Acta Bot. Neerl. 33(3), August 1984, p. 275–282.

STUDIES ON COLOMBIAN CRYPTOGAMS XXII: THE BREUTELIA SUBARCUATA COMPLEX IN COLOMBIA AND NEIGHBORING AREAS

D. GRIFFIN, III

Department of Botany, the Florida State Museum, University of Florida, Gainesville, Florida, U.S.A. 32611

SUMMARY

In Colombia and neighboring areas there are three species of *Breutelia* which produce smooth or rugulose (not longitudinally plicate) capsules. These are: *B. subarcuata* (C. Muell.) Schimp. *in* Besch., *B. squarrosa* Jaeg. and *B. rhythidioides* Herz. Although all are similar in gross morphology, they can be distinguished by the areolation of the alar region of the leaves. In *B. squarrosa* the alar region is scarcely distinct with no more than 1–3 inflated, hyaline cells in the basal corners and with a few enlarged supraalar cells. In both *B. subarcuata* and *B. rhythidioides* the alar region is clearly distinct with 2 or more rows of enlarged cells and with the outer 1–2 rows of inflated, hyaline cells. The intramarginal alar cells in *B. subarcuata* are non-porose, or essentially so, while in *B. rhythidioides* the intramarginal alar cells are quite porose. A review of type and secondary collections shows that the three members of this complex are wide-ranging in the neotropics but apparently with the highest frequency of populations in the northern Andes. *B. rhytidioides* Crum is rejected as a *hom. illeg.*

1. INTRODUCTION

One complex of species within the *Acoleos* section of *Breutelia* includes those taxa which produce smooth to rugulose, rather than longitudinally plicate, capsules. The species involved are restricted, apparently, to the neotropics.

While engaged in the task of determining a fairly large series of *Breutelia* collections from Colombia made by Dr. A. M. Cleef, I became aware of a widespread confusion in the literature over the concepts applied to the members of this complex, a confusion that shows up also in the high percentage of misidentified collections in herbaria. Having now examined all of the critical types plus many secondary collections, I feel some clarification for this problem can be offered.

MITTEN (1869) separated *B. subarcuata* from 15 other New World species of *Breutelia* on the basis of the globose, smooth capsule. He placed *B. squarrosa* in the group having plicate capsules, however, the type collection for *B. squarrosa* (Holton 15-NY!) is sterile and no sporophytic details are included with the description for this species. It is concluded that the assigning of *B. squarrosa* to the plicate capsule group was done as a matter of probabilities. There is some,

albeit questionable, justification for such a decision since most of the species of the genus do produce longitudinally furrowed capsules. I have encountered in this study fertile collections of *Breutelia* that match closely the type for *B. squarrosa* but which have smooth to rugulose capsules. For this reason, this species is considered to belong to the *B. subarcuata* complex.

MITTEN (1869) cited, along with the type (Liebmann s.n.-C!), a Colombian collection of Weir (No. 119) which contains an admixture of *B. subarcuata* and *B. squarrosa*. The plants, while intermixed, are perfectly distinct. Mitten emphasized leaf shape in his key to *Breutelia* species, and, insofar as leaf shape is similar in these two taxa, it may be that he considered other differences, such as alar region areolation, of insufficient importance to warrant comment. It is also possible that he simply overlooked the admixture.

BARTRAM (1949) described *B. subarcuata* in his Guatemalan flora, but the plant he illustrated has a furrowed capsule. He did mention that the alar region of the leaf is made up of 4–5 rows of lax, oblong, pellucid cells extending well up the basal margins. Although his description accords with the concept accepted here for *B. subarcuata*, it is concluded that the plant which was illustrated represents *B. chrysea* (C. Muell.) Jaeg. The relationship between *B. subarcuata* and *B. chrysea* is discussed in another paper which the author has in preparation.

ROBINSON (1967), in his study of Colombian bryophytes, treated *B. squarrosa* as a synonym of *B. subarcuata* and to reach *B. subarcuata* in his key to species one must elect the lead "basal marginal cells mostly small and quadrate, poorly differentiated." This characterization fits the concept for *B. squarrosa* (which I regard as distinct from *B. subarcuata*) but is at variance with the morphology of the type of *B. subarcuata*.

Finally, there is *B. rhythidioides* Herz., another member of the complex, which has not been discussed in the literature since the original description by Herzog (1934)[1]. The type for *B. rhythidioides* is sterile, however, in my review of collections, I have come across fertile plants that are quite similar vegetatively to the type and which have smooth to rugulose capsules. For that reason *B. rhythidioides* is included also within this treatment.

2. MORPHOLOGY AND TAXONOMY

When sterile, the members of the *B. subarcuata* complex generally can be recognized by the relatively broad upper lamina of the leaf, which typically narrows abruptly to an acuminate and ± aristate tip and by the relatively short cells of the acumen (usually less than 10× length/width). When fertile, the arcuate setae, 4–12 mm long, and the globose to subglobose or ovoid capsules, that at maturity are smooth to irregularly rugulose, are diagnostic.

[1] *B. rhytidioides* Crum (MÄGDEFRAU 1983) must be rejected as a *hom. illeg.* insofar as this name is already occupied (the fact that Crum's species is an orthographic variant does not legitimize its nomenclatural standing – cf. Art. 64, International Code of Botanical Nomenclature). The species described by Crum differs in two important ways from Herzog's species, *viz.*, the leaves are slenderly acuminate above, and the alar region is composed of non-porose, quadrate to subquadrate cells.

The most consistent difference among these species concerns the alar region. In *B. squarrosa* the alar cells are only weakly differentiated with usually only 1–3 inflated, hyaline cells in the extreme basal corners plus a few enlarged supraalar cells. In *B. subarcuata* and *B. rhythidioides* there are 4–9 rows of enlarged cells and 1–2 rows of inflated, hyaline cells at the leaf margin. In *B. subarcuata* the intramarginal alar cells are non-porose, or essentially so, while in *B. rhythidioides* alar cells of the intramarginal rows are clearly porose. Furthermore, in *B. rhythidioides* the intramarginal alar cells, on average, are more than 2:1 L/W while in *B. subarcuata* the corresponding cells average 1–2:1 L/W. Other differences have been noted among these species with regard to the length of the exostome, however, so few fertile collections have been found with intact peristomes that it does not seem wise to elevate the importance of this character until more material is available for study.

3. DISTRIBUTION

All three species of the complex, *B. rhythidioides* Herz., *B. squarrosa* Jaeg. and *B. subarcuata* (C. Muell.) Schimp. *in* Besch., occur in the tropical Andes and in the mountains of Central America, and are adapted to moist or wet páramos and humid cloud forest ecotones. Colombia offers the greatest areal extent of these kinds of habitats among neotropical countries, and, perhaps for that reason alone, populations of the species seem most frequent in Colombia. It is also possible that some of the "frequency" is an artifact of collecting efforts. The correlation cannot be entirely artifactual, however, since mosses from the páramos of neighboring countries (*e.g.* Ecuador, Venezuela, Costa Rica) also have been collected extensively by various individuals and, at least on the basis of the numbers of collections available to me, it is clear the frequency of populations of members of this complex diminishes with increasing distance from Colombia. One species, *B. subarcuata*, reaches Mexico where its ecology is slightly different from that observed in other parts of its range. In Mexico, the high elevation habitats above timberline (> 3900 m) are substantially drier than are many areas at corresponding elevations in the South American páramos. This can be surmised by reviewing the proportionally high number of xerophytes in the Mexican alpine moss flora (cf. DELGADILLO 1971, 1979). In Mexico, *B. subarcuata* is restricted to oak-pine cloud forests and to montane forests of *Pinus* spp. and *Abies religiosa*. Similarly, in Peru all of the collections which I have seen have been made in cloud forests, not in the puna which, like the alpine regions of Mexico, is measurably drier than the páramos.

4. DESCRIPTIONS

1. *Breutelia squarrosa* Jaeg., Ber. S. Gall. Naturw. Ges. 1873–74: 98. 1875 (Ad. 1: 560). *Figures 1–10.*
Bartramia squarrosa Mitt., J. Linn. Soc. Bot. 12: 265. 1869. *hom. illeg.*

Type: COLOMBIA, Andes Bogotenses, Bogotá, Holton 15 (holotype NY!). Plants moderate to robust, 5–10 cm high, often densely tomentose, subsimple to irregularly pinnate, perichaetia subtended by a whorl of branches, stem leaves typically squarrose to squarrose-recurved, occasionally erect-spreading to wide-spreading, ovate-lanceolate, 3–4 mm long, quite plicate at base, margins revolute to mid-leaf or slightly above, upper margins plane, 1–3 stratose, sharply serrulate, costa excurrent in acuminate-subaristate tip, upper cells elongate, weakly sinuous and faintly porose, 4–10:1 L.W, averaging 7:1 L/W or less, papillose mainly on dorsal side at posterior end, basal cells longer, to 12:1, mostly smooth, alar region little differentiated, typically with 1–3 inflated, hyaline cells in basal corners plus 7–10 enlarged supraalar cells, intramarginal cells rectangular, 2–6:1, non-porose or, occasionally, with some cells porose. Dioicous. Setae 7–9 mm long, arcuate, capsules subglobose, 3 mm long × 2 mm wide, irregularly rugulose when dry. Peristome inserted below the mouth, exostome of 16 lanceolate teeth, 150 μm long, finely granulose, endostome adherent to and nearly equalling exostome in length. Spores subreniform, areolate-tuberculate, 33–38 μm long × 25–27 μm wide.

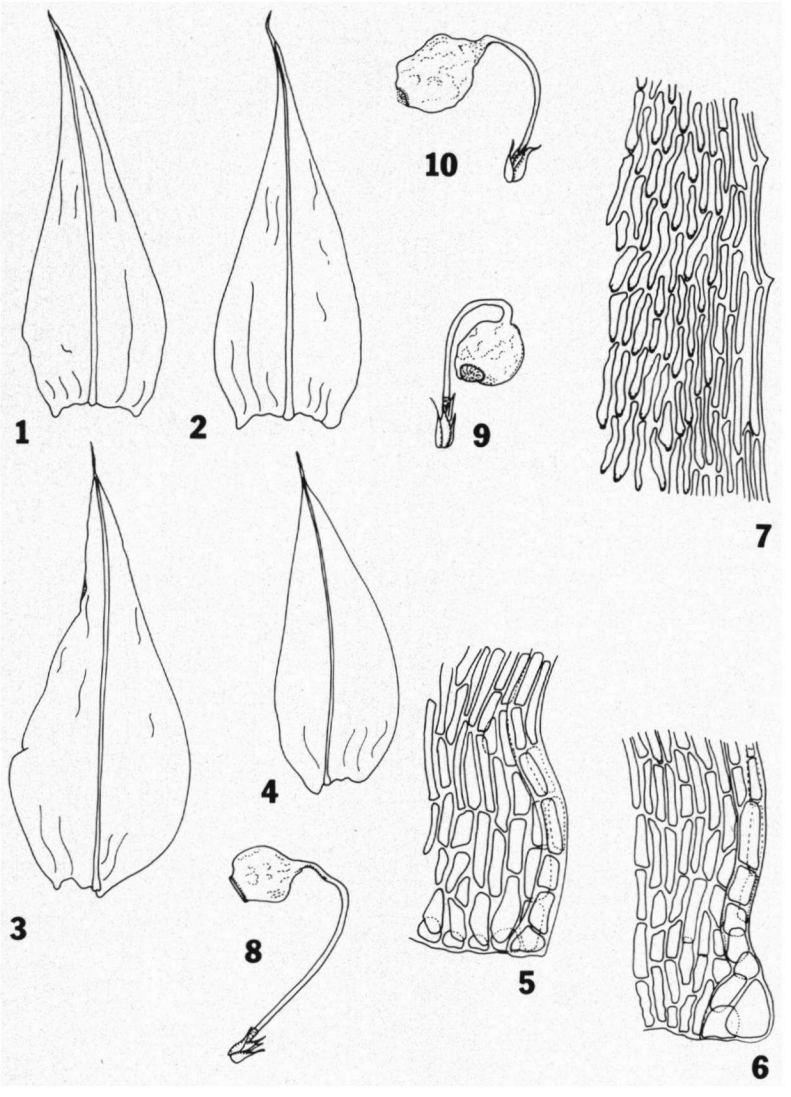
Distribution: Costa Rica tot Peru.

Ecology: Cloud forest clearings and páramos, 2000–3700 m.

Specimens examined (abridged list): COSTA RICA. San José, Cerro de las Vueltas, Standley & Valerio 43551 (F) (as *Breutelia chrysea*). COLOMBIA. Andes Bogotenses, Weir 119 pro parte (H, NY, FLAS); Boyacá, Páramo de Pisva, Cleef 4595 (U, COL, FLAS) (as *Breutelia subarcuata*), Vado Hondo, fondo del valle del río Cusiana, Cleef, Cuatrecasas & Jaramillo 9231 (U, COL, FLAS); Cundinamarca, Páramo de Cruz Verde, Onraedt 6326 (private Herb. M. Onraedt, FLAS) (as *Breutelia subarcuata*); Páramo de Sumapaz, Cleef 4926 (U, COL, FLAS), Páramo de San Cristóbal, Steere 7596 (NY, FLAS). VENEZUELA. Mérida, Páramo La Negra, Griffin, López & Ruiz-Terán 2159 (MER, FLAS) (as *Breutelia subarcuata*), Parque Nacional de la Sierra Nevada de Mérida, Fransén 1458 (private herb. S. Fransén, FLAS), Páramo de San José, Ruiz-Terán, López & Cuatrecasas 8405 (MER, FLAS). ECUADOR. Carchi, Páramo El Angel, Gradstein, Weber & Lanier Gr. 3398 (U, FLAS). Peru. Amazonas, Calla Calla, P. & E. Hegewald 6900 (private herb. Hegewalds, FLAS) (as *Breutelia subarcuate*), Cajamarca-Chachapoyas road, J.-P. Frahm *et al.* 1086 (DUIS, B, FLAS), Huánuco, below Chinchao, Ferreyra 13121 (USM, FLAS).

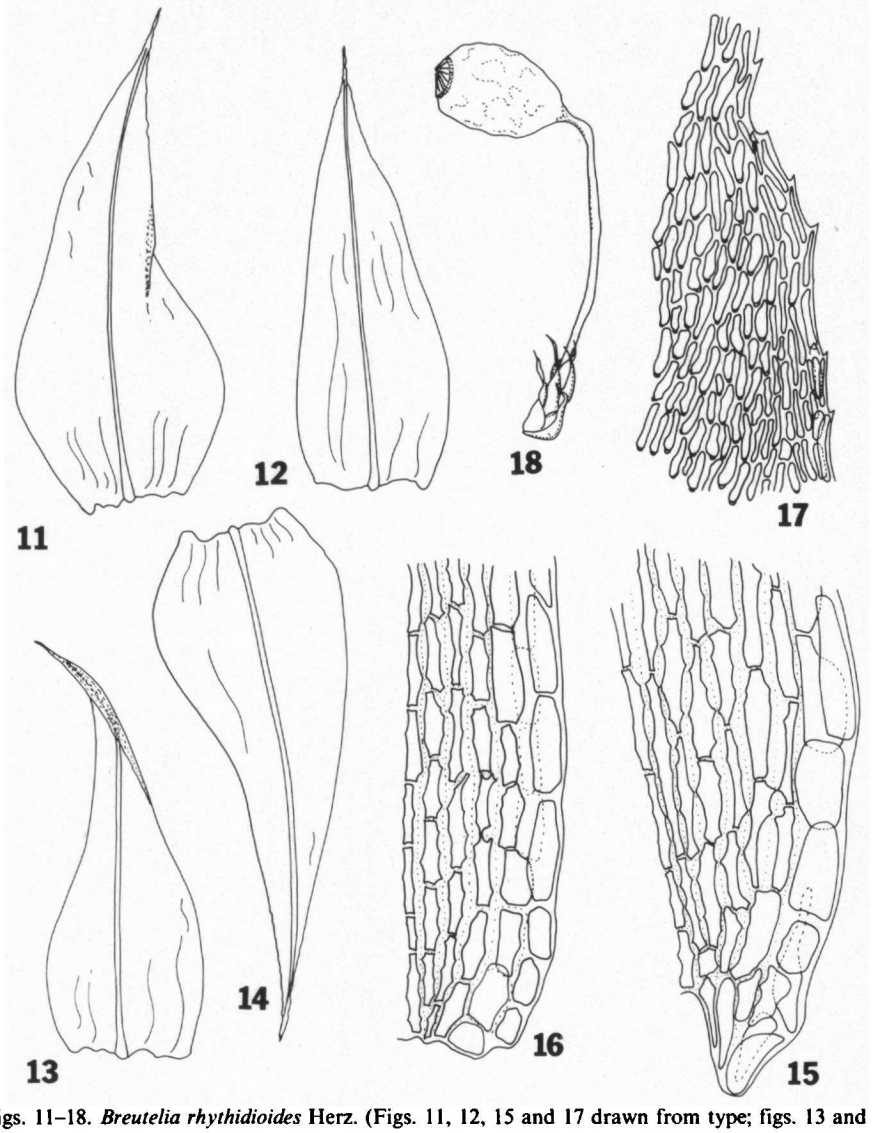
2. *Breutelia rhythidioides* Herz., Hedwigia 74: 108. 1934. *Figures 11-18.*

Type: COLOMBIA, Páramo del Boquerón, 3500 m, C. Troll 2152 (isotype S!). Plants relatively robust, 6–8 cm high, often densely tomentose, subsimple to irregularly pinnate, perichaetia subtended by a whorl of branches, stem leaves falcate-spreading to divaricate, ovate-lanceolate, 4–6 mm long, quite plicate at base, margins plane or revolute to mid-leaf or above, upper margins plane, 1–2 stratose, sharply serrulate to serrate, costa excurrent in ± abruptly narrowed, acuminate tip, upper cells variable in length, 3–10:1 L/W, averaging 3–5:1, non-porose or weakly porose, papillose on dorsal side at posterior end, basal cells



Figs. 1–10. *Breutelia squarrosa* Jaeg. (Figs. 1, 2, 5, 6 and 7 drawn from type; figs. 3 and 4 drawn from Griffin, López & Ruiz-Terán 2159; figs. 8, 9 and 10 drawn from Fransén 1458). Figs. 1–4. Leaves, × 17; figs. 5–6. Alar region, × 245; fig. 7. Upper margin of leaf, × 245; figs. 8–10. Sporophytes, × 4.

longer, 8–20:1, mostly smooth, cells at extreme base and toward basal margins distincly porose, alar cells enlarged, rectangular, typically more than 2 × as long as wide, in 5–9 rows with outer 1–2 rows of hyaline, thin-walled cells. Dioicous. Setae 10–12 mm long, arcuate, capsules subglobose to ovoid, 4 mm long × 3 mm wide, irregularly rugulose when dry, peristome inserted below the mouth,



Figs. 11–18. *Breutelia rhythidioides* Herz. (Figs. 11, 12, 15 and 17 drawn from type; figs. 13 and 16 drawn from Cleef 10.043; figs. 14 and 18 drawn from Griffin, López & Ruiz-Terán 699). Figs. 11–14. Leaves, × 17; figs. 15–16. Alar region, × 260; fig. 17. Upper margin of leaf, × 260; fig. 18. Sporophyte, × 4.

exostome equalling the exostome or nearly so, pale yellow, smooth below, papillose above. Spores subreniform, areolate-tuberculate, 33–35 μm long × 25–26 μm wide.

Distribution: Costa Rica, Colombia, Venezuela, Peru.

Ecology: moist sunny habitats, clearings in mountain forests.

Specimens examined: COSTA RICA. San José, La Ascensión, Crosby & Crosby 5725 (MO, FLAS) (as *Breutelia subarcuata*). COLOMBIA. Arauca, Sierra Nevada del Cocuy, Cleef 10.043 (U, COL, FLAS) (as *Breutelia subarcuata*); Boyacá, Peña de Arnical, N of Vado Hondo, Cleef 9470 (U, COL, FLAS); Cundinamarca, Páramo de Sumapaz, Cleef 3611 (U, COL, FLAS) (as *Breutelia subarcuata)*. VENEZUELA. Táchira, Páramo El Batallón, Griffin, López & Ruiz-Terán 485 (MER, FLAS) (as *Breutelia subarcuata*), Páramo El Rosal, Griffin, López & Ruiz-Terán 643, 699 (MER, FLAS) (as *Breutelia subarcuata*). PERU. Cuzco, La Convención, Bües 1474 (NY) (annotated as *B. aureola* (C. Muell.) Besch.)

3. *Breutelia subarcuata* (C. Muell.) Schimp *in* Besch., Mem. Soc. Sc. Nat. Cherb. 16: 204. 1872. *Figures 19–28.*
Bartramia subarcuata C. Muell., Syn. 2: 617. 1851.
Type: MEXICO, Vera Cruz, Pico de Orizaba, Liebmann s.n., Pl. Mexic. Liebm. 131 (holotype C!, isotype BM!).
Only an abridged description is given here highlighting the critical differences between this species and the other members of the *B. subarcuata* complex. A more detailed description along with additional specimens examined are included in another paper in preparation which compares *B. subarcuata* and *B. chrysea.*

Alar cells enlarged, rectangular to subquadrate, in 3–7 rows, intramarginal rows little or not porose, outer 1–2 rows of hyaline, thin-walled cells.
Distribution: Mexico to Peru
Ecology: montane habitats, clearings, páramos, ca. 1500–3500 m.
Specimens examined (abridged list): MEXICO. México, Laguna de Zempoala, Frahm 792315 (DUIS, FLAS), Vera Cruz, Dos Hermanos, Mpio. de Las Vigas, Delgadillo & Cárdenas 4308 (MEXU, FLAS) (as *Breutelia tomentosa* (Sw.) Schimp.). VENEZUELA. Mérida, Páramo La Negra, Griffin, López & Ruiz-Terán 2172 (MER, FLAS). PERU. Cajamarca, Puente Bajo between Encañada and Celendin, P. & E. Hegewald 6575 (private herb. Hegewalds, FLAS).

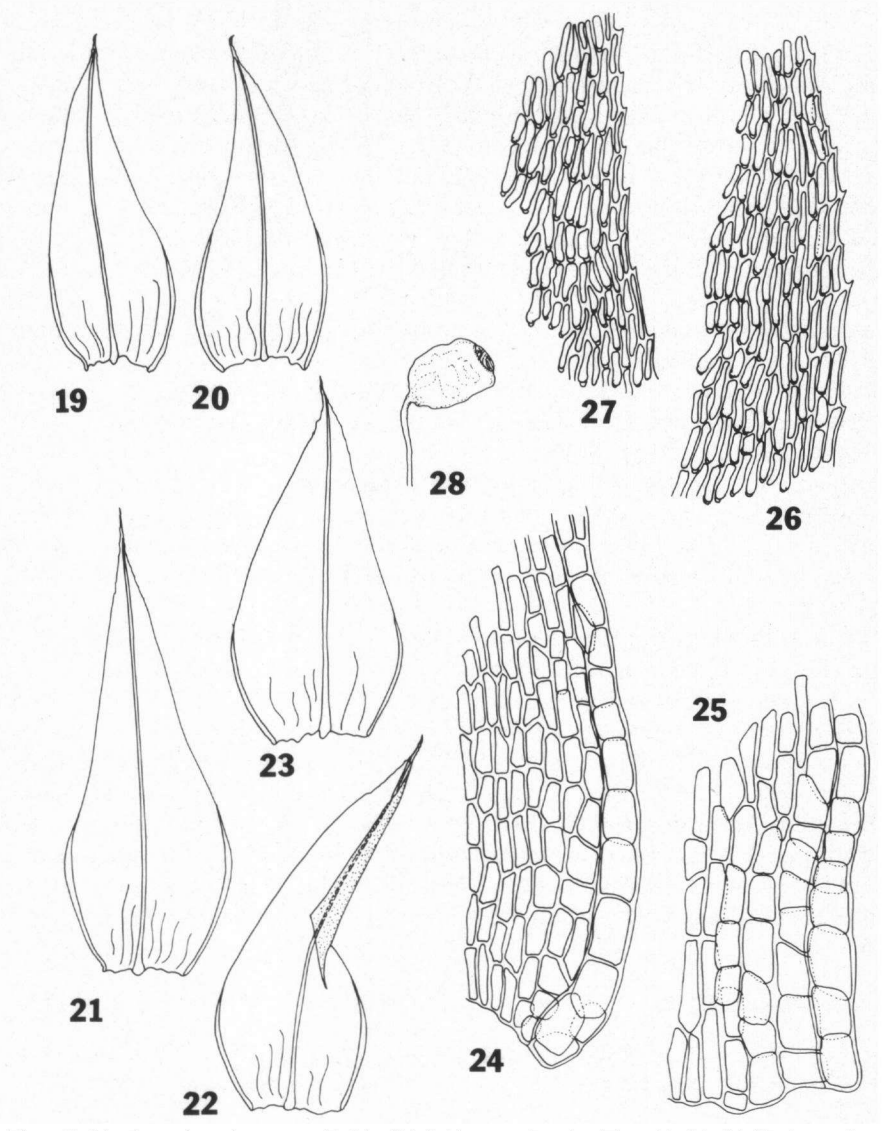
ACKNOWLEDGEMENTS

I thank the curators of the following herbaria for the loan of material: BM, C, DUIS, F, H, MER, MEXU, MO, S, U, USM, private herbaria of S. Fransén and P. & E. Hegewald.

Florida Agricultural Experiment Station Journal Series Paper No. 5490.

REFERENCES

BARTRAM, E. B. (1949): Mosses of Guatemala. *Fieldiana: Botany* **25**: 1–442.
DELGADILLO, Claudio M. (1971): Phytogeographic studies on alpine mosses of Mexico. *Bryologist* **74** (3): 331–346.
— (1979): Notes on alpine mosses of Mexico. *Bryologist* **82** (4): 629–631.
HERZOG, T. (1934): Die Bryophyten der Andenreise von C. Troll (Bolivia, Columbia, Panama).



Figs. 19–28. *Breutelia subarcuata* (C. Muell.) Schimp. *in* Besch. (Figs. 19, 20, 24–27 drawn from type; figs. 21–22 drawn from Delgadillo & Cárdenas 4308; fig. 23 drawn from P. & E. Hegewald 6575; fig. 28 drawn from Frahm 792315). Figs. 19–23. Leaves, × 17; figs. 24–25. Alar region, × 260; figs. 26–27. Upper margin of leaf, × 260; fig. 28. Capsule, × 4.

Hedwigia **74**: 79–114.

MÄGDEFRAU, Karl (1983): The bryophyte vegetation of the forests and páramos of Venezuela and Colombia. *Nova Hedwigia* **38**: 1–63.

MITTEN, W. (1869): Musci austro-americani. *J. Linn. Soc. Lond. Bot.* **12**: 1–659.

ROBINSON, Harold (1967): Preliminary studies on the bryophytes of Colombia. *Bryologist* **70**: 1–61.