimmia trichophylla* subsp. *azorica* (Renauld & Cardot) Luisier, Brotéria, Sér. Bot. 17: 42. 1919. TYPE: Portugal. Azores: Sta. Maria, *Trelease 1393c* (lectotype, here designated, PC; isolectotype, MO; syntype, [Graciosa, *Brown s.n.*] PC).

Grimmia trichophylla f. *propagulifera* H. Winter, Hedwigia 55: 101. 1914, nom. illeg., non Limpr., 1889. TYPE: Spain. Santa Cruz de Tenerife: Guímar, auf Felsen dem Sanatorium, Mar. 1912, *Winter s.n.* (lectotype, here designated, JE).

Dioicous. *Plants* olive-green. *Stems* erect or ascending, to 3 cm, with central strand. *Leaves* erect and appressed when dry, spreading to squarrose when moist, 1.7–3.0 × 0.5–0.7 mm, lanceolate, acute, keeled, not plicate; *margins* recurved proximally, to ½–⅔ the leaf length on one side and flat or more narrowly recurved proximally, to ⅓–½ the leaf length on the other side; *costa* reniform, differentiated, ventral epidermis (2)4–6 cells wide in cross section; *lamina* 1–2-stratose, 2-stratose at margins and in streaks in the distal ⅔; *distal cells* 5–12 μm long, isodiametric, rectangular and oblate, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 17–50 × 7–14 μm, rectangular (1.5–6.0 : 1), walls thick and straight; *proximal marginal cells* 10–35 × 8–12 μm, isodiametric to rectangular (1–3 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 1.2 mm, denticulate. *Propagula* (not seen in American specimens; description from Mediterranean specimens) 40–60 μm diam., spherical to broad-ellipsoid, multicellular, on branched stalks on the dorsal side of leaf base, olive-green or brownish with yellowish green to brownish walls. *Perichaetial leaves* 2.6–3.6 × 0.6–0.9 mm, convolute and larger than vegetative leaves (2–4 ×). *Androecia* terminal. *Setae* curved, 3–5 mm long. *Capsules* exserted, ellipsoid, symmetric, weakly ribbed, stramineous, with stomata at the base; *exothecial cells* 20–35 × 14–25 μm, mostly rectangular ([1]2 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 40–70 μm wide at the mouth, entire or irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 12–18 μm, minutely granulose.

Illustrations. Figure 21.

Distribution (Fig. 6). Europe, northern Africa, northern America. *Grimmia lisae* occurs commonly along the Pacific coast from Vancouver Island to Baja California. The Mexican localities of this species lie in the southernmost area of Californian vegetation. It is found on rocks and soil over rocks in coastal sage shrub vegetation at low elevations near sea level.

Grimmia lisae has straight non-flexuous leaves not folded along the costae, short hair-points, and costae reniform in cross section. Under the dissecting microscope the leaves are quite flat in the distal part, and closely appressed to the stem. It has usually been considered a synonym of *G. trichophylla*, but they are readily distinguished by costa structure. *Grimmia trichophylla* has more flexuous leaves usually folded along the costae. When sporophytes are present, the ovoid, weakly ribbed capsules of *G. lisae* markedly contrast with the ellipsoid to cylindrical, strongly ribbed capsules of *G. trichophylla*. Propagula, when found, are distinctive, although I have never seen them in American specimens of *G. lisae*. In *G. lisae*, they originate from dorsal bases of leaves. In *G. trichophylla* propagula are sessile on the laminae. European collections of *G. lisae* sometimes have propagula, in contradiction to Greven (1995: 90). Greven (1995: 90) also mistakenly attributed this taxon to specimens collected in "Toros Daglari in Turkey," confusing the Latin *taurinensibus* (= "from Taurinum," Turin, Italy) and *tauricus* (= "from Taurus," Toros Dağlari, Turkey, or "from Tauria," Crimea, Ukraine) (Stearn, 1983).

Additional specimens examined. MEXICO. **Baja California**: 75 km S of Tijuana on Ensenada Road, 6 Sep. 1962, *Sharp s.n.* (TENN); Punta Banda, near Los Arbolitos, *Mulroy 3* (TENN); Sonorabampo Canyon near La Misión, *Mulroy 5* (TENN), *6* (TENN).

14. Grimmia longirostris Hook., Musci Exot. 1: 62. 1818. TYPE: [Ecuador. Chimborazo: mt. Chimborazo], *Humboldt 76* (lectotype, designated by Deguchi (1984), BM; isolectotypes, BM, PC).

Grimmia affinis Hornsch., Flora 2: 443. 1819 [July], nom. illeg. [non Hornsch. 1819, Flora 2: 85 [February] (= *Grimmia fuscolutea* Hook.)]. *Dryptodon ovatus* var. *affine* (Hornsch.) Hartm., Handb. Skand. Fl. ed. 3: 271. 1838. *Grimmia ovata* var. *affinis* (Hornsch.) Bruch & Schimp., in Bruch, Schimp. & W. Gümbel, Bryol. Europ. 3: 123, tab. 255ß. 1845. *Grimmia ovalis* var. *affinis* (Hornsch.) Broth., Acta Soc. Sci. Fenn. 19: 86. 1892. *Grimmia ovalis* f. *affinis* (Hornsch.) Mönk., Laubm. Eur. 360. 1927. TYPE: [Austria:] Windissmattrey Tauern, *Hornschuch s.n.* (lectotype, designated by Deguchi (1978), B).

Grimmia columbica De Not., Mem. Reale Accad. Sci. To-

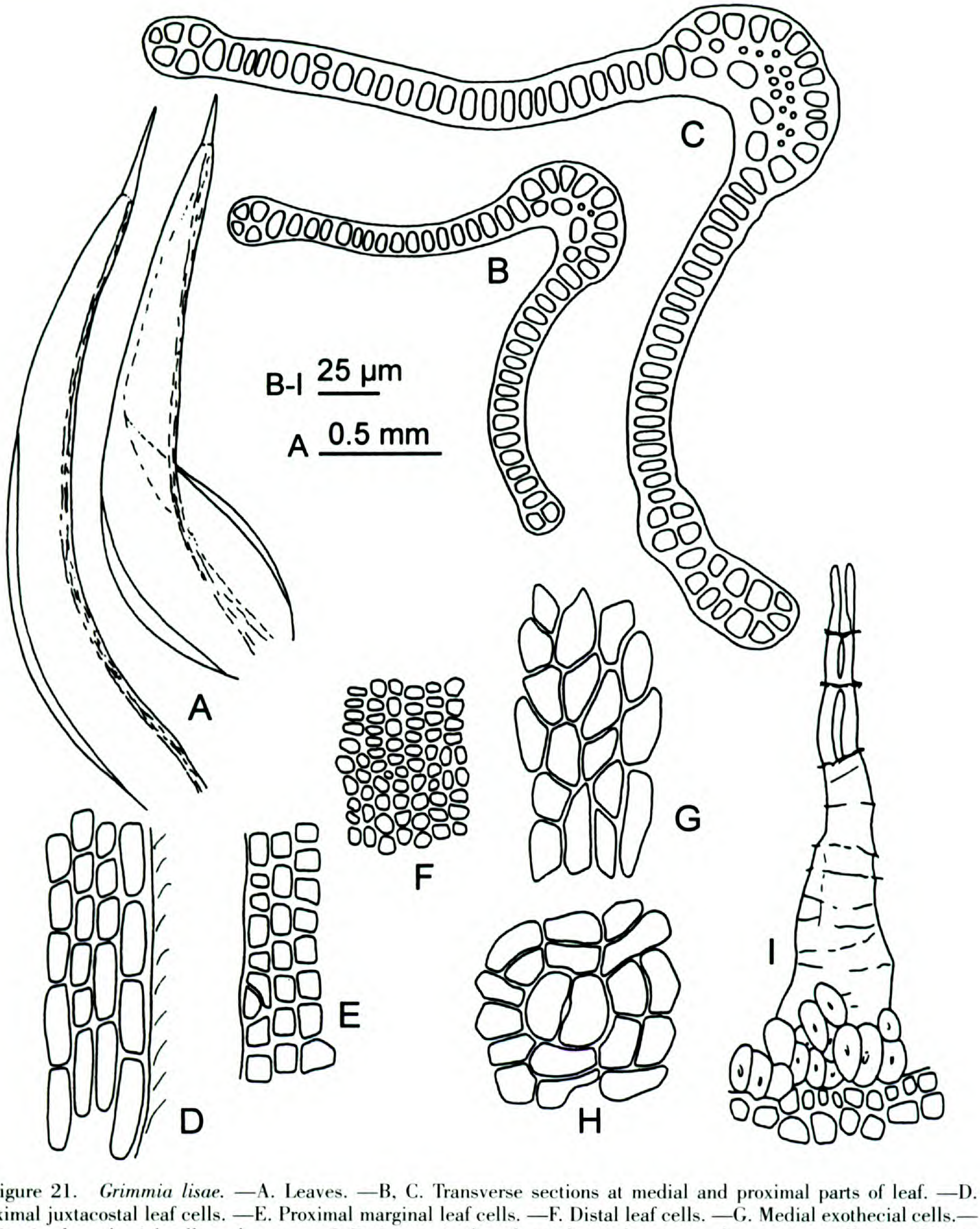

Figure 21. *Grimmia lisae*. —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells.— H. Proximal exothecial cells and stoma. —I. Peristome tooth and annulus (only contour shown, not papillosity). (*Mulroy 5*, TENN.)

rino, ser. 2, 18: 447, fig. 7. 1859. TYPE: [Ecuador. Napo:] ad rivum Napo, *Osculati s.n.* (holotype, RO?; isotype, H-SOL).

Grimmia peruviana Sull., U. S. Expl. Exped., Musc. 8, Tab. 5A. 1860. TYPE: Peru. Andes, [*Rick & Brackenridge s.n.*] (lectotype, designated by Muñoz (1998c), BM; isolectotypes, BM, FH, NY).

Grimmia bogotensis (Hampe) A. Jaeger, Ber. Tätigk. St. Gallischen Naturwiss. Ges. 1872–1873: 70. 1874. *Guembelia bogotensis* Hampe, Linnaea 32: 142. 1863. TYPE: Colombia. Cundinamarca: Bogotá, Los Laches, *Lindig 2011* (lectotype, designated by Muñoz (1998c), PC; isolectotype, NY).

Grimmia integridens Müll. Hal., Linnaea 43: 460. 1882. TYPE: Argentina. Tucumán: in der Cienaga, 1893, *Lorentz s.n.* (lectotype, designated by Muñoz (1998c), PC).

Grimmia leucophaeola Müll. Hal., Linnaea 43: 456. 1882.

TYPE: Argentina. Tucumán: Tafi, 1872, *Lorentz s.n.* (lectotype, designated by Muñoz (1998c), JE; isolectotypes, BM, JE, NY).

Grimmia raphidostega Müll. Hal., Linnaea 43: 459. 1882. TYPE: Argentina. Salta: Nevado de Castillo, 1873, *Lorentz s.n.* (lectotype, designated by Muñoz (1998c), JE).

Grimmia vernicosula Müll. Hal., Linnaea 43: 458. 1882. TYPE: Argentina. Salta: Orán, *Lorentz s.n.* (lectotype, designated by Muñoz (1998c), JE; isolectotype, BM).

Grimmia rufa Müll. Hal., Bot. Jahrb. Syst. 5: 81. 1884. TYPE: [South Africa.] Kerguelen Isl., Nov. 1874, *Naumann s.n.* (lectotype, here designated, PC; isolectotype, H-BR).

Grimmia nanoglobosa Müll. Hal. ex E. Britton, Bull. Torrey Bot. Club 23: 477. 1896. TYPE: Bolivia. La Paz: Mapiri, May 1886, *Rusby s.n.* (holotype, NY).

Grimmia breviexserta Müll. Hal., Bull. Herb. Boissier 5: 200. 1897. TYPE: Guatemala. Quezaltenango: Quezaltenango, *Bernoulli & Cario 115* (lectotype, designated by Muñoz (1998c), PC).

Grimmia micro-ovata Müll. Hal., Nuovo Giorn. Bot. Ital., n.s. 4: 128. 1897. TYPE: Bolivia. Cochabamba: prope Choquecamata, *Germain 1142* (lectotype, designated by Muñoz (1998c), JE; isolectotype, NY).

Grimmia subovata Schimp. ex Müll. Hal., Nuovo Giorn. Bot. Ital., n.s. 4: 128. 1897. TYPE: Bolivia. Larecaja: vicinitis Sorata, Ancouma, hacienda Peñas, *Mandon 1634* (lectotype, designated by Muñoz (1998c), BM; isolectotype, BM 2 replicates, FH, G).

Grimmia itatiaiae Müll. Hal., Bull. Herb. Boissier 6: 109. 1898. TYPE: Brazil. Minas Gerais: Serra do Itatiaia, Agulhas-Negras, *Ule 1830* (lectotype, designated by Muñoz (1998c), H-BR).

Grimmia itatiaiensis Broth. ex Müll. Hal., Bull. Herb. Boissier 6: 108. 1898. TYPE: Brazil. Minas Gerais: Serra do Itatiaia, 2100 m, Mar. 1894, *Ule 1913* [Ule & Brotherus, Bryotheca brasiliensis, n° 124] (lectotype, designated by Muñoz (1998c), H-BR; isolectotypes, GOET, JE, NY, PC, UPS).

Grimmia praetermissa Cardot, Rev. Bryol. 36: 105. 1909. TYPE: Mexico. México: in the crater of the Volcano of Toluca, 25 Sep. 1892, *Pringle s.n.* [Pringle, Plantae mexicanae n° 26a] (lectotype, designated by Muñoz (1998c), NY; isolectotypes, JE, PC 2 replicates).

Grimmia herzogii Broth., in Herzog, Biblioth. Bot. 87: 55. 1916. TYPE: [Bolivia. Cochabamba:] An Felsen eines Gipfel der Yanakakabastion, 4500 m, *Herzog 3826* (lectotype, designated by Deguchi (1987), JE; isolectotype, H-BR).

Grimmia nigella Herzog, Biblioth. Bot. 87: 55, fig. 17. 1916. TYPE: Bolivia. Bei der Saittulaguna, *Herzog 2679* (lectotype, designated by Muñoz (1998c), JE).

Grimmia speirophylla Herzog, Biblioth. Bot. 87: 55. 1916. TYPE: Bolivia. Cochabamba: Yanakakabastion, *Herzog 3827* (lectotype, designated by Muñoz (1998c), JE; isolectotype, JE; syntypes, *Herzog 4871*, *Herzog 3148*, JE; *Herzog 3811*, NY; *Herzog 4811*, PC).

Grimmia speirophylla f. *humilis* Herzog, Biblioth. Bot. 87: 55. 1916. TYPE: Bolivia. Cochabamba: Torreni-Yanakaka, July 1911, *Herzog s.n.* (holotype, JE).

Grimmia allionii Broth., Rev. Bryol. 47: 9. 1920. TYPE: [Ecuador.] Azuay: in rupibus montis prope Cañar, 16 Nov. 1909, *Allioni s.n.* (lectotype, designated by Muñoz (1998c), H-BR; isolectotypes, H-BR, PC).

Grimmia trollii Herzog, Hedwigia 74: 102. 1934. TYPE: Bolivia. [Oruro:] Curahuara, *Troll 58* (lectotype, designated by Deguchi (1987), JE).

Grimmia cinerea Thér., Rev. Bryol. Lichénol. 9: 9, fig. 3. 1936. TYPE: [Ecuador. Pichincha:] rochers du Condorguachana, *Benoist 3153* (holotype, PC).

Grimmia stenopyxis Thér., Rev. Bryol. Lichénol. 9: 8. 1936. TYPE: [Ecuador. Pichincha:] Pichincha, 24 Oct. 1930, *Benoist s.n.* (lectotype, designated by Muñoz (1998c), PC).

Grimmia antillarum Thér., Rev. Bryol. Lichénol. 13: 13. 1944. TYPE: Dominican Republic. Azua: Cordillera Central, Los Vallecitos de Yaque, *Ekman 13630* (lectotype, designated by Muñoz (1998c), PC; isolectotype, NY).

For additional synonyms, see Muñoz (1998c).

Cladautoicous. *Plants* yellowish green, olive-green, rusty, golden, or black above, brownish to black in the internal parts. *Stems* erect, to 6 cm but commonly 1–3 cm, with central strand. *Leaves* erect and appressed, occasionally flexuous when dry, erect to patent when moist, 1.7–2.6 × 0.3–0.6 mm, lanceolate to ovate-lanceolate, acute, canaliculate, not plicate; *margins* recurved proximally, to ½–⅔ the leaf length on one side, plane elsewhere, seldom recurved in both sides; *costa* reniform, slightly to clearly differentiated, ventral epidermis 2–6 cells wide in cross section; *lamina* 2(3)-stratose, occasionally with 3(4)-stratose margins and streaks in the distal ⅔; *distal cells* 4–11 μm long, isodiametric, rectangular and oblate intermingled, not bulging, walls sinuose; *proximal juxtacostal cells* 25–60 × 7–13 μm, rectangular (3–7 : 1), walls thick and nodulose; *proximal marginal cells* 9–25 × 6–11 μm, usually rectangular ((1)–3 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* seldom lacking, flat or terete, straight to moderately flexuous, to 3 mm, entire to denticulate. *Perichaetial leaves* 2.6–3.5 × 0.6–0.7 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* terminal. *Setae* erect and straight, 1–4 mm long. *Capsules* immersed to exserted, ovoid to cylindric, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 18–50 × 18–20 μm, rectangular (2 : 1), although many isodiametric intermingled, thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–80 μm wide at the mouth, entire or irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange to reddish, contrasting with the urn; *opercula* mammillate to long-rostrate; *calyptrae* mitrate (very rarely cucullate); *spores* 8–12 μm, minutely granulose.

Illustrations. Figure 22; Afonina (1986: ris. 1 figs. 1–8, as *G. affinis*; ris. 2 figs. 9–16, as *G. ovalis*); Cao and Churchill (1995a: pl. 1, as *G. af-*

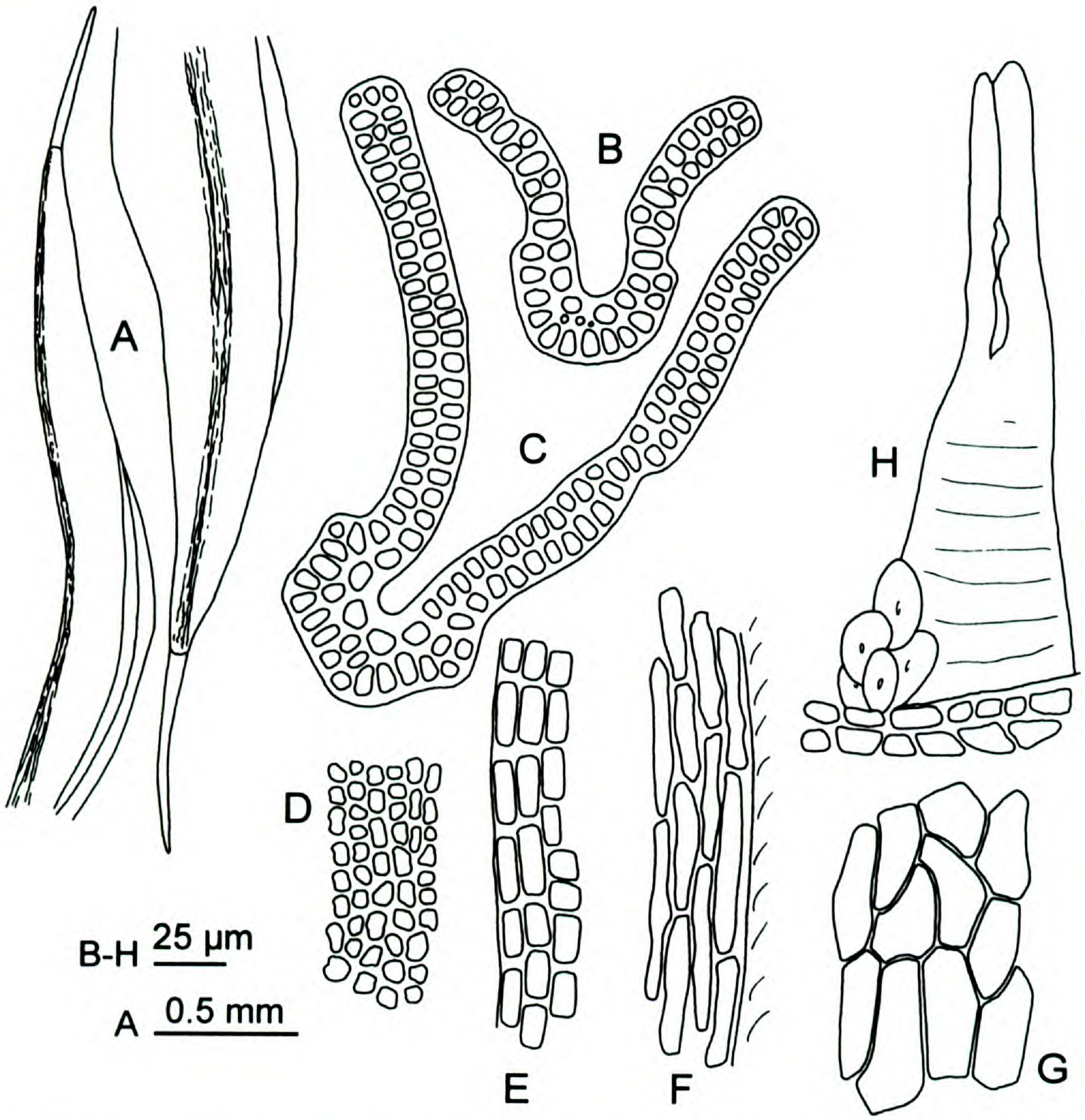

Figure 22. *Grimmia longirostris*. —A. Leaves. —B, C. Transverse sections at distal and medial parts of leaf. —D. Distal leaf cells. —E. Proximal marginal leaf cells. —F. Proximal juxtacostal leaf cells. —G. Medial exothecial cells. —H. Peristome tooth and annulus (only contour shown, not papillosity). (*Sharp 1833*, TENN.)

finis); Deguchi (1978: figs. 12, 13; 1984: fig. 6; 1987: pl. 4, 5, as *G. herzogii*, pl. 6, 7); Eddy (1990: fig. 313, as *G. affinis*); Herzog (1916: fig. 17, as *G. nigella*); Ignatov and Cao (1994: fig. 7, as *G. affinis*); Ireland (1982: pl. 134, as *G. affinis*); Jóhannsson (1993: fig. 36, as *G. affinis*); Maier and Geissler (1995: fig. 1, as *G. affinis*); Muñoz (1998c: fig. 1); Noguchi (1988: fig. 140 A, as *G. affinis*).

Distribution (Fig. 23). Europe, Africa, temperate and tropical Asia, Australasia, northern and southern America; Mexico, Mesoamerica, Caribbean, Andean Range from Venezuela to northern Argentina, central Argentina, southeast Brazil, Tierra del Fuego. On any kind of rock, from acidic to ultrabasic, seldom on bark. Forests and open areas, between 1800 and 5300 m elevation.

Grimmia longirostris has canaliculate leaves that are distally flattened when dry. At least one of the leaf margins is recurved proximally. The costae are reniform in cross section, and the ventral epidermis consists of 2 to 6 cells. Along with long-rectangular, nodulose, proximal juxtacostal cells, and an *affinis*-type annulus, those characters are stenotypic, separating *G. longirostris* from every other taxon in the genus. The species is widespread, and is also morphologically variable. The setae are erect and straight, although one Philippine specimen (Luzón, *Tan 82–195*, FH) was observed with arcuate setae. Setae vary

Figure 23. Distribution of *Grimmia longirostris*.

broadly in length, from 1 to 4 mm, and consequently the capsules range from immersed to long-exserted. Operculum shape is quite variable, as has been illustrated by Cao and Vitt (1986: fig. 2). The taxonomy and distribution of *Grimmia longirostris* have been studied by Muñoz (1998c), placing 55 validly published names into synonymy for this taxon.

Selected specimens examined. COSTA RICA. **Cartago**: near summit of Inter American Highway at La Ascensión, *Crosby & Crosby 6137* (MO). **San José**: summit of Pan-American Hwy. at Cerro de la Muerte, *Crosby 3917* (TENN). DOMINICAN REPUBLIC. **Azua**: Cordillera Central, Los Vallecitos del Yaque, *Ekman 13630* (PC). **La Vega**: 6.3 km S of Valle Nuevo, *Steere 23052* (G). **San Juan**: summit of Pico Duarte, *Buck 8396* (NY). GUATEMALA. **Huehuetenango**: near Paquix above Huehuetenango, *Sharp 4777* (TENN). **Quezaltenango**: Cerro La Pedrera, S of Quezaltenango, *Standley 65530* (FH). **Sacatepéquez**: slopes of Volcán de Agua, above Santa María de Jesús, *Standley 65262* (FH). **Totonicapán**: entre Las Trojadas y Empuxet, *Smith 780* (F). HONDURAS. **Lempira**: Montaña Celaque, summit of Cerro Mojón, *Allen 12260* (MO). MEXICO. **Distrito Federal**: Ajusco, *Orcutt 5353* (FH). **Baja California**: Lomas de San Pedro Mártir, ca. 41 km SW of Observatory, *Meyer 21A* (TENN). **Baja California Sur**: Sierra de La Laguna, 15 mi. E of Todos los Santos, *Bowers et al. 5205A* (TENN). **Chihuahua**: 21 mi. N of San Juanito, *Bowers et al. 5403* (TENN); Ejido de Bocoyna, SW part of Creel Valley, *Bye 7295* (TENN). **Distrito Federal**: 12 km W de San Miguel Ajusco, 15 Aug. 1985, *Cárdenas s.n.* (ALTA). **Durango**: below El Salto, *Sharp 1833* (FH). **Guanajuato**: 4 km S de San José Iturbide, *Cárdenas S. 5344* (MO). **Hidalgo**: 14 km E de Pachuquilla, carretera Pachuca–Tulancingo, 14 Feb. 1984, *Cárdenas 3378* (ALTA). **Jalisco**: ladera N del Nevado de Colima, 27 July 1983, *Delgadillo s.n.* (ALTA). **México**: volcán de Toluca, *Pringle 26A* (JE). **Michoacán**: Paracho, about 6 km N on way to Cheran, *Frey & Frey 3072* (FH, UC). **Nayarit**: Acaponeta, 4 mi. E of La Ciénaga on ridge about 5 mi. NW of Mesa de Nayar, *Norris & Taranto 14330* (UC). **Oaxaca**: 13 km E of La Cumbre pass between Oaxaca and Ixtlán de Juárez, *Sharp et al. 2607* (TENN). **Puebla**: ladera NW del Pico de Orizaba, 22 Apr. 1980, *Delgadillo s.n.* (ALTA). **Sinaloa**: along Hwy. 40, about 2 mi. E of Las Palmitas, *Norris et al. 20567* (H, UC); 11 mi. NE of Baviácora, *Richards et al. 675* (TENN). **Veracruz**: cima del Cofre de Perote, 7 Dec. 1979, *Delgadillo s.n.* (ALTA).

ARGENTINA. **Córdoba**: Depto. Punilla, Sierra Grande de Córdoba, Pampa de Achala, südl. La Posta, *Hosseus 207* (FH, PC). **Jujuy**: Cochinoca, 1.5 km W of the top of Abra Rechaite, *Taylor 11268* (IBA). **Salta**: Nevado de Castillo prope Salta, 1881, *Lorentz s.n.* (BM, JE). **Santa Cruz**: Lac Cami, baie de la Chaloupe, *Skottsberg 370* (PC). **Tucumán**: in alpinis prope Ciénaga, 1871, *Lorentz s.n.* (JE, PC). BOLIVIA. **Chuquisaca**: prov. Yamparaez, Tarabuco, *Lewis 83-1661* (F, MO). **Cochabamba**: NW slope of Mt. Tunari, near Liriuni Aguas Termales Hotel, *Hermann 25149* (ALTA, MO). **La Paz**: Loayza, río Atoroma Chuma (Glacier Camp), *Lewis 87-1908* (MO); Murillo, Lago Choquecota, *Asplund 13* (JE); Omasuyos, vicinitis Achacache, *Mandon 1635* (BM); Pacajes, Estación General Campero, *Asplund 53* (JE); Saavedra, trail between Charasani and Niño Karine, NNW of Chuma, *Lewis 79-946* (F). **Oruro**: Carangas, Cerro Lajama, *Asplund 75* (JE). **Potosí**: Tomás Frías, Cerro Kari Kari, SE de Potosí, *Lewis 79-214* (FH, MO, UBC). **Tarija**: Méndez, 5 mi. NE of Iscyachi, *Lewis 79-691* (F). BRAZIL. **Espírito Santo**: National park Serra de Caparaó, *Schäfer-Verwimp & Verwimp 11500* (FLAS). **Minas Gerais**: Serra do Itatiaia, Mar. 1894, *Ule s.n.* (GOET, H-BR, PC, UPS). **Rio de Janeiro**: Serra do Itatiaia, Pico das Agulhas Negras, *Vitt 21541* (FLAS). CHILE. **Magallanes**: Porvenir, *Dusén 113* (PC). COLOMBIA. **Antioquia**: Urrao, Páramo de Frontino, ca. 17 km N of Urrao, *Churchill 13335* (ALTA, UC). **Boyacá**: Valle de las Playas, Sierra Nevada de Cocuy, *Grubb & Guymer B.216-A* (BM). **Cundinamarca**: from Bogotá (vía La Calera) to Mundo Nuevo, Cordillera Oriental, *Steere 7713* (IBA). **Magdalena**: Sierra Nevada de Santa Marta, *Mägdefrau 1187* (COL). **Nariño**: Carchi, just N of Bolívar, Interandean Valley, *Steere 9498* (IBA). **Risaralda**: Pereira, Nevado de Santa Isabel, *Reenen 582* (FLAS). **Santander**: Páramo Frailejonale, near Vetas, *Killip & Smith 17987* (BM, FH). ECUADOR. **Azuay**: Area Nacional de Recreación "Cajas," WNW of Sayausí, *Lewis 78-2336* (F-1064894). **Bolívar**: Guaranda, río Salinas, *Acosta Solís 5858* (MO). **Chimborazo**: NW Seite, Paramo-region, *Meyer 5518* (JE). **Cotopaxi**: Parque Nacional Cotopaxi, *Raeymaekers 1013* (FLAS). **Imbabura**: E side of Cerro Cotacachi, NW of Cotacachi, *Lewis 78-2675* (F). **Napo**: Cerro Antisana, near the main western glacier at Antisana, 1960, *Grubb 2500* (FH). **Pichincha**: Pichincha, *Spruce s.n.* (FH-SULL). **Tungurahua**: El Altar, Paramo-region, *Meyer 5435* (JE). PERU. **Ancash**: Huaraz, Monterrey bei Huaraz, *Hegewald & Hegewald 7482* (MO). **Apurimac**: Andahuaylas, Pampa Runtojoch bei Chincheros, *Hegewald & Hegewald 5761* (MO). **Arequipa**: Sumbay, 16 Aug. 1939, *Schmidt s.n.* (F). **Ayacucho**: Huamanga, Pass Huamina zw. Andahuaylas und Ayacucho, *Hegewald & Hegewald 8993* (MO). **Cajamarca**: Contumazá, 2 km südlich Contumazá, *Hegewald & Hegewald 7280* (MO). **Cuzco**: Calca, Pisaja, *Vargas 7099* (FH). **Huancavelica**: Tayacaja, Quebrada Pucayacu zw. Aya-

cucho u. Huancayo, *Hegewald & Hegewald 9125* (IBA, MO). **Junín**: Tarma, Río Yanamayo hinter Palca zw. Tarma u. San Ramón, *Hegewald & Hegewald 8377* (IBA, MO). **La Libertad**: Otuzco, Huancamarca, Quebrada Hornillo, *Hegewald & Hegewald 5156* (MO). **Lima**: Canta Province, 2 km vor Canta an der Straße nach Lima, *Hegewald & Hegewald 7425* (MO). **Pasco**: from Cerro de Pasco to Lima, *Vitt 21717* (FLAS). **Puno**: San Román, Panamericana zw. Laguna Maquera u. Laguna La Calzada, *Hegewald & Hegewald 8586* (IBA, MO). **San Martín**: prov. Marical Cáceres, Pampa del Cuy, *B. León & K. Young 2118* (FLAS). VENEZUELA. **Barinas**: páramo de Santo Cristo, *Griffin III & Díaz M. PV-119* (FLAS). **Mérida**: Cañada Cerrada above Cachopo, *Pittier 13183* (NY); Distr. Libertador, Sierra Nevada de Mérida, near Laguna de Los Anteojos just below the loma R, *Griffin III et al. 398* (ALTA, MO, NY); Distr. Rangel, páramo de Piedras Blancas, *Griffin III et al. 1451* (FLAS); Distr. Rivas Dávila, páramo La Negra, above the town of Bailadores, *Griffin III et al. 2047* (ALTA, MO, NY). **Trujillo**: Distr. Carache, páramo El Jabón, *Griffin III & López PV-1360* (FLAS).

15. Grimmia molesta J. Muñoz, sp. nov. TYPE: Peru. Arequipa: Arequipa, am Weg nach Puno, *Hegewald & Hegewald 5480* (holotype, MO; isotypes, H, IBA, NY).

A *G. pseudoanodon* foliis bistratosis margineque recurvatis atque peristomio exsistenti dignoscitur.

Cladautoicous. Plants olive-green to brownish. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 1.6–1.9 × 0.4–0.5 mm, lanceolate, acuminate, keeled, not plicate; *margins* recurved proximally, to ⅓ the leaf length on one side, occasionally recurved only in the middle part of the leaf; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 8–15 μm long, isodiametric, rectangular and oblate, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 30–60 × 15–20 μm, rectangular (1.5–3.0 : 1), walls medium-thick to thick, nodulose; *proximal marginal cells* 15–55 × 10–12 μm, rectangular (1.5–5.0 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight to flexuous, to 1 mm, denticulate. *Perichaetial leaves* 3.0–3.5 × ca. 1 mm, convolute and larger than vegetative leaves (4 ×). *Androecia* terminal. *Setae* straight, 0.6–0.8 mm long. *Capsules* immersed, cylindrical, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 35–80 × 13–30 μm, rectangular (2–4 : 1), thin-walled; *annulus* compound and revoluble, *elongata* type; *peristome teeth* 70–90 μm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* mammillate to rostellate; *calyptrae* mitrate; *spores* 10–12 μm, minutely granulose.

Illustration. Figure 24.

Distribution (Fig. 10). Southern America. Known only from the type collection in Arequipa (Peru), where it grows on rocks at 4000 m elevation.

Grimmia molesta has lanceolate, bistratose leaves with recurved margins, short straight setae, and immersed peristomate capsules with a compound and revoluble annulus. The male buds arise at the ends of branches separated from perichaetia.

Deguchi (1987: 29) considered *Hegewald & Hegewald 5480* to be *G. pseudoanodon.* However, the specimen in MO (Hegewald's original herbarium) contains no material of this species. *Grimmia pseudoanodon* differs from *G. molesta* in having unistratose leaves with plane margins and gymnostomous capsules.

Etymology. Molesta: burdensome, annoying, irksome.

Specimens examined. PERU. **Arequipa**: Arequipa, am Weg nach Puno, *Hegewald & Hegewald 5480* (H, IBA, MO, NY).

16. Grimmia montana Bruch & Schimp., Bryol. Europ. (fasc. 25–28) 3: 128, tab. 250. 1845. TYPE: [Germany. Rhineland-Palatinate:] Donnersberg, Apr. 1843, *Gümbel s.n.* (lectotype, designated by Cao & Vitt (1986), BM).

Grimmia laxa Müll. Hal., Bot. Zeitung (Berlin) 5: 801. 1847. *Guembelia laxa* (Müll. Hal.) Müll. Hal., Syn. Musc. Frond. 1: 771. 1849. TYPE: Mexico. In monte Orizabae, *Deppe & Schiede s.n.* (lectotype, designated by Muñoz (1998d), PC).

Grimmia schiedeana Müll. Hal., Bot. Zeitung (Berlin) 13: 765. 1855. TYPE: Mexico: [no locality given] *Deppe & Schiede s.n.* (lectotype, here designated, BM; isolectotype, PC).

Grimmia arctophila Kindb., Rev. Bryol. 23: 18. 1896. TYPE: Greenland. Claushavn, 1870, *Berggren s.n.* (lectotype, here designated, S).

For additional synonyms, see Muñoz (1998d).

Dioicous. Plants olive-green above, dark green or blackish below. *Stems* erect, to 1 cm, with central strand. *Leaves* erect, loosely appressed and flexuous when dry, with patent proximal part and incurved apex, sigmoid in lateral view when moist, 1–2 × 0.3–0.6 mm, lanceolate, acuminate, keeled, not plicate; *margins* plane proximally and incurved distally; *costa* semi-terete, slightly to clearly differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2(3–4)-stratose in the distal ⅔; *distal cells* 4–8 μm long, isodiametric, not bulging or bulging weakly on the dorsal surface, walls straight

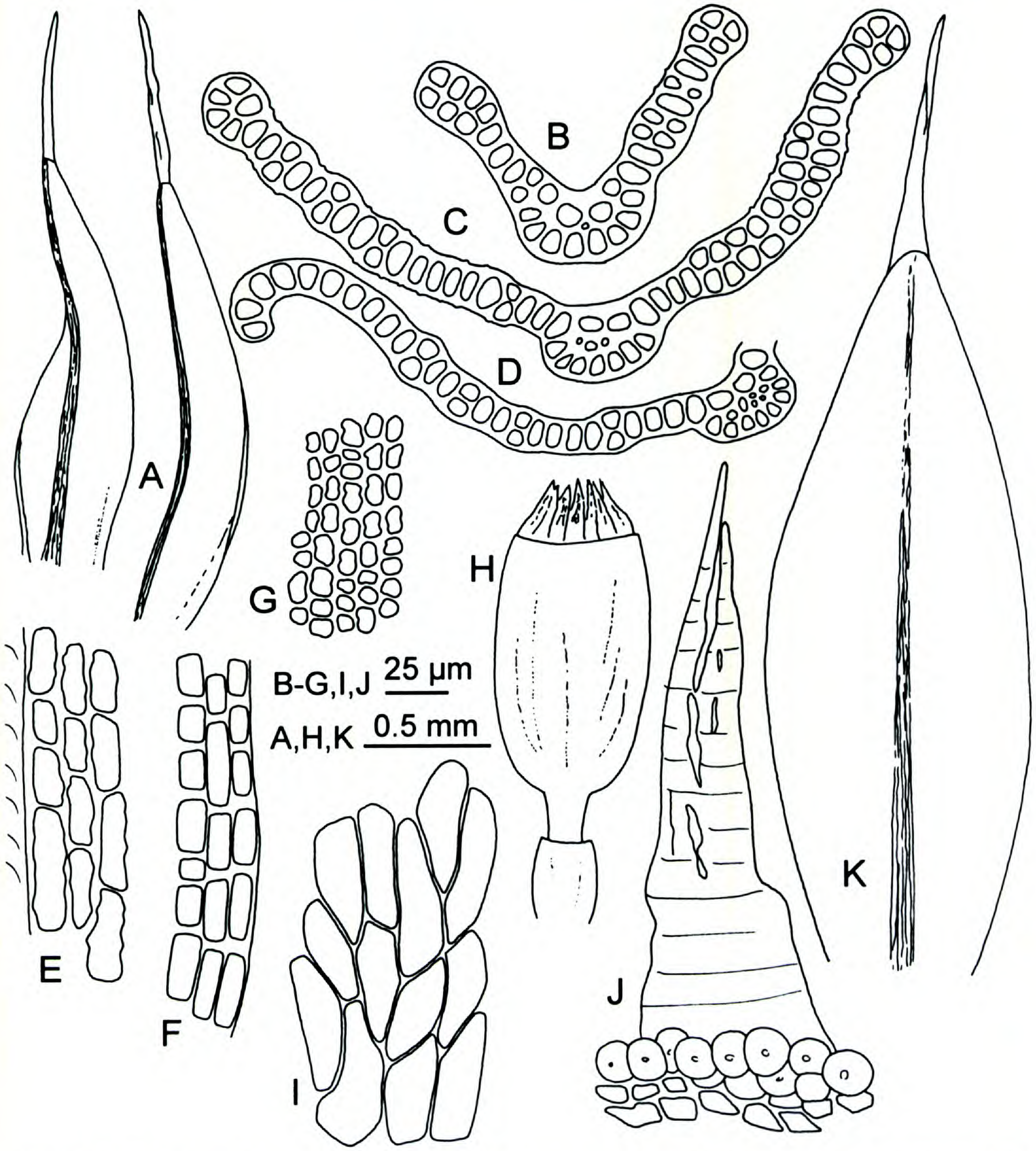

Figure 24. *Grimmia molesta*. —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E. Basal juxtacostal leaf cells. —F. Basal marginal leaf cells. —G. Distal leaf cells. —H. Capsule. —I. Medial exothecial cells. —J. Peristome tooth and annulus (only contour shown, not papillosity). —K. Perichaetial leaf. (*Hegewald & Hegewald 5480*, MO.)

to slightly sinuous; *proximal juxtacostal cells* 20–50 × 8–15 µm, rectangular (2.0–4.5 : 1), walls medium-thick and straight; *proximal marginal cells* 20–50 × 8–15 µm, rectangular (2.0–4.5 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 1.5 mm, obtusely denticulate, seldom serrate. *Perichaetial leaves* 1.7–2.4(4) × 0.6–0.9 mm, convolute and larger than vegetative leaves (2–4 ×). *Androecia* terminal. *Setae* erect and straight, 2–4 mm long. *Capsules* exserted, ovoid or ellipsoid, symmetric, smooth, castaneous, lacking stomata; *exothecial cells* 30–70 × 10–25 µm, rectangular (2–4 : 1), thin-walled; *annulus* simple and persistent, *Schistidium* type; *peristome teeth* 50–90 µm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose

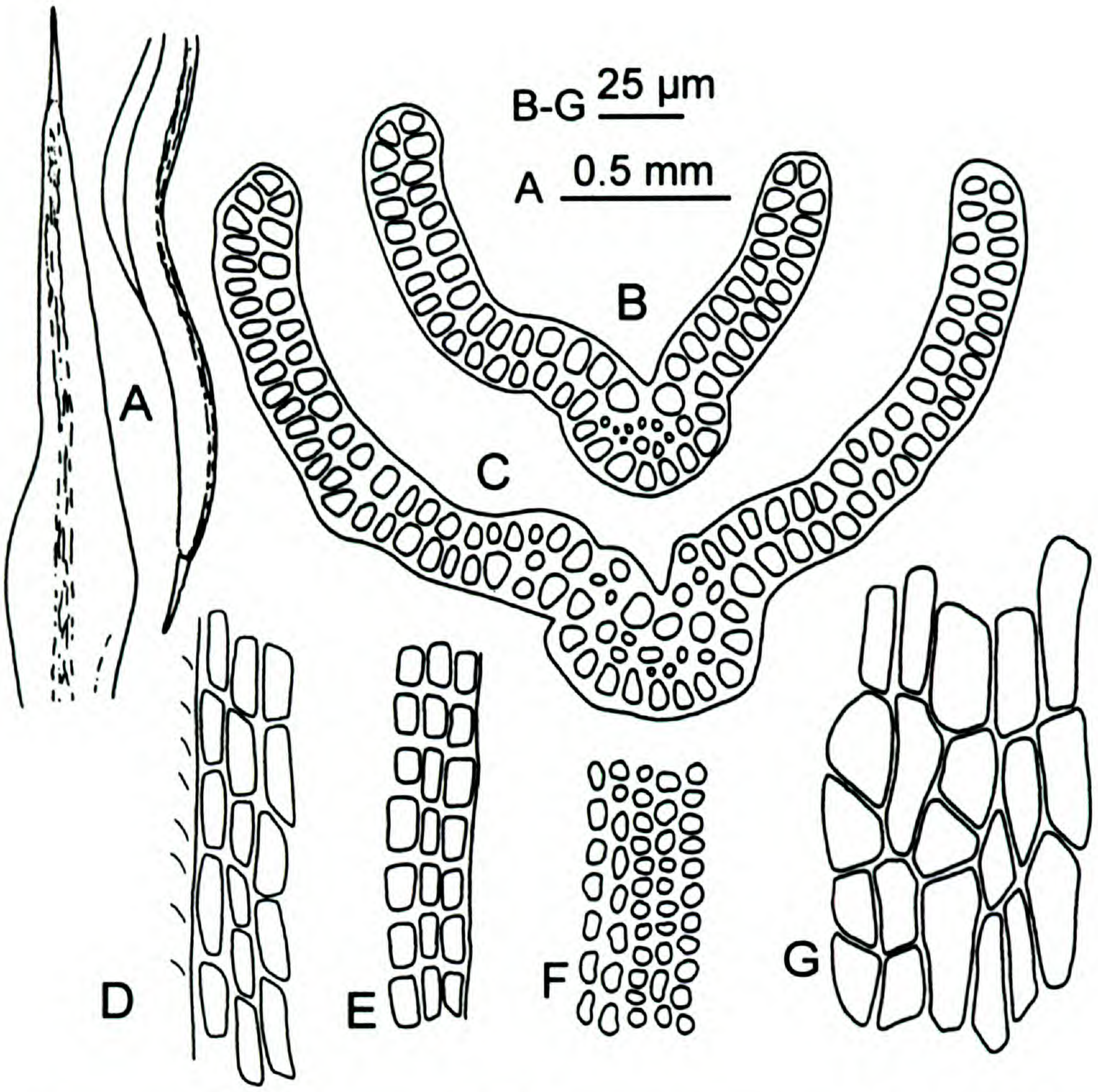

Figure 25. *Grimmia montana*. —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. (*Vitt 17520*, TENN.)

throughout, castaneous, concolorous with the urn; *opercula* rostrate, the beak oblique; *calyptrae* cucullate; *spores* 10–14 µm, minutely granulose.

Illustrations. Figure 25; Bruch and Schimper (1845: tab. 250); Chałubiński (1882: tab. 8 fig. 14); Jóhannsson (1993: fig. 26); Maier and Geissler (1995: fig. 17); Muñoz (1998d: fig. 12); Nyholm (1956: fig. 69 B).

Distribution (Fig. 26). Europe, northern America. *Grimmia montana* is common in western Europe and western North America. In the area here covered it is known only from Mexico, where it has been collected on igneous rocks in open pine forests and in subalpine areas above the tree line, between 2250 and 4800 m elevation.

Grimmia montana has keeled, bistratose or thicker leaves and rostrate opercula. The species is dioicous, and the capsules lack stomata. In leaf morphology and anatomy it is almost inseparable from *G. ungeri*. However, *G. ungeri* is an autoicous species with mammillate to rostellate opercula. Another useful character is the length of the setae. Setae are longer in *G. montana* (2–4 mm) than they are in *G. ungeri* (less than 2 mm). Unfortunately, the autoicous condition of the latter is usually difficult to demonstrate, and poor specimens are generally impossible to name with confidence.

The variability of *G. montana* and its relationships with other species of *Grimmia* subg. *Orthogrimmia* have been studied by Muñoz (1998d). The Mexican specimens have, like other American or northern European ones, a relatively short leaf acumen. Otherwise they fall in the expected range of variation for the species.

For the differences between *G. montana* and *G. reflexidens*, see the latter species.

Additional specimens examined. MEXICO. **Baja California**: Guadalupe Island, summit, *Moran 5664* (FH); National Park, San Pedro Mártir Mts., *Hammond 10837* (NY); Sierra de San Pedro Mártir, Cerro de la Encantada, pass below observatory, *Sharp et al. 5594* (TENN), *5663A*

Figure 26. Distribution of: ● *Grimmia montana*; ▲ *Grimmia navicularis*.

(TENN), *5668* (TENN), *5671* (TENN), *6055* (TENN). **México**: Popocatépetl, *Sharp 4749* (TENN). **Puebla**: Mt. Ixtaccíhuatl, *Hermann 20845* (TENN), *Kiener 18518* (FH), *18518B* (FH), *Vitt 17520* (ALTA, TENN); above Huejotzingo, *Sharp 4289* (TENN); ladera SW del pico Orizaba, *Delgadillo 4117* (ALTA). **Veracruz**: monte Orizaba, *Little 1* (TENN), *Smith s.n.* (FH), *Purpus 4277* (F, PC); road from Perote to the Cofre, *Sharp et al. 71646* (TENN).

17. Grimmia navicularis Herzog, Beih. Bot. Centralbl. 26: 65. 1909. TYPE: Bolivia. Cochabamba: Abra de San Benito, Jan. 1908, *Herzog s.n.* (lectotype, designated by Deguchi (1987), JE; syntypes, [Cochabamba: über dem Tunarisee, Jan. 1908, *Herzog s.n.*], JE, PC).

Grimmia chilensis Thér., in Herzog, Darwiniana 11: 217. 1957. TYPE: [Argentina. Río Negro:] Parque Nacional Argentino Nahuelhuapi, Cerro López, *Donat 114* (lectotype, here designated, JE; isolectotype, JE).

Dioicous. Plants olive-green to reddish green. *Stems* erect, to 1 cm, with central strand. *Leaves* erect and appressed when dry, erect when moist, 1.0–1.8 × 0.3–0.4 mm, lanceolate, acute, keeled, not plicate; *margins* recurved proximally, to ½–⅔ the leaf length on one side and flat or more narrowly recurved proximally, to ⅓–½ the leaf length on the other side, occasionally both margins plane; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1–2-stratose, 2-stratose at margins and in streaks in the distal ⅔; *distal cells* 7–13 μm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 30–60 × 10–14 μm, rectangular (2–4:1), walls thin and straight to medium-thick and nodulose; *proximal marginal cells* 15–50 × 7–12 μm, rectangular (2–5:1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, flexuous, but straight if short, to 1 mm, denticulate. *Perichaetial leaves* 2.5–3.5 × 0.7–0.8 mm, convolute and larger than vegetative leaves (2–4 ×). *Androecia* terminal. *Setae* curved, 2.3–3.2 mm long. *Capsules* exserted, ellipsoid, symmetric to slightly asymmetric at base, smooth, stramineous, with stomata at the base; *exothecial cells* 25–65 × 12–30 μm, oblong (2–5:1), somewhat collenchymatous, thin-walled; *annulus* compound and revoluble, *elongata* type; *peristome teeth* 60–75 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic to short-rostrate; *calyptrae* cucullate; *spores* 9–13 μm, minutely granulose.

Illustrations. Figure 27; Deguchi (1984: fig. 2, as *G. chilensis*; 1987: pl. 8, 9).

Distribution (Fig. 26). Southern America; Andean Range between Venezuela and Patagonia. *Grimmia navicularis* grows on rocks in open grassy areas above the tree line between 1500 and 5300 m elevation.

Grimmia navicularis has lanceolate leaves with recurved margins and proximal marginal cells with transverse walls thicker than the longitudinal ones. The sporophytes, which are not common, are characterized by the curved setae and the smooth capsules occasionally weakly asymmetric at the base. At high elevations, filiform shoots arising from basal stems are commonly found. These shoots have small, tightly appressed, ovate leaves that are muticous and mucronate, appearing very different from normal vegetative leaves.

Grimmia navicularis is gametophytically similar to *G. elongata* in that both are usually reddish, with strongly keeled leaves. Hair-points are longer in *G. navicularis*, to 1 mm, and the proximal marginal cells have the transverse walls thicker than the longitudinal walls. Hair-points are seldom longer than 0.3 mm in *G. elongata*, and the walls of the proximal marginal cells are thin with wall diameters similar. If fertile, both taxa can be readily separated: *G. navicularis* has curved setae whereas those of *G. elongata* are straight.

Additional specimens examined. ARGENTINA. **Río Negro**: Parque Nacional Argentino Nahuel-Huapi, Tronador, *Donat 175* (JE, PC); Puerto Moreno, 12 July 1897,

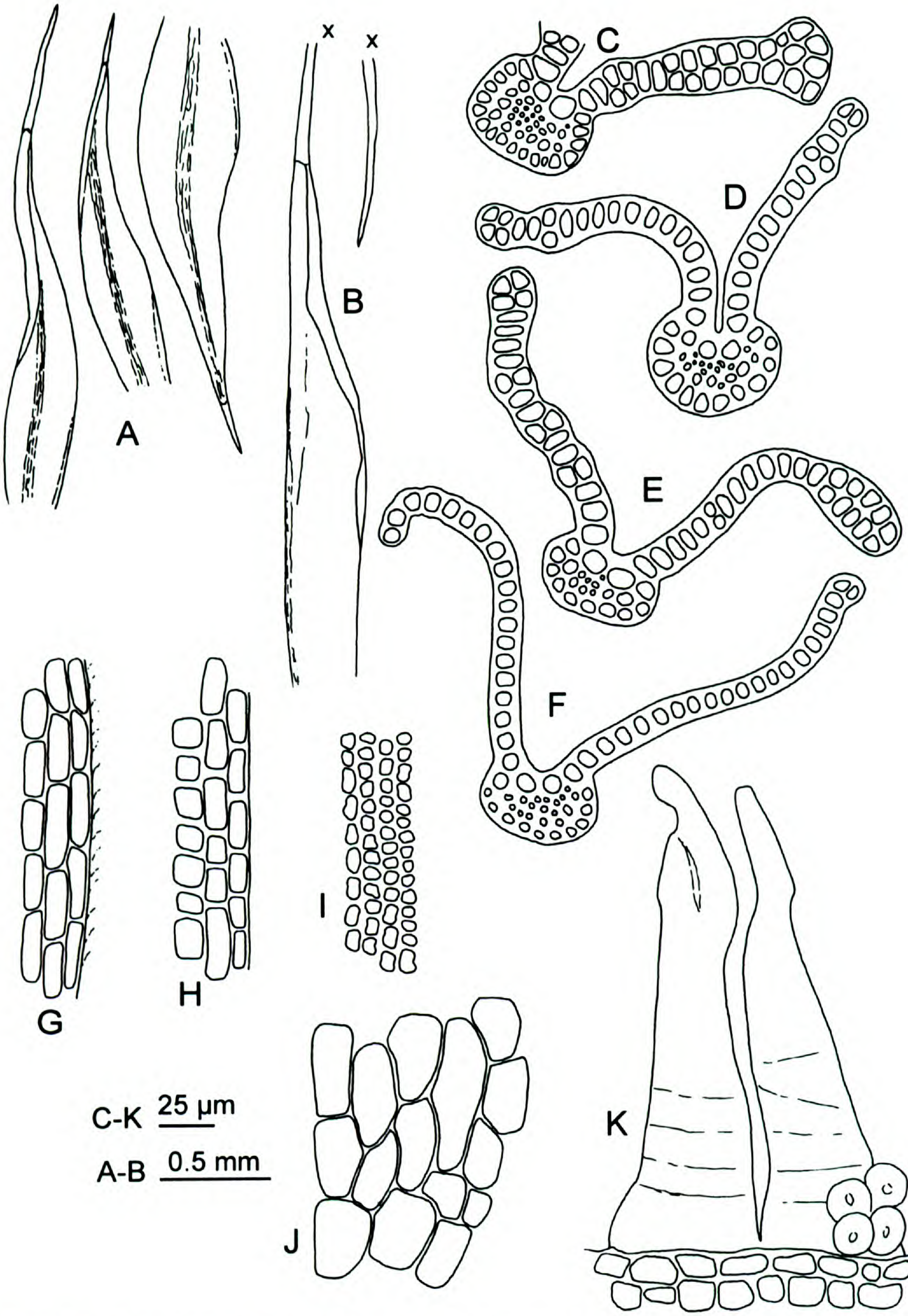

Figure 27. *Grimmia navicularis.* —A. Leaves. —B. Perichaetial leaf. —C, D. Transverse sections at distal part of leaf. —E, F. Transverse sections at medial and proximal parts of leaf. —G. Proximal juxtacostal leaf cells. —H. Proximal marginal leaf cells. —I. Distal leaf cells. —J. Medial exothecial cells. —K. Peristome teeth and annulus (only contour shown, not papillosity). (A, B, D, G–K: *Donat 175*, PC; C, E, F: *Herzog s.n.*, JE.)

Dusén s.n. (PC). BOLIVIA. **Cochabamba**: Abra de San Benito, Jan. 1908, *Herzog s.n.* (JE); über dem Tunarisee, *Herzog s.n.* (JE), *306* (JE), *4913* (JE). **La Paz**: Huallata pass, *Williams 1781* (F); prov. Inquisivi, Mina Poldi, *Lewis 87-875* (MO); Cumbre Sayaquira, *Lewis 87335* (CAS); prov. Loayza, 11 km SE from Viloco, *Lewis 87-1819* (MO), *Herzog 3146A* (JE); Yanakakaberge, July 1911, *Herzog s.n.* (BM); bei der Saittulaguna, *Herzog 2675* (JE); prov. Los Andes, Cerro Jankho Karka, *Lewis 84-199* (F, IBA), *83-209* (F, IBA); prov. Murillo, 5 km NE of Milluni, *Lewis 79-1728B* (F, IBA), *79-1731* (F). **Potosí**: above Solapampa, *Williams 1782* (F); prov. Quijarro, cerro Purgatorio Mundo, SW of Estación Yura, *Lewis 79-368* (F). COLOMBIA. **Boyacá**: Municipio Güicón, Sierra Nevada del Cocuy, sitio Las Cabañas, carretera Güicón–Cubara, *Escobar & Santa 403* (MO), *404* (IBA, MO, NY); páramo de La Rusia, *Cleef 6965* (FLAS); farm Ritacuva, *Grubb & Guymer B.68* (FH). ECUADOR: **Chimborazo**: Paramo-region, NNW Seite, July 1903, *Meyer 5478* (H), *5500* (H), *5510* (H), *5511* (H), *5512* (H), *5513* (H), *5514* (H), *5515* (H), *5516* (H), *5517* (H), *5519* (H), *5522* (H), *5531* (H). PERU. **Ancash**: Huari, zwischen Tunnel Cahuish und Chavín, quebrada Pucavado, *Hegewald & Hegewald 7718* (IBA, MO), *7798A* (MO); Ostseite des Tunnel Cahuish, *Hegewald & Hegewald 7697* (IBA, MO); Cordillera Blanca, Parque Nacional Huascarán, Laguna Llanganuco, *Frahm 824071* (IBA). **Junín**: Jauja, La Oroya, bei der laguna Añascocha bei Canchayllo, *Hegewald & Hegewald 5427* (MO). **La Libertad**: Santiago de Chuco, Pampas de Julia bei Quiruvilca, *Hegewald 6001* (MO). **Puno**: Melgar, 7 km W of La Raya Pass, *Hegewald & Hegewald 5512A* (MO), *5526A* (MO). VENEZUELA. **Mérida**: distr. Miranda, above pico El Águila, *Griffin III et al. 1318* (FLAS); distr. Rangel, páramo de Piedras Blancas, *Griffin III et al. 1444* (FLAS), *1485* (FLAS), *1494* (FLAS), *1495* (FLAS).

18. Grimmia ochyriana J. Muñoz, Nova Hedwigia 66: 235. 1998. TYPE: Nepal. Près du Camp de Base, direction de Lobuje, *Zimmermann 558* (holotype, G; isotype, IBA).

Dioicous. Plants yellowish to brownish green, glossy. *Stems* erect, to 3 cm, with central strand. *Leaves* erect and appressed, flexuous apically when dry, patent to spreading when moist, 2–3 × 0.5–0.7 mm, lingulate-lanceolate, acuminate, canaliculate, not plicate; *margins* recurved proximally, to ½ the leaf length on one side and flat on the other side, occasionally only shortly and narrowly recurved proximally, in the middle of one side; *costa* reniform, differentiated, ventral epidermis 6–8 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 5–16 μm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 25–80 × 6–12 μm, rectangular (2–10 : 1), walls thin and straight to medium-thick and nodulose; *proximal marginal cells* 10–30 × 10–16 μm, isodiametric to rectangular (1–3 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* lacking. *Perichaetial leaves* 4.0–5.5 × 0.6–1.2 mm, convolute and larger than vegetative leaves (3–5 ×). *Androecia* terminal. *Setae* erect and straight, 1.5–2.1 mm long. *Capsules* immersed, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 24–50 × 15–35 μm, isodiametric to oblong (1.0–3.5 : 1), somewhat collenchymatous, thin-walled; *annulus* compound and revoluble, *elongata* type; *peristome teeth* 60–80 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, yellowish orange, contrasting with the urn; *opercula* rostellate to rostrate; *calyptrae* mitrate; *spores* 10–16 μm, minutely granulose.

Illustrations. Figure 28; Muñoz (1998a: figs. 1–11).

Distribution (Fig. 29). Tropical Asia, northern America; Mexico, Guatemala. Previously known only from the type locality in Nepal, the species seems not to be rare in Mexico. It grows on igneous rocks, either granite and basalt, between grasses in open areas above the tree line, mainly in places with melting water, between 3700 and 4200 m elevation.

Grimmia ochyriana has muticous, glossy leaves 2(3 to 4)-stratose in thickness. The costa is 7 to 8 cells wide in the ventral epidermis, and reniform in cross section. The most striking characteristics are the length of the muticous perichaetial leaves and its immersed capsules. Although not always found with capsules, the easily recognizable perichaetial leaves are conspicuously longer than other leaves, even at very early stages of perichaetial development.

The only other species with muticous leaves and wide costae in the study area is *G. atrata*. Known only from Bolivia to date, it could be also found at high elevations in Mexico. *Grimmia atrata* differs from *G. ochyriana* in the bistratose proximal alar regions of the leaves, the perichaetial leaves that are undifferentiated, as well as the exserted capsules on long setae.

Additional specimens examined. GUATEMALA. **San Marcos**: near summit of Tajamulco, *Sharp 5428* (TENN); upper slopes of Volcán Tacaná, *Steyermark 36091A* (FH). MEXICO. **México**: Mt. Popocatépetl, *Kiener 18554A* (TENN, FH), *18591BA* (FH), *Sharp 4753* (TENN), *4747* (TENN), *Horton 7463* (TENN), *Vitt 17488* (ALTA, TENN); Nevado de Toluca, *Iltis & Iltis 2128* (TENN), *3128A* (TENN), *Horton 7837, 7890A* (TENN). **Puebla**: Mt. Ixtaccíhuatl, *Kiener 18518C* (FH); Las Cuevas on Ixtaccíhuatl above Huejotzingo, *Sharp 4270, 4276* (TENN). **Veracruz**: cerca del Cofre de Perote, *Ortega 630* (TENN).

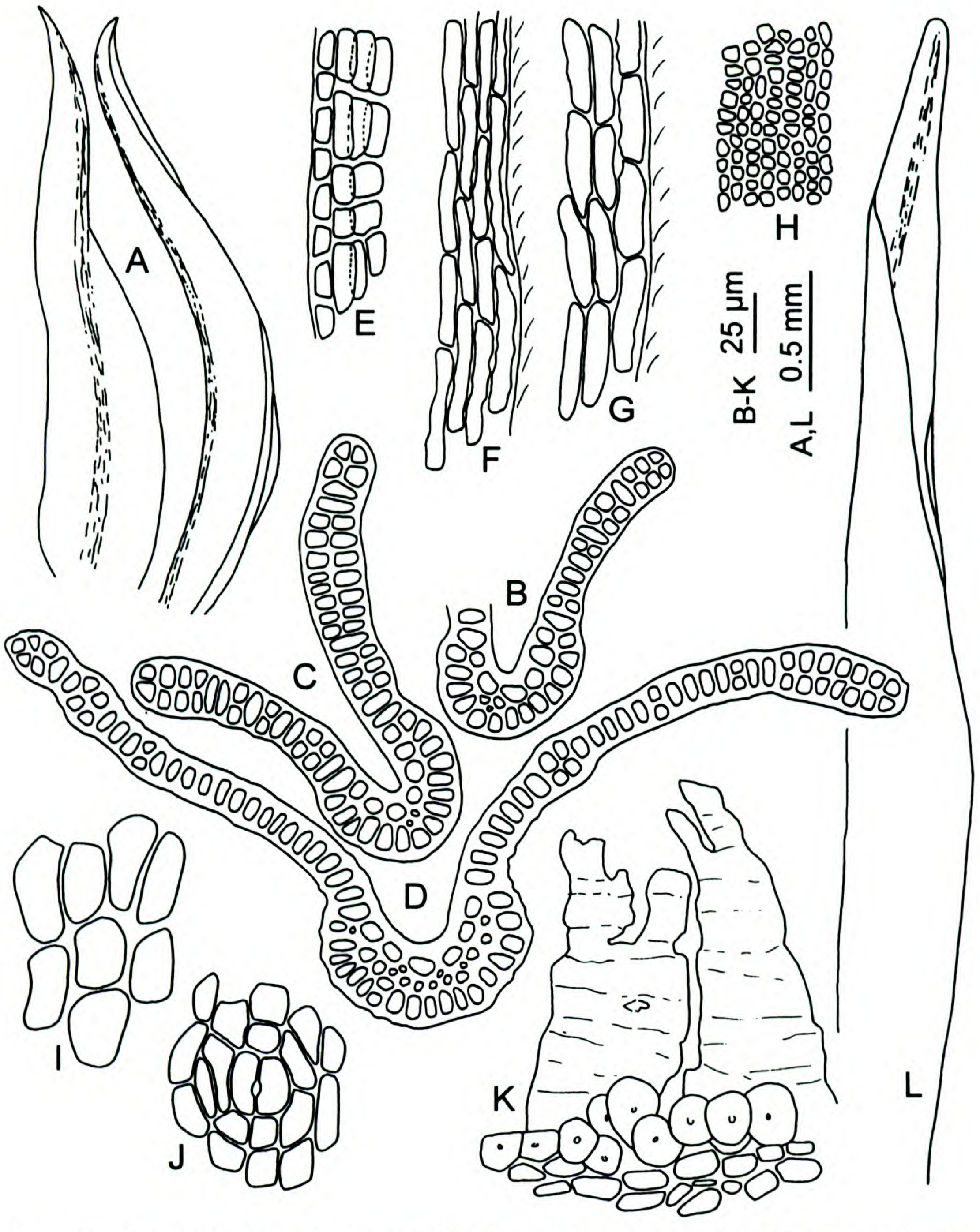

Figure 28. *Grimmia ochyriana*. —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E. Proximal marginal leaf cells. —F, G. Proximal juxtacostal leaf cells. —H. Distal leaf cells. —I. Medial exothecial cells. —J. Proximal exothecial cells and stoma. —K. Peristome teeth and annulus (only contour shown, not papillosity). —L. Perichaetial leaf. (*Vitt 17488*, ALTA.)

19. Grimmia ovalis (Hedw.) Lindb., Acta Soc. Sci. Fenn. 10: 75. 1871. *Dicranum ovale* Hedw., Sp. Musc. Frond: 140. 1801. *Dicranum ovale* Hedw., Descr. Micr.-Anal. Musc. Frond. 3: 81, tab. 34 figs. 1–6. 1792, nom. inval. *Dicranum ovatum* Sw., Kongl. Vetensk. Acad. Nya Handl. 16: 243. 1795, nom. inval. *Bryum ovale* Hoffm., Deutschl. Fl. 2: 35. 1795

Figure 29. Distribution of: ● *Grimmia ochyriana*; ▲ *Grimmia trinervis*.

"1796," nom. inval. *Trichostomum ovatum* P. Beauv., Prodr. Aethéogam: 91. 1805, nom. illeg. incl. sp. prior. *Dicranum ovatum* Brid., Muscol. Recent. Suppl. 1: 214. 1806, nom. illeg. incl. sp. prior. *Grimmia elliptica* Funck, Deutschl. Moose: 16, tab. 11 fig. 1. 1820, nom. illeg. incl. sp. prior. *Trichostomum ovale* (Hedw.) Roehl. ex Steud., Nomencl. Bot. 2: 99 [also 421]. 1824, nom. inval. in synon. *Campylopus ovalis* (Hedw.) Wahlenb., Fl. Suec. 2: 748. 1826. *Dryptodon ovatus* (Hedw.) Brid., Bryol. Univ. 1: 202. 1826. *Grimmia commutata* Huebener, Muscol. Germ.: 185. 1833, nom. illeg. incl. sp. prior. *Dryptodon ellipticus* (Funck) Hartm., Handb. Skand. Fl. ed. 3: 271. 1838, nom. illeg., non Brid. 1826. *Guembelia elliptica* (Funck) Hampe, Bot. Zeitung (Berlin) 4: 125. 1846. *Guembelia ovalis* (Hedw.) Müll. Hal., Syn. Musc. Frond. 1: 774. 1849. *Guembelia commutata* (Huebener) Rabenh., Krypt. Fl. Sachsen 1: 444. 1863, nom. illeg. incl. sp. prior. *Dryptodon ovalis* (Hedw.) Hartm. ex H. Möller, Ark. Bot. 26A(2): 14. 1934 "1933," nom. inval. in synon. err. pro *Dryptodon ovatus* Brid. TYPE: Germany. "Grimmia commutata B & S Specimina ab Hedw. ad iconem Dicrani ovali adhibita [manu Schwägrichen]" (lectotype, designated by Geissler & Maier (1995), G not seen).

Grimmia ovata F. Weber & D. Mohr, Naturh. Reise Schweden: 132, tab. 2 fig. 4a–c. 1804. *Campylopus ovalis* var. *ovatus* (F. Weber & D. Mohr) Wahlenb., Fl. Suec. ed. 2, 2: 776. 1833. *Dryptodon ovatus* (F. Weber & D. Mohr) Hartm., Handb. Skand. Fl. ed. 3: 271. 1838, nom. illeg., non Brid., 1826. *Grimmia ovata* var. *euovata* Loeske, Laubm. Eur. Part I: 113. 1913, nom. inval. TYPE: [Sweden.] Holmiae. (lectotype, here designated, BM).

Grimmia commutata f. *epilifera* J. E. Zetterst., Revis. Grimm. Scand: 90. 1861. *Grimmia commutata* var. *imberbis* Lindb. ex H. Möller, Ark. Bot. 26A(2): 17. 1934 "1933," nom. inval., pro synon. *Grimmia commutata* var. *mutica* J. E. Zetterst. ex H. Möller, Ark. Bot. 26A(2): 17. 1934 "1933," nom. inval., pro synon. TYPE: [Sweden.] Juxta Gottsunda prope Upsaliam, 5 May 1858, *Zetterstedt s.n.* (lectotype, here designated, H).

Grimmia cossonii Besch., Cat. Mouss. Alg. 18. 1882. TYPE: Algeria. Djebel Ksel pr. Geryville, 30 May 1856, *Cosson s.n.* (lectotype, here designated, PC).

Grimmia bernoullii Müll. Hal., Bull. Herb. Boissier 5: 200. 1897. TYPE: [Guatemala.] Quezaltenango: *Bernoulli & Cario s.n.* (lectotype, here designated, PC).

Dioicous. *Plants* dark green above, blackish or rusty below, sometimes the entire plant blackish. *Stems* erect or ascending, to 5 cm, with central strand. *Leaves* erect and appressed or flexuous when dry, erect, sigmoid in lateral view when moist, 1.7–2.5 × 0.4–0.7 mm, lanceolate or from an ovate ± sheathing base extended into an acuminate apical part, acuminate, concave, not plicate; *margins* plane; *costa* semi-elliptical to flat, undifferentiated, ventral epidermis 4–7 cells wide in cross section; *lamina* 2–4(5)-stratose in the distal ⅔; *distal cells* 4–8 μm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 50–105 × 8–14 μm, rectangular (4–8:1), walls thick and nodulose; *proximal marginal cells* 20–40 × 8–14 μm, rectangular (2–3:1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 2 mm, denticulate. *Perichaetial leaves* 3.5–4.0 × 0.8–1.0 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* terminal. *Setae* erect and straight, 3.5–7.0 mm long. *Capsules* exserted, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 20–60 × 14–35 μm, rectangular ([1]2–3:1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–70 μm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* cucullate; *spores* 10–14 μm, minutely granulose.

Illustrations. Figure 30; Abramov et al. (1961: ris. 137 figs. 8–14); Jóhannsson (1993: fig. 38); Lawton (1971: pl. 63 figs. 1–8); Maier and Geissler (1995: abb. 20); Petrov (1975: tab. 62 fig. 5); Smith (1978: fig. 150 5–9).

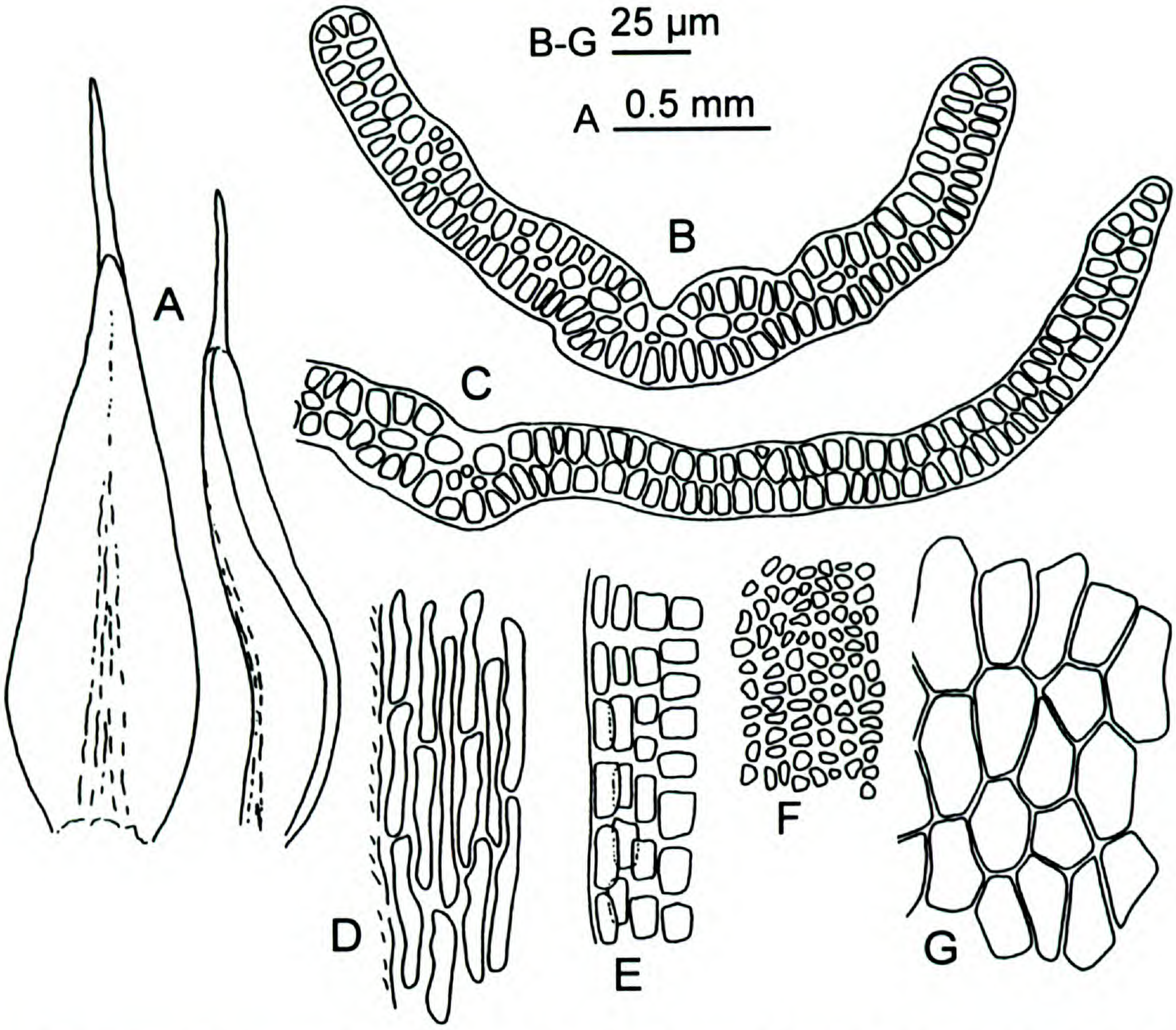

Figure 30. *Grimmia ovalis*. —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. (*Bernoulli & Cario 115*, PC.)

Distribution (Fig. 31). Europe, northern Africa, temperate and tropical Asia, northern America; Mexico, Guatemala. *Grimmia ovalis* grows mainly on granite and slate, but also on ultrabasic rocks like basalt, on sunny and dry places. It occasionally also covers rocks along streams and rivers. In Mexico it has been collected on igneous rocks and boulders in pine-oak forests and open areas between 2000 and 2730 m elevation.

Grimmia ovalis is readily recognized in the field by its large size, dark green color, ascending stems, and distally indistinct costae. The taxon is rather stenotypic, with most variation related to hair-point length. However, for genus *Grimmia*, hair-point length variation is often greater within than among populations or taxa, and is therefore mostly useless. Despite this, some specimens show puzzling features noteworthy of comment:

The type of *G. bernoullii* (*Bernoulli & Cario s.n.*, PC) and some, but not all, Mexican specimens (e.g., *Bowers 5270A*, TENN) have mitrate calyptrae. This could constitute a basis for recognition as a separate taxon. Nevertheless, except for this character, these plants are identical to other collections of *G. ovalis* from Eurasia and North America.

Setae in *G. ovalis* are straight, but I have studied one specimen from Punjab, India (*Koeltz 7304*, MO), with slightly curved setae.

Additional specimens examined. GUATEMALA. **Quetzaltenango**: Quetzaltenango, *Bernoulli & Cario s.n.* (PC). MEXICO. **Baja California**: Sierra de Juárez, ca. 8.5 km W of Cóndor–La Rumorosa Jct., *Meyer 44C* (TENN). **Chihuahua**: Ejido de Bocoyna, SW part of Creel Valley, *Bye 7297* (TENN); valley of Basihuare, 21 km S of Cusarare, *Weber & Bye B-60309* (TENN); 21 mi. N of San Juanito, *Bowers et al. 5402* (TENN), *5414B* (TENN). **Durango**: a few km before Palos Colorados, W of Durango, *Sharp 1749* (TENN); along Hwy. 40 about 4 mi. W of La Ciudad, *Bowers et al. 5270A* (TENN), *Norris et al. 20878* (UC); below Salto, *Sharp 1833A* (TENN); near Estación Coyotes E of El Salto, *Norris et al. 20991* (UC). **Michoacán**: vicinity of Morelia, Campanario, *Arsène 7449* (PC). **Puebla**: near San Agustín bridge E of Serdan, *Sharp 784* (TENN). **Tlaxcala**: top of falls on Río Zuahuapán near Amaxas, *Sharp 417* (TENN); mt. Tlacuapango, *Sharp 443* (TENN). **Zacatecas**: Cerro de la Bufa, *Cárdenas 354*

Figure 31. Distribution of: ● *Grimmia ovalis*; ▲ *Grimmia austrofunalis*.

(ALTA); Fresnillo, 2 km de San Juan de los Hornillos, cerca de la Presa Hornos, *Cárdenas 781* (ALTA).

20. Grimmia pilifera P. Beauv., Prodr. Aethéogam: 58. 1805. TYPE: "Etats-Unis d'Amerique" (holotype, G? not seen).

Grimmia arizonae Renauld & Cardot, Rev. Bryol. 19: 85. 1892. TYPE: U.S.A. Arizona: Fort Grand, *La Forêt s.n.* (lectotype, here designated, PC; isolectotypes, FH, NY).

Grimmia arsenei Cardot, Rev. Bryol. 40: 37. 1913. TYPE: Mexico. Michoacán: vicinity of Morelia, *Arsène 7894* (lectotype, here designated, PC; isolectotypes, F, PC 2 replicates).

Grimmia santaritae E. B. Bartram, Bryologist 27: 60, pl. 9. 1924. TYPE: U.S.A. Arizona: Santa Cruz Co., White House Canyon, Santa Rita Mountains, *Bartram 694* (lectotype, here designated, FH; isolectotypes, FH, NY).

Grimmia santaritae f. *propagulifera* E. B. Bartram, Bryologist 27: 60. 1924. *Grimmia arizonae* f. *propagulifera* (E. B. Bartram) G. N. Jones, in Grout, Moss Fl. N. Amer. 2: 33. 1933. TYPE: U.S.A. Arizona: Santa Cruz Co., Patagonia Mountains, *Bartram 618* (lectotype, here designated, FH).

Dioicous. Plants olive-green. *Stems* erect to ascending, to 6 cm, central strand lacking on sterile stems. *Leaves* erect and appressed when dry, patent to spreading when moist, 2–3 × 0.5–0.8 mm, lanceolate or from an ovate ± sheathing base extended into an acuminate apical part, acuminate, concave, not plicate; *margins* recurved; *costa* semi-terete to semi-elliptical, differentiated, sometimes weakly, ventral epidermis 2 cells wide in cross section; *lamina* 2–3(4)-stratose in the distal ⅔; *distal cells* 6–9 μm long, isodiametric, rectangular and oblate, not bulging, walls sinuous; *proximal juxtacostal cells* 28–80 × 7–11 μm, rectangular (3–11 : 1), walls thick and nodulose; *proximal marginal cells* 10–35 × 7–14 μm, isodiametric to rectangular (1.0–3.5 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight to flexuous, to 3 mm, dentate. *Perichaetial leaves* 3–4 × 0.9–1.2 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* terminal. *Setae* erect and straight, 1.0–1.3 mm long. *Capsules* immersed, ovoid to ellipsoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 17–55 × 14–25 μm, mostly rectangular (1–3 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–90 μm wide at the mouth, entire or irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 13–17 μm, minutely granulose.

Illustrations. Figure 32; Deguchi (1978: figs. 38, 39); Ignatov and Cao (1994: fig. 6); Noguchi (1988: fig. 142 B).

Distribution (Fig. 10). Temperate Asia, northern America. In Mexico, *G. pilifera* grows on rocks in open areas as well as pine and oak forests, from full sun and dry to shady and more or less moistened places at the bottom of deep ravines, between 1500 and 2730 m elevation.

Typical specimens of *Grimmia pilifera* have distinctive leaves, with a broad base abruptly narrowing to an acuminate apical part, forming "shoulders" at the base-acumen transition, and with the margins proximally recurved. This distinctive leaf morphology along with the immersed capsules on short setae, make it easy to recognize. Unfortunately, *G. pilifera* is commonly sterile, and gametophytically variable. Specimens from eastern North America or growing in shade have long-acuminate apices quite distinct from the ovate bases, and with costae clearly differentiated from the lamina. However, specimens from southwestern North America, or from sunny habitats, have lanceolate leaves with bases scarcely differentiated from apices, and costae less clearly differentiated from laminae. This morphological gradation of lanceolate leaves in eastern North America to ovate ones in the southwest occurs continuously from east to west. No sharp distinction can be drawn separating typical eastern *G. pilifera* from taxa described from southwestern specimens (i.e., *G. arizonae*, *G. arsenei*, *G. santaritae*, and *G. santaritae* f. *propagulifera*). This

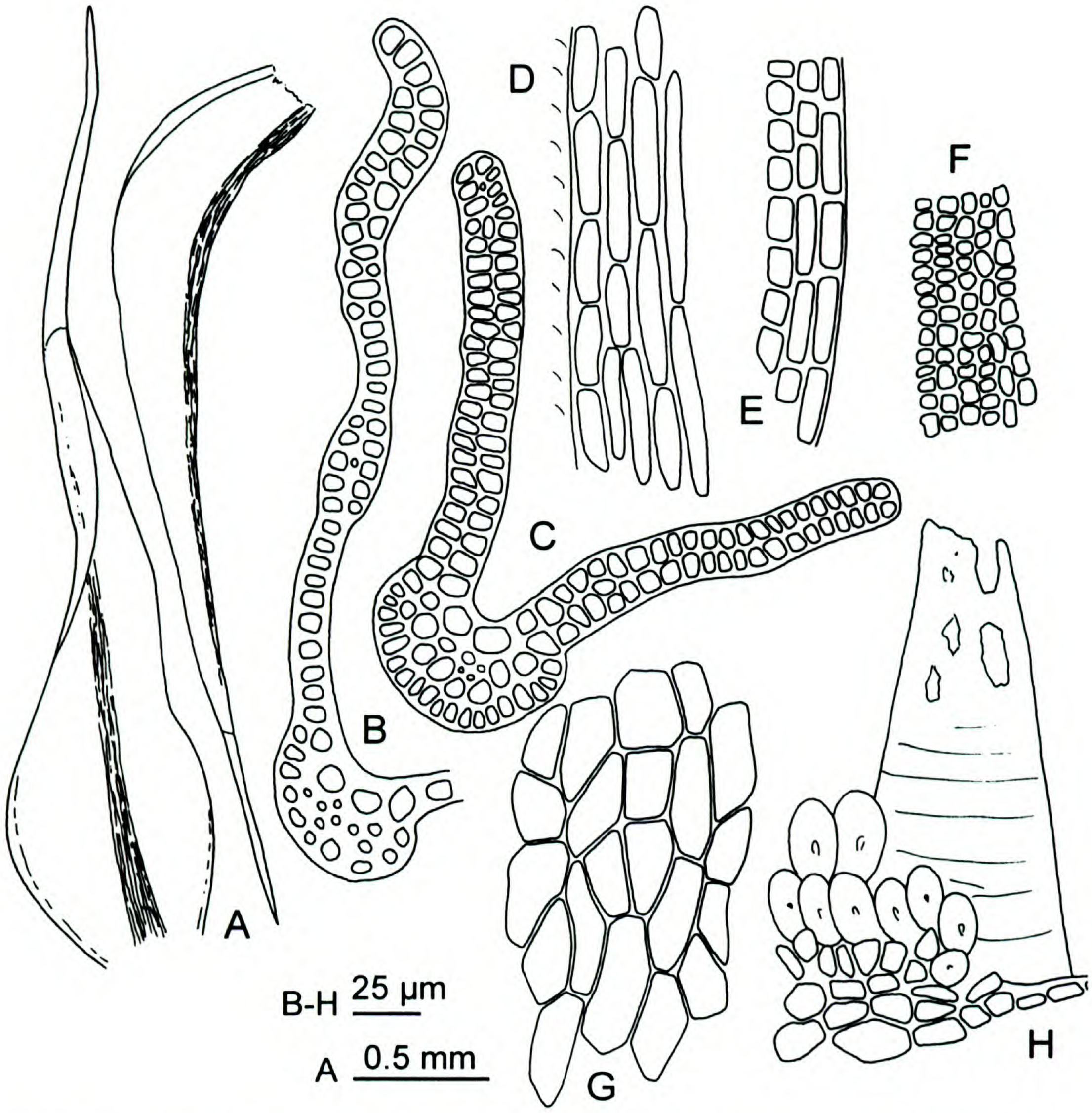

Figure 32. *Grimmia pilifera*. —A. Leaves. —B, C. Transverse sections at proximal and medial parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. —H. Peristome tooth and annulus (only contour shown, not papillosity). (*White 4210*, TENN.)

variability in acumen shape was previously noted by Deguchi (1978: 205–206).

This gametophytic variability makes it difficult to separate *G. pilifera* from sterile *G. longirostris*, or from populations of the latter with short setae (described from Arizona as *G. catalinensis*, but found across the entire world range of *G. longirostris*). Their principal difference lies in the morphology of costae cross sections. Costae in *G. longirostris* are reniform (2- to 6-celled on the ventral epidermis), but can be weakly distally differentiated. In *G. pilifera* costae are semi-terete, distinct, and only 2-celled on the ventral epidermis.

The presence or absence of a central strand in the stem is too variable to be a reliable character. Fertile stems usually have a distinct central strand; sterile stems or those with unfertilized perichaetia usually lack it.

Additional specimens examined. MEXICO. Cerro San Miguel, pr. Morelia, Dec. 1910, *Arsène 5070a* (FH, PC). **Chihuahua**: Puerto del Río Urique 38 mi. S of Creel, *Bowers et al. 5315A* (TENN), *5371C* (TENN); Cusarare, 20 km S of Creel, *Weber & Bye B-60292* (TENN). **Durango**: below El Salto, *Sharp 1892A* (TENN); near Palos Colorados, W of Durango, *Sharp 1786* (TENN). **Hidalgo**: Dublan, 2 July 1901, *Pringle s.n.* (PC). **Jalisco**: 9 mi. above San Martín Hidalgo, *Sharp et al. 2737* (TENN), *3233* (TENN), *3245B* (TENN). **Michoacán**: vicinity of Morelia, *Arsène 5070* (PC, FH) *7894* (PC), *7906* (PC); Cerro de la Campana, 4 km E of Tuxpán,

Delgadillo 4960 (ALTA); Uripitío, 11 km NE de Maravatio, *Delgadillo 4909* (ALTA); Negro Country, *LeSeur C8A* (F), *C9A* (F), *D5A* (F), *D7A* (F, FH). **Nuevo León**: Monterrey, *Arsène s.n.* (PC). **Oaxaca**: 38 km N of Oaxaca, between Oaxaca and Ixtlán de Juárez, *Sharp et al. 2608B* (TENN). **San Luis Potosí**: 44 mi. W of Antiguo Morelos on road to Huizache, *Pursell 5435* (TENN). **Sonora**: rancho El Roble, NE of El Tigre, *White 4210* (TENN). **Tlaxcala**: mt. Tlacuapango, *Sharp 443A* (TENN). **Zacatecas**: 7 km S de la Laguna Grande, al N de Monte Escobedo, 27 Aug. 1983, *Cárdenas s.n.* (H); Fresnillo, 2 km S de San Juan de los Hornillos, cerca de la presa Hornos, *Cárdenas 767* (ALTA); Valparaíso, 14 km N de Valparaíso, *Cárdenas 805* (ALTA); Tlaltenango, Cerro del Moro, 29 km W de Jalpa, *Cárdenas 832* (ALTA).

21. Grimmia plagiopodia Hedw., Sp. Musc. Frond.: 78, tab. 15 figs. 6–13. 1801. *Grimmia plagiopus* Spreng., Bot. Zeitung (Regensburg) 1: 74. 1802, nom. inval., orthogr. err. *Schistidium plagiopodium* (Hedw.) Loeske, Laubm. Eur. Part I: 52. 1913. TYPE: Germany. Saxoniae, *Flügge s.n.* (holotype, G not seen).

Grimmia brandegei Austin, Bull. Torrey Bot. Club 6: 45. 1875. TYPE: U.S.A. Colorado: 1874, *Brandegee s.n.* (lectotype, here designated, NY).

Grimmia nivea Dusén, Bot. Not. 1905: 303. 1905. TYPE: Argentina. Santa Cruz: Patagonia australis, in valle rivuli Aryo. Pelque, 16 Jan. 1905, *Dusén s.n.* (holotype, S not seen (Deguchi, 1984: 22); isotypes, H-BR, PC).

Cladautoicous or goniautoicous. Plants green, yellowish green to rusty. *Stems* erect, to 1 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent or homomallous when moist, 0.5–1.5 × 0.25–0.40 mm, oval, obtuse, concave, not plicate; *margins* plane, occasionally weakly recurved distally; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose, occasionally the marginal row 2-stratose in the distal ⅔; *distal cells* 9–20 μm long, isodiametric and rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 12–40 × 12–15 μm, isodiametric to rectangular (1.0–2.5 : 1), walls thin to medium-thick and straight; *proximal marginal cells* 20–27 × 10–14 μm, isodiametric to rectangular (1.0–2.5 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* sometimes lacking (but always present in perichaetial leaves), plane, straight or flexuous, to 1 mm, denticulate. *Perichaetial leaves* 1.3–1.6 × 0.7–0.8 mm, convolute and larger than vegetative leaves (3–5 ×). *Androecia* terminal or below perichaetia. *Setae* curved, 0.5–1.2 mm long. *Capsules* immersed, ovoid to subglobose, ventricose, smooth, stramineous, with stomata at the base; *exothecial cells* 30–50 × 12–25 μm, rectangular (1.5–3.0 : 1), thick-walled, occasionally thin-walled proximally and thick-walled in the distal ⅓; *annulus* simple and persistent, *Schistidium* type; *peristome teeth* 80–115 μm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, occasionally both surfaces almost smooth, orange, contrasting with the urn; *opercula* mammillate to rostellate; *calyptrae* mitrate; *spores* 9–14 μm, smooth.

Illustrations. Figure 33; Deguchi (1984: fig. 7); Ignatov and Cao (1994: fig. 17); Jóhannsson (1993: fig. 23); Limpricht (1890: 190); Maier and Geissler (1995: abb. 21); Ochyra (1993: fig. 1).

Distribution (Fig. 34). Europe, temperate Asia, Australasia, Antarctic, northern and southern America. *Grimmia plagiopodia* is known from three localities in South America; only two were available for this study, both lacking habitat information. Besides the specimens here studied, Ochyra (1993) reported another collection from Mendoza (Argentina, *Anonymous 10749*, FH, on loan, not seen). *Grimmia plagiopodia* grows on rocks of any composition, granites, limestone, or sandstone, usually in open and exposed situations below 1600 m elevation.

Grimmia plagiopodia has unistratose leaves usually tipped with flat hair-points, with curved setae asymmetrically attaching to immersed, ventricose, and peristomate capsules. Confusion of this plant with any other is very unlikely, although it has been described as novel several times from the Southern Hemisphere.

Although a characteristic seen in specimens beyond Latin America, it is interesting to note that *G. plagiopodia* sometimes has muticous leaves. Otherwise these plants fit within the expected normal range of variation of *G. plagiopodia.* As reiterated under *G. anodon* and *G. ovalis*, hair-point length is too variable in Grimmiaceae to be taxonomically valuable.

Grimmia brandegei was synonymized under *G. plagiopodia* by Ochyra and Bednarek-Ochyra (1994: 669). Its type packet contains a mixture of *Grimmia plagiopodia* and *G. poecilostoma* plants. A further microscope slide from the type is identified as *G. poecilostoma.* The protologue for *G. brandegei* describes features from both *G. plagiopodia* and *G. poecilostoma.* It seems best to select as lectotype *G. plagiopodia* plants to preserve the usage of Ochyra and Bednarek-Ochyra (1994).

Additional specimens examined. ARGENTINA. **Santa Cruz**: in valle rivulis Pelque, *Dusén 5713* (H-BR, PC). CHILE. **Magallanes**: Natales, *Siple 391-6* (FH).

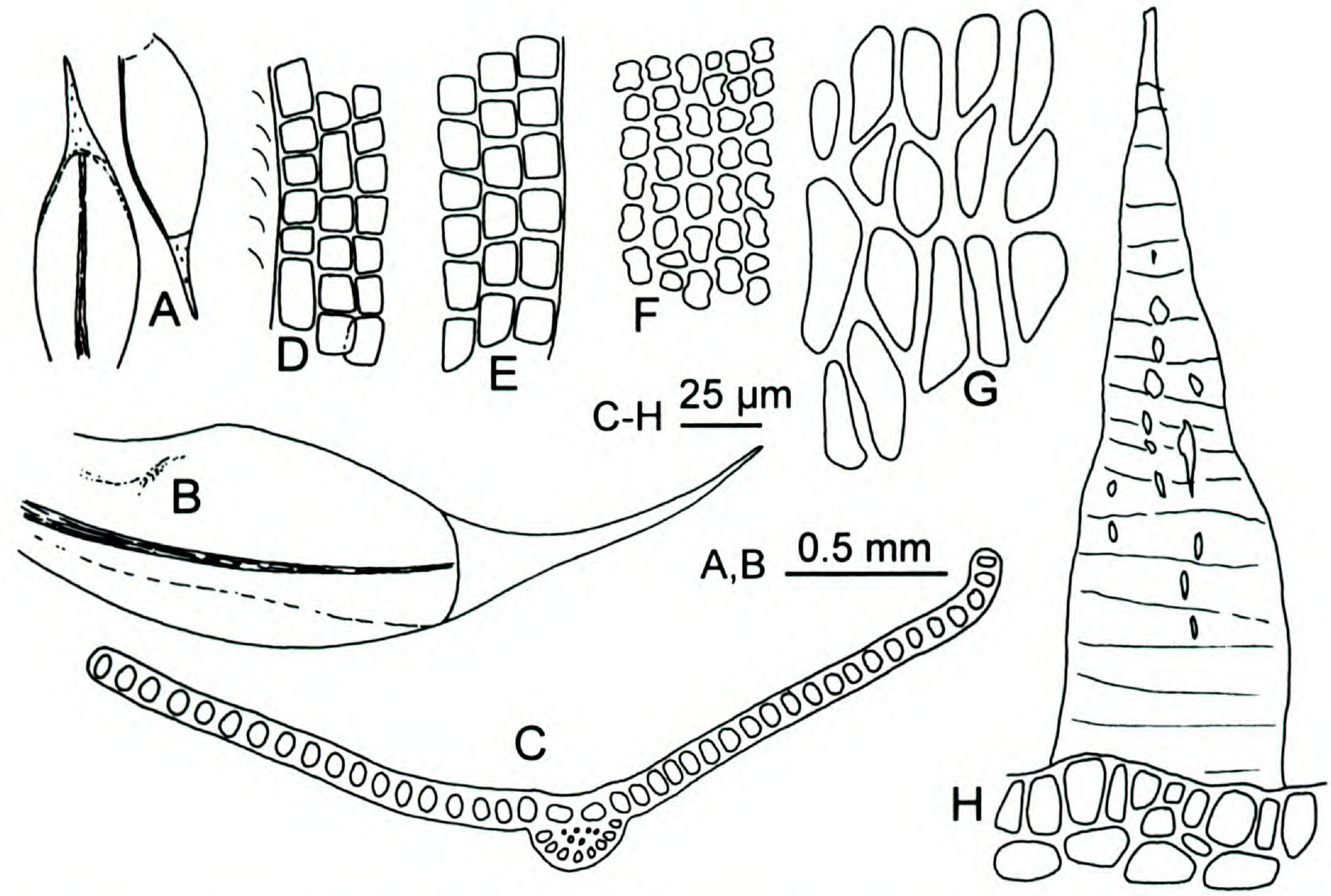

Figure 33. *Grimmia plagiopodia.* —A. Leaves. —B. Perichaetial leaf. —C. Transverse section at medial part of leaf. —D. Basal juxtacostal leaf cells. —E. Basal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. —H. Peristome tooth and capsule mouth showing the annulus simple and persistent. (*Dusén s.n.*, PC.)

Figure 34. Distribution of: ● *Grimmia plagiopodia*; ○ *Grimmia plagiopodia* (Argentina. Mendoza: Depto. Las Heras, quebrada del Portero Puerta, *Anonymous 10749*, FH not seen, *fide* Ochyra, 1993); ▲ *Grimmia pseudoanodon*; ■ *Grimmia pulla.*

22. Grimmia poecilostoma Cardot & Sebille, in Sebille, Rev. Bryol. 28: 118, tab. 5. 1901. *Grimmia tergestina* var. *poecilostoma* (Cardot & Sebille) Loeske, Laubm. Eur. Part I: 84. 1913. *Grimmia crinitoleucophaea* Cardot, Rev. Bryol. 17: 18–19. 1890, nom. inval., published as a formula (Greuter et al., 1994, ICBN H.10.3). *Grimmia cardotii* Hérib., Mém. Acad. Sci. Clermont-Ferrand, sér. 2, 14: 358. 1899, nom. inval., not accepted by the author (ICBN art. 34.1a). TYPE: France. Isère: Clapier de Saint-Christophe-en-Oisans, *Sèbille s.n.* (lectotype, here designated, PC; syntype, [Pont-de-Longe près Clermont, Auvergne, 3 Avril 1888, *Gasilien*], PC).

Grimmia crassifolia Lindb. ex Broth., Acta Soc. Sci. Fenn. 19(12): 84. 1892. TYPE: [Russia. North Ossetia:] in valle fl. Ardon inter Alagir et Misurtsy, July 1877, *Brotherus s.n.* (lectotype, here designated, H-BR; isolectotypes, H, JE, PC, UPS).

Grimmia gymnostoma Culm., Rev. Bryol. 23: 108. 1896. *Grimmia tergestina* var. *gymnostoma* (Culm.) G. Roth, Eur. Laubm. 1: 410. 1903 "1904." *Grimmia tergestina* f. *gymnostoma* (Culm.) Loeske, Laubm. Eur. Part I: 82. 1913, comb. inval., pro synon. TYPE: Switzerland. Appenzell: Ostabhang der Ebenalp, 24 Aug. 1896, *Culmann s.n.* (lectotype, here designated, PC).

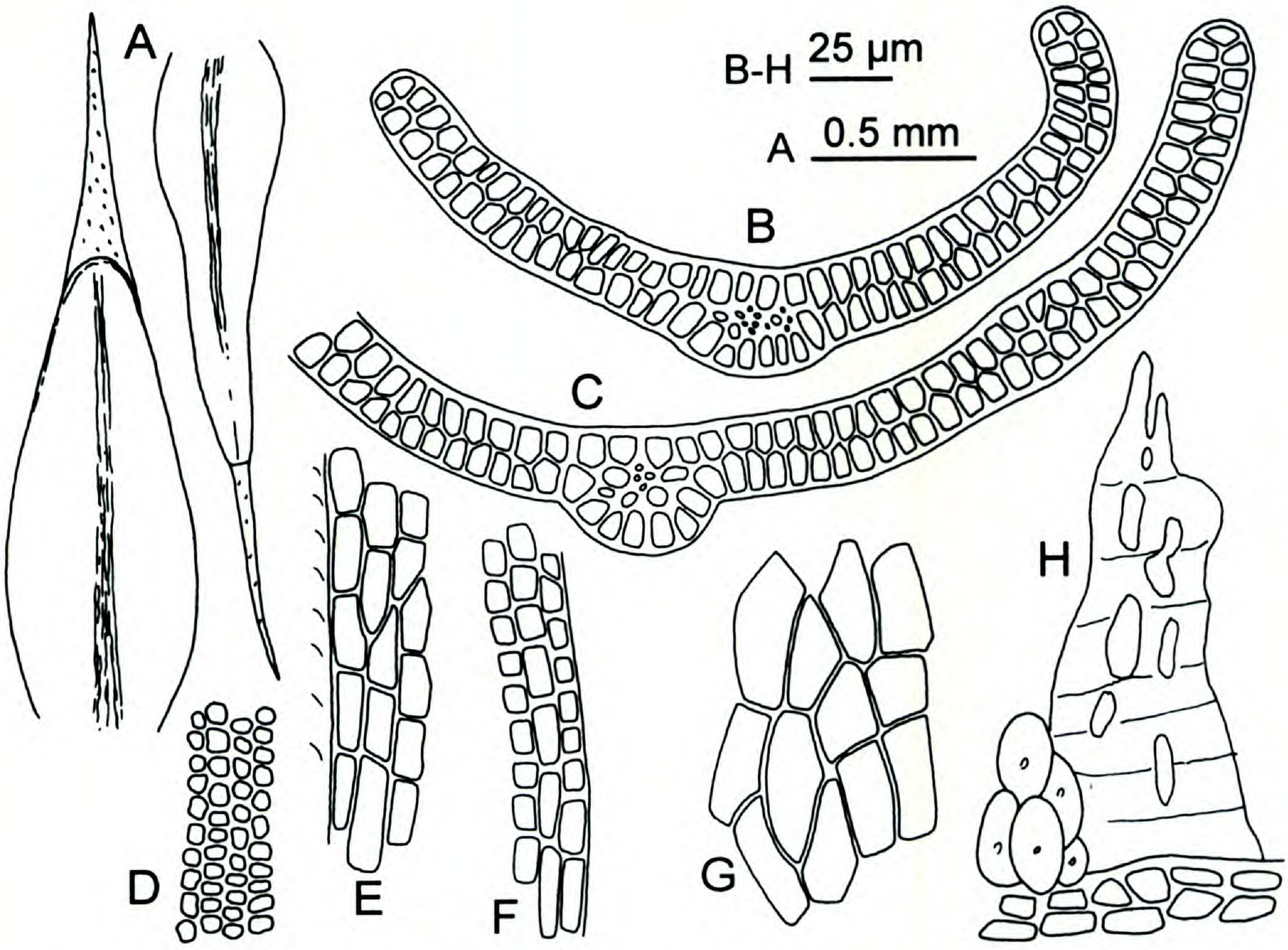

Figure 35. *Grimmia poecilostoma.* —A. Leaves. —B, C. Transverse sections at distal and medial parts of leaf. —D. Distal leaf cells. —E. Proximal juxtacostal leaf cells. —F. Proximal marginal leaf cells. —G. Medial exothecial cells. —H. Peristome tooth and annulus (only contour shown, not papillosity). (*Stark & Castetter 1182*, MO.)

Dioicous. Plants olive-green to blackish. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 1.1–2.0 × 0.4–0.6 mm, ovate to lanceolate, obtuse to acuminate, concave, not plicate; *margins* plane; *costa* semi-elliptical, undifferentiated, ventral epidermis 3–7 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 8–12 µm long, mostly isodiametric, but also rectangular and oblate, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 20–40 × 10–14 µm, rectangular (1.5–3.5 : 1), walls thin to moderately thick and straight; *proximal marginal cells* 7–25 × 10–18 µm, oblate to rectangular (0.7–2 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete distally and flat proximally, somewhat decurrent, straight, to 2 mm, entire to dentate. *Perichaetial leaves* 1.8–2.5 × 0.8–1.2 mm, convolute, hyaline and filmy, scarcely discernible, larger than vegetative leaves (3–3.5 : 1). *Androecia* terminal. *Setae* curved, 0.4–0.6 mm long. *Capsules* immersed, ovoid, ventricose, smooth, stramineous, with stomata at the base; *exothecial cells* 35–70 × 20–35 µm, rectangular (1.5–2.5 : 1), thin-walled, seldom internal side thickened; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 60–115 µm wide at the mouth, cribrose throughout and irregularly cleft at apex, both surfaces papillose throughout, orange, contrasting with the urn; *operculum* rostrate; *calyptrae* mitrate; *spores* 9–12 µm, smooth.

Illustrations. Figure 35; Jones (1933: pl. 6); Nowak and Poelt (1979: figs. 13–14, as *G. tergestina* var. *poecilostoma*); Sebille (1901: pl. 5).

Distribution (Fig. 36). Europe, temperate Asia, northern America. *Grimmia poecilostoma* is unknown from Latin America, but it grows in New Mexico close to the Mexican border, and its presence in Mexico is likely. In New Mexico it grows on dry and sunny granite at about 2000 m elevation.

Grimmia poecilostoma is extremely variable in leaf shape. Leaves range from small, triangular and obtuse to larger, acuminate, resembling those of *G. ovalis.* Sporophytes appear less variable, with the only deviation seen in a specimen from France (*Sèbille s.n.*, PC, the lectotype). This specimen has proximal exothecial cells that are thin-walled, but

Figure 36. Distribution of: ● *Grimmia poecilostoma*; ▲ *Grimmia reflexidens*; ■ *Grimmia ungeri*.

distal exothecial cells are incrassate on the inner capsule wall.

The gametophyte morphology and anatomy of *G. poecilostoma* are identical to those of *G. americana*, *G. involucrata*, and *G. tergestina*. All four species have strongly modified perichaetial leaves, which are almost completely hyaline and filmy, and much larger than other leaves. Perichaetial leaves are usually overlooked because they are difficult to discriminate even under the compound microscope. These four species form an interesting group of two pairs differing in sexuality and sporophyte morphology as well as geographical distribution. *Grimmia poecilostoma* and *G. americana* have ventricose capsules on curved setae. However, *G. poecilostoma* is dioicous and holarctic; *G. americana* is gonioautoicous and North American. In contrast, *Grimmia tergestina* and *G. involucrata* bear symmetric capsules on straight setae. Again, the former is dioicous and holarctic, whereas the latter is gonioautoicous and North American.

Greven (1995: 30, 115) stated that *G. poecilostoma* can be separated from *G. tergestina* by its ecology. According to him, *G. poecilostoma* occurs only on acidic rocks, whereas *G. tergestina* grows only on basic substrata. Despite this, indisputable fertile collections reveal most of the Asiatic and some European specimens of *G. poecilostoma* have been collected from calcareous rocks, and that *G. tergestina* also grows on quarzite (e.g., *Handel-Mazzetti 2948*, from Turkey). Already Cardot (1890: 18–19) had stressed in the protologue the subcalcareous nature of the substrate where the type of *G. poecilostoma* was collected.

Study of the types of *Grimmia crassifolia* reveals this taxon to be identical with *G. poecilostoma*, having curved setae and ventricose capsules. Greven (1995: 57) applied this name, *G. crassifolia*, to a different taxon, with straight setae and symmetric capsules. From its illustration it appears to resemble, indeed it is identical, to *G. tergestina*. If it proved to be a distinct taxon, it would need a new name.

Additional specimen examined. U.S.A. **New Mexico**: Dona Ana Co., slopes and ravines of the Organ Mountains, E side, Sugarloaf Peak, *Stark & Castetter 1182* (MO).

23. Grimmia pseudoanodon Deguchi, in Inoue, Studies on Cryptogams in Southern Peru: 29, pl. 11. 1987. TYPE: Peru. Puno: prov. Puno, Chucuito, near Acora, *Deguchi 30008* (holotype, TNS not seen; isotype, NY).

Cladautoicous. Plants olive-green to reddish or blackish. *Stems* erect, to 1 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 0.8–1.2 × 0.30–0.45 mm, ovate to lanceolate, acute, keeled, not plicate; *margins* plane; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose except for the 2-stratose marginal row in the distal ⅔; *distal cells* 7–20 μm long, isodiametric to rectangular, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 18–36 × 8–15 μm, rectangular (1.5–5.0 : 1), walls medium-thick, straight to somewhat sinuous; *proximal marginal cells* 14–30 × 10–15 μm, isodiametric to rectangular (1–3 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* flat, straight, to 1 mm, smooth to denticulate. *Perichaetial leaves* 1.6–1.8 × ca. 0.8 mm, convolute and larger than vegetative leaves (2–4 ×). *Androecia* terminal. *Setae* straight, 0.5–0.7 mm long. *Capsules* immersed, ovoid to cylindric, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 40–70 × 12–24 μm, rectangular (3–6 : 1), thin-walled; *annulus* compound and revoluble, *elongata* type; *peristome teeth* lacking; *opercula* conic to mammillate; *calyptrae* mitrate; *spores* 11–20 μm, coarsely granulose.

Illustrations. Figure 37; Deguchi (1987: pl. 11).

Distribution (Fig. 34). Southern America. *Grimmia pseudoanodon* was originally described from southern Peru. Subsequently, Hastings (1997) re-

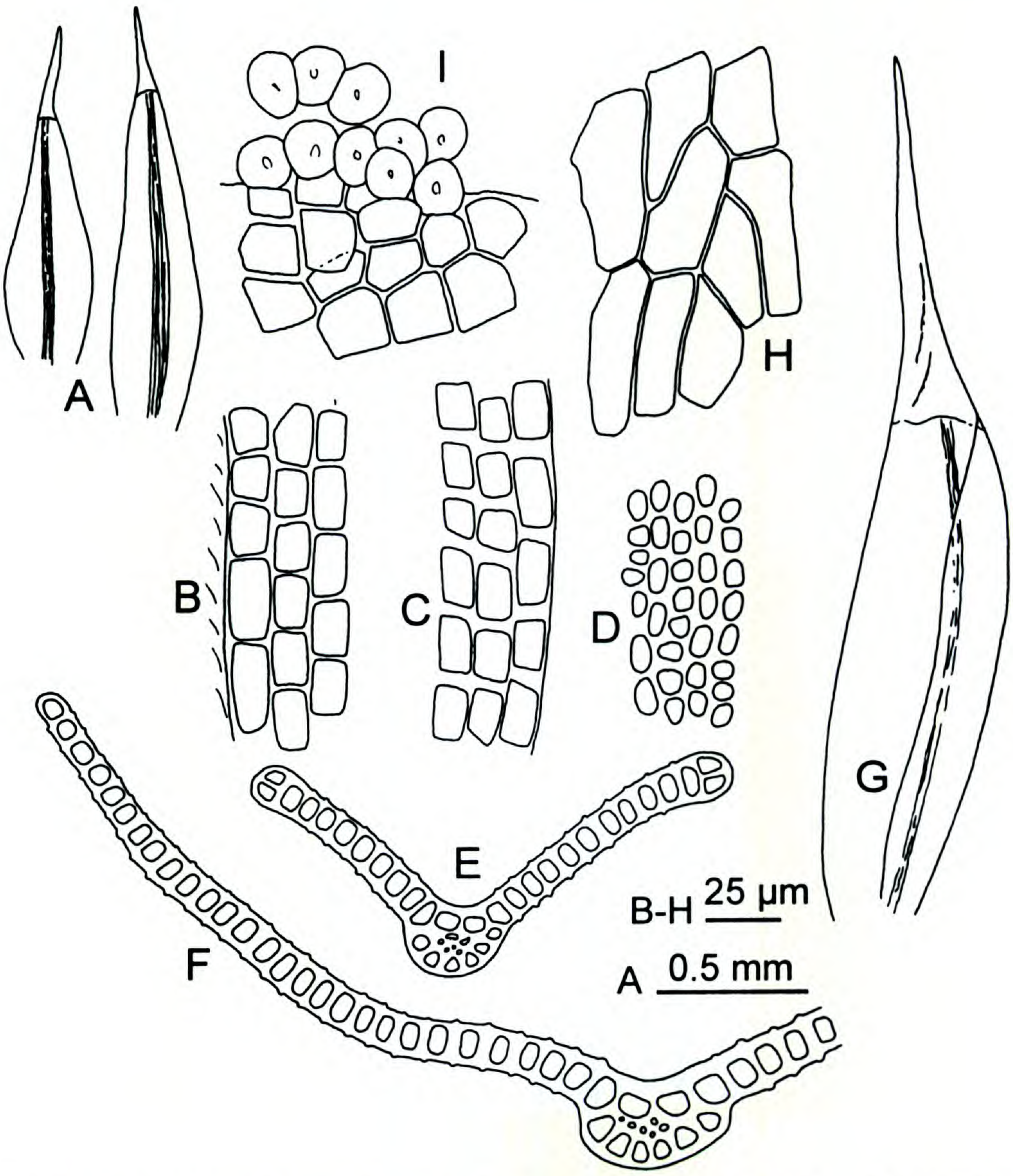

Figure 37. *Grimmia pseudoanodon.* —A. Leaves. —B. Proximal juxtacostal leaf cells. —C. Proximal marginal leaf cells. —D. Distal leaf cells. —E, F. Transverse sections at medial and proximal parts of leaf. —G. Perichaetial leaf. —H. Medial exothecial cells. —I. Capsule mouth and annulus. (*Hegewald 5438a,* IBA.)

ported its presence from Bolivia, and its range is here extended to northern Argentina. It grows on rocks in open areas above the tree line between 4000 and 4900 m elevation.

Grimmia pseudoanodon is characterized by ovate to lanceolate leaves with flat margins, and symmetric, gymnostomous capsules on straight setae. It is similar to *G. anodon* as already indicated by Deguchi (1987: 30). However, considering the overall variability of *G. anodon,* it is difficult to discriminate their gametophytes except by male bud position. Male buds are terminal on separate branches in *G. pseudoanodon,* but remain hidden below the perichaetia in *G. anodon.* Both taxa are unequivocally identified by their sporophytic characters.

Additional specimens examined. ARGENTINA. **Salta**: Nevado de Castillo, *Lorentz s.n.* (JE). BOLIVIA. **Oruro**: prov. Atahuallpa, SE slope of Cerro Separaya, *Lewis 79–2004* (F); prov. Atahuallpa, Cerro Tata Sabaya, *Lewis 79–2015* (F, IBA); prov. Sajama, Cerro Achuta, *Lewis 84–260* (F, IBA), *84–271* (F, IBA), *84–286* (F, IBA), *84–315* (F, IBA); prov. Sajama, Nevado Sajama, *Lewis 84–266* (F, MO). PERU. **Arequipa**: Arequipa, laguna Las Salinas, *Hegewald & Hegewald 5483A* (IBA, MO). **Puno**: Puno, Chucuito, near Acora, *Deguchi 30008* (NY).

24. Grimmia pulla Cardot, Rev. Bryol. 36: 106. 1909. TYPE: Mexico. Hidalgo: Honey Station, *Pringle s.n.* [Pringle, Plantae mexicanae, n° 10423] (lectotype, here designated, PC; isolectotypes, CANM-197543, FH, JE, NY, PC 2 replicates, TENN, UC-133015).

Grimmia pulla var. *squarrosa* Thér., Rev. Bryol. Lichénol. 5: 99. 1933. TYPE: Mexico. México: San Rafael,

Amable 1857 (lectotype, here designated, PC; syntypes, [Mexico. México: Contreras, *St. Pierre 1472*], H-BR, PC).

Dioicous. *Plants* yellowish green above, brownish below. *Stems* erect or ascending, to 2 cm, with central strand. *Leaves* erect and appressed or somewhat flexuous apically when dry, spreading to squarrose when moist, 1.5–2.0 × 0.3–0.4 mm, lingulate, acute, keeled, not plicate; *margins* recurved from ⅓ to ½–⅔ the leaf length on one or both sides; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose except for the 2-stratose two marginal rows in the distal ⅔; *distal cells* 6–8 μm long, isodiametric, rectangular and oblate, not bulging, walls sinuous; *proximal juxtacostal cells* 20–50 × 8–12 μm, rectangular (2–5 : 1), walls medium-thick and straight; *proximal marginal cells* 12–35 × 8–14 μm, isodiametric to rectangular (1–2 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* usually brownish at base, terete, straight, to 0.6 mm, dentate. *Perichaetial leaves* 2 × 0.5–0.6 mm, convolute and larger than vegetative leaves (1.5 ×). *Androecia* terminal. *Setae* curved, 3–4 mm long. *Capsules* exserted, ellipsoid, symmetric, ribbed, stramineous, with stomata at the base; *exothecial cells* 30–60 × 14–25 μm, rectangular (1.5–2 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–70 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 10–16 μm, minutely granulose.

Illustrations. Figure 38; Crum (1994: fig. 306).

Distribution (Fig. 34). Northern America. *Grimmia pulla* is known only from Mexico. It grows on acid rocks and bases of tree trunks in open areas and forests between 2300 and 2600 m elevation.

Grimmia pulla is a very stenotypic species typified by its narrowly lingulate leaves and short, sharply dentate, brownish hair-points. The only species to be confused with it is *G. pulvinata*. However, *G. pulvinata* has wider leaves, and longer, smoother hair-points. *Grimmia pulvinata* is autoicous, with perigonial buds found just below the perichaetia, and is typically fertile.

Additional specimens examined. MEXICO. **Distrito Federal**: La Venta, *Saint-Pierre 1803* (PC); near Cerro Zacayuca in Pedrigal near Contreras, *Sharp & Miranda 1176B* (TENN). **Durango**: Hwy. 40 about 9 mi. W of La Ciudad, *Bowers et al. 5068B* (TENN). **Hidalgo**: river ledges, near Honey Station, 12 Dec. 1909, *Pringle s.n.* (NY). **Jalisco**: between Cd. Venustiano Carranza and Tapalpa, *Valentine 8–14* (TENN). **Michoacán**: near Las Cabras, between Chilchota and Zacapú, *Sharp 3715* (TENN); along Hwy. 15 near Zacapú, *Norris & Taranto 15408* (TENN); about 1 mi. E of Las Penas on Hwy. 15, *Norris & Taranto 15642A* (UC). **México**: 2 mi. S of Hwy. 15 on road to Valle Bravo, *Sharp & Cárdenas 8713A* (TENN), *8716* (TENN); Contreras, *Amable 1475* (FH); La Escondida, 8 mi. E of Lerma, *Hermann & Crum 20884* (TENN); San Rafael, *Amable 1860* (PC); near Llano Grande, near Río Frío, *Sharp 178* (TENN). **Morelos**: at mirador, near km 67 on Cuernavaca–México City toll road, Hwy. 95D, *Magill 2527* (TENN); old Rt. 95, 42.5 km from México to Cuernavaca, *Snider 262* (TENN). **Oaxaca**: Mts. Oaxaca, *Spotts 1757* (FH). **Veracruz**: Ixhuacán de los Reyes, al SW de Teocelo, *Viveros-Juárez 465* (TENN).

25. Grimmia pulvinata (Hedw.) Sm., Engl. Bot. 24: 1728. 1807. *Fissidens pulvinatus* Hedw., Sp. Musc. 158, tab. 40 fig. 1–3. 1801. TYPE: Germany (lectotype, designated by Cao & Vitt (1986), G not seen).

Fissidens pulvinatus var. *africanus* Hedw., Sp. Musc. Frond. 159, tab. 40 figs. 4–6. 1801. *Dicranum africanum* (Hedw.) F. Weber & D. Mohr, Index Mus. Pl. Crypt.: 2. 1803. *Dicranum pulvinatum* (Hedw.) Lag., D. García & Clemente var. *africanum* (Hedw.) Schleich., Cat. Pl. Helv. ed. 4: 40. 1821. *Dryptodon obtusus* Brid., Bryol. Univ. 1(1): 198. 1826. *Grimmia africana* (Hedw.) Arn., Arnott, G.A.W. Mém. Soc. Linn. Paris 5: 243. 1827. *Grimmia pulvinata* var. *obtusa* Huebener, Muscol. Germ. 194. 1833. *Dryptodon obtusus* Hartm., Handb. Skand. Fl. ed. 3: 270. 1838. *Grimmia pulvinata* var. *africana* (Hedw.) Wilson, in Hooker, Bot. Antarct. Voy., Fl. Nov.-Zel. 2: 75. 1854. *Grimmia obtusa* (Brid.) Loeske, Laubm. Eur. Part I: 165. 1913. *Grimmia pulvinata* f. *obtusa* Vilh., Věstn. Král. České Společn. Nauk, Tř. Mat.-Přir. 1924: 27. 1924. TYPE: [South Africa.] Ad Cap. bonae Spei lecta specimina misit O. Swartz. (lectotype, here designated, G).

Dicranum cribrosum Brid., Muscol. Recent. Suppl. 1: 212. 1806. *Dryptodon cribrosus* (Brid.) Brid., Bryol. Univ. 1: 198. 1826. TYPE: South Africa. Promontorium Bonae Spei, *Thunberg s.n.* (lectotype, here designated, H-SOL).

Grimmia cygnicolla Taylor, London J. Bot. 5: 45. 1846. TYPE: Australia. Swan River, *Drummond s.n.* (lectotype, here designated, FH; isolectotypes, FH, H-SOL, NY).

Grimmia callosa Müll. Hal. & Hampe, Linnaea 26: 498. 1855. TYPE: Australia. Victoria: Barossa range, *Müller s.n.* (lectotype, here designated, JE).

Grimmia gibertii Mitt., J. Linn. Soc., Bot. 12: 100. 1869. TYPE: Uruguay. Montevideo, *Gibert 729* (lectotype, here designated, NY; isolectotypes, FH, H-BR, NY, PC).

Grimmia auresia Besch., Cat. Mouss. Alg. 17. 1882. TYPE: Algeria. Aurès, *Balansa s.n.* (lectotype, here designated, PC; isolectotype, F).

Grimmia campbelliae Müll. Hal., Hedwigia 37: 162. 1898. TYPE: Australia. Hume River, *Campbell s.n.* (lectotype, here designated, JE; isolectotypes, H-BR, JE).

Grimmia woollsiana Müll. Hal., Hedwigia 37: 162. 1898. TYPE: [Australia.] New South Wales: *Woolls s.n.* (lectotype, here designated, H-BR; isolectotype, JE).

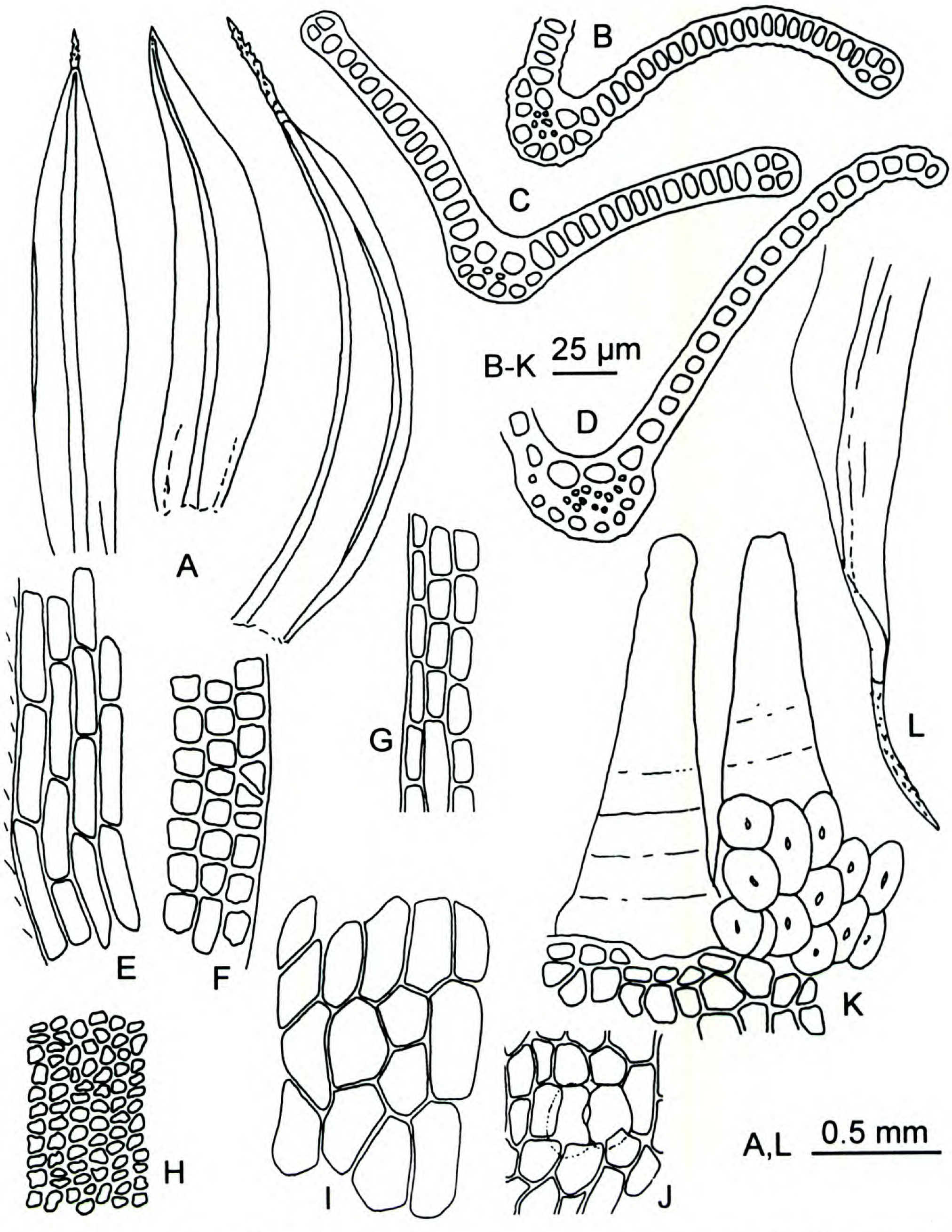

Figure 38. *Grimmia pulla.* —A. Leaves. —B, C. Transverse sections at medial part of leaf, B showing pseudopapillosity. —D. Transverse section at proximal part of leaf. —E. Proximal juxtacostal leaf cells. —F, G. Proximal marginal leaf cells. —H. Distal leaf cells. —I. Medial exothecial cells. —J. Proximal exothecial cells and stoma. —K. Annulus and peristome teeth (only contour shown, not papillosity). —L. Perichaetial leaf. (*Pringle 10423*, PC.)

Grimmia subcurvula Kindb., Öfvers. Förh. Kongl. Svenska Vetensk.-Akad. 57: 1007. 1900 "1899." TYPE: [Sweden.] Dalsland, Rostock, 14 Aug. 1898 *Kindberg s.n.* (lectotype, here designated, S; isolectotype, PC).

Grimmia orbicularis var. *patagonica* Cardot, Wiss. Erg. Schwed. Südpolar-Exp. 4(8): 284. 1908. *Grimmia arachnoidea* Dusén, Rep. Princeton Univ. Exped. Patagonia 8: 122. 1903, nom. nud. TYPE: Chile. Aisén: Patag. occ. in valle fluminis Aysen, 18 Feb. 1897, *Dusén s.n.* (lectotype, here designated, H-BR).

Grimmia phyllorhizans Broth., Nat. Hist. Juan Fernandez 2(3): 419, tab. 26 fig. 21–24. 1924. TYPE: [Chile. Valparaíso:] Juan Fernández, Masatierra, Villagra,

Skottsberg 129 (lectotype, here designated, H-BR; isolectotypes, FH, NY, UPS).

Grimmia decurrentipilis Thér., in Felipp., Rev. Bryol. Lichénol. 2: 216, fig. 8. 1929. TYPE: Uruguay. [Canchones:] La Paz, *Felippone 837* (lectotype, here designated, PC).

Grimmia montevidensis Thér., in Felipp., Rev. Bryol. Lichénol. 2: 216, fig. 7. 1929. TYPE: Uruguay. Montevideo: Montevideo, *Felippone 839* (lectotype, here designated, BM; isolectotype, PC).

Gonioautoicous. Plants yellowish green above, brownish below. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed or somewhat flexuous apically when dry, patent to spreading when moist, 1.0–1.8 × 0.3–0.6 mm, lingulate to elliptic, obtuse to acute, keeled, not plicate; *margins* recurved from ⅓ to ½–⅔ the leaf length on one or both sides; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose except for the 2-stratose two marginal rows and occasional streaks in the distal ⅔; *distal cells* 6–14 μm long, isodiametric, rectangular and oblate, not bulging, walls sinuous; *proximal juxtacostal cells* 10–70 × 10–15 μm, rectangular (1–4[8]:1), walls thin and straight, occasionally thickened and nodulose; *proximal marginal cells* 15–35 × 10–15 μm, isodiametric to rectangular (1–2:1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 2 mm, smooth to weakly denticulate. *Perichaetial leaves* 2 × 0.5–0.8 mm, convolute and larger than vegetative leaves (2 ×). *Androecia* below perichaetia. *Setae* curved, 3–4 mm long. *Capsules* exserted, ellipsoid or ovoid, symmetric, ribbed, stramineous, with stomata at the base; *exothecial cells* 30–50 × 13–20 μm, mostly rectangular ([1]2–3:1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 50–60 μm wide at the mouth, entire, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostellate to rostrate; *calyptrae* mitrate; *spores* 10–12 μm, minutely granulose.

Illustrations. Figure 39; Chałubiński (1882: tab. 4 fig. 4); Deguchi (1984: figs. 8, 9, as *G. pulvinata* var. *africana*); Lawton (1971: pl. 64 figs. 1–8); Maier and Geissler (1995: abb. 22); Smith (1978: fig. 151 1–5).

Distribution (Fig. 40). Europe, Africa, temperate and tropical Asia, Australasia, northern and southern America; Mexico, central Chile and Juan Fernández Islands, central Argentina, Tierra del Fuego, southern Brazil, Uruguay. This species is usually found in man-made habitats, such as concrete and limestone walls, roofs, and other kinds of constructions. In Latin America it grows on basic as well as acidic rocks like slate, seldom on tree bark, either dry or moist, in man-made habitats, rocky grasslands, and *Nothofagus* forests between sea level in southernmost Patagonia and 2250 m elevation.

Grimmia pulvinata has lingulate to elliptic leaves. Its perigonia lie cryptic just below the perichaetia and calyptrae are mitrate. Proximal juxtacostal cells are usually short-rectangular with thin, uniformly thickened walls. However, some populations have long-rectangular basal juxtacostal cells (up to 8:1 length:width ratio) with wavy walls. Sporophytes are more variable, for capsule and opercula lengths. However, this variability is not taxonomically significant. A related taxon not present in Latin America is *G. orbicularis* Wilson, which is a cladautoicous taxon with elongate, nodulose, basal juxtacostal cells, and cucullate calyptra. Scattered across the world range of *G. pulvinata* there are collections gametophytically similar to *G. orbicularis* in their long, wavy basal juxtacostal cells. All of these are gonioautoicous, have mitrate calyptrae, and, for the most part, long rostrate opercula (e.g., U.S.A. California *Crosby 17705*, MO).

Differences between *G. pulvinata* and *G. pulla* are discussed under the latter species.

Described from the Juan Fernández Islands off the coast of Chile, *G. phyllorhizans* is a small plant to 0.3 cm high. It displays remarkably long hair-points, to 2 mm, relative to the overall size of the plants. Capsules are short, ovoid. Bulbiform terminal male buds are occasionally seen, but axillary perigonia predominate.

In his treatment on Patagonian mosses, Dusén (1903: 122) listed *G. arachnoidea* as a nomen nudum. In a later publication, he changed his identification to *G. orbicularis* (Dusén, 1906: 14). Cardot (1908: 109) considered this specimen to be *G. orbicularis*, but in the "Additions" appendix (Cardot, 1908: 284) he described the specimen *Dusén 587* as *G. orbicularis* var. *patagonica*. From this it is clear that there is only one specimen on hand, although renamed several times. Neither PC nor S has specimens collected by Dusén in the protologue locality and determined to *Grimmia orbicularis* or its variety *patagonica* by Cardot. Under these circumstances, the specimen identified as *G. arachnoidea* Dusén serves as lectotype of *G. orbicularis* var. *patagonica*, although the actual collection number does not appear on the label.

Additional specimens examined. MEXICO. **Baja California**: Sierra de San Pedro Mártir, Cerro de la Encantada, pass below observatory, *Sharp et al. 5596* (TENN), *5661-B* (TENN), *5663* (TENN), *6074* (TENN); Sierra de

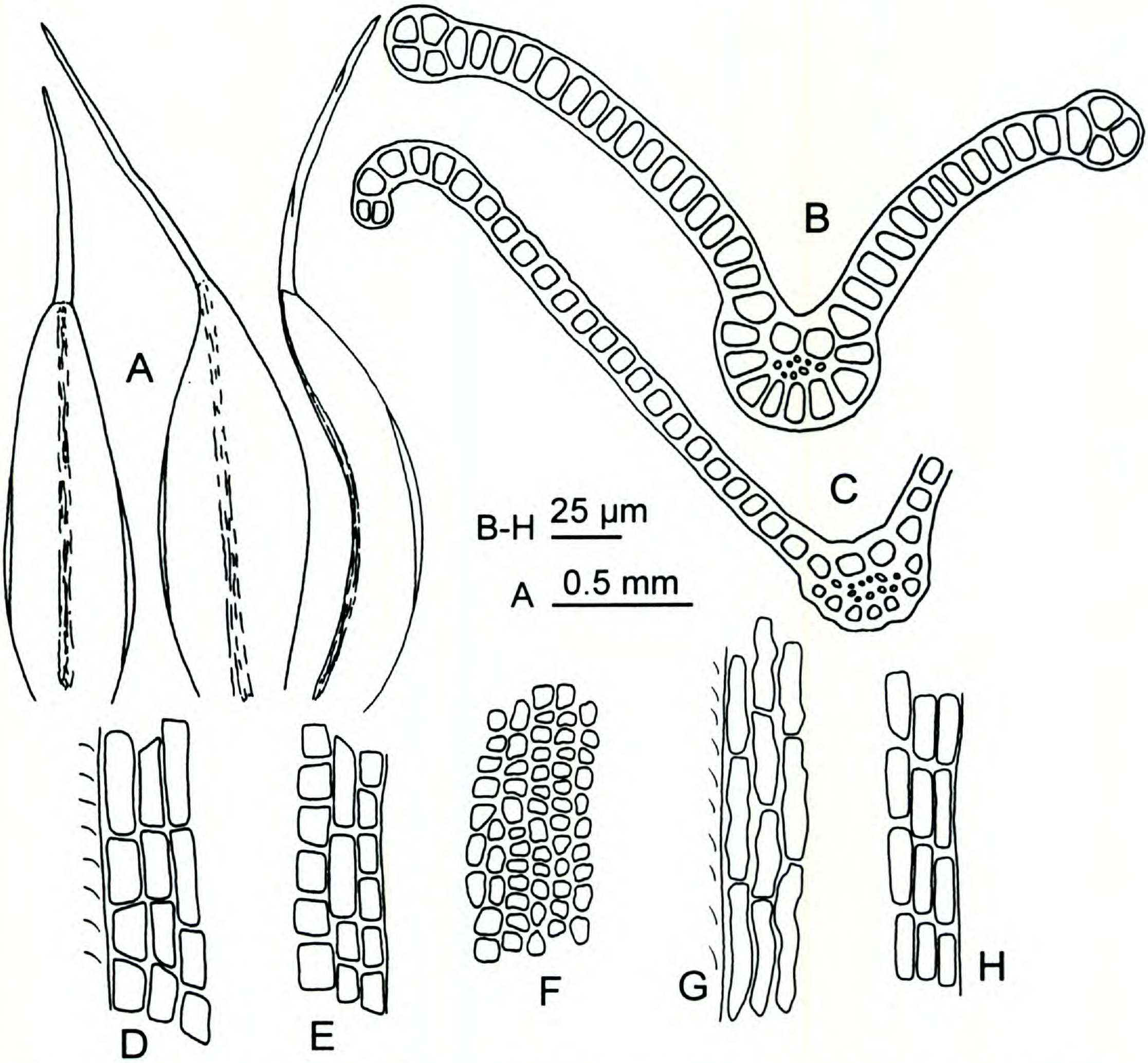

Figure 39. *Grimmia pulvinata.* —A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D & G. Proximal juxtacostal leaf cells. —E & H. Proximal marginal leaf cells. —F. Distal leaf cells. (A–F: *Sharp et al. 6074*, TENN; G, H: *Dusén s.n.*, H-BR.)

San Pedro Mártir, below Meling Ranch, E of Colenett, *Sharp et al. 6099-A* (TENN); ca. 18 km SW de El Cóndor en Sierra de Juárez, *Meyer 43B* (TENN); Guadalupe Island, *Palmer 113* (MO).

ARGENTINA. **Catamarca**: Dept. Capital, lomas vecinas a la capital, *Castillón 1002* (MO, FH). **Córdoba**: Depto. Punilla, Río Yuspe, Weg nach La Candelaria, *Hosseus & Weihmüller 911* (FH), *911A* (FH), *913* (FH); bei des Estafeta Casa Nueva (Pedernera), *Hosseus 1830B* (FH); Weg von Tanti nach Los Gigantes, *Hosseus 2220* (FH), *2221* (FH), *2228* (FH); Weg von Ascochinga nach La Cumbre, *Hosseus & Weihmüller 2598* (FH); Depto. Colón, pedanía Río Ceballos, cerca de Colonchanga, *Hosseus 2433* (FH); Anfang der Quebrada de Los Cóndores, *Hosseus 2447* (FH), *2447A* (FH), *2447B* (FH), *2448* (FH), *2449* (FH). **Río Negro**: Parque Nacional Argentino Nahuel Huapi, 11 Sep. 1936, *Donat s.n.* (JE). BRAZIL. **Rio Grande do Sul**: Pinheiro Machado, *Vital 9155* (FLAS). CHILE. **Los Lagos**: Llanquihué, Saltos de Petrohué, *Deguchi 25159* (HIRO). **Magallanes**: Parque Nacional Torres del Paine, *Deguchi 26063* (HIRO), *26074* (HIRO), *26090* (HIRO), *26091* (HIRO), *26102A* (HIRO); Península de Brunswick, around Puerto del Hambre, *Deguchi 26374* (HIRO). **Valparaíso**: Islas Juan Fernández, Masatierra, Quebrada Mono, *Hatcher & Engel 470* (NY). URUGUAY. **Canelones**: La Paz, *Felippone 720* (H-BR), *837* (PC); Colonia, Estanzuela, July 1928, *Herter s.n.* (JE). **Montevideo**: Montevideo, *Arechavaleta s.n.* (H-BR, JE), *201* (NY), *215* (NY), *Felippone 990* (PC), *2439* (PC), *Gibert 1262* (NY), *Herter 1267* (FH); Pocitos, pr. Montevideo, *Felippone 960 p.p.* (PC).

26. Grimmia reflexidens Müll. Hal., Syn. Musc. Frond. 1: 795. 1849. TYPE: Chile. *Pöppig s.n.* (lectotype, designated by Muñoz (1998d), BM; isolectotypes, JE, NY, PC).

For a list of synonyms, see Muñoz (1998d).

Cladautoicous or goniautoicous. Plants yellowish green at the tips. *Stems* erect, to 1 cm, with

Figure 40. Distribution of: ● *Grimmia pulvinata*; ▲ *Grimmia tergestina*; ■ *Grimmia tortuosa*.

central strand. *Leaves* erect and appressed when dry, patent to spreading when moist, 1.0–1.8 × 0.25–0.45 mm, ovate to lanceolate, acute, keeled, plane or very weakly plicate; *margins* plane or recurved proximally, to ½ the leaf length on one side, occasionally both sides briefly recurved proximally; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 8–12 μm long, isodiametric, bulging or not, walls straight to slightly sinuous; *proximal juxtacostal cells* 15–55 × 8–15 μm, usually rectangular ([1]1.5–6.0 : 1), walls medium-thick and straight; *proximal marginal cells* 10–50 × 8–15 μm, isodiametric to rectangular (1–5 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 1.5 mm, entire or very weakly denticulate. *Perichaetial leaves* 1.8–2.7 × 0.5–0.85 mm, convolute and larger than vegetative leaves (2×). *Androecia* axillary or terminal. *Setae* erect and straight, 1.5–3.0 mm long. *Capsules* exserted, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 35–70 × 10–35 μm, rectangular (1.5–3 : 1), thin-walled; *annulus* simple and persistent, *Schistidium* type; *peristome teeth* 45–70 μm wide at the mouth, entire or irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic or mammillate; *calyptrae* cucullate; *spores* 8–14 μm, minutely granulose.

Illustrations. Figure 41; Bell (1984: fig. 1); Cao and Vitt (1986: fig. 20 a, c, e–l, n, p, q, s, u); Cardot (1908: fig. 51); Deguchi (1978: fig. 41, as *G. subsulcata*); Maier and Geissler (1995: fig. 23, as *G. sessitana*); Muñoz (1998d: fig. 16).

Distribution (Fig. 36). Europe, Africa, temperate and tropical Asia, Australasia, Antarctic, northern and southern America; Andean Range from Bolivia to Tierra del Fuego. *Grimmia reflexidens* grows on rocks of unknown nature in open areas above the tree line, in snow beds and other harsh environments fed by thawing snow, between 1400 and 2600 m elevation in southern South America, but it reaches 5060 m in Bolivia.

Grimmia reflexidens is an autoicous taxon with narrowly keeled, bistratose leaves, straight setae, and stramineous capsules with stomata. It is widely distributed and gametophytically variable: identification of sterile specimens may be impossible.

To date, the geographical distributions of *G. montana*, *G. reflexidens*, and *G. ungeri* are not known to overlap. Consequently, incomplete specimens from South America can be assumed to be *G. reflexidens*. However, *G. reflexidens* is likely to be also present in high elevations in Mexico, within the geographic range of *G. montana* and *G. ungeri*. The use of sporophyte characters for correct identification is therefore indispensable within this species grouping.

Additional specimens examined. ARGENTINA. **Río Negro**: west. Bariloche am S. Ufer des L. Nahuel Huapi, 21 Feb. 1922, *Schiller s.n.* (JE); lac Nahuelhuapí, *Dusén 718* (H-BR). **Santa Cruz**: près des sources du río Ñirchuao, au sud de Pampa Chica, *Skottsberg 976* (PC); río Tarde, *Halle 369* (BM, H-BR, PC). BOLIVIA. **Oruro**: prov. Sajama, Cerro Chucarero, *Lewis 79-2092* (F, IBA), *79-2095A* (F, IBA); prov. Sajama, Cerro Achuta, *Lewis 84-305a* (F, IBA). CHILE. **Aisén**: Coyhaique, Cerros Divisaderos (Cordón de Bella Vista), *Santesson M340* (FH). **Libertador General Bernardo O'Higgins**: Colchagua, Vegas del Flaco, *Mahú & Tapia 50220, 50221* (MO). **La Araucanía**: Cautín, volcán Llaima, *Sparre 4832* (FH). **Los Lagos**: Osorno, Ottoshöhe, S Ufer des Lago Nahuel Huapi, *Schiller 25* (PC). **Región Metropolitana**: Santiago, laguna Lo Encanado, *Mahu 5539* (NY); El Volcán, *Santesson M123* (FH).

27. Grimmia tergestina Tomm. ex Bruch & Schimp., Bryol. Europ. 3: 126, tab. 258. 1845. *Grimmia tergestina* var. *eutergestina* Loeske, Laubm. Eur. Part I: 80. 1913, nom. inval. TYPE: Italy. Bosco de Melara bei Triest [. . .] zwischen Longera und Bozzal, Mar. 1845, *Tommasini s.n.* (lectotype, designated by Cao & Vitt (1986), BM; isolectotypes, BM 3 replicates, H-SOL).

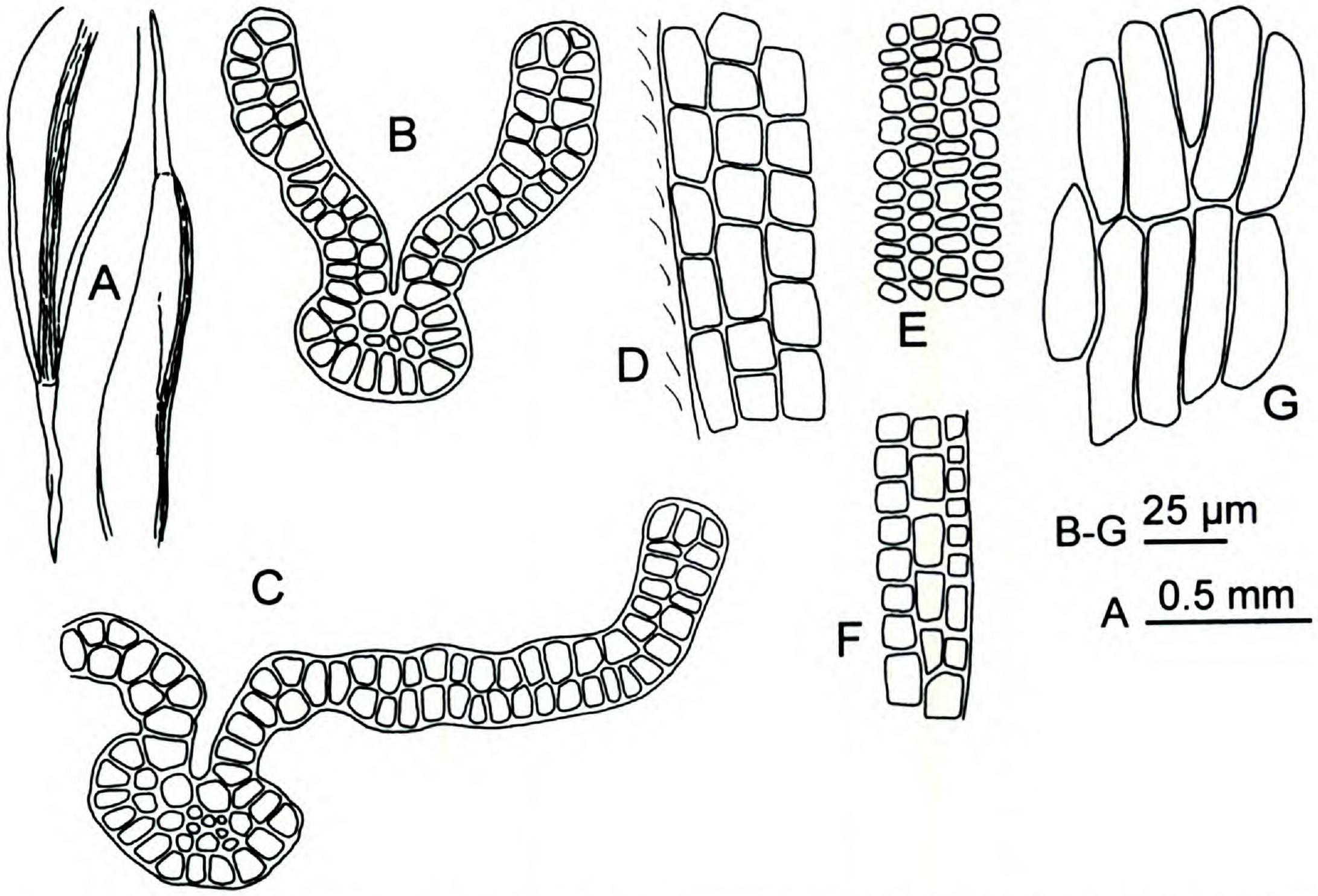

Figure 41. *Grimmia reflexidens.* —A. Leaves. —B, C. Transverse sections at distal and medial parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Distal leaf cells. —F. Proximal marginal leaf cells. —G. Medial exothecial cells. (*Mahú 5539*, MO.)

Dioicous. Plants olive-green to blackish. *Stems* erect, to 2 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 0.9–1.5 × 0.3–0.5 mm, ovate to lanceolate, obtuse to acuminate, concave, not plicate; *margins* plane; *costa* semi-elliptical, undifferentiated, ventral epidermis 2–6 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 6–13 µm long, isodiametric, rectangular and oblate, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 17–50 × 9–15 µm, rectangular (2–3 : 1), walls thin to moderately thick and straight; *proximal marginal cells* 10–30 × 10–20 µm, isodiametric to rectangular (1–2 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete distally and flat proximally, occasionally somewhat decurrent, straight, to 2 mm, smooth to dentate. *Perichaetial leaves* 2.0–2.5 × 1.0–1.2 mm, convolute, hyaline and filmy, scarcely discernible, larger than vegetative leaves (3.0–3.5 : 1). *Androecia* terminal. *Setae* erect and straight, 0.7–1.0 mm long. *Capsules* immersed, ovoid, symmetric, smooth, stramineous, with stomata at the base; *exothecial cells* 20–70 × 15–35 µm, rectangular (1.5–3.0 : 1), thin-walled; *annulus* compound and revoluble, *affinis* type; *peristome teeth* 65–85 µm wide at the mouth, cribrose throughout and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 10–16 µm, minutely granulose.

Illustrations. Figure 42; Bruch and Schimper (1845: tab. 21); Cao and Vitt (1986: fig. 29, but basal marginal cells inaccurate, drawn from outer perichaetial leaves); Chałubiński (1882: tab. 8 fig. 13); Maier and Geissler (1995: abb. 26); Nowak and Poelt (1979: figs. 8–11); Orbán and Vajda (1983: fig. 330 a–c); Vaněk (1940: figs. 1–11).

Distribution (Fig. 40). Europe, temperate Asia, northern and southern America; Caribbean, Peru, Bolivia. *Grimmia tergestina* grows in rocks and outcrops of undefined nature in open areas above the tree line in Bolivia and Peru, and in outcrops in pine forests in the Dominican Republic, between 2840 and 4520 m elevation.

Plants of *Grimmia tergestina* have bistratose leaves, indistinct costae, strongly modified perichaetial leaves, and symmetric capsules on a straight and erect seta. For its discrimination from

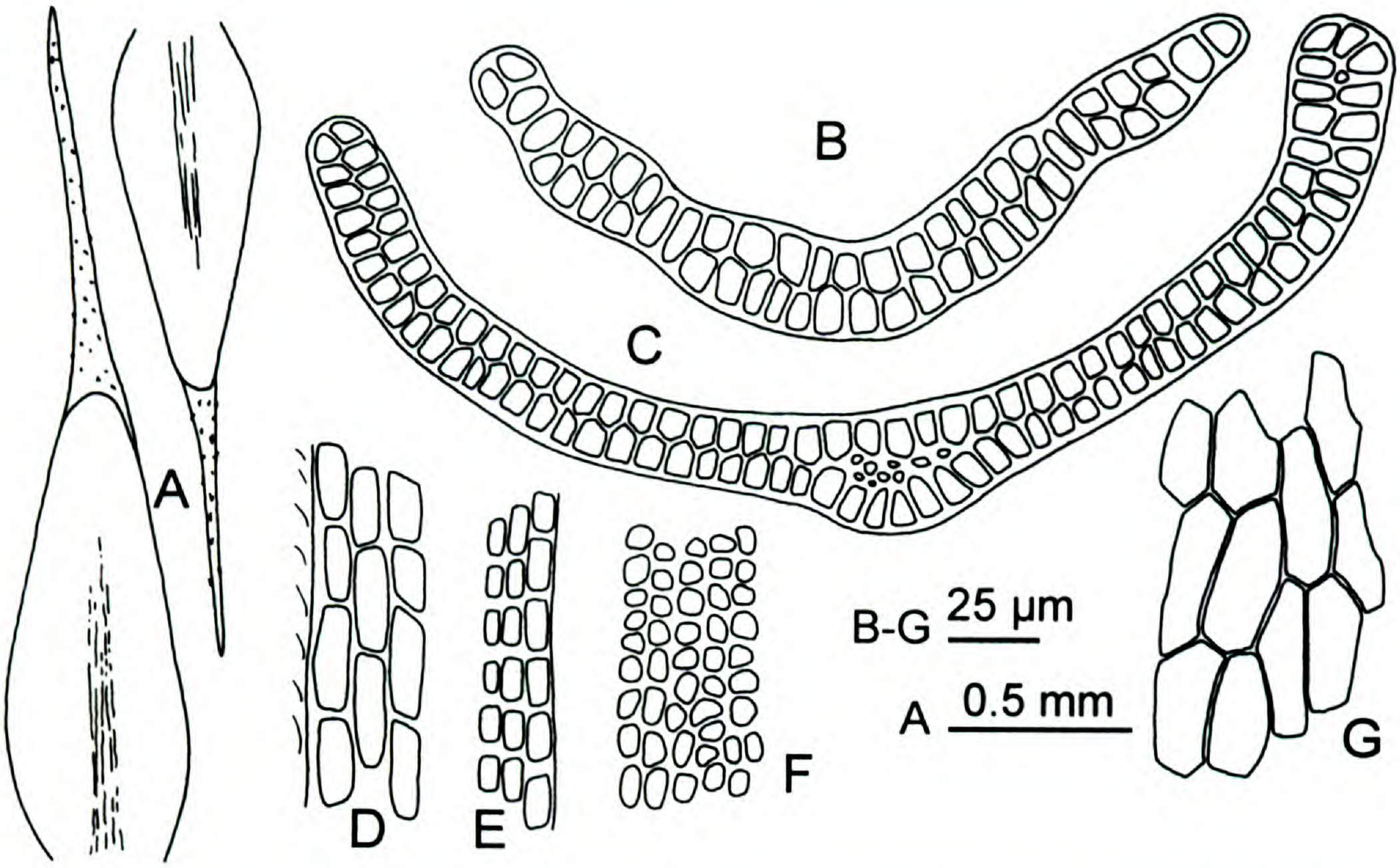

Figure 42. *Grimmia tergestina.* —A. Leaves. —B, C. Transverse sections at distal and medial parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Proximal marginal leaf cells. —F. Distal leaf cells. —G. Medial exothecial cells. (*Buck 8575*, NY.)

G. americana, *G. involucrata*, and *G. poecilostoma*, see the discussion under *G. poecilostoma*.

Bolivian and Dominican specimens have mature sporophytes, allowing unequivocable identifications. Unfortunately, Peruvian specimens are totally barren. As stated under *G. poecilostoma*, *Grimmia tergestina* belongs to a complex of taxa that can only be confidently determined from sporophytic material. Peruvian specimens are tentatively placed in *G. tergestina* based on these species distribution ranges.

Additional specimens examined. DOMINICAN REPUBLIC. **La Vega**: Alto de la Bandera, near summit, *Buck 8575* (NY).

BOLIVIA. **Potosí**: prov. Chayanta, 1 km NE of Macha, *Lewis 84-1641* (F, IBA); prov. Tomás Frías, cerro Kari Kari, *Lewis 79-243* (F). PERU. **Junín**: Jauja, südlich Canchayllo, *Hegewald & Hegewald 5848A* (MO); Tarma, Cerro Quinchomachay bei Tarma, vor Pueblo Coches Bajo, *Hegewald & Hegewald 6262* (IBA, MO).

28. Grimmia tortuosa Hook.f. & Wilson, London J. Bot. 3: 540. 1844. TYPE: Falkland Islands, 1839–1843, *Hooker s.n.* (lectotype, here designated, BM; isolectotypes, BM 7 replicates, FH 4 replicates, H-SOL, NY).

Gonioautoicous. Plants dark green to blackish. *Stems* erect, to 1.5 cm, central strand lacking or weakly developed. *Leaves* flexuous and crisped when dry, erect to patent when moist, 2.5–3.2 × 0.5–0.7 mm, lanceolate, acuminate, keeled, not plicate; *margins* plane; *costa* semi-terete to terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1-stratose, 2-stratose at margins and seldom in streaks in the distal ⅔; *distal cells* 6–9 µm long, isodiametric, seldom oblate, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 30–100 × 12–20 µm, rectangular (1.5–7.0 : 1), walls thin and straight to slightly nodulose; *proximal marginal cells* 40–120 × 10–16 µm, rectangular (3–10 : 1), the walls thin and straight, all alike, scarcely discernible; *hyaline hair-points* terete, straight, to 1.2 mm, smooth to denticulate. *Perichaetial leaves* 3–4 × ca. 0.8 mm, somewhat larger than vegetative leaves (1.5 ×), otherwise undifferentiated. *Androecia* below perichaetia. *Setae* straight, 0.5–0.6 mm long. *Capsules* immersed, cyathiform, symmetric, smooth, blackish, with stomata at the base; *exothecial cells* 14–30 × 4–10 (lumen) µm, elliptical (2–7 : 1), strongly thick-walled; *annulus* compound and tardily deciduous, *elongata* type; *peristome teeth* 90–110 µm wide at the mouth, entire to cribrose and irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* conic to mammillate; *calyptrae* mitrate; *spores* 8–10 µm, minutely granulose.

Illustrations. Figure 43; Cao and Churchill

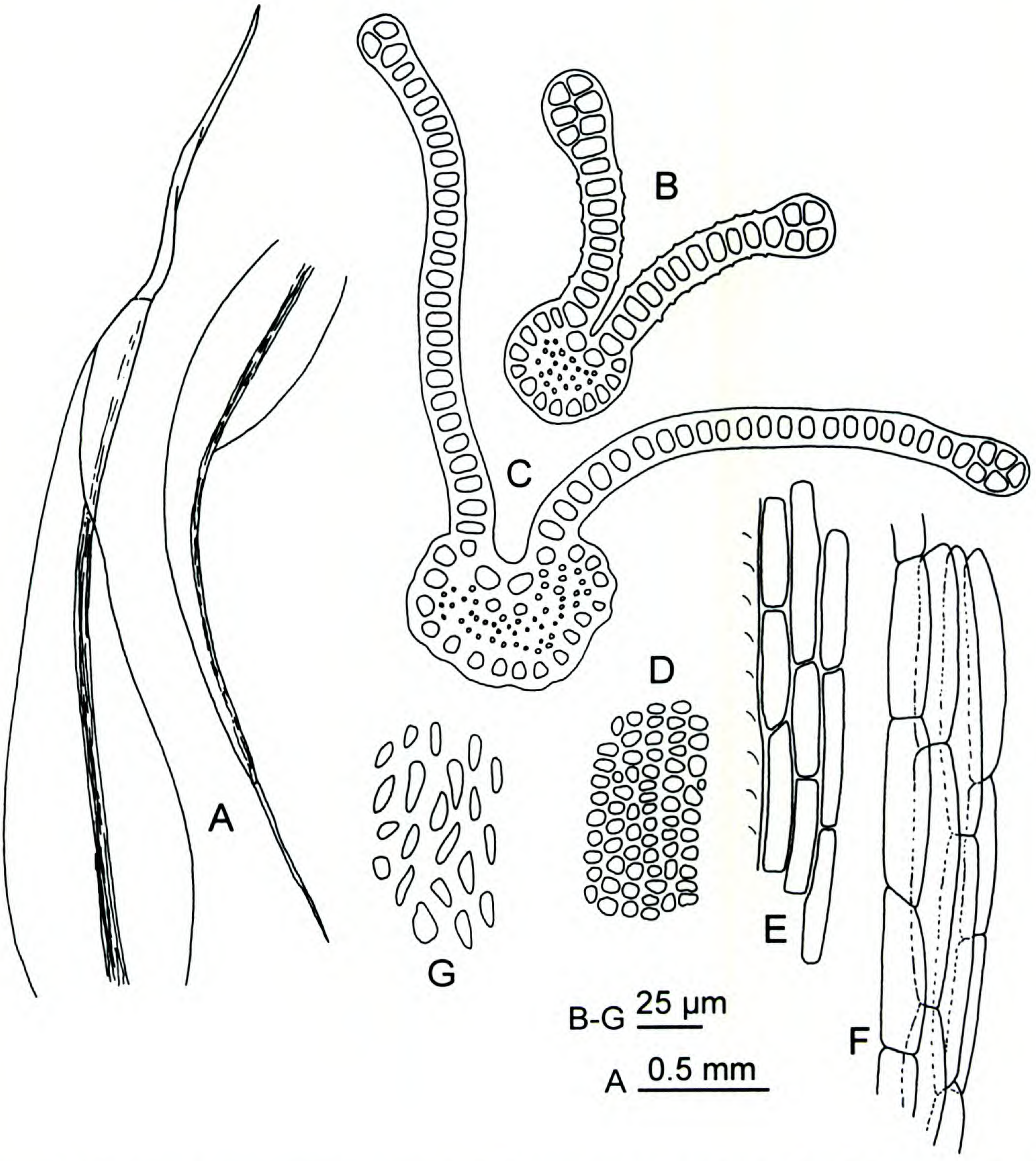

Figure 43. *Grimmia tortuosa*. —A. Leaves. —B, C. Transverse sections at distal and medial parts of leaf. —D. Distal leaf cells. —E. Proximal juxtacostal leaf cells. —F. Proximal marginal leaf cells. —G. Medial exothecial cells. (*Hooker s.n.*, BM.)

(1995b: pl. 1); Wilson and Hooker (1847: pl. 151 fig. 7).

Distribution (Fig. 40). Antarctic. Known only from the original collection made by J. D. Hooker on Mount Vernet, Falkland Islands, but its presence in southern South America is likely. According to Wilson and Hooker (1847: 400), the plants were growing on dry quartz rocks at 300 m elevation.

Material of *Grimmia tortuosa* is characterized by straight setae, immersed capsules with strongly incrassate exothecial cell walls, perigonia situated just below the perichaetia, and proximal cells of the leaves being thin-walled, lax, and inflated.

Ochyra (1993: 227) reported *G. tortuosa* from South Georgia (*Walton et al. BAS Misc. 166*, BM), but this specimen is better referred to *G. incrassicapsulis* Bell. The latter can be differentiated from *G. tortuosa* by its asymmetric, ventricose capsules on curved setae.

Cao and Churchill (1995: 515) erroneously reported that Cardot (1902) had cited *G. tortuosa* from "the antarctic." However, Cardot (1902: 7) only cit-

ed *G. tortuosa* in a list of the species of the "Terres Magellaniques" considered endemic to that area. New collections were not listed by Cardot. His report obviously refers to the Falkland Islands specimen collected by Hooker, with Cardot (1902: 5) stating, "Sous le dénomination de Terres magellaniques, je comprends . . . et les îles Falkland ou Malouines. . . ."

Specimens examined. FALKLAND ISLANDS. Mount Vernet, 1839–1843, *Hooker s.n.* (BM, FH, FH-SULL, H-SOL, NY, TCD).

29. Grimmia trichophylla Grev., Fl. Edin: 235. 1824. *Grimmia affinis* Hornsch. ex Brid., Bryol. Univ. 1: 771. 1827, nom. nud. pro syn. on. *Dryptodon trichophyllus* (Grev.) Brid., Bryol. Univ. 1: 771. 1827. *Grimmia trichophylla* subsp. *eutrichophylla* Loeske, Laubm. Eur. I: 128, fig. 37, 38. 1913, nom. inval. TYPE: [United Kingdom.] Scotland: Edinburgh, *Greville s.n.* (lectotype, designated by Geissler & Maier (1995), E not seen; isolectotypes, FH, H-SOL).

Grimmia consobrina Kunze ex Müll. Hal., Syn. Musc. Frond. 1: 785. 1849. TYPE: Chile. *Pöppig s.n.* (lectotype, here designated, NY; isotypes BM 2 replicates).

Grimmia imberbis Kunze ex Müll. Hal., Syn. Musc. Frond. 1: 788. 1849. TYPE: Chile. *Kuntze s.n.* (lectotype, here designated, JE).

Grimmia trichophylla var. *meridionalis* Müll. Hal., Syn. Musc. Frond. 1: 785. 1849. *Grimmia trichophylla* subsp. *meridionalis* (Müll. Hal.) Loeske, Biblioth. Bot. 101: 171. 1930. TYPE: Spain. Granada: In coll. siccis prope Granatam, *Schimper s.n.* (lectotype, here designated, H-SOL; isolectotype, NY; syntype, NY [Spain. Madrid: El Escorial, *Schimper s.n.*]).

Grimmia crispatula Müll. Hal. & Hampe, Linnaea 26: 499. 1855. *Grimmia crispata* Müll. Hal. & Hampe ex Mitt., Trans. Roy. Soc. Victoria 19: 55. 1882, nom. inval. orthogr. err. TYPE: [Australia. South Australia:] Flinders range. (lectotype, here designated, H-SOL; isolectotype, MEL; syntypes, [. . . juxta rivulum Fift creek] H-SOL, MEL).

Grimmia densa Kindb., Bull. Torrey Bot. Club 17: 271. 1890. *Grimmia depilata* Kindb., in Macoun & Kindberg, Cat. Canad. Pl., Musci 69, 1892, nom. illeg. incl. sp. prior. TYPE: [Canada. British Columbia:] Vancouver Island, Mt. Benson, 8 June 1887, *Macoun s.n.* (lectotype, here designated, S; isolectotype, CANM-198083).

Grimmia sardoa var. *gracilis* Warnst. & M. Fleisch., Bot. Centralbl. 65: 299. 1896. *Grimmia trichophylla* var. *gracilis* (Warnst. & M. Fleisch.) Paris, Index Bryol. Suppl. 176. 1900. *Grimmia trichophylla* f. *gracilis* (Warnst. & M. Fleisch.) Podp., Consp. Musc. Eur. 288. 1954. TYPE: Italy. Romano: Monti Albani, Mt. Cavo, 7 June 1895, *Fleischer s.n.* [Fleischer & Warnstorf, Bryotheca europaea meridionalis. Cent. 1, n° 55. 1896] (lectotype, here designated, FH).

Grimmia trichophylla var. *teneriffae* Renauld & Cardot, Bull. Herb. Boissier, sér. 2, 2: 436. 1902. TYPE: [Spain.] Santa Cruz de Tenerife: Las Cañadas, 1896, *Tullgren s.n.* (lectotype, here designated, PC).

Grimmia macropulvinata Dusén, Rep. Princeton Univ. Exped. Patagonia 8: 78, fig. 8, pl. 8 fig. 7. 1903. TYPE: "Patagonia austr." [verosimiliter Chile. Magallanes: in territorio fontinali fluminis Río Chico in saxis], 1896–1897, *Hatcher s.n.* (lectotype, here designated, S; isolectotypes, FH, NY).

Grimmia flexicaulis var. *dicksonii* Dusén, Bot. Not. 1905: 303. 1905. *Grimmia dicksonii* (Dusén) Dusén, Ark. Bot. 6(10): 14. 1907, nom. nov., nom. illeg., non Turner, 1804. TYPE: Chile. Aisén: Patagonia, in vallis fluminis Aysén, 11 Feb. 1897, *Dusén s.n.* (lectotype, designated by Deguchi (1984), S-PA not seen; isolectotypes, FH 2 replicates).

Grimmia pachyphylla Dusén, Bot. Not. 1905: 302. 1905, nom. illeg., non Müll. Hal., 1885. TYPE: [Chile. Aisén:] Patagonia occ. in valle flumini Aysen, 11 Feb. 1897, *Dusén s.n.* (lectotype, here designated, H-BR).

Grimmia trichophylla var. *subincurva* H. Winter, Hedwigia 55: 101. 1914. TYPE: Portugal. Madeira: Levada de Gordon, May 1912, *Winter s.n.* (lectotype, here designated, JE).

Grimmia gusindei J. Froehl., Ann. Naturhist. Mus. Wien 59: 117. 1953. TYPE: [Chile. Magallanes:] Canal Beagle, *Gusinde 359* (lectotype, here designated, S).

Dioicous. Plants green to yellowish green. *Stems* erect, to 3 cm, with central strand. *Leaves* flexuous when dry, erect to spreading when moist, 1.5–3.0 × 0.4–0.7 mm, lanceolate, acuminate, keeled, not plicate; *margins* recurved proximally, to ½–⅔ the leaf length on one side and flat or more narrowly recurved proximally, to ⅓–½ the leaf length on the other side, occasionally both margins plane; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 1–2-stratose, 2-stratose at margins and in streaks in the distal ⅔; *distal cells* 7–12 μm long, isodiametric to rectangular, not bulging, walls sinuous; *proximal juxtacostal cells* 20–90 × 7–14 μm, rectangular (2–11 : 1), walls thin and straight to medium-thick and nodulose; *proximal marginal cells* 15–35 × 10–14 μm, rectangular (2–4 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hairpoints* terete, straight to flexuous, to 1.2 mm, smooth to denticulate. *Propagula* 35–60 μm diam., spherical to broad-ellipsoid, multicellular, sessile on the dorsal side of upper lamina, seldom on the costa, olive-green to brownish with brownish walls. *Perichaetial leaves* 2.0–2.7 × 0.6 mm, convolute proximally and prolonged in a very narrow acuminate distal half, larger than vegetative leaves (1.5 ×). *Androecia* terminal. *Setae* curved, 3–5 mm long. *Capsules* exserted, ellipsoid, symmetric, ribbed, stramineous, with stomata at the base; *exothecial cells* 20–50 × 15–30 μm, rectangular (2.0–3.5 : 1), thin-walled; *annulus* compound and revoluble, *af-*

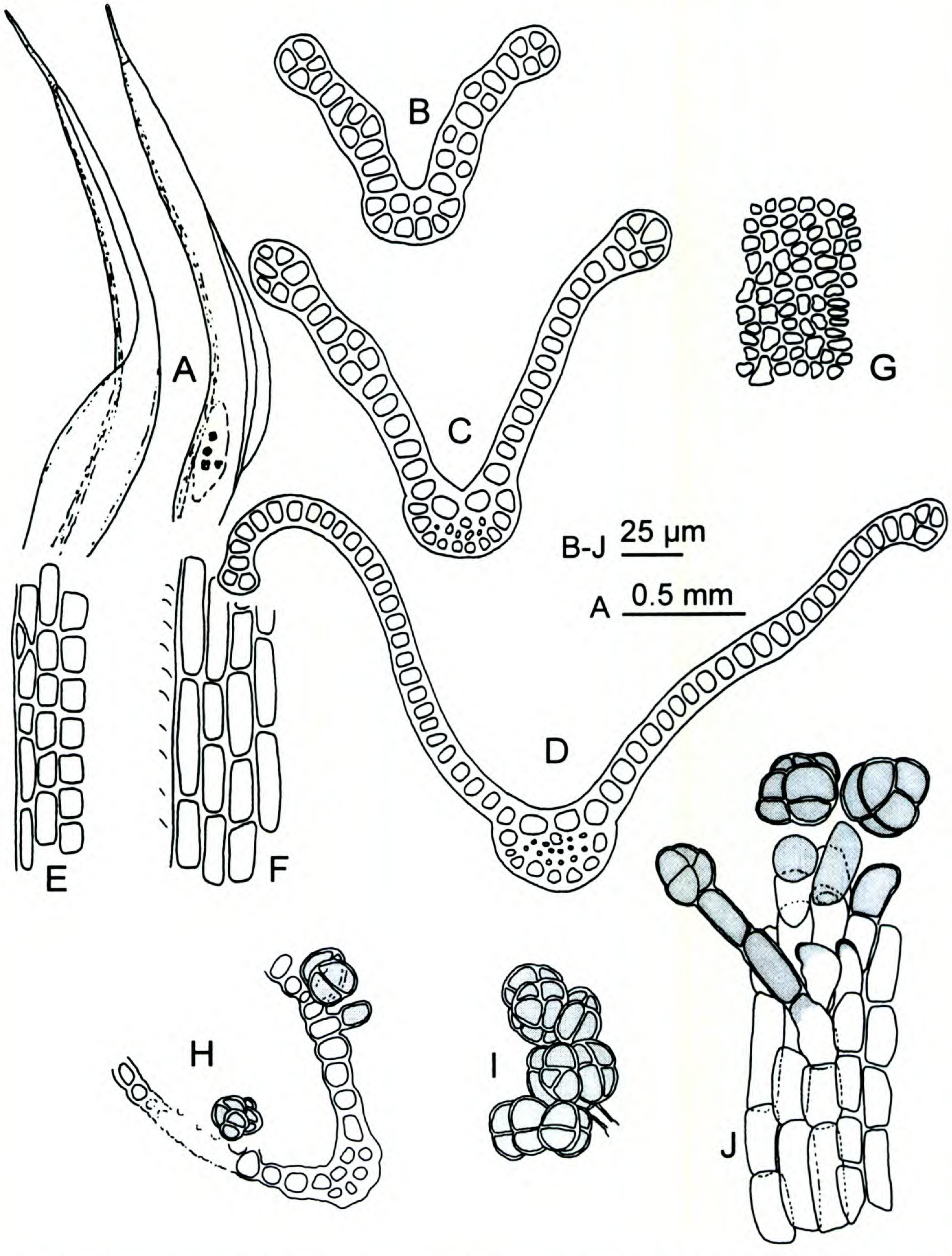

Figure 44. *Grimmia trichophylla.* —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E. Proximal marginal leaf cells. —F. Proximal juxtacostal leaf cells. —G. Distal leaf cells. —H. Transverse section at propaguliferous area. —I. Cluster of propagula. —J. Propaguliferous area showing hyaline, inflated cells and liberated propagula. (A–G, J: *Sharp 6058*, TENN; H, I: *Hatchmann s.n.*, NY.)

finis type; *peristome teeth* 55–70 µm wide at the mouth, irregularly cleft at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, orange, contrasting with the urn; *opercula* rostrate; *calyptrae* mitrate; *spores* 11–14 µm, minutely granulose.

Illustrations. Figure 44; Maier and Geissler

Figure 45. Distribution of *Grimmia trichophylla.*

(1995: abb. 28 a, c, g, but b and d–f, are most probably *G. lisae*); Petrov (1975: tab. 61 fig. 3); Smith (1978: fig. 152 1–6, 10–12, as var. *tenuis*; 13–15, as var. *subsquarrosa*; 16–19, as var. *stirtonii*).

Distribution (Fig. 45). Europe, Africa, temperate and tropical Asia, Australasia, northern and southern America; Mexico, Mesoamerica, Andean Range from Venezuela to Tierra del Fuego. On acid, seldom basic, dry rocks and trunk bases in open areas, paramos and forests between sea level in southernmost Patagonia and 5200 m elevation in Ecuador.

Plants of *G. trichophylla* have semi-terete costae with 2 cells in the ventral epidermis cross sections. Propagula are sessile on the lamina; the leaves are bistratose along the margins and in streaks, and are usually flexuous, yellowish and dull. Stems are erect, to 3 cm, and are generally shorter and more branched than those of related *G. austrofunalis*. For problematic specimens, features related to the propagula best identify the species. Propagula attributes appear stable, and only one specimen of *G. trichophylla* (Mexico, *Sharp et al. 1660b*, TENN) has been seen with two long, slightly branched filaments, but producing small propagula. The sequence of formation of the propagula in *G. trichophylla* is illustrated in Figure 44.

In *Grimmia trichophylla*, a patch of otherwise normal mature green cells of the lamina, with thick and nodulose walls, typically dedifferentiate, becoming hyaline, thin-walled, and inflated. Subsequently these laminar cells distally protrude (either ventrally or dorsally) outward from the lamina, forming a 1- or 2-celled brownish filament. Each cell of the filament divides several times to generate the propagula, a process initiating with the distalmost cell. Proximal cells of each filament, appearing in the first stages of development like a short stalk, also undergo consecutive perpendicular divisions and become part of the gemma, whereas the mother cell shrinks. The eventual collapse of all laminar cells originally involved in the gemmae development produces the degeneration and subsequent destruction of the leaf. Several propagula occasionally coalesce to form a bigger cluster, of the type seen in *G. austrofunalis*, but this is not common in *G. trichophylla*. In fact, typical small propagula are always abundant in these populations of *G. trichophylla* with only some larger, clustered propagula evident. This was first observed by Correns (1899: 108, fig. 63L), who recognized the differences in propagula morphology and development between *G. trichophylla* and *G. muehlenbeckii*.

I have studied several specimens from southern Chile that deviate markedly in leaf shape (e.g., *Barros 6856, 6957, 8629, 8652, Dusén 123, 366 p.p., 555*, and *Skottsberg 378*). These Chilean collections have widely ovate leaves, wider even than typical in *G. austrofunalis*, and developing distinct auricles. Nevertheless, these specimens bear small, sessile propagula on the lamina, and all other characters are consistent with typical *G. trichophylla*. These collections are maintained in *G. trichophylla* because specimens with similar characters are seen from other localities outside the range of *G. austrofunalis*.

Grimmia trichophylla has been confused with *G. austrofunalis* and *G. lisae*. Costae reniform in cross section, with 4 to 6 cells in the ventral layer, rapidly discriminate *G. lisae*. Specimens of *G. austrofunalis* and *G. trichophylla* are more difficult to distinguish. *Grimmia austrofunalis* is a larger plant, to 8 cm tall, with ascendent and scarcely branched stems; leaves are straight (or slightly flexuous at apices), strongly glossy, and with a reddish tinge. Leaves of *G. austrofunalis* usually have wider bases than those of typical *G. trichophylla* (but see prior discussion about Chilean anomalous specimens). Finally, leaves in *G. austrofunalis* are essentially unistratose. The best characters to separate both species remain the point of origin and morphology of the gemmae (Figs. 7, 8, 44).

Grimmia trichophylla is a problematic species for most bryologists. It often tends to be the specific assignment given to otherwise unnameable specimens. The identification to species of most *Grimmia*

can be confidently determined from sporophytic material. However, sporophytes are of little value in the *G. austrofunalis–G. trichophylla* pair, being identical in both taxa except for spore ornamentation. Additionally, the synonymy of several disparate taxa under *G. trichophylla* has contributed to its problematic status. Nevertheless, the removal of extraneous taxa such as *G. austrofunalis* and *G. lisae* minimizes variability within *G. trichophylla*. Granted the taxon is variable; however, if considered in the restricted sense of this paper, it probably does not vary more than other species in the genus, e.g., *G. longirostris* or *G. pilifera*.

Additional specimens examined. COSTA RICA. **Cartago**: El Guarco Cantón, Cordillera de Talamanca, páramo Buenavista, carretera interamericana km 85, *Dauphin 1690* (MO). GUATEMALA. **Quetzaltenango**: Getena area, N of Sija, *Sharp 2211* (TENN, FH). **San Marcos**: near summit of Tajamulco, *Sharp 5415* (TENN), *5421* (TENN), *5434* (TENN), *5439* (TENN), *5441* (TENN); upper slopes of Volcán Tacaná, *Steyermark 36091* (FH); mountains along the road between San Marcos and Serchil, *Standley 85410* (FH). **Totonicapán**: Región de Chiu Jolom, mountains above Totonicapán, on road to Desconsuelo, *Standley 84451* (FH, UC), *84462* (FH), *84474* (FH, UC). MEXICO. **Baja California**: Sierra de San Pedro Mártir, Cerro de la Encantada, *Sharp et al. 5660-B* (TENN), *5662* (TENN), *5664* (TENN), *6058* (TENN), *6073* (TENN); Guadalupe Island, Oct. 1896, *Anthony s.n.* (NY), *Palmer 113A* (MO). **Chiapas**: cima del Cerro Mozotal, 30 km NW de Motozintla, *Delgadillo 4779* (CAS). **Distrito Federal**: monte Alegre, 19 Feb. 1927, *Antipovitch s.n.* (PC). **Durango**: 9 mi. W of La Ciudad, *Bowers et al. 5061* (TENN), *Norris et al. 20896A* (UC). **Hidalgo**: National Park near Mineral del Chico, *Sharp et al. 81* (TENN), *95D* (TENN), *1686* (TENN). **Michoacán**: Cerro del Águila, 15 km N de Capácuaro, *Cárdenas S. 5502* (MO), *5981* (MO); about 1 mi. E of Las Penas on Hwy. 15, *Norris & Taranto 15642* (UC). **México**: 14 km E of San Pedro Nexapa, *Delgadillo 1148* (TENN), *1151* (TENN); Desierto de Los Leones near México City, *Sharp 72A* (TENN); Ixtapaluca, lado S del Cerro del Telapón, *Flores 308* (ALTA); Mt. Ixtaccíhuatl, *Kiener 18518A* (FH); Popocatépetl, *Hermann 20796* (TENN), *Hermann 20822* (TENN), *Horton 7457* (TENN), *Sharp 4761* (TENN); NW slopes of Nevado de Toluca, *Pócs 9550/J* (MO), *Sharp et al. 1334* (TENN), *Sharp et al. 1335* (TENN), *Sharp et al. 1341A* (TENN); Zinacantepec, Raíces, *Rzedowski 27260* (TENN, UC); above Río Frío, *Sharp et al. 1660C* (TENN), *Mexía 2702* (UC). **Oaxaca**: along route 175, Sierra Juárez, 20 mi. N of Ixtlán, *Hermann 26223* (TENN). **Puebla**: along route 119, 15 mi. S of Chignahuapan, *Hermann 26444* (TENN); below las cuevas de Ixtaccíhuatl above Huejotzingo, *Sharp 4296* (TENN), *Sharp 4296A* (TENN), *Sharp 4306* (TENN); near Tlamacas, *Delgadillo 1165* (TENN). **Veracruz**: in summo Pic d'Orizaba, *Liebmann s.n.* (PC); Xalapa, *Bonpland s.n.* (PC); La Muñeca, above Perote, *Sharp 3656* (TENN); Cofre de Perote, 2 Oct. 1984, *García s.n.* (ALTA), *Iltis et al. 891* (TENN), *892* (TENN), *893* (TENN), *897* (TENN), *Sharp et al. S6AB* (TENN). **Zacatecas**: Cerro de la Bufa, 9 June 1979, *Cárdenas 343* (ALTA). PANAMA. **Chiriquí**: at summit of volcán Barú, *Allen 9093* (MO).

ARGENTINA. **Chubut**: Vallée 16 Oct., *Skottsberg 378* (BM, PC). **Río Negro**: Parque Nacional Argentino Nahuel Huapi, Puerto Guerrero, Isla Victoria, *Donat 77* (JE, PC), *78* (JE); San Carlos de Bariloche, *Donat 166* (JE); Nauelhuapí, *Dusén 717* (FH). **Santa Cruz**: Lago San Martín, *Skottsberg 380* (UPS). **Tucumán**: Cumbre de Cauhagui, Cuesta de las Cañas, Ostseite, June 1920, *Kühn s.n.* (BM). BOLIVIA. **La Paz**: prov. Larecaja, Nevado Jankho Uma, *Lewis 79-1546* (F, IBA); prov. Loayza, río Atoroma Chuma (Meta Camp), 11 km SE of Viloco, *Lewis 87-1812* (MO). CHILE. **Aisén**: río Aisén, *Dusén 502* (NY, PC), *555* (FH). **Bío-Bío**: Antuco, *Barros 6870* (FH); Chillán, Bureo, *Barros 6858* (FH), *8629* (FH), *8652* (FH); Calbuco, O. Küste, *Schwabe 114* (FH, PC); Coquimbo, 1838, *Gay s.n.* (PC); Los Ángeles, *Dusén 347* (JE, NY, PC), *366A* (FH, JE, NY, PC). **La Araucanía**: Malleco, Angol, El Vergel, *Hosseus 766* (JE); La Ermita, Los Condes, 60 km de Santiago, *Jaffuel 152* (PC); Cautín, Dept. Villarrica, Pucón, *Hosseus 407A* (JE); Villarrica, *Barros 6856* (FH). **Libertador General Bernardo O'Higgins**: Colchagua, Baños de Cauquenes, *Dusén 143* (PC), *145* (FH, JE, NY), *149* (FH, JE, NY), *151* (NY). **Los Lagos**: lago Pillaifa, río Llancahue, *Schawbe 10* (JE); Calbuco, *Schawbe 114* (JE); Chiloé, Dep. Llanquihué, Puerto Varas, in der Nähe des río Maullín, *Hosseus 294A* (JE); Valdivia, Dep. Corral, Amargos, *Hosseus 567* (JE), *589* (JE), *590A* (JE); Los Perales, Sep. 1919, *Bertho s.n.* (FH); Los Perales, Sep. 1923, *Bertho s.n.* (FH); Marga-Marga, 1916, *Costes s.n.* (BM); San José de la Mariquina, *Barros 6957* (FH). **Magallanes**: Jan. 1897, *Dusén s.n.* (BM). **Maule**: Linares, E of Linares along river Atchibuena, *Taylor & Gereau 11044* (FH). **Ñuble**: San Fabián ca. 60 km E of San Carlos, *Landrum 1504B* (NY); Panguipulli, *Hollermayer 72* (NY, PC); Recinto, 20 Apr. 1929, *Roivainen s.n.* (H). **Región Metropolitana**: Linares, Bullileo ca. 50 km E of Parral, *Landrum 1525A* (NY), *1526* (NY), *1528* (NY), *1538* (NY); Santa Lucia, *Schwabe 17B* (PC, JE). **Valparaíso**: Estero Marga Marga, *Schwabe 102/B* (JE); El Salto prope Valparaíso urbem, *Dusén 123* (NY); Alto del Puerto, *Santesson M150* (FH). COLOMBIA. **Antioquia**: Urrao, Páramo de Frontino, ca. 17 km directamente N de Urrao, *Churchill 13329* (MO). **Caldas**: Villamaría, carretera Manizales–Bogotá, sobre la carretera que conduce al Nevado del Ruiz (km 213), *Churchill et al. 16307* (IBA). ECUADOR. Avenida volcanica del Cotopaxi, *Espinosa 19* (JE). **Imbabura**: E side of Cerro Cotacachi, NW of Cotacachi, *Lewis 78-2705* (F), *78-2769* (F, UBC); E side of Cerro Imbabura above La Esperanza, ENE of Otavalo, *Lewis 78-2917* (F), *78-2918* (F), *78-2981* (F). **Pichincha**: second camp on Chimborazo, *Bell 153* (FH), *Whymper 1347* (BM). PERU. **Ancash**: Huari, zwischen Tunnel Cahuish und Chavin, Quebrada Pucavado, *Hegewald & Hegewald 7729* (MO). **Arequipa**: Arequipa, am Weg nach Puno, *Hegewald & Hegewald 5467* (MO), *5479* (MO). VENEZUELA. **Barinas**: distr. Urdaneta, páramo de La Estrella, *Griffin III et al. 1400* (FLAS). **Mérida**: páramo de Piñango, *Griffin III & Díaz M. PV-21* (FLAS); páramo de Los Conejos, *Griffin III & López F. PV-543* (FLAS); distr. Libertador, páramo de Don Pedro, *Ruiz-Terán & López-Palacios 8695* (FLAS); distr. Rangel, páramo de Mucubají, *Vareschi 8872* (FLAS), *8874* (FLAS). **Trujillo**: Ribas, páramo de la Teta de Niquitao, *Ruiz-Terán & López-Palacios 7525* (FLAS).

30. Grimmia trinervis R. S. Williams, Bull. New York Bot. Gard. 3: 124. 1903. *Coscinodon trinervis* (R. S. Williams) Broth., in Herzog, Bibl. Bot. 87: 52. 1916. TYPE: Peru. Juliaca, *Williams 2814* (holotype, NY; isotype, F).

Dioicous. Plants glaucous or dark green to blackish. *Stems* erect, to 1 cm, with central strand. *Leaves* erect and appressed when dry, erect to patent when moist, 0.8–1.4 × 0.3–0.5 mm, obovate base suddenly narrowed into an acuminate apical part, acute, keeled, plicate; *margins* plane in the proximal half, incurved in the distal half and cucullate at tip; *costa* semi-terete, differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2-stratose in the distal ⅔; *distal cells* 6–14 μm long, isodiametric to rectangular, not bulging, walls straight to slightly sinuous; *proximal juxtacostal cells* 15–50 × 10–15 μm, rectangular, seldom isodiametric ([1]2–5 : 1), walls thin and straight to medium-thick and somewhat sinuous; *proximal marginal cells* 15–40 × 9–15 μm, isodiametric to rectangular (1–3 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 1.3 mm, smooth. *Perichaetial leaves* 1.8–2.2 × 0.8–1.2 mm, convolute, hyaline and filmy, scarcely discernible, larger than vegetative leaves (3–5 : 1). *Androecia* terminal. *Setae* curved to coiled, 0.9–1.5 mm long. *Capsules* immersed, ovoid to subglobose, ventricose, smooth, stramineous, with stomata at the base; *exothecial cells* 25–60 × 24–30 μm, rectangular (1.5–2.5 : 1), thin-walled; *annulus* compound and tardily deciduous, *elongata* type; *peristome teeth* lacking; *opercula* conic; *calyptrae* mitrate; *spores* 10–12 μm, minutely granulose.

Illustrations. Figure 46; Deguchi (1987: pl. 15); Hastings (1996: figs. 1–10).

Distribution (Fig. 29). Southern America. *Grimmia trinervis* is known to date from northwestern Bolivia and southeastern Peru. It grows on dry sandstone and basalt cliffs in open puna areas and in forests of *Polylepis racemosa* between 3850 and 5100 m elevation.

Grimmia trinervis has strongly plicate leaves and gymnostomous capsules immersed and ventricose on a curved seta. Sterile specimens cannot be separated with confidence from species of *Coscinodon*, despite Hastings's (1996) work on South American *Coscinodon.*

Grimmia trinervis was transferred to *Coscinodon* by Brotherus (in Herzog, 1916: 52), a placement followed later by Churchill (1981) and recently by Hastings (1996). Hastings discussed at length the generic placement of *Grimmia trinervis*, concluding that *G. trinervis* should be within *Coscinodon* based on: (1) gametophytic similarities between *Coscinodon cribrosus* (Brid.) Jur. and *G. trinervis*, as no member of *Grimmia* subg. *Grimmia* has plicate leaves; (2) capsule/seta length ratios being smaller in *G. trinervis* than in natural members of *Grimmia* subg. *Grimmia*; (3) the length of the seta cells, isodiametric in *Grimmia anodon* and *G. plagiopodia* (members of *Grimmia* subg. *Grimmia*), but rectangular in *G. trinervis*, *Coscinodon pseudocribosus* Hastings, and *C. calyptratus* (Drumm.) Kindb.; (4) setae in *G. trinervis* sometimes longer than expected for a member of *Grimmia* subg. *Grimmia.* Furthermore, Hastings found these setae to be "considerably different than that found in the *Gasterogrimmia*" (1996: 421–422). (5) Finally, the dioicous nature of *G. trinervis* was significant for this author, because all other members of *Grimmia* subg. *Grimmia* are autoicous.

However, none of the aforementioned characters are generically reliable for *Coscinodon*: all of them show parallel unreliable variation in both *Grimmia* and *Coscinodon.*

(1) *Plication of leaves. Grimmia caespiticia* (Brid.) Jur. shares similar leaf morphology and areolation with *Coscinodon cribrosus.* When sterile these two species may be impossible to separate (Muñoz, 1998d). In contrast, the leaves of *Coscinodon calyptratus* are nonplicate. Plication occurs in both genera and is not a diagnostic character at the generic level.

(2) *Capsule/seta length ratio. Coscinodon calyptratus* has long setae, resulting in emergent to exserted capsules. At the other extreme is *C. cribrosus*, with short setae and immersed capsules. The same situation can be found in *Grimmia. Grimmia* species may typically have exserted capsules, such as *G. ovalis.* Conversely, species such as *G. pseudoanodon* display immersed capsules. An extreme example that seta lengths are variable and generically uninformative is *G. longirostris* Hook., with capsules ranging from immersed to longly exserted (Muñoz, 1998c).

(3) *Length of seta cells.* This character strongly correlates with capsule/seta length. In general, the longer the seta cells, the longer the setae will be. The same can also be observed in relation to leaf length. Leaves with longer acumina usually have longer laminal cells.

(4) *Seta length.* Hastings (1996) referred *Grimmia anodon* and *G. plagiopodia* to his "*Gasterogrimmia,*" both species with short setae. Within *Grimmia* subg. *Grimmia*, seta length in *G. crinita* Brid. and *G. pitardii* Corb. ranges from 0.6 to 1.1 mm and capsule length ranges from 0.7 to 1.1 mm, with these values exceeding Hastings's observations. Capsule/seta length ratio for subgenus *Grimmia* varies much more than Hastings observed. *Grimmia trinervis* capsule/seta ratio (1 : 1) falls within the range of variation for subgenus *Grimmia.*

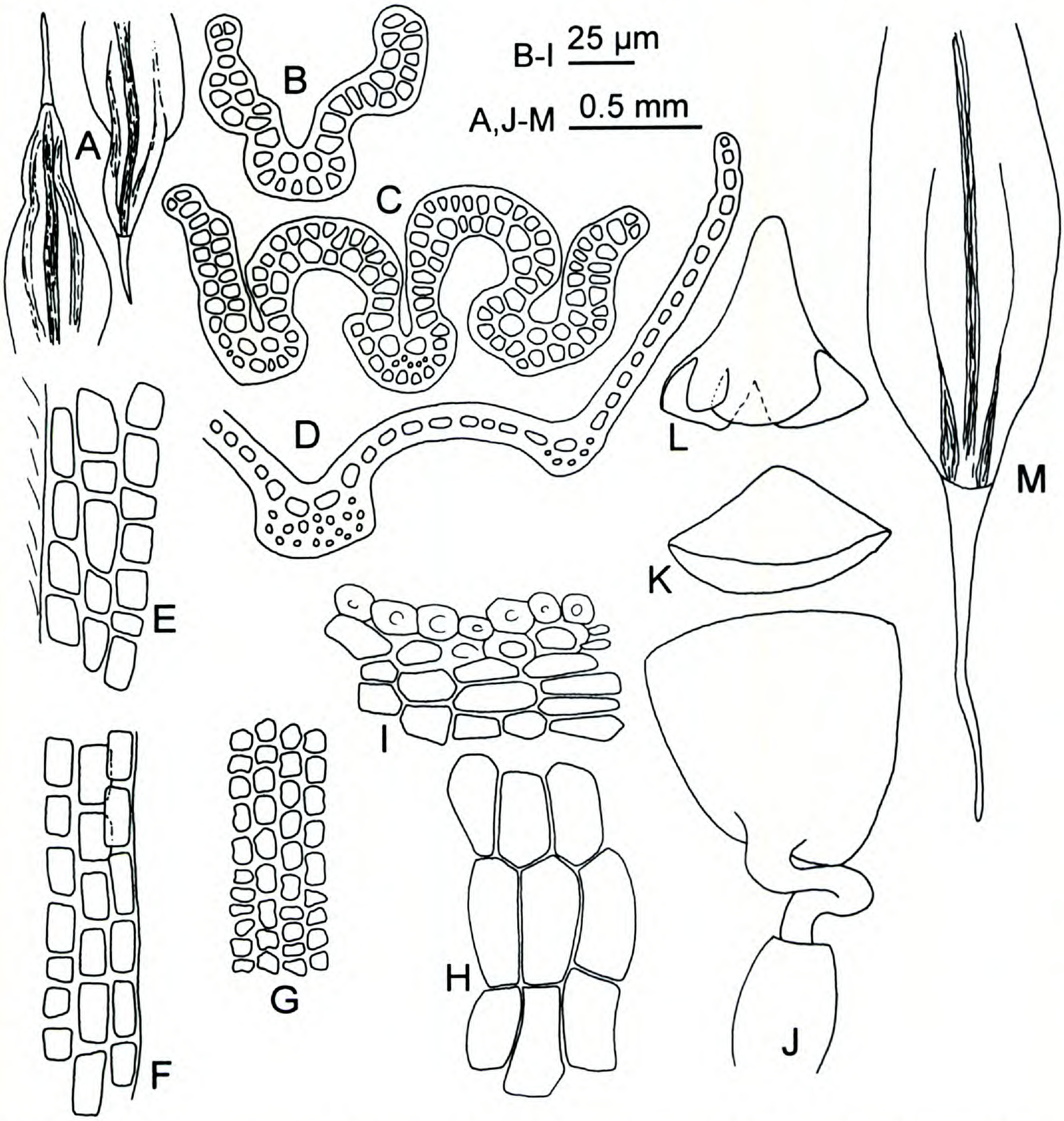

Figure 46. *Grimmia trinervis*. —A. Leaves. —B–D. Transverse sections at distal, medial, and proximal parts of leaf. —E. Proximal juxtacostal leaf cells. —F. Proximal marginal leaf cells. —G. Distal leaf cells. —H. Medial exothecial cells. —I. Capsule mouth and annulus. —J. Deoperculate sporophyte. —K. Operculum. —L. Calyptra. —M. Perichaetial leaf. (A, E–M: *Williams 2814*, NY; B–D: *Lewis 79–2073A*, MO.)

Both *G. crinita* and *G. pitardii* have seta cells rectangular (20–45 × 10–15 µm, ratio 2–3 : 1), with these being three times longer than reported by Hastings (1996: 421), even exceeding his report for *G. trinervis*.

(5) *Sexual condition*. Sexuality in *Coscinodon* and *Grimmia* cannot be used to decide generic placements. *Coscinodon calyptratus* is autoicous (Muñoz, 1998b) whereas the rest of the genus, with 5 to 7 species, is dioicous. In *Grimmia*, about 40% of the species are autoicous, with no apparent pattern to the distribution of sexual condition among subgenera.

In summary, the five characters considered by Hastings supporting the inclusion of *G. trinervis* in *Coscinodon* are widely variable within both genera *Grimmia* and *Coscinodon* and are systematically useless for defining these genera.

In marked contrast, *G. trinervis* does share with other members of *Grimmia* subg. *Grimmia* four character states strongly supporting its inclusion within this subgenus: (1) the setae are short and

curved or even coiled; (2) these setae attach asymmetrically to the capsules; (3) the capsules are ventricose; and (4) the calyptrae are smooth, not plicate, and extend only to the capsule mouth. Deguchi (1987: 32–33) also suggested the lack of peristome teeth as a character to retain this species in *Grimmia* subg. *Grimmia*. However, this character is shared with *Coscinodon arctolimnius* and other species among other taxa of Grimmiaceae, such as *Schistidium flaccidum* (De Not.) Ochyra.

Additional specimens examined. BOLIVIA. Huaillattenisee, *Herzog 2971* (H-BR). **Cochabamba**: prov. Tapacari, 3 km N of Challa, *Lewis 83-3938* (F, IBA). **La Paz**: prov. Aroma, 1 km S of Villa Santa Cruz, *Lewis 86-2115* (F, IBA); prov. Camacho, W of Escoma, N side of Lago Titicaca, *Lewis 79-778* (IBA, MO); Chacaltaya, Mar. 1908, *Buchtien s.n.* (PC). **Oruro**: Sajama, Cerro Kohuiri Tarak, W of Nevado Sajama, *Lewis 79-2073A* (MO). **Potosí**: prov. Bustillos, 3 km SE of Uncia, *Lewis 84-1587* (F, IBA); prov. Quijarro, cerro Purgatorio Mundo, *Lewis 79-371* (F). PERU. **Ancash**: Huaraz, Monterrey, *Hegewald & Hegewald 7483* (MO). **Arequipa**: Arequipa, laguna Las Salinas, *Hegewald & Hegewald 5483* (MO); Juliaca, *Rose 19091A* (NY). **La Libertad**: Otuzco, Huancamarca, Quebrada Hornillo, *Hegewald & Hegewald 5158* (MO). **Puno**: prov. Azángaro, Jarjani, about 7 km SW of Asillo, *Deguchi 29943* (HIRO), *29952* (HIRO), *29962* (HIRO); prov. Lampa, Cara Cara, near Pucará, *Deguchi 29871* (HIRO), *29872* (HIRO), *26879* (HIRO); prov. Melgar, 7 km W of La Raya Pass, *Hegewald & Hegewald 5512* (MO), *5526* (MO); prov. Puno, around laguna Umayo, *Deguchi 29848* (HIRO), *29851* (HIRO).

31. Grimmia ungeri Jur., in Unger & Kotschy, Ins. Cypern: 169. 1865. TYPE: Cyprus. In Olimpo Cypri, vere 1862, *Unger s.n.* (lectotype, designated by Muñoz (1998d), BM; isolectotype, BM 2 replicates, GOET 2 replicates, H-SOL, S).

For a list of synonyms, see Muñoz (1998d).

Cladautoicous. Plants olive-green to blackish. *Stems* erect, to 1.5 cm, central strand weakly developed. *Leaves* erect and appressed when dry, patent when moist, 1.0–1.7 × 0.3–0.5 mm, ovate, acute, weakly keened, not plicate; *margins* plane proximally and incurved distally; *costa* semi-terete, slightly to clearly differentiated, ventral epidermis 2 cells wide in cross section; *lamina* 2–3(4)-stratose in the distal ⅔; *distal cells* 5–7 μm long, isodiametric, not bulging or bulging weakly on dorsal surface, walls straight to slightly sinuous; *proximal juxtacostal cells* 20–35 × ca. 16 μm, isodiametric to rectangular (1–3 : 1), walls medium-thick and straight; *proximal marginal cells* 10–25 × 6–10 μm, isodiametric to rectangular (1–2 : 1), the transverse walls thicker than the longitudinal walls; *hyaline hair-points* terete, straight, to 1.5 mm, entire. *Perichaetial leaves* 1.5–2.5 × 0.5–0.9 mm, convolute and larger than vegetative leaves (2–3 ×). *Androecia* terminal. *Setae* erect and straight, to 2 mm long. *Capsules* exserted, ovoid or ellipsoid, symmetric, smooth, castaneous, lacking stomata; *exothecial cells* 17–65 × 13–45 μm, rectangular (1.5–3 : 1), thin-walled; *annulus* simple and persistent, *Schistidium* type; *peristome teeth* 40–50 μm wide at the mouth, entire or moderately cribrose at apex, external surface nearly smooth proximally and papillose distally, internal surface papillose throughout, castaneous, concolorous with the urn; *opercula* conical to rostellate; *calyptrae* cucullate; *spores* 9–13 μm, minutely granulose.

Illustrations. Figure 47; Muñoz (1998d: fig. 18).

Distribution (Fig. 36). Europe, Macaronesia, northern America; Mexico. *Grimmia ungeri* is common along the west coast of North America, becoming rarer to the south (Muñoz, 1998d). In Mexico it is known from scattered localities, but further exploration may fill in the gaps in its known distribution. It grows on igneous rocks between 1500 and 4000 m elevation.

Grimmia ungeri is the only species in the genus combining autoicous sexuality with the absence of stomata in the capsules. In spite of this clear definition, its differentiation from *G. montana* can be impossible in poor or sterile material. Both taxa have keeled, 2 to 3(4)-stratose leaves, erect setae, and capsules lacking stomata. *Grimmia ungeri* has conical to rostellate opercula, and is autoicous. *Grimmia montana* has rostrate opercula and is dioicous. The latter usually has longer proximal juxtacostal cells, but the length of the juxtacostal cells appears intermediate in some collections, so the likelihood of misidentifications using this character alone is great.

Additional specimens examined. MEXICO. **Baja California**: Las Cuevitas, Sierra Juárez, ca. 10 mi. S of Laguna Hanson, *Wiggins 9177* (FH). **México**: Mt. Popocatépetl, *Kiener 18590* (F, FH), *18591* (FH).

Taxa Excluded from *Grimmia*

The following taxa have been described or included in Grimmia, but they pertain to other genera.

Grimmia abscondita Cardot, Wiss. Erg. Schwed. Südpolar-Exp. 4(8): 107, fig. 19. 1908. *Schistidium absconditum* (Cardot) Ochyra, Fragm. Florist. Geobot. 43: 104. 1998. TYPE: [Chile. Magallanes:] lac San Martin, Río Fósiles, *Du-*

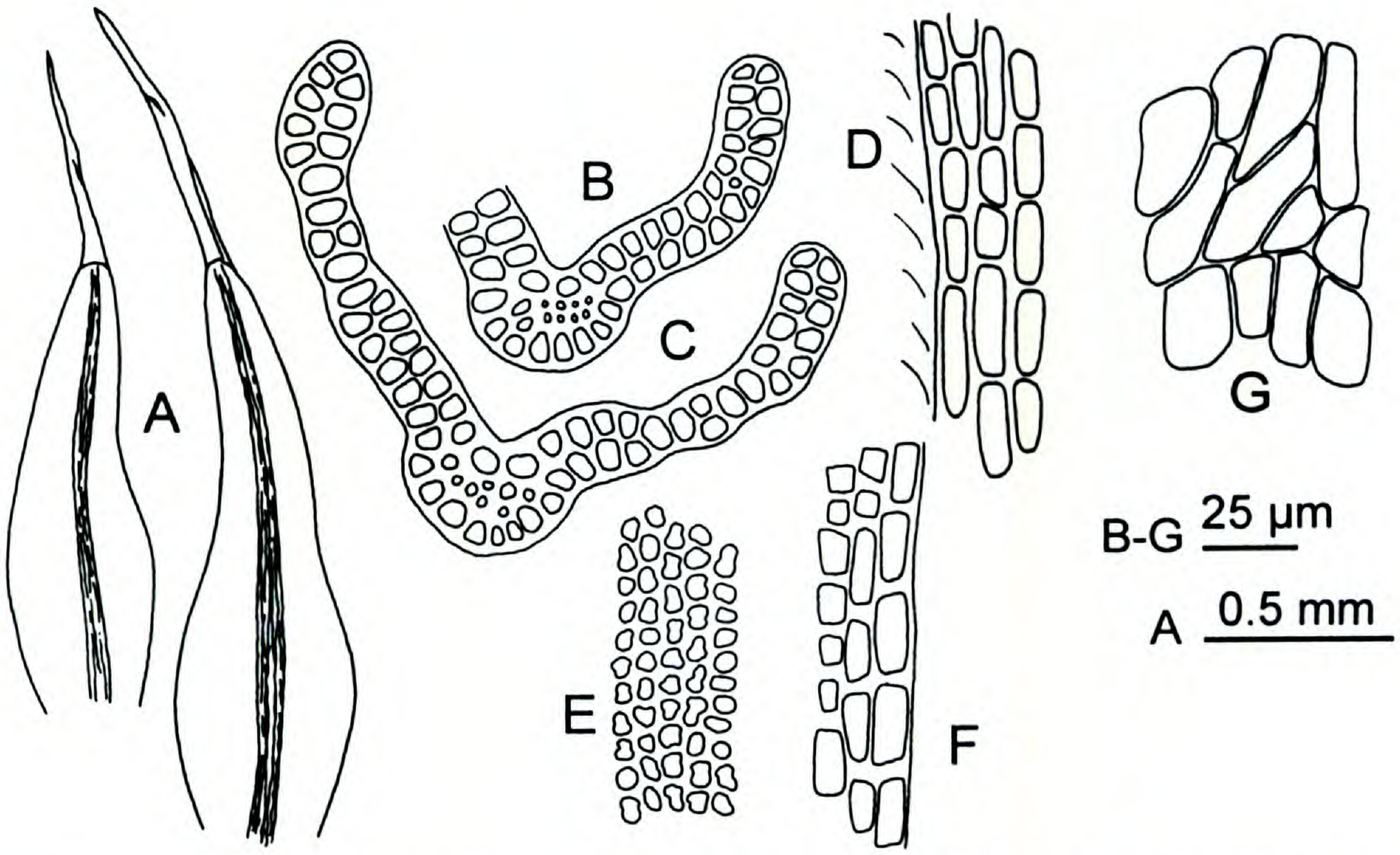

Figure 47. *Grimmia ungeri.*—A. Leaves. —B, C. Transverse sections at medial and proximal parts of leaf. —D. Proximal juxtacostal leaf cells. —E. Distal leaf cells. —F. Proximal marginal leaf cells. —G. Medial exothecial cells. (*Kiener 18590*, FH.)

sén 5944 (type, PC not seen). This taxon belongs in *Schistidium.*

Grimmia amblyophylla Müll. Hal., Syn. Musc. Frond. 1: 779. 1849. *Schistidium amblyophyllum* (Müll. Hal.) Ochyra & Hertel, Polish Bot. Stud. 1: 26. 1990. TYPE: [Chile. Magallanes:] Hermite Island, Cap Horn, *Hooker 122* (lectotype, designated by Ochyra & Hertel (1990), BM; isolectotypes, NY 2 replicates). This taxon belongs in *Schistidium.*

Grimmia austroleucophaea Besch., Bull. Soc. Bot. France 32: LIV–LXIX. 1885. *Guembelia austroleucophaea* (Besch.) Müll. Hal., in Paris, Index Bryol. 2: 540. 1895. *Willia austroleucophaea* (Besch.) Broth., Nat. Pflanzenfam. 3(1): 453. 1902. TYPE: "Terre de Feu, île Horn" *Hariot 157* (type, BM? not seen). This taxon belongs in *Willia* Broth. (Pottiaceae).

Grimmia calycina Herzog, Beih. Bot. Centralbl. 27: 354. 1910. *Schistidium calycinum* (Herzog) Ochyra, Fragm. Florist. Geobot. 43: 105. 1998. TYPE: Bolivia. Chacaltaya, 1908, *Buchtien s.n.* (isotype, S not seen). This taxon belongs in *Schistidium.*

Grimmia chubutensis Cardot & Broth., Kongl. Svenska Vetenskapsakad. Handl. 63(10): 26, tab. 2 fig. 6. 1923. *Schistidium chubutense* (Cardot & Broth.) Ochyra, Fragm. Florist. Geobot. 43: 105. 1998. TYPE: Argentina. Chubut, Valle Diez-y-seis de Octubre, *Skottsberg 439* (isotypes, H-BR, UPS). This taxon belongs in *Schistidium.*

Grimmia donatii Herzog & Thér., Repert. Spec. Nov. Regni Veg. 41: 290, tab. 236 e–n. 1937. *Schistidium donatii* (Herzog & Thér.) Ochyra & Matteri, Fragm. Florist. Geobot: 1008. 1996. TYPE: [Chile.] Aisén, Ventisquero, *Donat 48* (holotype, JE; isotype, JE). This taxon belongs in *Schistidium.*

Grimmia fallax Dusén, Rep. Princeton Univ. Exped. Patagonia 8: 77, fig. 7, pl. 8, figs. 5, 6. 1903. *Schistidium fallax* (Dusén) Ochyra & Matteri, Fragm. Florist. Geobot: 1008. 1996. TYPE: "Princeton Scientific Expedition to Patagonia 1896–1897." [Chile. Magallanes:] South Patagonia, *Hatcher s.n.* (holotype, S not seen; isotype, NY). This taxon belongs in *Schistidium.*

Grimmia fasciculata Dusén, Bot. Not. 1905: 302. 1905, nom. illeg., non Brid., 1819. TYPE: (lectotype, designated by Ochyra & Bell (1984), S not seen; isolectotype, UPS not seen). This taxon belongs in *Schistidium falcatum* (Hook.f. & Wilson) B. Bremer.

Grimmia julacea R. S. Williams, Bull. New York Bot. Gard. 6: 260. 1910, nom. illeg., non F. Weber & D. Mohr, 1803. *Grimmia williamsii* Deguchi, Studies on Cryptogams in Southern Peru: 33. 1987. TYPE: [Peru.] Arequipa, *Williams 2805* (holotype, NY; isotypes, F, JE 2

replicates). This name is a synonym of *Jaffueliobryum wrightii* (Sull.) Thér.

Guembelia lorentziana Müll. Hal., Linnaea 43: 450. 1882. *Grimmia lorentzi* (Müll. Hal.) Kindb., Enum. Bryin. Exot., Suppl. 1: 91. 1889. *Grimmia lorentziana* (Müll. Hal.) Paris, Index Bryol. 2: 529. 1895. *Schistidium lorentzianum* (Müll. Hal.) Ochyra & Matteri, Fragm. Florist. Geobot: 1008. 1996. TYPE: Argentina. Tafi, *Lorentz s.n.* (lectotype, designated by Ochyra & Matteri (1996), JE; isolectotype, BM). This taxon belongs in *Schistidium.*

Grimmia macrotyla Cardot & Broth., Kongl. Svenska Vetenskapsakad. Handl. 63(10): 26, tab. 2, fig. 5. 1923. *Schistidium macrotylum* (Cardot & Broth.) Ochyra, Fragm. Florist. Geobot. 43: 106. 1998. TYPE: [Argentina.] Chubut: meseta Chalia, *Skottsberg 382* (isotypes, H-BR, UPS). This taxon belongs in *Schistidium.*

Grimmia olivacea Herzog, Biblioth. Bot. 87: 56, fig. 18g–m. 1916. TYPE: Bolivia. Im oberen Chocayatal, *Herzog 3587* (isotypes, JE, PC). This taxon belongs in *Schistidium.*

Grimmia perplexa Thér., Revista Chilena Hist. Nat. 27: 11, Lám. 2. 1923. *Schistidium perplexum* (Thér.) Ochyra, Fragm. Florist. Geobot. 43: 106. 1998. TYPE: Chile. La Ermita (Las Condes), Oct. 1919, *Bertho s.n.* (isotypes, FH 2 replicates). This taxon belongs in *Schistidium.*

Guembelia praemorsa Müll. Hal., Linnaea 43: 452. 1882. *Grimmia praemorsa* (Müll. Hal.) Kindb., Enum. Bryin. Exot., Suppl. 1: 91. 1889. TYPE: Argentina. Catamarca: Yakutula, in Vayas altas [sic], convallis altas Grandillas [sic], Feb. 1872, *Lorentz s.n.* (isotypes, BM, JE). This taxon belongs in *Schistidium.*

Grimmia rivulariopsis R. S. Williams, Bull. Torrey Bot. Club 43: 327, pl. 19. 1916. *Schistidium rivulariopsis* (R. S. Williams) Ochyra, Fragm. Florist. Geobot. 43: 106. 1998. TYPE: Peru. Ollantaytambo, *Cook & Gilbert 753* (lectotype, designated by Deguchi (1987), NY; isolectotype, F). This name is a synonym of *Schistidium rivulare* (Brid.) Podp.

Grimmia saxatilis Mitt., J. Linn. Soc., Bot. 12: 97. 1869. *Schistidium saxatile* (Mitt.) Ochyra, Fragm. Florist. Geobot. 43: 106. 1998. TYPE: [Ecuador.] Chimborazo, *Spruce 132* (lectotype, designated by Bremer (1980), NY; isolectotype, FH). This taxon belongs in *Schistidium.*

Grimmia scabripes E. B. Bartram, Farlowia 2: 310. 1946. *Schistidium scabripes* (E. B. Bartram) Deguchi, in Inoue, Studies on Cryptogams in Southern Chile: 27. 1984. TYPE: Chile. Ñuble: Recinto, Las Trancas, *Roivainen 1003* (holotype, FH). This name is now *Schistidium scabripes* (E. B. Bartram) Deguchi.

Grimmia squamatula Herzog, Biblioth. Bot. 87: 56, fig. 18a–f. 1916. TYPE: Bolivia. Yanakakabastion, July 1911, *Herzog s.n.* (lectotype, here designated, JE). This taxon belongs in *Schistidium.*

Grimmia yaulensis Broth., Bot. Jahrb. Syst. 56(2), Beibl. 123: 11. 1920. TYPE: Peru. An der Lima-Oroya-Bahn, Hacienda Arana bei Yauli, *Weberbauer 373 ex p.* (lectotype, here designated, H-BR; isolectotype, PC 2 replicates). This taxon belongs in *Schistidium.*

Taxa for Which Type Specimens Have Not Been Located

Grimmia depressa Müll. Hal., Flora 68: 421. 1885. TYPE: "Fuegia, Staten Island, Port Cook, ad truncos putridos in sylvis, Martio 1882. Fuegia australis, Burnst Island, ad ramos Chilostrii amelloidis in sylvis, Majo 1882: Spegazzini."

Grimmia depressa var. *terrestris* Müll. Hal., Flora 68: 421. 1885. TYPE: "Beagle Channel, in sinu Fandagaia, ad glaream orae maritimae, Majo 1882: Spegazzini."

Although none of the consulted herbaria house type specimens of these two names, they might belong in *Racomitrium,* according to the protologue ("*. . . dentibus densis angustis in crura duo adglutinata asperula lutescentia usque fere ad basin fissis*").

Nomina Nuda

Grimmia anodon var. *mutica* Broth. ex Paris, Index Bryol. ed. 2, 2: 263. 1904 (= *G. poecilostoma*).

Grimmia biplicata Broth., in H. J. A. Mey., In den Hoch-Anden von Ecuador: 518. 1907 (= *G. navicularis*).

Grimmia flexiseta Dusén, Rep. Princeton Univ. Exped. Patagonia 8: 122. 1903 (= *G. trichophylla*).

Grimmia flexiseta Schimp. ex Jard., Bull. Soc. Linn. Normandie, sér. 2, 9: 263, 264. 1875 (= *G. lisae*).

Grimmia meridensis Vareschi, Flora de los Páramos de Venezuela: 87. 1970 (= *G. longirostris*).

Grimmia nivalis Liebm. ex Besch., Mexic. pl. 1: 19. 1872 (= *G. donniana*).

Grimmia ovata f. *dioica* Cardot, in Pringle, Plantae mexicanae n° 10539 (= *G. longirostris*).

Grimmia pycnophylla Dusén, Rep. Princeton Univ. Exped. Patagonia 8: 122. 1903 (= *G. trichophylla*).

Grimmia paramophila Broth., in H. J. A. Mey., In den Hoch-Anden von Ecuador: 518. 1907 (= *G. navicularis*).

Grimmia sardoa var. *robusta* M. Fleisch. & Warnst., Bryotheca meridionalis n° 342. *Grimmia trichophylla* f. *robusta* (M. Fleisch. & Warnst.) Podp., Consp. Musc. Eur. 288. 1954, nom. inval. (= *G. lisae*).

Grimmia serripila Dusén ex Paris, Index Bryol. ed. 2: 287. 1904 (= *G. laevigata*).

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List of Species

1. *Grimmia americana* E. B. Bartram
2. *Grimmia anodon* Bruch & Schimp.
3. *Grimmia atrata* Hornsch.
4. *Grimmia austrofunalis* Müll. Hal.
5. *Grimmia bicolor* Herzog
6. *Grimmia donniana* Sm.
7. *Grimmia elongata* Kaulf.
8. *Grimmia fuscolutea* Hook.
9. *Grimmia humilis* Mitt.
10. *Grimmia involucrata* Cardot
11. *Grimmia kidderi* James
12. *Grimmia laevigata* (Brid.) Brid.
13. *Grimmia lisae* De Not.
14. *Grimmia longirostris* Hook.
15. *Grimmia molesta* J. Muñoz
16. *Grimmia montana* Bruch & Schimp.
17. *Grimmia navicularis* Herzog
18. *Grimmia ochyriana* J. Muñoz
19. *Grimmia ovalis* (Hedw.) Lindb.
20. *Grimmia pilifera* P. Beauv.
21. *Grimmia plagiopodia* Hedw.
22. *Grimmia poecilostoma* Cardot
23. *Grimmia pseudoanodon* Deguchi
24. *Grimmia pulla* Cardot
25. *Grimmia pulvinata* (Hedw.) Sm.
26. *Grimmia reflexidens* Müll. Hal.
27. *Grimmia tergestina* Bruch & Schimp.
28. *Grimmia tortuosa* Hook.f. & Wilson
29. *Grimmia trichophylla* Grev.
30. *Grimmia trinervis* R. S. Williams
31. *Grimmia ungeri* Jur.

Index to Exsiccatae

Specimens are listed alphabetically by collector last name, followed by collection number; the species is indicated by a number in parentheses corresponding to the number in the List of Species above.

M. Acosta Solís 5858 (14); L. Acurio 99 (14); P. G. Aguilar F. 150 (14); J. Aguirre C. 1085 (14); B. Allen 9093 (29), 12260 (14); M. Allioni 8095 (14); B. Amable, 1401 (14), 1448 (10), 1472 (24), 1475 (24), 1681 (14), 1697 (14), 1857 (24), 1860 (24); T. Amatt 1401 (14); E. André 591 (14); Fr. Apollinaire-Marie 3 (14); J. Arechavaleta 201 (25), 215 (25); G. Arsène 7449 (19), 7894 (20), 7906 (20); E. Asplund 13 (14), 53 (14), 75 (14), 78 (14).

Balls 4100 (7); H. G. Barclay & P. Juajibioy 7350 (14); C. R. Barnes & Land 368 (14); H. H. Bartlett 19123 (4); E. B. Bartram 189 (1); P. R. Bell 153 (29), 154 (14), 155 (14), 375 (4); R. Benoist 2276 (14), 2281 (14), 2957 (14), 3076 (14), 3116 (4), 3117 (4), 3153 (14), 3386 (14), 3457 (8), 3458 (8); F. Bowers et al. 5061 (29), 5068B (24), 5178 (14), 5205A (14), 5254A (14), 5254B (14), 5270A (19), 5278B (14), 5315A (20), 5319 (14), 5371C (20), 5376A (14), 5402 (19), 5403 (14), 5405 (14), 5410A (14), 5414A (14), 5414B (19), 5436 (14), 6299D (14); G. S. Bryan 85 (14), 122 (14), 249 (14); G. Buchtien & O. Buchtien 1750 (14); W. R. Buck 8037 (14), 8396 (14), 8575 (27), 8608 (14), 14040 (14), 14275 (14), 14277 (14), 14289 (14); R. Bye 7295 (14), 7297 (19) 7308 (14).

Á. Cárdenas S. 343 (29), 354 (19), 647 (8), 767 (20), 781 (19), 805 (20), 832 (20), 1070 (14), 1091 (14), 3378

(14), 3512 (8), 5344 (14), 5502 (29), 5981 (29); M. Castillo H. 1983 (14), 2030 (14); L. Castillón 1002 (25); E. Cerrate 1097 (14), 3118 (14), 3262 (14), 5197 (14), 5697 (14); S. P. Churchill et al. 13329 (29), 13334 (29), 13335 (14), 15307 (14), 16307A (4), 16307 (29), 18812 (14), 19012 (14); S. P. Churchill & W. Rengifo M. 17258 (4); A. M. Cleef 1798 (14), 2156 (14), 2319 (14), 4186 (14), 6595 (17), 6965 (17), 7006C (4), 8148 (14), 8855 (4), 8941 (14), 9703 (14); A. M. Cleef & P. A. Florschütz 5520 (14); A. M. Cleef & O. Huber 4809 (14); M. R. Crosby 3917 (14); M. R. Crosby & C. A. Crosby 6137 (14).

G. Dauphin 1690 (29); H. Deguchi 26027 (9), 26028 (2), 26070 (2), 26074 (2), 26102 (2), 26407 (9), 26528 (9), 26879 (30), 29848 (30), 29851 (30), 29871 (30), 29872 (30), 29943 (30), 29952 (30), 29962 (30), 29980 (2), 29983 (2), 29996 (2), 30008 (23); C. Delgadillo M. 1148 (29), 1151 (29), 1165 (29), 2361 (2), 2414 (2), 2429 (2), 3057 (8), 3093 (14), 4081 (7), 4117 (16), 4779 (29), 4909 (20), 4960 (20); A. Donat 28 (9), 77 (29), 78 (29), 110 (9), 114 (17), 166 (29), 175 (17); L. J. Dorr et al. 4926 (14), 5326 (14); Dunn et al. 21901 (7); P. Dusén 141 (9), 605 (14), 611 (7), 717 (29), 718 (26), 924 (14), 5713 (21).

E. L. Ekman 13630 (14); M. Escobar & J. Santa 252 (14), 355 (14), 403 (17), 404 (17); R. Espinosa 19 (29).

F. Felippone, 720 (25), 837 (25), 839 (25), 960P.P. (25), 990 (25), 2439 (25); D. Flores M. 308 (29); P. A. Florschütz 3974 (14), 4166 (14); J.-P. Frahm 824021 (4), 824071 (17); T. C. Frey & E. M. Frey 3072 (14).

H. Galeotti 6974 (14); Gardens 4812 (14); P. Germain 1142 (14); E. J. Gibert 729 (25), 1243 (12), 1262 (25); H. Glummer 1976 (8); L. N. Godding 2122 (14); J. Gómez 565 (14); D. Griffin III PV-948 (14); D. Griffin III et al. PV-513 (14), PV-1170 (4), 211 (14), 363 (14), 377 (14), 390 (14), 398 (14), 896 (14), 1314 (14), 1318 (17), 1328 (29), 1359 (14), 1397 (14), 1400 (29), 1401 (14), 1430 (14), 1433 (14), 1444 (17), 1451 (14), 1453 (14), 1457 (14), 1471 (14), 1472 (14), 1480 (14), 1485 (17), 1488 (14), 1491 (14), 1493 (14), 1494 (17), 1495 (17), 1497 (14), 1498 (8), 1499 (8), 1502 (14), 1509 (14), 1513 (14), 2015 (14), 2034 (14), 2047 (14), 2099 (14), 2115 (14); D. Griffin III & D. Díaz M. PV-16 (14), PV-21 (29); D. Griffin III & J. Dugarte PV-1135 (14), PV-1144 (14), PV-1180 (14); D. Griffin III & N. Griffin PV-270 (14), PV-295 (14), PV-316 (14), PV-317 (14), PV-321 (14) PV-340 (14), PV-392 (14), PV-406 (14), PV-413 (14), PV-670 (14); D. Griffin III & M. López F. PV-20 (14), PV-119 (14), PV-120 (14), PV-477 (14), PV-543 (29), PV-544 (14), PV-636 (29), PV-1065 (14), PV-1069 (14), PV-1360 (14); D. Griffin III & D. M. Vital 23 (14), 57 (14); F. J. Grubb 2500 (14), 2501B (6); F. J. Grubb & D. A. Guymer B8 (14), B.68 (17), B.210 (14), B.216-A (14), L4.A (14); H. L. Gunckel 1768 (11).

T. G. Halle 369 (26); Hammond 10837 (16); E. Hegewald 5459 (14), 5943 (14), 5981 (14), 5987 (14), 6001 (17); P. Hegewald & E. Hegewald 5076 (14), 5080 (14), 5098 (14), 5100 (14), 5104 (14), 5135 (14), 5156 (14), 5158 (30), 5180 (14), 5274 (14), 5290 (14), 5324 (14), 5338 (14), 5375 (14), 5427 (17), 5465 (14), 5467 (29), 5479 (29), 5480 (15), 5483 (30), 5483b (2), 5483A (23), 5512 (30), 5512A (17), 5526 (30), 5526A (17), 5537 (14), 5544 (14), 5633 (14), 5645 (14), 5718 (14), 5719 (14), 5761 (14), 5848 (14), 5854 (14), 6018 (14), 6018 (14), 6029 (14), 6151 (14), 6220 (14), 6241 (14), 6262 (27), 6296 (14), 6543 (14), 6553 (14), 7236 (14), 7280 (14), 7425 (14), 7483 (30), 7482 (14), 7568 (14), 7605 (14), 7638 (14), 7639 (14), 7667 (14), 7697 (17), 7698 (4), 7698A (17), 7718 (17), 7718A (14), 7729 (29), 7752 (14), 7918 (14), 7921 (14), 8377 (14), 8586 (14), 8602 (14), 8649 (14), 8660 (14), 8993 (14), 9125 (14), 9195 (14); F. J. Hermann 20796 (29), 20822 (29), 20845 (16), 20847 (14), 25122 (14), 25149 (14), 26223 (29), 26444 (29), 26463 (14), 26464 (14); F. J. Hermann & H. Crum 20884 (24); W. G. Herter 1267 (25); T. Herzog 306 (17), 308 (5), 2584A (14), 2662 (8), 2675 (17), 2679 (14), 2680 (5), 2971 (30), 2979 (3), 3146A (17), 3148 (14), 3170 (3), 3572 (8), 3579 (14), 3585 (14), 3587 (5), 3587A (14), 3597 (14), 3745 (14), 3826 (14), 3827 (14), 4156 (14), 4772 (5), 4811 (14), 4863 (14), 4870 (8), 4871 (14), 4912 (14), 4913 (17), 4938 (14); D. G. Horton 7457 (29), 7463 (18), 7837 (18), 7859 (7) 7876 (8), 7890A (18), 7893 (8); C. C. Hosseus 207 (14), 394 (4), 423 (4), 449 (4), 470 (4), 761 (12), 910 (12), 911 (25), 913 (25), 1830B (25), 1856 (12), 2220 (25), 2221 (25), 2433 (25), 2447B (25), 2447A (25), 2447 (25), 2448 (25), 2449 (25); C. C. Hosseus & H. Guérin 2598 (25); C. C. Hosseus & H. G. Weihmüller 886 (12), 887 (12), 888 (12), 889 (12), 911A (25), 1146 (14), 1156 (14), 1157 (14), 1487 (12), 2216 (12), 2217 (12), 2218 (12), 2227 (12), 2228 (25), 2309 (12), 2372 (12).

H. H. Iltis et al. 891 (29), 892 (29), 893 (29), 897 (29); H. H. Iltis & C. M. Iltis 2128 (18), 3128A (18), 3128 (14), 3160 (14), 3221 (7), 3228 (7), 3229 (7), 3234 (14).

F. Jaffuel 225 (14), 247 (8).

W. Kiener 18517 (14), 18518 (16), 18518A (29), 18518B (16), 18518C (18), 18554 (7), 18554A (18), 18590 (31), 18591 (31), 18591a (7), 18591B (7), 18591Ba (18), 18592B (7); E. P. Killip & A. C. Smith 17434 (14), 17985 (14), 17987 (14), 17988 (14), 22055 (14); R. M. King et al. 6667F (14); C. P. Kofron 502 (14); O. Kühnemann 4137 (12); G. Kunkel 186 (14).

I. M. Lamb 5288 (14), 5566 (8); B. León & K. Young 2118 (14); H. LeSeur B2B (14), C8A (20), C9A (20), D5A (20), D7A (20); M. Lewis 78-2336 (14), 78-2338 (14), 78-2518 (14), 78-2560 (14), 78-2675 (14), 78-2705 (29), 78-2769 (29), 78-2770 (14), 78-2917 (29), 78-2918 (29), 78-2981 (29), 78-2991 (14), 78-3130 (14), 78-3234 (14), 79-26 (14), 79-34 (14), 79-48 (14), 79-54 (14), 79-70A (14), 79-108 (14), 79-128 (14), 79-134 (14), 79-164 (14), 79-168 (14), 79-206 (8), 79-214 (14), 79-230B (14), 79-233 (14), 79-242 (8), 79-243 (27), 79-246 (8), 79-248 (14), 79-292 (14), 79-296 (14), 79-300 (8), 79-316 (14), 79-317 (14), 79-368 (17), 79-371 (14), 79-371 (30), 79-372 (14), 79-377 (14), 79-382 (14), 79-461 (14), 79-468 (8), 79-677 (14), 79-691 (14), 79-778 (30), 79-793 (4), 79-794A (4), 79-803 (4), 79-804 (14), 79-806 (4), 79-824 (8), 79-827 (8), 79-840A (8), 79-844A (8), 79-921 (8), 79-945 (14), 79-946 (14), 79-1002 (14), 79-1004 (14), 79-1233 (14), 79-1354 (4), 79-1393 (4), 79-1510 (14), 79-1546 (29), 79-1560 (14), 79-1567 (14), 79-1569 (14), 79-1636 (14), 79-1649 (14), 79-1651 (14), 79-1712A (8), 79-1727 (5), 79-1728B (17), 79-1731 (17), 79-1799 (14), 79-1809 (4), 79-1814A (4), 79-1824 (8), 79-1825A (8), 79-1826 (8), 79-1867A (8), 79-1922 (14), 79-1947 (2), 79-2004 (23), 79-2008B (2), 79-2015 (23), 79-2061 (14), 79-2073A (30), 79-2076 (14), 79-2092 (26), 79-2095A (26), 79-2398B (4), 79-2427 (8), 79-2429 (8), 79-2434 (14), 79-2437 (14), 79-2438A (8), 79-2438 (8), 79-2506 (14), 79-2521 (14), 79-2539 (8), 79-2568 (4), 79-2581 (5), 79-2585 (5), 79-2599 (8), 83-1635 (14), 83-1642 (14), 83-1661 (14), 83-1766 (14), 83-1826 (4), 83-2051 (7), 83-2051A (14), 83-2119 (4), 83-2121D (14), 83-2122A (4), 83-2122 (4), 83-2125 (14), 83-2129A (7), 83-2130 (4), 83-2133 (4), 83-2138 (7), 83-2139 (4), 83-2178 (4), 83-

2180C (4), 83-2183 (8), 83-2186M (4), 83-2186 (8), 83-2187A (4), 83-2189A (4), 83-2221 (14), 83-2229A (8), 83-2229 (4), 83-2232 (7), 83-2234 (14), 83-2235 (7), 83-2240B (4), 83-2240A (4), 83-2249 (4), 83-2383 (14), 83-2478B (4), 83-2486B (4), 83-2488A (4), 83-2494 (4), 83-3045 (14), 83-3182C (4), 83-3186 (4), 83-3194A (4), 83-3243 (6), 83-3247 (14), 83-3252 (14), 83-3283 (4), 83-3287 (4), 83-3291 (7), 83-3301 (7), 83-3305 (14), 83-3306A (7), 83-3314 (7), 83-3317 (7), 83-3435B (4), 83-3451A (4), 83-3460 (4), 83-3929 (14), 83-3932 (8), 83-3936 (14), 83-3938a (7), 83-3938 (30), 83-3945 (7), 83-3948 (14), 83-3954 (14), 83-3961 (7), 83-3962 (14), 83-3966 (14), 83-3971 (7), 83-4353 (8), 83-4354B (8), 83-4442 (14), 83-4444 (14), 83-4561 (4), 83-4605 (4), 83-4640 (14), 83-4718 (4), 84-137 (14), 84-139BA (4), 84-139A (14), 84-145A (4), 84-148A (14), 84-166 (14), 84-199 (17), 84-205A (8), 84-209a (5), 84-209 (17), 84-219 (14), 84-226 (14), 84-239 (14), 84-239A (14), 84-241 (14), 84-244 (14), 84-246 (14), 84-248 (14), 84-257 (14), 84-259 (14), 84-260 (23), 84-263 (14), 84-266 (23), 84-269 (14), 84-271 (23), 84-285 (14), 84-286 (23), 84-288 (14), 84-293 (6), 84-294 (14), 84-303 (14), 84-305 (17), 84-305a (26), 84-308A (6), 84-315 (23), 84-334 (14), 84-338 (14), 84-369 (14), 84-383 (14), 84-407 (14), 84-413 (14), 84-482 (4), 84-499 (14), 84-1505B (14), 84-1521 (8), 84-1540 (8), 84-1540A (14), 84-1546 (14), 84-1587 (30), 84-1589 (14), 84-1641 (27), 84-1653 (14), 84-1761 (14), 84-1794 (14), 84-1827 (7), 84-1868 (7), 84-2499 (14), 84-2529 (14), 84-2944 (14), 85-115 (4), 85-296 (4), 85-1649 (4), 86-109 (4), 86-768 (14), 86-769 (14), 86-2114 (14), 86-2115 (30), 86-2125 (14), 86-2216 (4), 86-2482 (4), 87-314 (8), 87-321 (4), 87-324 (8), 87-335 (17), 87-522 (4), 87-620A (8), 87-750 (4), 87-844 (4), 87-853 (4), 87-875 (17), 87-884 (3), 87-901 (3), 87-914 (3), 87-926 (3), 87-947 (14), 87-958 (14), 87-979 (4), 87-1789B (4), 87-1812 (29), 87-1819 (17), 87-1853 (14), 87-1878 (14), 87-1879 (5), 87-1908 (14), 88-417 (8); A. Lindig 2011 (14); A. Liogier & P. Liogier 25032 (14); Little 1 (16); B. Lojtnant 15345 (14); G. Looser 1037 (26).

K. Magdefrau 626B (14), 1187 (14); R. E. Magill 2527 (24); M. Mahú 5539 (26); M. Mahú & S. Tapia 50220 (26), 50221 (26); G. Mandon 1631 (14), 1633 (8), 1634 (14), 1635 (14); K. D. McFarland & A. J. Sharp 8691 (14); I. Mexía 2702 (29); H. Meyer 21B (14), 21A (14), 32A (12), 33 (12), 34A (12), 43B (25), 44C (19), 5435 (14), 5478 (17), 5500 (17), 5510 (17), 5511 (17), 5512 (17), 5513 (17), 5514 (17), 5515 (17), 5516 (17), 5517 (17), 5518 (14), 5519 (17), 5522 (17), 5531 (17); R. Moran 5664 (16); T. W. Mulroy 3 (13), 5 (13), 6 (13), 8 (12).

D. H. Norris et al. 20567 (14), 20741 (14), 20742 (14), 20770 (14), 20817 (14), 20869 (14), 20878 (19), 20895 (14), 20896A (29), 20896 (14), 20953 (14), 20968 (14), 20991 (19), 20993 (14), 20994 (14); D. H. Norris & D. J. Taranto 14330 (14), 14436 (14), 15396 (14), 15408 (24), 15420 (14), 15436 (14), 15438 (14), 15439 (14), 15442 (14), 15460 (14), 15642A (24), 15642 (29).

M. Onraedt 5060 (14), 5223 (14), 5293 (14); C. R. Orcutt 5353 (14), 7082 (1); R. Ortega 630 (18).

E. Palmer 113 (25), 113A (29); R. Patrick 292 (7); F. W. Pennell 18400D (14); H. Pittier 13183 (14), 13198 (14); T. Pócs 9550/J (29); C. G. Pringle 26A (14), 4277B (14), 10423 (24), 10599 (10), 10599A (14), 15076 (14); C. A. Purpus 4277 (16), 4277a (7); R. A. Pursell 5435 (20).

G. Raeymaekers 534 (14), 544 (14), 550 (8), 615 (14), 621 (14), 728B (14), 735 (14), 747 (14), 758 (14), 769 (14), 776 (14), 788 (14), 1013 (14); G. v. Reenen 585 (14); D. Richards et al. 675 (14); H. Roivainen 326 (9); J. N. Rose 18882 (14), 18882A (14), 19091 (14), 19091A (30); L. Ruiz-Terán 7863 (14); L. Ruiz-Terán & M. López-Figueiras 8695 (29); L. Ruiz-Terán & S. López-Palacios 7440 (14), 7525 (29); J. Rzedowski 27260 (29).

M. Saint-Pierre 1773 (14), 1781A (7), 1795 (7), 1797A (7), 1797B (7), 1797Ba (14), 1803 (24), 1891 (14), 1896 (14), 1899 (7), 1905 (14); R. Santesson M123 (26), M340 (26), M542 (9); A. Schäfer-Verwimp & B. Verwimp 11500 (14), 12280 (8), 12282 (8); C. J. W. Schiede 1070B (8); V. Schiffner 461 (14), 773 (14); W. Schiller 25 (26); T. Seki 1/70-72 (4), 1345 (29), 1368 (29); A. J. Sharp 72A (29), 172A (14), 178 (24), 417 (19), 443 (19), 443A (20), 784 (19), 1171 (14), 1749 (19), 1782 (14), 1786 (20), 1807 (14), 1814 (14), 1815 (14), 1833 (14), 1833A (19), 1848 (14), 1878 (14), 1892A (20), 2211 (29), 2290A (14), 3654 (14), 3656 (29), 3715 (24), 3744 (14), 3912 (2), 4169 (14), 4170 (14), 4270 (18), 4271 (14), 4276 (18), 4280 (14), 4289 (16), 4291 (14), 4296A (29), 4296 (29), 4306 (29), 4747 (18), 4749 (16), 4753 (18), 4761 (29), 4761A (6), 4771 (14), 4777 (14), 5041 (14), 5415 (29), 5421 (29), 5429 (7) 5434 (29), 5439 (29), 5441 (29), 8734 (14); A. J. Sharp et al. S6AB (29), 81 (29), 95D (29), 1334 (29), 1335 (29), 1341A (29), 1506B (7), 1514 (7), 1534 (14), 1660B (14), 1660C (29), 1686 (29), 2607 (14), 2608B (20), 2608B-A (14), 2618B (14), 2737 (20), 2822 (14), 2825 (14), 2832 (14), 3233 (20), 3245B (20), 5594 (16), 5596 (25), 5660-B (29), 5661-B (25), 5662 (29), 5663 (25), 5663A (16), 5664 (29), 5668 (16), 5671 (16), 6055 (16), 6058 (29), 6073 (29), 6074 (25), 6086 (12), 6090 (12), 6097A (12), 6099-A (25), 7168B (14), 7175B (7), 7177D (14), 7459C (14); A. J. Sharp & Á. Cárdenas 8703 (14), 8713A (24), 8716 (24); A. J. Sharp & K. D. McFarland 8895 (14), 9005A (14), 9015 (14), 9034 (14); A. J. Sharp & F. Miranda 1176B (24); A. J. Shaw 5610 (14); P. A. Siple 391.3 (9), 391-6 (21); C. Skottsberg 70 (8), 370 (14), 371 (11), 377 (9), 378 (29), 379 (29), 380 (4), 381 (4), 976 (26); D. N. Smith 780 (14); J. A. Snider 262 (24); B. Sparre 4832 (26); H. Spotts 1757 (24); R. Spruce 133 (14); P. C. Standley 65262 (14), 65526A (14), 65530 (14), 85410 (29), 84451 (29), 84462 (29), 84474 (29); L. R. Stark & R. Castetter 1182 (22); W. C. Steere 7713 (14), 9285 (14), 9498 (14), 23052 (14); J. A. Steyermark 35547A (7), 35548 (7), 35549A (7), 36091 (29); G. Suárez 559 (14), 561 (14).

C. M. Taylor 11268 (14); C. Troll 58 (14), 64 (14); T. G. Tutin 196 (8).

E. Ule 1830 (14), 1913 (14).

L. Valcarcel 40 (14); J. M. Valentine 8–14 (24); V. Vareschi 1274 (14), 8803 (14), 8872 (29), 8873 (14), 8874 (29); J. C. Vargas 5039 (14), 7099 (14), 7676 (14), 8674 (14), 8709 (14), 8780 (14), 10039 (14), 15863 (14); D. M. Vital 1708 (14), 9155 (25), 9196 (12); D. H. Vitt 17469 (7), 17486 (7), 17488 (18), 17520 (16), 17887 (7), 17894 (8), 17902 (7), 17907 (8), 17920 (8), 17921 (8), 21541 (14), 21717 (14), 21754 (14); E. Viveros-Juárez 465 (24).

W. A. Weber & R. Bye B-60292 (20), B-60304 (14), B-60309 (19); A. Weberbauer 373 (8); H. A. Weddell 4 (14); J. Weir 297 (14); S. S. White 4210 (20); E. Whymper 1347 (29); I. L. Wiggins 9177 (31); R. S. Williams 1777 (8), 1778 (14), 1781 (17), 1782 (17), 2813 (14), 2815 (14), 2823 (4).

INDEX TO SCIENTIFIC NAMES (ACCEPTED NAMES IN ITALICS)

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