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RESULTS OF A BOTANICAL EXPEDITION TO MOUNT RORAIMA, GUYANA. I. BRYOPHYTES

S.R. Gradstein and J. Florschütz-de Waard

Institute of Systematic Botany, Heidelberglaan 2, Utrecht

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Abstract: A bryological inventory of the Upper Mazaruni District, Guyana (former British Guiana) yielded almost three hundred species, including 2 genera and 11 species new to science and 130 species new to the Guianas. The densely forested and very humid north slope of Mount Roraima (500-2300 m.) proved to be the richest area for bryophytes and most of the novelties were found there. The present paper provides an enumeration of the species collected with a brief characterization of their habitat. The following species are described as new: *Haesselia acuminata* Gradst., *Plagiochila gymnocalyx* Inoue, *Radula gradsteinii* Yamada, *Radula guyanensis* Yamada, *Radula mazarunensis* Yamada and *Stenorrhypis grollei* Gradst. *Anastrophyllum* subg. *Vanaea* Inoue & Gradst. from Mount Roraima is elevated to generic rank.

INTRODUCTION

This paper presents results of a botanical exploration in the Upper Mazaruni District, Guyana (former British Guiana) in February 1985. Main goal was to inventory the north side of Mount Roraima. The exploration took place in the framework of the Flora of the Guianas project and was done by the first author in collaboration with H.J. Sipman and A. Aptroot (lichens) and J. Renz (orchids). A detailed itinerary of this expedition has been published elsewhere (Jansen-Jacobs et al. 1986, Gradstein 1986).

Mount Roraima (2750 m.) is the highest and probably best known mountain of a group of table mountains or 'tepui's of the Roraima sandstone formation (Guayana Highlands) surrounding the 'Gran Sabana' in the southeastern corner of Venezuela. The mountain is located on the intersection of the borders of Venezuela, Brazil and Guyana (Fig. 1). The major part of the

mountain lies in Venezuela and only a small northern portion belongs to Guyana. Mount Roraima is the highest point in the Guianas and the only mountain in this region with a well-developed montane flora.

The summit of Mt. Roraima is almost completely encircled by two sheer cliffs, each 400-500 m. high. The inaccessibility of the summit, noted by R. Schomburck and other 19th century explorers of the region, gave way to the belief that prehistoric forms of life persisted on the plateau and inspired A. Conan Doyle to write the novel *The Lost World*. Since 1884, when E. Im Thurn and H.J. Perkins discovered the ascent route to the summit and made the first botanical collections on the plateau, numerous expeditions have been made to Mount Roraima and its vascular flora has become comparatively well known. However, very little is

known about the bryophyte flora of Mount Roraima. The only relevant papers are by V.F.

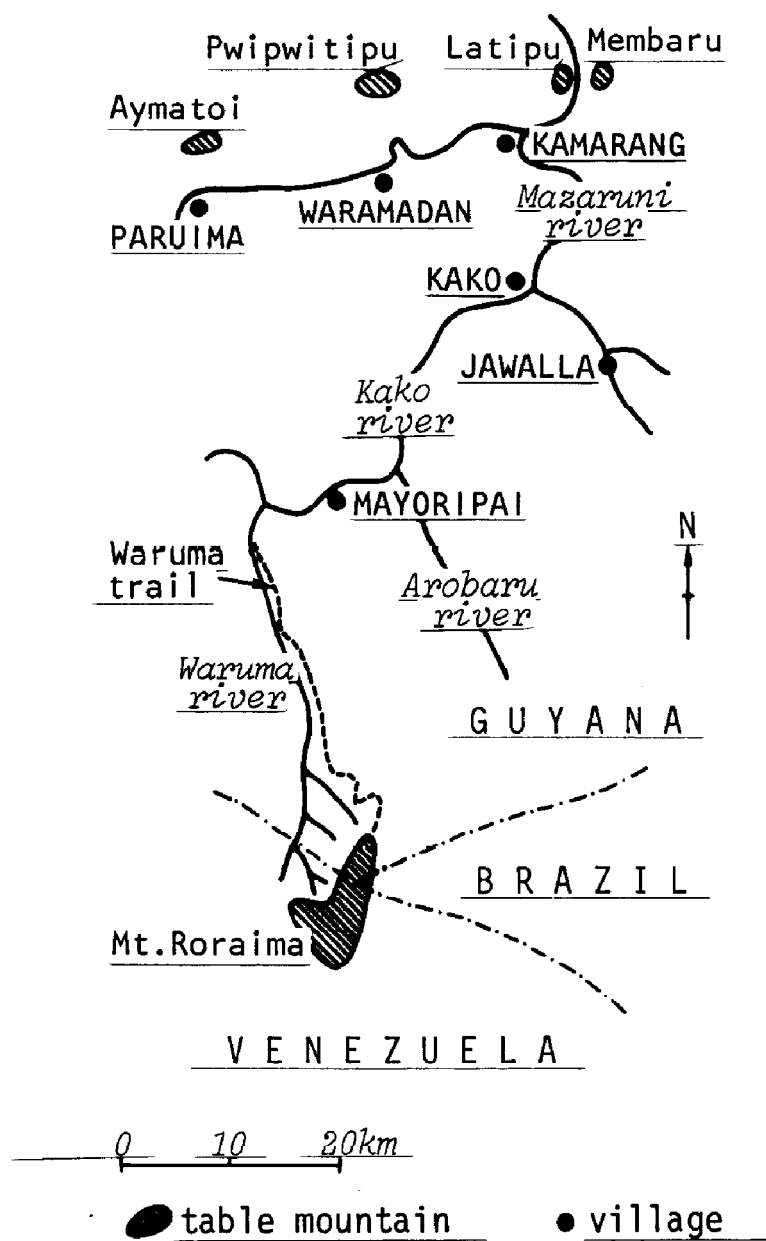


Fig. 1. Map of the region showing the inventoried localities.

Brotherus on the mosses and F. Stephani on the liverworts collected by F.V. McConnell and J.J. Quelch in 1896 (Brown et al. 1901). Although cited as originating from 'British Guiana', these collections are all from the Venezuelan part of the mountain and it is unlikely that any plant material was collected on the Guyana side of the mountain before 1971 (Steyermark 1981). Access to the summit is in the south in Venezuela, where the cliffs are at their lowest and meet with the uplands of the Gran Sabana at about 1400 m. At the north side, in Guyana, the mountain is surrounded by dense primary forest, which was not traversed by botanists until 1971 when a party of the Oxford Explorers Club led by A. Warren approached the mountain from Guyana. The route to the mountain from the north, the 'Waruma trail' (Fig. 1), is described in detail by Warren (1973) and MacInnes (1974).

Collecting at Mount Roraima during the 1985 expedition was done at altitudes of 550-2300 m. along the 'Waruma trail', following the Waruma river and up the north slope of the mountain to the ridge below the summit. A brief account on the topography and climatological conditions of this area was given by Warren (l.c.) and Holttum & Edwards (1983). The north side of the mountain is densely forested and wet as winds in the area are prevailing north-easterly, blowing moisture-laden ocean air from the Guyana coast to Mount Roraima. At the village of Pilippai (500 m.) in a flat river drainage area approximately 45 km east of Mount Roraima, annual rainfall amounts to 2800-3600 mm. It may be assumed that the northern slopes of the mountain receive considerably more precipitation. During much of the year, the upper slopes of Mount Roraima are enveloped in clouds. As a result, a 'mossy' submontane and montane forest vegetation is found on the slopes at this side of mountain from about 600 m. upwards.

Up to 1985, several British expeditions had explored the vascular flora of the Guyana side of the mountain but the bryophytes remained virtually unknown. P.J. Edwards (Kew Gardens) collected 18 specimens along the Waruma trail in 1978 and 1979, including 10 species of mosses and 3 species of liverworts (Edwards oral comm.). Our expedition yielded about 600 bryophyte collections (ca. 400 liverworts and 200 mosses)

from the Waruma trail area and the north slope of Mount Roraima. In addition, about 400 specimens were collected in other locations in the Upper Mazaruni District, including the surroundings of the Amerindian villages Mayoripai, Jawalla, Kamarang and Waramadan, the hills between Mt. Pwipwiti and Waramadan (colls. cited here as "Waramadan"), and Mt. Latipu (1000 m.) near Kamarang.

The localities are shown in Fig. 1.

To date, all of the mosses and the majority of the liverworts of the 1985 expedition have been identified. Lacking are the identifications of some Lejeuneaceae, Aneuraceae and Bazzania species. This paper presents the bryological results available thus far. In addition, some specimens gathered recently in the Upper Mazaruni District by other collectors are also included, viz. collections of P.J.M. Maas et al. (1981) from Mt. Aymatoi (1150 m.) and Paruima Mission, of P.J.M. Maas & L.Y.Th. Westra (1977, 1979) from Mt. Latipu and Mt. Membaru (ca. 1000 m.), and collections of H.E. Robinson (1986) from the surroundings of Kamarang.

All collections are in the Cryptogamic Herbarium of the University of Utrecht. S.R. Gradstein is responsible for the identification of the liverworts and J. Florschütz-de Waard for the mosses, unless otherwise indicated. The systematic arrangement of the families and genera in this paper follows the arrangement in the *Catalogue of the Bryophytes of the Guianas* (Gradstein & Hekking 1989; Florschütz-de Waard in prep.). Taxa new to the Guianas are marked by an asterisk.

ANNOTATED LIST OF SPECIES

HEPATICAEE

Herbertaceae

Herbertus divergens (Steph.) Herz. - Common epiphyte in montane scrub, also on exposed rock, 1000-2300 m. alt. Roraima (ridge): 5360; Latipu (summit): 5621, 5622, 5646.

**Herbertus juniperoides* (Sw.) Grolle - On trunks in humid rainforest, 500-700 m. alt. Roraima: 5044, 5115; Kamarang: 4803, 4806.

Earlier records of this species from the Guianas (Onraedt & Cremers 1980) belong to *H. divergens* (fide specimens in CAY and U).

**Herbertus pensilis* (Tayl.) Spruce - Common epiphyte on trunks, poles and twigs in sub montane and montane rainforest and scrub, 700-2300 m. alt. Roraima: 5132, 5207, 5366, 5410A, 5415.

Trichocoleaceae

Trichocolea tomentosa (Sw.) Gott. - Terrestrial in montane rainforest, 1200-1600 m. alt. Roraima: 5229, 5411.

Lepidoziaceae

Arachniopsis diacantha (Mont.) Howe (= *A. coactilis* Spruce) On dead wood and termite mounds in humid rainforest, often near creeks, and on boggy ground in montane scrub, 500-2300 m. alt. Roraima: 5017, 5368 (between *Trabacellula tumidula*), 5396a (between *Haesselia acuminata*); Latipu: 5582; Jawalla: 4876, 4901.

**Arachniopsis pecten* Spruce - On periodically flooded bank of Waruma river, on moist sand, with *Pteropsiella serrulata*, 550 m. alt. Roraima: 5028, 5032.

**Kurzia capillaris* (Sw.) Grolle - On moist soil along creeks and on sandstone rock, 550-800 m. alt. Roraima: 5032, 5081, 5082; Latipu: 5594; Waramadan: 5721.

Lepidozia coilophylla Tayl. - Common on rotten logs in mesic rainforest on white sand or clay, also on trunk bases and humus, 500-800 m. alt. Kamarang: 4790; Latipu: 5597; Waramadan: 5696, 5728.

**Lepidozia macrocolea* Spruce - On tree trunks and on soil in montane rainforest and scrub, 1150-1600 m. alt. Roraima: 5224; Aymatoi: Maas et al. 5833.

Telaranea nematodes (Gott. ex Aust.) Howe - On rotten wood, on humus and over litter in riverine, submontane and montane rainforest, 500-1600 m. alt. Roraima: 5253, 5302, 5409; Jawalla: 4892.

Bazzania gracilis (Hampe & Gott.) Steph. - Common epiphyte on trunks and poles in submontane and montane rainforest, also

terrestrial on shaded soil in montane scrub, 700-2300 m. alt. Roraima: 5121, 5258, 5301, 5333, 5353, 5412.

Bazzania hookeri (Lindenb.) Trevis. - On trunk in submontane rainforest, 700 m. alt. Roraima: 5123.

Bazzania cf. longistipula (Lindenb.) Trevis. - On bark and on humus in montane rainforest and scrub, 1200-2300 m. alt. Roraima: 5267, 5367, 5393.

Bazzania roraimensis (Steph.) Fulf. - On exposed branches in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5351, 5365.

Bazzania stolonifera (Sw.) Trevis. - Common epiphyte on trunks and poles in rainforest, 550-1600 m. alt. Roraima: 5067, 5251, 5410.

**Micropterygium campanense* Spruce ex Reimers - On branches in montane scrub, with *Odontoschisma atropurpureum*, 2000-2300 m. alt. Roraima (ridge): 5362.

**Micropterygium carinatum* (Grev.) Reimers - On wet rock in montane rainforest, with *M. pterygophyllum*, 1200-1600 m. alt. Roraima: 5380.

Micropterygium grandistipulum Steph. - On moist soil in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5396.

**Micropterygium pterygophyllum* (Nees) Trevis. - On wet sandstone rock in montane rainforest, with *M. carinatum*, 1200-1600 m. alt. Roraima: 5380.

Micropterygium trachyphyllum Reimers - Very common on rotten logs, roots and trunk bases in rainforest, 500-1600 m. alt. Roraima: 5114, 5124, 5416; Jawalla: 4921; Kamarang: 4795 (leg. Aptroot & Sipman).

**Micropterygium tumidulum* Fulf. - On rock and dry bark in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5395.

This rare species was previously only known from the Ayan tepui, Venezuela.

**Mytilopsis albifrons* Spruce - On rock, shaded soil and trunk bases in submontane scrub and in montane rainforest, 600-1600 m. alt. Roraima: 5375; Latipu (summit): 5652; Membaru: Maas & Westra 4321, 4324.

**Paracromastigum bifidum* (Steph.) Schust. - On periodically flooded sandy soil along Waruma river, with *Pteropsiella serrulata*, 550 m. alt. Roraima: 5081.

Pteropsiella serrulata Spruce ex Steph. - On moist, periodically flooded sand in savannahs and on riverbanks, also on termite mounds, 500-650 m. alt. Roraima: 5018, 5081; Mayoripai: 4974, 4978; Waramadan: 5686.

**Zoopsidella monodactyla* (Spruce) Schust. - On moist sand in savannah, with *Pteropsiella serrulata*, 500 m. alt. Mayoripai: 4974.

**Zoopsis integrifolia* (Spruce) Steph. - On humus and roots at trunk base in riverine rainforest, 550 m. alt. Roraima: 5040.

**Zoopsis macella* (Spruce) Steph. - On rotten wood and on termite mound in riverine rainforest, 550-800 m. alt. Roraima: 5017, 5052, 5129.

Calypogeiaceae

**Calypogeia caespitosa* (Spruce) Steph. (det. G.B.A. van Reenen) - On trunk in montane rainforest, 1200-1600 m. alt. Roraima: 5326.

**Calypogeia cellulosa* (Spreng.) Steph. (det. G.B.A. van Reenen) - On trunk bases in riverine rainforest, 550 m. alt. Roraima: 5063.

This species was previously only known from the West Indies.

**Calypogeia crenulata* Bischler (det. G.B.A. van Reenen) - On shaded rock in submontane rainforest and on litter in montane scrub, 700-2300 m. alt. Roraima: 5177, 5368a.

**Calypogeia laxa* Lindenb. & Gott. - On rotten wood and on soil over rock in moist rainforest, 800 m. alt. Waramadan: 5722.

**Calypogeia lechleri* (Steph.) Steph. - On rotten wood in rainforest, 600 m. alt. Latipu: 5559.

Calypogeia miquelii Mont. (?=*C. amazonica* (Spruce) Steph.) On clay soil and on trunk bases in moist rainforest, 500-600 m. alt. Roraima: 5014; Latipu: 5528.

Calypogeia peruviana Nees & Mont. - On humus, roots and dead wood in submontane and montane rainforest, 800-1600 m. alt. Roraima: 5282, 5432; Latipu: 5598.

**Calypogeia venezuelana* Fulf. - Epiphyte on bark of old trunks, roots and buttresses in riverine rainforest, 550-700 m. alt. Roraima: 5002, 5071, 5092, 5125.

Adelanthaceae

by R. Grolle, Jena

**Adelanthus squarrosus* Grolle spec. ined. - On trunks in montane rainforest, 1200-1600 m. alt. Roraima: 5419 (type specimen), 5283.

This new species is being described in the Journal of the Hattori Botanical Laboratory Vol. 67. It constitutes the first record of the family Adelanthaceae from the Guianas.

Cephaloziaceae

**Cephalozia crassifolia* (Lindenb. & Gott.) Fulf. - On rotten wood, on roots and on thin soil over rock in submontane forest, 800 m. alt. Latipu: 5589; Waramadan: 5722.

**Nowellia evansii* Grolle - On decorticated logs in moist, riverine rainforest, 500-700 m. alt. Kamarang: 4827 (leg. Aptroot & Sipman); Roraima: 5098, 5128.

**Alobiella husnotii* (Gott.) Schiffn. (?=*Alobiella campanensis* Steph.) - On shaded, moist rock and soil in submontane and montane rainforest, often forming extensive mats on cliffs, occasionally rheophytic in streams (nr. 5099), 700-1600 m. alt. Roraima: 5099, 5197, 5266, 5279, 5427.

Fulford (1971) recorded *A. campanensis* Steph. from the Guayana Highlands of Venezuela. We have checked original material of *A. campanensis* from Peru (Mt. Guayrapurina, Spruce s.n. as *A. husnotii*) and found that these plants are essentially similar to *A. husnotii* but stand out by their rather small size, rather spatiate leaves and leaf cells little narrowed towards the margins. Most likely *A. campanensis* is just a modification of *A. husnotii*. Caribbean material of the latter species has been described and illustrated by Fulford (1968) and Schuster (1969). The cell walls in the Roraima materials vary from faintly striate-verruculose as in typical *A. husnotii* to strongly and densely verrucose (5266, 5197). In coll. 5197 this variation is found within single specimens. Coll. 5099 is very peculiar and is only tentatively placed in *A. husnotii*. The leaves in these specimens are rather obliquely inserted and of two shapes: 1) widely spreading and more or less convex above, 2) obliquely spreading and more or less concave with a sheathing base. The

wide-spreading leaves are bifid up to 1/5-1/4 of their length, somewhat more deeply bifid than usual although Fulford (1968: Pl. 103, 2c) depicted a similar leaf in Caribbean *A. husnotii*. The oblique-spreading leaves, however, are much more deeply bifid, up to 2/3 of their length. Shallowly bifid leaves are located at the upper portions of the shoots, whereas deeply bifid leaves are normally positioned lower down. As the plants in all other respects seem to be identical to *A. husnotii*, we hesitate to describe them as a different taxon. Possibly the plants are an adaptation to the rheophytic habitat; the deeply bifid leaves may represent the juvenile leaf condition and thus constitute a paedomorphic expression of the species.

**Odontoschisma atropurpureum* Steph. - On branches in montane scrub, with *Micropterygium campanense*, 2000-2300 m. alt. Roraima (ridge): 5362.

**Odontoschisma denudatum* (Mart.) Dum. - On trunk bases, roots and rotten wood in rainforest, 500-800 m. alt. Roraima: 4988; Waramadan: 5710.

Anomoclada portoricensis (Hampe & Gott.) Vána (= *A. mucosa* Spruce) - Common on rotten logs and roots, also on trunk bases, moss-covered rock and boggy ground, in mesic or moist rainforest and in montane scrub, 550-2300 m. alt. Roraima: 5000, 5038, 5127, 5369; Latipu: 5634, Maas & Westra 4186; Aymatoi: Maas et al. 5796; Membaru: Maas & Westra 4263, 4287.

**Trabacellula tumidula* Fulf. - Epiphyte on stilt roots and trunks in riverine and montane rainforest, also on litter in montane scrub, 550-2300 m. alt. Roraima: 5091, 5303, 5368.

Haesselia roraimensis Grolle & Gradst. - On rotten logs and dead wood in riverine and submontane rainforest, also on trunk bases and roots, with *Anomoclada mucosa* and *Micropterygium trachyphyllum*, 550-1600 m. alt. Roraima: 5100 (type specimen), 5066, 5280, 5296, 5435.

This new genus and species was described by Grolle & Gradstein (1988).

**Haesselia acuminata* Gradst. spec. nov. (Fig. 2) - On moist soil in montane scrub among *Anomoclada portoricensis*, *Arachniopsis diacantha* and *Micropterygium tumidulum*,

north slope of Mt. Roraima (ridge), 2000-2300 m. alt., leg. S.R. Gradstein 5369a, 14-17 February 1985 (U holotype; isotype in hb. Grolle).

A Haesselia roraimensis differt: *statura minore, ramis ventrali-intercalaribus, foliis acuminatis atque dorsaliter decurrentibus, cellulis foliorum maioribus.*

Dioicous, brownish when dry, the shoot fragments up to 2 cm long, 1.5-2 mm wide, creeping (?), sparsely and irregularly branched, the branches ventral-intercalary, stolons lacking; rhizoids colorless, scattered on the ventral stem surface, on some shoot portions lacking.

Stems thick and rigid, ca. 0.3 mm in diameter, reddish brown, dorsally with a strip of 2(4) cortical cells free of leaf insertion, the ventral merophyte 1 row of cortical cells wide. Cross section of stem applanate above, about 9 cells high, with a distinct hyalodermis of rather large cells with slightly thickened, colorless walls surrounding a medulla made up of smaller cells with strongly thickened, pitted brown walls, the hyalodermis asymmetric: dorsally of 1 layer of cells, ventrally in part of 2 layers of cells.

Leaves alternate, succubous, spreading at an angle of ca. 60° and somewhat ventrad, the surface convex, the outline broadly and asymmetrically ovate-triangular, 1.2-1.4 mm long, 1-1.3 mm wide, the insertion line suboblique, straight for most of its length, curved downwards towards the ventral leaf base, about 4/5 x leaf length; dorsal leaf base longly decurrent, ventral leaf base not decurrent, the margins entire, the dorsal margin more or less plane and straight except near the apex, the ventral margin recurved, arched and somewhat ampliate near the base, the leaf apex usually recurved, short acuminate (3-4 cells long) with a 1-celled tip.

Leaf cells very large and almost empty, short rectangular, pentagonal or hexagonal, in the upper middle of the leaf 90-140 x 60-100 µm, towards the base up to 200 µm long, the walls brownish, slightly thickened by stellate trigones, the trigone rays of variable length, opposite rays approaching each other and leaving a narrow pit; cuticle smooth; oilbodies not observed.

Underleaves lacking. Androeceia not seen.

Gynoeceia at the tip of a leading shoot, with a single ventral-intercalary innovation, the vege-

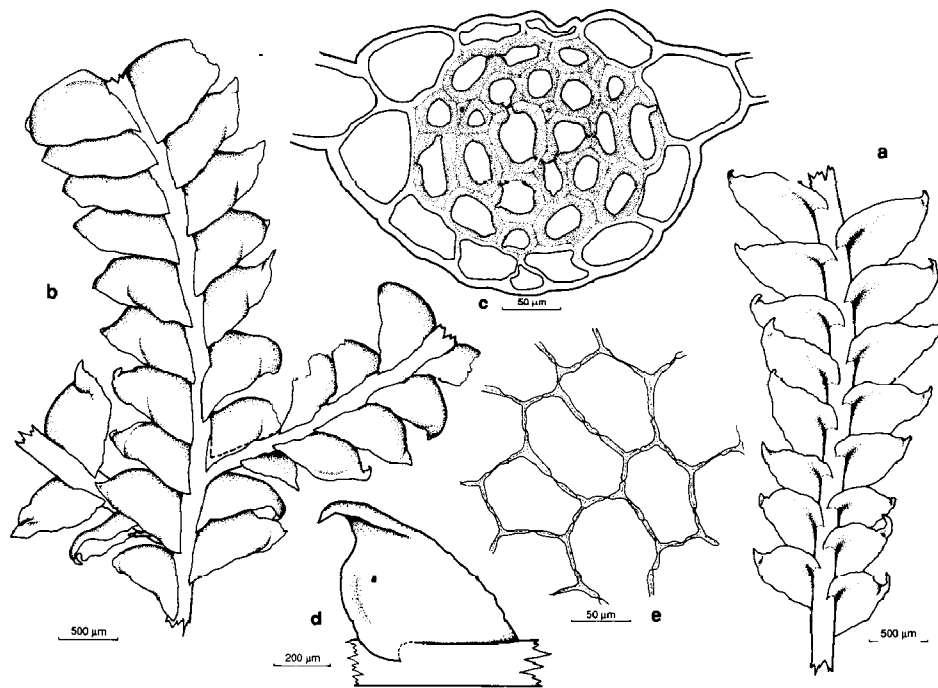


Fig. 2. *Haesselia acuminata* Gradst. a. Portion of stem, ventral view. b. Ibid., dorsal view. c. Cross section of stem. d. Leaf, ventral view. e. Leaf cells. Drawn from the holotype (by M. Aptroot-Teeuwen).

tative leaves gradually (5-6 leaf cycles) becoming transverse towards the involucre, their apex becoming unequally bilobed to 1/3, their dorsal base becoming slightly concave, without tooth. Involucre erect, brush-like compressed in absence of fertilization, with bracteoles, the bracts and bracteoles in 2(?) series, free, the bracts very different from ordinary leaves, slightly longer, bisbifid to 3/4 of their length, the lobes lanceolate-acute, the lateral lobes shorter and narrower than the median lobes; bracteoles narrower than the bracts, narrowly oblong, bifid to 3/4. Perianth lacking.

Vegetative reproduction not observed.

Haesselia acuminata belongs in the genus *Haesselia* (Cephaloziaceae subfam. Trabacelluloideae) because of the somewhat obliquely Jungermanniaceae

5233, 14-18 February 1985, fertile plants (U holotype; isotype in hb. Grolle).

Additional material: Guyana, Mabura Hill ca. 180 km. SSE of Georgetown, mixed lowland rainforest near Yaya Creek, on rocks near running water, 0-50 m. alt., leg. H. Cornelissen, S.R. Gradstein & H. ter Steege C103, 9 March 1985, sterile plants (U).

Planta monoica ab S. madagascariensis, cui affinis est, differt foliis apice truncatis vel rotundatis.

Plants monoicous, forming small dark-green mats on rocks in streams, consisting of erect leafy shoots arising from leafless creeping stolons, the erect shoots up to 1 cm long, unbranched and without rhizoids, in the lower half brown and usually leafless or with rudimentary leaves, stoloniform, in the upper half greenish-brown and with well-developed leaves, the creeping stolons brown, without or with sparse rhizoids, irregularly branched, the branches intercalary. Stem rather fragile, up to 0,2 mm in diameter, in

**Stenorhipis grollei* Gradst. *spec. nov.* (Fig. 3) -

On rock in stream, north slope of Mount Roraima, ca. 1200 m. alt., leg. S.R. Gradstein

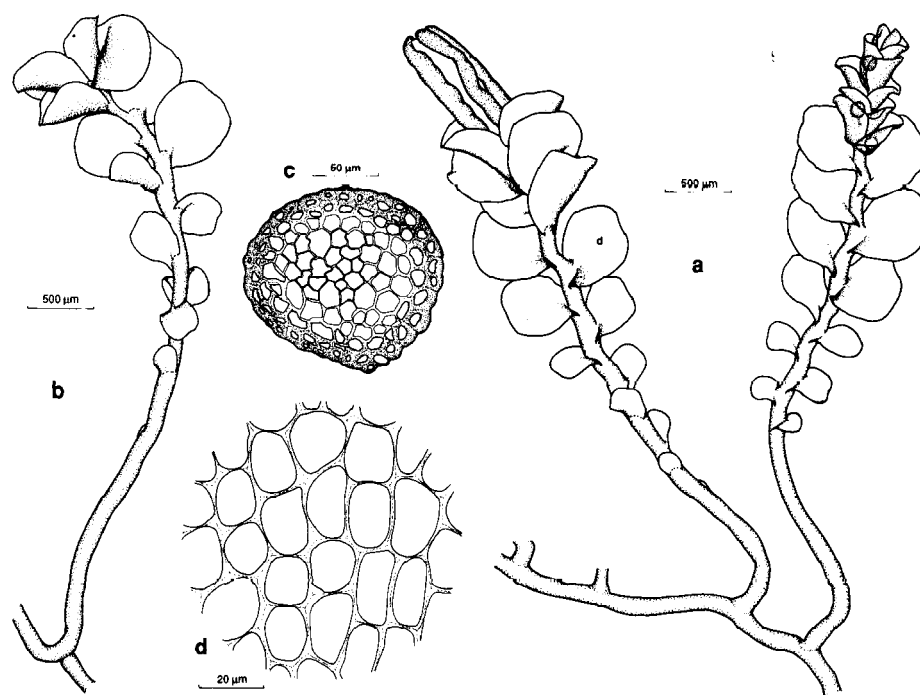


Fig. 3. *Stenorrhapis grollei* Gradst. a. Portion of fertile plant, dorsal view. b. Leafy shoot, ventral view. c. Cross section of stem. d. Leaf cells. Drawn from the holotype (by M. Aptroot-Teeuwen).

cross section consisting of a 2-celled thickwalled brown epidermis surrounding a thinwalled hyaline medulla, the outer epidermal cells small, ca. 12 µm high, the subepidermal cells larger and less thickened, 14-17 µm high, the medullary cells 16-23 µm high.

Leaves succubous, oblique to subtransverse, obliquely to widely spreading, the lamina plane to convex, concave at the base, quadrate to obovate, 0,5-0,9 mm long, the margins entire, plane, straight or slightly curved, narrowed to the base, the apex truncate to rounded; leaf cells small, quadrate to rectangular, in the upper middle 12-22 x 10-20 µm, slightly larger near the base, the walls somewhat thickened, the cuticle smooth; oil bodies not observed.

Underleaves lacking.

Androecia in spikes terminal on the leafy shoots, the androecial bracts in 6-8 series, much smaller than vegetative leaves, saccate-imbricate, bearing 2 antheridia each; androecial bracteoles

lacking; antheridium ovoid, ca. 100 µm in diameter, the stalk shorter than the body, uniseriate.

Gynoeceium terminal on a leafy shoot, without innovations, the bracts transverse, in 2 series, resembling vegetative leaves (undivided, margins entire) but the subinvolucral bracts slightly larger, the involucral bracts smaller, their bases connate with the perianth, unequal in size: the outer involucral bract slightly shorter than the subinvolucral bracts and spreading at apex, the inner one much smaller, ca. 1/2 x the length of the subinvolucral bracts, fully erect and more or less appressed to the perianth.

Perianth cylindrical, longly exserted beyond the involucre, ca. 2 mm long, deeply 4-lobed over its entire length, the lobes rounded-smooth on their backs, slightly waving, separated from each other by a narrow sinus; perianth mouth truncated, irregularly crenate, of thickwalled rectangular cells.

Stenorhipis grollei constitutes the first New World record of *Stenorhipis* Herz., a small, poorly known genus previously collected a few times on the East African Islands (*S. madagascariensis* (Steph.) Grolle) and in Malesia (*S. rhizomatica* Herz.). All species seem to be rheophytic and exhibit the characteristic growth habit of creeping stolons and short, erect leafy shoots. *S. grollei* differs from the other species by the undivided leaves, those in *S. rhizomatica* and *S. madagascariensis* being bifid (Grolle 1963). *S. madagascariensis* seems to approach *S. grollei* most closely because of its broad and shallow leaf incision and rounded lobes. The Roraima material is the first collection of *Stenorhipis* with mature gynoecia. Dr. R. Grolle is acknowledged for his advice concerning the generic position of this new species.

**Vanaea* (Inoue & Gradst.) Inoue & Gradst. *gen. nov.* (*Anastrophyllum* subg. *Vanaea* Inoue & Gradst., Bull. Nat. Sci. Mus. Tokyo, Ser. B, 14: 88, 1988).

Type species: *Vanaea plagiophiloides* (Inoue & Gradst.) Inoue & Gradst. *comb. nov.* (*Anastrophyllum plagiophiloides* Inoue & Gradst., Bull. Nat. Sci. Mus. Tokyo, Ser. B, 14: 88, 1988). Reddish epiphyte pendent from branches in the montane scrub and the montane rainforest canopy on the north slope and ridge of Mt. Roraima, ca. 1400-2300 m. alt. ("2000-2300 m." in sched.): 5363 (type specimen), 5364, Aptroot 17108a.

This peculiar new species was originally placed in the subgenus *Vanaea* Inoue & Gradst. of *Anastrophyllum*, characterized by several unique features such as the leaves, which are widely spreading, flat or more or less convex and narrowly oblong with subtruncate apex, the oblique dorsal leaf insertion, the leaf-free strip on the dorsal stem surface and the pendent, epiphytic growth. Particularly striking are the leaf insertion-line and the leaf-free strip on the stem, the latter character being unique in Jungermanniaceae and being reminiscent of Cephaloziaceae. We have now come to the conclusion that the species should be removed from *Anastrophyllum* and placed in a new genus. We acknowledge the advice of our colleagues Dr. Riclef Grolle and Dr. Jiri Vána as to the generic

placement of the species.

The Gradstein collections are from the North ridge of Mt. Roraima, where the species is rather common on isolated shrubs. The Aptroot specimen is from the canopy of the montane rainforest lower down on the north slope and consists of a few shoots, which were growing in a mat of *Frullania pendulostyla*.

**Jamesoniella rubricaulis* (Nees) Grolle - On dry bark of *Clusia* sp. in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5401.

**Syzygiella perfoliata* (Sw.) Spruce (det. J. Vána) - On branches in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5352.

Scapaniaceae

**Scapania portoricensis* Hampe & Gott. - On mossy trunks in montane rainforest and on wet bark and humus in montane scrub, 1200-2300 m. alt. Roraima: 5252, 5407, 5413.

Geocalycaceae

**Leptoscaphus cuneifolius* (Hook.) Mitt. - On dry bark of *Clusia* sp. in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5400c.

**Leptoscaphus gibbosus* (Tayl.) Mitt. - Epiphyte on trunks and canopy-branches in montane rainforest and in scrub, 1000-1600 m. alt. Roraima: 5337, 5467; Latipu: 5613.

**Leptoscaphus ovatus* (Spruce) Grolle - Common on branches and twigs in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5355, 5357.

**Lophocolea liebmanni* Gott. - On trees in village, 500 m. alt. Jawalla: 4831.

Lophocolea martiana Nees - Common on rotten logs, dead wood and roots in rainforest, also on boulders in stream, 500-800 m. alt. Jawalla: 4907; Latipu: 5533, 5536, 5599; Waramadan: 5743.

Lophocolea perissodonta (Spruce) Steph. - On rotten log in riverine forest, 550 m. alt. Roraima: 5042.

**Lophocolea trapezoidea* Mont. - Common epiphyte on mossy trunks, poles, saplings, logs and dead wood in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5131, 5171, 5234, 5290, 5300, 5461.

Plagiochilaceae

by H. Inoue, Tokyo

Plagiochila abrupta Lehm. & Lindenb. - Epiphyte on trunks, poles, saplings and logs in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5116, 5119, 5276, 5409.

****Plagiochila aerea*** Tayl. (= *P. steyermarkii* Robins.) - On canopy branches and on shaded soil under rock in montane rainforest and scrub, 1000-2300 m. alt. Roraima: 5468a, 5344; Latipu (summit): 5635, 5644. *P. steyermarkii* is only a young, slender form of *P. aerea*.

****Plagiochila arcuata*** Lindenb. - On base of dead trunk in rainforest, 600 m. alt. Latipu: 5572.

****Plagiochila bidens*** Gott. - On trunks, poles and wet rock in montane rainforest and scrub, 1000-1600 m. alt. Roraima: 5310, 5378, 5462; Latipu (summit): 5620.

Plagiochila bursata (Desv.) Lindenb. - Common epiphyte on trunks, branches, poles, saplings and logs in submontane and montane rainforest, occasionally in scrub, (500-)700-1600 m. alt. Roraima: 5117, 5184, 5247, 5437; Kamarang: 4811 (leg. Aptroot & Sipman); Latipu: Maas & Boyan 2661; Membaru: Maas & Westra 4284.

Plagiochila depressa Spruce - Common on trunks, roots, logs and rock in rainforest, 500-800 m. alt. Roraima: 5019; Jawalla: 4839; Latipu: 5566, 5587, 5602.

Plagiochila disticha (Lehm. & Lindenb.) Mont. (= *P. hypnoides* Lindenb.) - On dead trunk in rainforest, 600 m. alt. Latipu: 5532. The synonymy is discussed in Inoue (1989).

Plagiochila divaricata Lindenb. - Epiphyte on twigs, poles, saplings and logs in rainforest, 500-700 m. alt. Roraima: 4989, 5118, 5178; Kamarang: 4826; Jawalla: 4842.

****Plagiochila dussiana*** Steph. - On soil under rock in montane rainforest, 1200-1600 m. alt. Roraima: 5220.

****Plagiochila echinella*** Gott. - Epiphyte on trunks, branches and logs in rainforest and scrub, 550-1000 m. alt. Roraima: 5004; Latipu: 5635a, Maas & Westra 4206.

****Plagiochila esmeraldana*** Steph. - Common on mossy trunks and poles in montane rainforest, also on rock, 1200-1600 m. alt. Roraima: 5226, 5291, 5331.

****Plagiochila guilleminiana*** Mont. - Epiphyte on trunks, saplings and logs in mesic rainforest, 500-600 m. alt. Jawalla: 4838, 4868; Latipu: 5576.

****Plagiochila gymnocalyx*** Inoue *spec. nov.* - On soil in riverine rainforest along Waruma river, ca. 15 km. north of Mt. Roraima, 550 m. alt., leg. S.R. Gradstein 5056, 10 February 1985 (TNS holotype; isotype in U).

Plagiochila divaricata Lindenb. *valde affinis, sed differt 1) marginibus foliorum vulgo nudis vel raro 1-3 dentatis, dentibus minoribus (non 6-10 dentatis), et 2) marginibus bractearum nudis.*

Plants medium to large in size, 3-6 cm long and 4-6 mm wide, dull to pale brownish green, obliquely ascending, without creeping stem. Stem about 300 µm thick, bright brown, broadly exposed both dorsally and ventrally, in cross section about 18 cells across, the cortical cells in 2(-3) layers, thick-walled, with bright brown color, the inner cells thin-walled; branches sparse, always lateral-intercalary, as vigorous as the leading shoot, gradually attenuate toward the apex when sterile.

Leaves remote, rather flat, nearly horizontally or sometimes subobliquely spreading, the dorsal margin weakly revolute, moderately decurrent along the dorsal stem-midline, the ventral margin hardly decurrent, at base not extending to the ventral midline, leaving a ventral merophyte of 3-4 cell rows; leaves oblong or oblong-ligulate, 1-1,5 mm wide and 2,1-2,5 mm long (1,6-2,2 x as long as wide), widest at the middle, moderately cuneate toward the base, the dorsal margin nearly straight to moderately arched, entire, the apex rounded or obliquely truncate, entire or sometimes with 1-3 small teeth (or sometimes only angulations), the ventral margin arched, entire. Cells of the leaf middle 20-30 x 30-45 µm, of the leaf base 25-33 x (45-)50-75 µm, the walls thin, the trigones small, elongated along the cell walls as in *P. bursata* (thus, cell walls sometimes appearing to be evenly thickened), cuticle smooth; oil bodies not observed.

Underleaves vestigial, 2-3 cells wide, with 2-3 cilia of 2-3 cells long each, easily dropped off on

mature shoots.

Asexual reproduction not seen.

Gynoecea terminal on shoot, with 1-2 innovations; bracts similar to leaves in size and shape, the margins entire or sometimes with 1-3 small teeth (or merely angulations) around the apex; perianth long exserted, cylindrical, 2,8-3,3 mm long and 1,8-2,1 mm wide, the dorsal keel near equal to (or little longer than) the ventral keel, not winged, the mouth nearly truncate and spinosely toothed, the teeth 1-2(-3) cells wide at base and 3-6 cells long.

This new species is very similar to *Plagiochila divaricata* Lindenb., but well characterized by 1) the nearly horizontally spreading leaves, 2) the usually entire leaf margins (sometimes with 1-3 small teeth), 3) the moderately cuneate leaf base, 4) the small trigones narrowly elongating along the cell walls as in *P. bursata*, and 5) the long exserted cylindrical perianth.

**Plagiochila hansmeyeri* Steph. - On small trunk in rainforest, 600 m. alt. Latipu: 5531.

**Plagiochila irmscheri* Steph. - On rock in montane rainforest, 1200-1600 m. alt. Roraima: 5223.

Plagiochila laetevirens Lindenb. - On leaning trunk in rainforest, 500 m. alt. Jawalla: 4852.

**Plagiochila lansbergii* Gott. - On trunks and rock in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5120, 5307.

Plagiochila macrifolia Tayl. - Epiphyte on trunks and branches in mesic rainforest and scrub, 500-1000 m. alt. Jawalla: 4893, 4927; Latipu (summit): 5612.

Plagiochila micropterys Gott. - Common epiphyte on trunks in mesic rainforest, also on saplings, 500-800 m. alt. Latipu: 5546, 5570; Waramadan: 5691.

**Plagiochila pearceana* Steph. - On trunk bases and litter in montane rainforest, 1200-1600 m. alt. Roraima: 5418.

**Plagiochila pittieri* Steph. - On branches overhanging the Waruma river, 550 m. alt. Roraima: 5055.

Plagiochila raddiana Lindenb. (= *P. patentissima* Lindenb.) - Common on boulders in stream, 800 m. alt. Waramadan: 5744.

**Plagiochila rubescens* (Lehm. & Lindenb.) Lindenb. - Epiphyte on buttresses and twigs in riverine rainforest, 550 m. alt. Roraima: 4991,

5003.

Plagiochila rutilans Lindenb. - Epiphyte on trunks, poles, saplings and canopy branches in riverine and montane rainforest, 600-1600 m. alt. Roraima: 5222, 5425, 5468; Latipu: 5537.

Plagiochila serrata (Roth) Lindenb. - On trunk in mesic rainforest, 500 m. alt. Jawalla: 4959.

Acrobolbaceae

by R. Grolle, Jena

**Marsupidium gradsteinii* Grolle - Locally common on trunk bases, roots, rotten wood and periodically flooded soil and rock along rivers in rainforest, 500-1600 m. alt. Roraima: 5029, 5080, 5111 (type specimen), 5173, 5236; Jawalla: 4922; Kamarang: 4814 (leg. Aptroot & Sipman).

This new species was described by Grolle (1989). It has also become known from French Guiana and Brazil (Amazonas).

**Tylimanthus striolatus* Steph. - On mossy trunks in montane rainforest, 1200-1600 m. alt. Roraima: 5305, 5414.

**Tylimanthus subtilis* Steph. - On twig in montane rainforest, 1400 m. alt. Roraima: 5442.

Balantiopsaceae

**Isotachis multiceps* (Lindenb. & Gott.) Gott. - On sand over rocks in riverbed in montane rainforest, 1200-1600 m. alt. Roraima: 5340a.

**Neesioscyphus argillaceus* (Nees) Grolle (det. R. Grolle) - On sand over rocks in riverbed in montane rainforest, 1200-1600 m. alt. Roraima: 5309.

Pleuroziaceae

**Pleurozia heterophylla* Steph. ex Fulf. - On smooth bark of *Clusia* sp. and on exposed branches in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5359, 5394.

Radulaceae

by K. Yamada, Ise

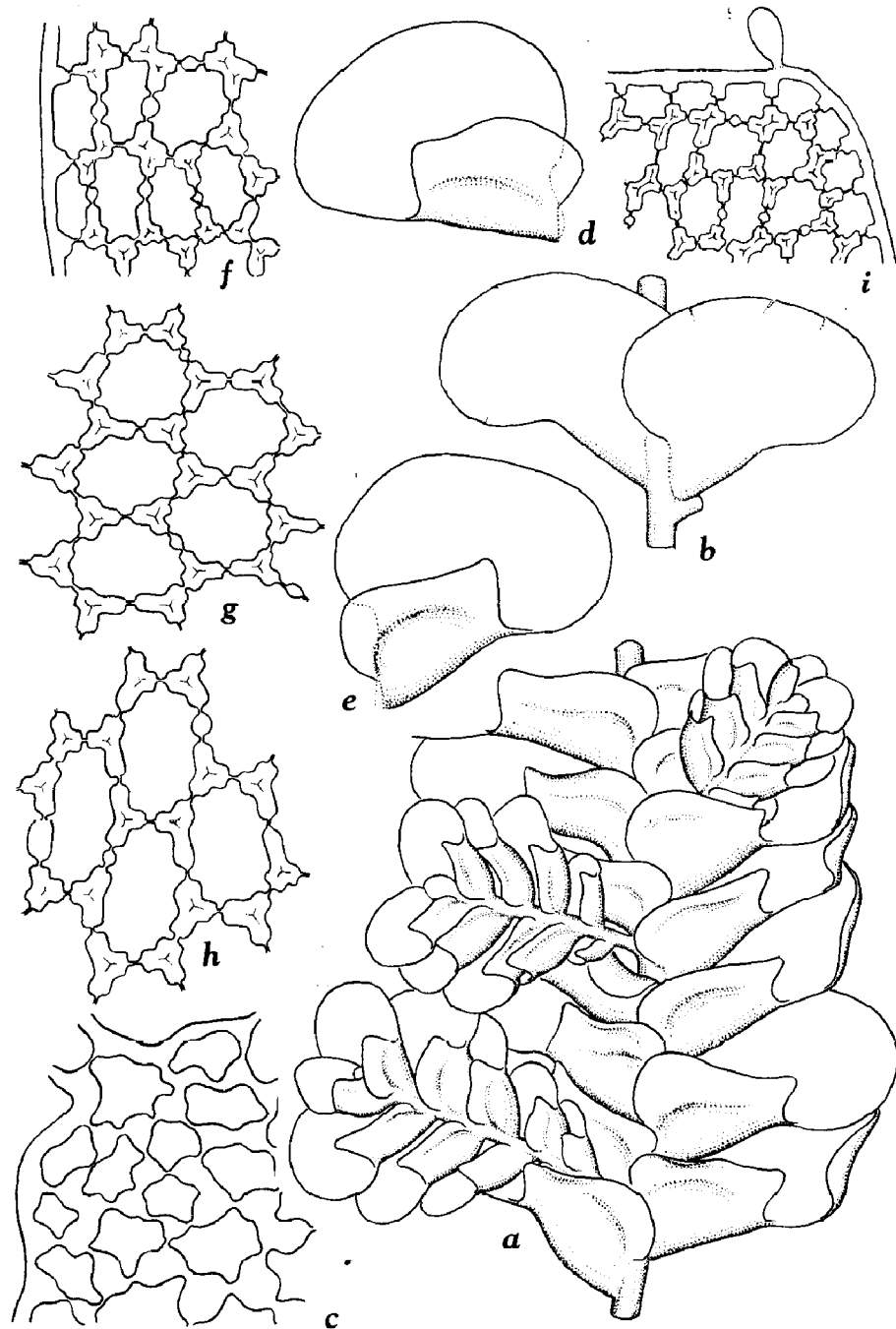


Fig. 4. *Radula gradsteinii* Yamada. a. Portion of stem, ventral view, x 26. b. Leaves on stem, dorsal view, x 26. c. Portion of cross section of stem, x 533. d, e. Leaf lobes, x 26. f-h. Cells of lobe of stem leaf (f from margin, g from middle, h from base), x 533. i. Apical portion of leaf lobule, x 533. Drawn from the holotype.

Radula flaccida Lindenb. & Gott. - On living leaves in rainforest, with *Cyclolejeunea convexistipa*, 500 m. alt. Jawalla: 4862.

****Radula gradsteinii*** Yamada *spec. nov.* (Fig. 4)
- On poles in scrubby vegetation, summit of Mt. Latipu ca. 8 km. north of Kamarang, 1000 m. alt., leg. S.R. Gradstein 5608, 25 February 1985 (U holotype; isotype in NICH).

Planta sterilis, mediocris, olivacea; caulis dense et irregulariter pinnatim ramosus; lobi foliorum caulinarum moderate imbricati, in plano ovati, plerumque apice anguste incurvo, cellulis majoribus, parietibus tenuioribus trigonis majoribus, bene nodulosus, cuticula dense et minute verrucosa; lobuli laxe imbricati, in plano subquadrati, apice in plano angulato, area caulinati valde inflata, subrecta (vel leviter arcuata), sinu lato vel fere nullo.

Plants medium-sized, yellow-brown in herbarium. Stem 10-25 mm long, ca. 0,13 mm in diam., with leaves 2,0-2,3 mm wide, irregularly pinnately branched, branches 1,7-2,0 mm long, ca. 0,08 mm in diam., with leaves 1,1-1,2 mm wide; stem 5-7 cells thick, cortical cells as large as medullary cells, all cells somewhat thick-walled with large, nodulose trigones, pale yellow.

Leaf-lobes moderately imbricate, widely spreading, slightly concave, ovate, 1,3-1,4 mm long, 1,0-1,2 mm wide, apices obtuse, narrowly incurved, basal margins arched. not auriculate at base, dorsally extending more than stem-width beyond the farther edge of stem, insertion almost straight; marginal cells 20-21 x 21-24 µm, median cells 25-28 x 21-22 µm, basal cells 31-38 x 21-24 µm, all cells thin-walled with large, strongly bulging, nodulose trigones, intermediate thickenings present; cuticle minutely and densely verrucose; leaf-lobules loosely imbricate, widely spreading, subquadrate, ca. 1/2 of the lobe length, 0,7-0,8 mm long, ca. 0,6 mm wide, apices bluntly angular (when flat), abaxial margins almost straight, decurrent, adaxial margins arched toward base, the bases not auriculate, extending less than stem-width beyond the opposite edge of stem, insertions almost straight, short, carinal regions usually widely inflated; rhizoids scarce, brown; keel spreading at angles of ca. 60° with the stem, 0,6-0,75 mm long, straight or slightly arched, not decurrent, sinuses very wide or absent.

Sexual organs not seen.

Radula gradsteinii is characterized by 1) the cell-walls of the leaf-lobes thin with large, strongly bulging, nodulose trigones and with a minutely and densely verrucose cuticle, and 2) the widely spreading, subquadrate leaf-lobules with almost straight and not-decurrent keels. The species is unique by the cell-wall characters mentioned above and seems to have no close relative in tropical America. It belongs in the subsection *Densifoliae* (Castleex Grolle) Yamada & Piipo of the subgenus *Radula*.

****Radula guyanensis*** Yamada *spec. nov.* (Fig. 5)

- On roots in rainforest, Jawalla village at confluence of Kukui river and Mazaruni river, 500 m. alt., leg. S.R. Gradstein 4859, 6-7 February 1985 (U holotype; isotype in NICH).

Planta sterilis, brunnea; caulis dichotomae ramosus (?); lobi foliorum caulinarum laxe vel moderati imbricati, in plano ovati, apice obtuso, parietibus cellularum medianae tenuibus, trigonis minutis, cuticula laevis; lobuli oblique patuli, subquadrati vel quadrati, basi caulem 1/2-1/3 tegente, rotundato vel triangulato, carina sub angulo 50° patente, subrecta vel leviter arcuata, non decurrente.

Plants small, brown in herbarium. Stem 5-10 mm long, ca. 0,18 mm in diam., with leaves 1,6-1,8 mm wide, dichotomously branched (?), secondary branches present but infrequent, branches 1-2 mm long. Stem 6-7 cells thick, epidermal walls strongly thickened, pale yellow, medullary cells thin-walled without trigones, subhyaline.

Leaf-lobes loosely to moderately imbricate, widely spreading, slightly concave, when flat ovate, falcate, 0,8-0,85 mm long, 0,6-0,65 mm wide, apices obtuse, not incurved, dorsal bases arched, not auriculate, covering the stem 2/3-4/5 of the stem-width (rarely extending slightly beyond the opposite edge of the stem), insertion almost straight; marginal cells 13-16 x 9-10 µm, median cells 19-21 x 16-18 µm, basal cells 24-28 x 13-15 µm, all cells thin-walled with minute trigones, intermediate thickenings lacking, cuticle smooth; leaf-lobules remote, obliquely spreading, subquadrate to quadrate, ca. 1/3 of the lobe length, 0,2-0,3 mm long, apices bluntly angular (or occasionally obtuse and prolonged),

appressed to the lobe, abaxial margins slightly arched to almost straight, not decurrent, adaxial margins almost straight toward the rounded to bluntly angular bases, sinuate at middle, basal portions covering the stem 1/3-1/2 of the stem-width (never extending beyond the stem), insertions slightly arched, carinal regions narrowly inflated; rhizoids scarce, brown; keel spreading at angles of ca. 50° with the stem, 0,2-0,3 mm long, almost straight to slightly arched on lower stem portions, not decurrent, sinuses bluntly angular to obtuse.

Sexual organs not seen.

The diagnostic characters of *Radula guyanensis* are 1) the thickened epidermal walls of the stem, 2) the ovate leaf-lobes with obtuse apices, 3) the thin-walled leaf cells with smooth cuticle, 4) the more or less quadrate leaf-lobules with rounded to bluntly triangular, non-auriculate bases (covering 1/3-1/2 of the stem-width) and more or less straight keels, and 5) the keels spreading at ca. 50° with the stem.

The new species is closely related to *Radula longiloba* Yamada from Cuba. The latter species differs by its irregularly pinnate branching, its longer, ovate-oblong leaf-lobes and its slightly wider spreading keel (60°). Although the branching pattern of *R. guyanensis* remains unclear, presumably this new species belongs in the section *Dichotomae* Castle ex Grolle.

**Radula husnotii* Castle - On trunk in montane rainforest, 1200-1600 m. alt. Roraima: 5339.

**Radula involvens* Spruce - On poles, logs and wet rock in montane rainforest, 1200-1600 m. alt. Roraima: 5287, 5391, 5441.

Radula caldana Aongstr. (= *R. surinamensis* Steph.; *R. longifolia* Steph.) - Common epiphyte on tree trunks in mesic rainforest, savannah bush and orchards, 500-650 m. alt. Jawalla: 4832, 4851, 4961; Waramadan: 5665.

This species is closely related to *R. macrostachya* Lindenb. & Gott. (see Yamada 1988: 384).

**Radula mazarunensis* Yamada *spec. nov.* (Fig. 6) - On rough bark of trunk in rainforest at the foot (N. side) of Mt. Latipu, ca. 8 km. north of Kamarang, 500 m. alt., leg. S.R. Gradstein 5548, 24 February 1985 (U holotype; isotype in NICH).

Planta mediocris, flavobrunnea; caulis irregu-

lariter pinnatim ramosus, oblique patulis; lobifoliorum moderate vel laxi imbricati, ovati (raro falcati-ovati), apice obtuso, cellularum parietibus tenuibus, trigonis minutis, cuticula laevi; lobuli remoti, oblique patuli (sub angulo ca. 30° patentibus), subquadrati raro subrhombici, basi caulem 1/4-1/2 tegente (raro haud tegente), angulata, carina subrecte vel leviter arcuata, sinu angulato. Dioica (androecia haud visa)? Gynoeceia in ramis et caulibus terminalia vel lateralia, lobiflorales ovati, apice obtuso; perianthia longi bucciniformia.

Plants medium-sized, yellow-brown in herbarium. Stem 1 cm long, ca. 0,1 mm in diam., with leaves 1,4-2 mm wide, rather sparsely irregularly pinnate, primary branches obliquely spreading, 2,5-4 mm long; stem 6 cells thick, cortical cells as large as medullary cells, all cells thin-walled without trigones, pale yellow.

Leaf-lobes moderately to loosely imbricate, widely spreading, nearly flat, ovate (rarely falcate-ovate), 0,7-0,9 mm long, 0,6-0,7 mm wide, apices obtuse, not incurved, dorsal margins arched, not auriculate at base, covering 1/2-2/3 of the stem width (rarely extending beyond the opposite edge of the stem), insertions almost straight; marginal cells 15-16 x 8-10 µm, median cells 19-21 x 13-15 µm, basal cells 25-28 x 10-14 µm, all cells uniformly thin-walled with minute trigones, intermediate thickenings, cuticle smooth; leaf-lobules remote, obliquely spreading, when flat subquadrate, rarely subrhombic, ca. 1/2 of the lobe-length, 0,25-0,3 mm long, 0,15-0,25 mm wide, apices bluntly angular, not elongate, depressed to the lobe, margins almost straight, the adaxial margin often sinuate at middle, the basal portions bluntly angular, small, covering up to 1/4-1/2 of the stem-width (rarely not covering the stem), insertions ± straight, carinal regions slightly inflated; rhizoids few, pale brown; keel spreading at angles of ca. 30° with the stem, 0,3-0,4 mm long, straight to slightly arched, not decurrent, sinuses bluntly angular.

Dioicous (androecium not seen)? Gynoecium terminal or lateral on stem and branch, with two subfloral innovations, bracts one pair; bract-lobe ovate with obtuse, ± incurved apex, bract-lobule subquadrate with sinuate keel; perianth long, trumpet-shaped, ca. 2,7 mm long, 0,6 mm wide at

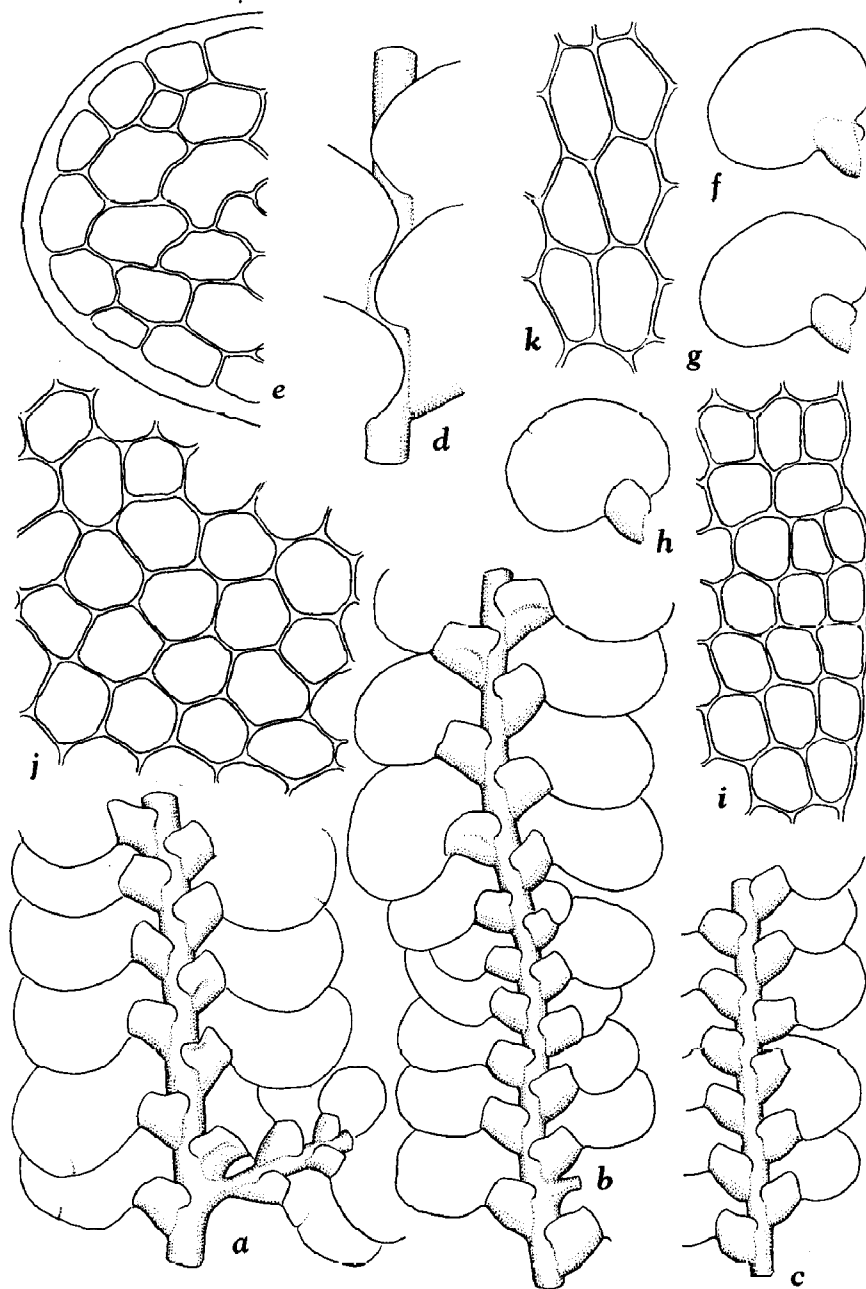


Fig. 5. *Radula guyanensis* Yamada. a-c. Portions of stem, ventral view, x 26. d. Basal portions of leaf lobe, dorsal view, x 26. e. Portion of cross section of stem, x 533. f-h. Leaf lobes, x 26. i-k. Cells of lobe of stem leaf (i from margin, j from middle, k from base), x 533. Drawn from the holotype.

mouth, mouth weakly undulate; capsule-wall thin, two-layered, cell-walls of the inner layer with poorly developed secondary thickenings, cell walls of the outer layer thin with red-brown secondary thickenings.

The diagnostic characters of *Radula mazarunensis* are 1) the stem 6 cells thick, 2) the ovate, nearly flat leaf-lobes with obtuse apices, 3) the thinwalled cells with smooth cuticle, 4) the obliquely spreading, subquadrate (rarely subrhombic) leaf-lobules with bluntly angular apices and non-decurrent keels, 5) the small bases of the leaf lobules covering less than 1/2 of the stem width, and 6) the terminal or lateral gynoeceium with two innovations and a long trumpet-shaped perianth with a weakly undulate mouth.

The above combination of characters is unique and no close relative of this species is known. *R. mazarunensis* belongs in *Radula* section *Radula*.

Frullaniaceae

Frullania apiculata (Reinw. et al.) Dum. (? = *F. exilis* Tayl.) - Common epiphyte on bark in savannah, scrub and orchards, and in tree crowns of moist rainforest, 500-700 m. alt. Roraima: 5139, 5179; Mayoripai: 4977; Jawalla: 4940; Kamarang: 4799; Latipu: 5547, 5565; Waramadan: 5670.

****Frullania bicornistipula*** Spruce - On mossy rock face in montane rainforest, 1200-1600 m. alt. Roraima: 5340.

****Frullania brasiliensis*** Raddi - On base of shrub in scrubby vegetation, 1000 m. alt. Latipu (summit): 5607.

Frullania caulisequa (Nees) Nees (= *Frullania obcordata* (Lehm. & Lindenb.) Lehm. & Lindenb. var. *armata* Lindenb. & Gott. = *F. gymnotis* Mont., syn. nov.) -

Epiphyte on canopy branches in mesic rainforest and on dry bark of *Clusia* sp. in montane scrub, 800-2300 m. alt. Roraima (ridge): 5403; Mayoripai: 4973; Waramadan: 5697.

Yuzawa (1988) has shown that *F. caulisequa* is a highly variable species, with inner female bracts varying from entire to toothed. *F. obcordata* var. *armata* and *F. gymnotis* should therefore be

reduced to synonymy under *F. caulisequa*.

Frullania gibbosa Nees - On trees in village, 500 m. alt. Jawalla: 4941.

****Frullania cf. meridiana*** Steph. - In tree crowns in montane rainforest and on wet rock in montane scrub, 1200-2300 m. alt. Roraima: 5319, 5370.

****Frullania mucronata*** (Lehm. & Lindenb.) Lehm. & Lindenb. - Epiphyte on trunks and canopy branches in mesic rainforest, 800 m. alt. Waramadan: 5711, 5724.

Frullania neesii Lindenb. (det. J. Bekker) - On twigs in montane scrub, 2000-2300 m. alt. Roraima: 5347.

****Frullania pendulostyla*** Steph. - In the canopy of montane rainforest, 1200-1600 m. alt. Roraima: 5308, Aptroot 17108.

Lejeuneaceae

Ptychanthoideae

Acrolejeunea torulosa (Lehm. & Lindenb.) Schiffn. - On shrub in savannah bush, 850 m. alt. Waramadan: 5685.

****Archilejeunea crispistipula*** (Spruce) Steph. - On trunk of *Mora* sp. in riverine rainforest, ca. 500 m. alt. Kamarang: Robinson 85-0063.

Archilejeunea fuscescens (Hampe) Fulf. - Epiphyte on trunks and branches in rainforest, often with *Symbiezidium transversale*, 500-600 m. alt. Roraima: 5022; Jawalla: 4881; Latipu: 5585.

Archilejeunea parviflora (Nees) Schiffn. - On riverbank earth, periodically flooded, 500 m. alt. Confluence of Arobaru river and Kako river: 4966.

Bryopteris diffusa Nees - On tree trunk and vine in rainforest, ca. 500 m. alt. Kamarang: Robinson 85-0020.

****Dicranolejeunea axillaris*** (Nees & Mont.) Schiffn. - On rotten poles of old hammock camp in montane rainforest, 1400 m. alt. Roraima: 5260.

Lopholejeunea muelleriana (Gott.) Schiffn. - Common epiphyte on poles, twigs, leaves, lianas and logs in rainforest, also on boulders in river, 500-1500 m. alt. Roraima: 5250, 5445; Jawalla: 4841, 4866; Latipu: 5604; Waramadan: 5741.

Lopholejeunea subfusca (Nees) Steph. - Epi-

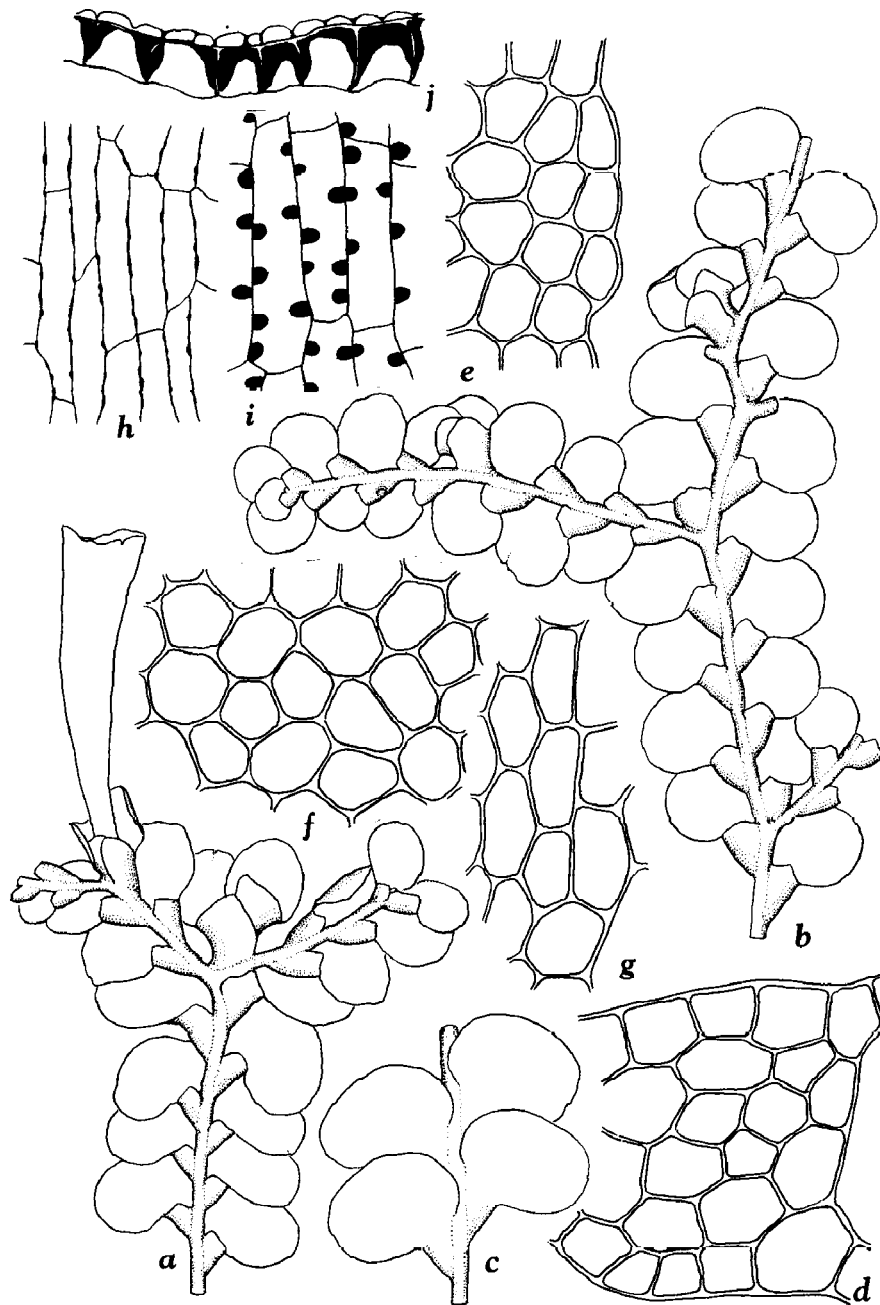


Fig. 6. *Radula mazarunensis* Yamada. a. Portion of stem with perianth, ventral view, x 18. b. Portion of stem with two female bracts, ventral view, x 18. c. Leaves on stem, dorsal view, x 18. d. Portion of cross section of stem, x 533. e-g. Cells of lobe of stem leaf (e from margin, f from middle, g from base), x 533. h,i. Capsule walls (h from inner view, i from outer view), x 533. j. Portion of cross section of capsule, x 533. Drawn from the holotype.

phyte on poles in mesic rainforest and on trees in village, 500 m. alt. Jawalla: 4883, 4946.

Mastigolejeunea auriculata (Wils.) Schiffn. - On trunk in savannah bush, 650 m. alt. Waramadan: 5680.

Odontolejeunea lunulata (Web.) Schiffn. - On living leaves in mesic and riverine rainforest, 500-600 m. alt. Jawalla 4850, 4914; Kamarang: 5657; Latipu: 5659a.

Stictolejeunea squamata (Willd.) Schiffn. - Pendent epiphyte on poles and saplings in rainforest, 550-800 m. alt. Roraima: 5048; Waramadan: 5702.

Symbiezidium transversale (Sw.) Trevis. var. *transversale* - On roots, twigs and litter in rainforest, 800 m. alt. Latipu: 5605.

Symbiezidium transversale (Sw.) Trevis. var. *hookerianum* (Gott.) Gradst. & van Beek - Locally common on trunks and poles in mesic rainforest, 500 m. alt. Jawalla: 4906.

Thysananthus amazonicus (Spruce) Schiffn. - Common epiphyte on poles, saplings, twigs and lianas in mesic or moist rainforest and scrub, occasionally also on trunks, growth ascending to pendent, 500-1000 m. alt. Roraima: 4993, 5151; Jawalla: 4857, 4835, 4911; Latipu: 5560, 5650; Waramadan: 5693.

Lejeuneoideae

by J. Bekker & S.R. Gradstein, Utrecht, R. Grolle, Jena and S. Jovet-Ast, Paris

Part of the Lejeuneoideae material remains unidentified.

Anoplolejeunea conferta (Meissn.) Schiffn. - On branches in submontane and montane scrub and savannah bush, 650-2300 m. alt. Roraima (ridge): 5400a, 5402, 5347; Latipu: 5628; Waramadan: 5667, 5669.

Ceratolejeunea cornuta (Lindenb.) Steph. (det. J. Bekker) - On isolated trees and shrubs in village and in savannah, usually with *Cheilejeunea trifaria*, 500 m. alt. Mayoripai: 4979; Jawalla: 4943, 4948.

**Ceratolejeunea laetefusca* (Aust.) Schust. (det. J. Bekker) - On trunk in rainforest, 500 m. alt. Jawalla: 4863.

Ceratolejeunea maritima (Spruce) Steph. - On bark in rainforest, 800 m. alt. Latipu: 5596.

Ceratolejeunea plumula (Spruce) Steph. (det. J. Bekker) - On twigs of shrubs in rainforest, 500 m. alt. Jawalla: 4844, 4856.

Ceratolejeunea spinosa (Gott.) Steph. (det. J. Bekker) - On mossy trunk in submontane rainforest, 700 m. alt. Roraima: 5145.

Cheilejeunea adnata (Kunze) Grolle - On smooth bark in rainforest, 600 m. alt. Latipu: 5545a.

**Cheilejeunea fragrantissima* (Spruce) Schust. (verif. R. Grolle) - Creeping or pendent on trunks and saplings in riverine and submontane rainforest, 550-700 m. alt. Roraima: 5011, 5093, 5146.

Cheilejeunea rigidula (Nees & Mont.) Schust. (det. J. Bekker) - On trees at edges of rainforest and along rivers, 500 m. alt. Confluence of Arobaru river and Kako river: 4971; Jawalla: 4920; Kamarang: 4776.

Cheilejeunea trifaria (Reinw. et al.) Mizut. - Epiphyte in mesic rainforest and on isolated trees and shrubs in savannah and villages, 500 m. alt. Mayoripai: 4980, 4976; Jawalla: 4925, 4948; Kamarang: 4821.

**Cheilejeunea sp.* "holostip" - Epiphyte in submontane rainforest, mixed with *C. fragrantissima*, 700 m. alt. Roraima: 5146a. Similar to *Cheilejeunea fragrantissima* but with different trigones (fide R. Grolle).

**Colura clavigera* Gott. ex Jov.-Ast (det. S. Jovet-Ast) - On base of shrub in wet savannah, 500 m. alt. Mayoripai: 4975.

Colura cylindrica Herz. (det. S. Jovet-Ast) - On smooth bark of trunk in rainforest, 600 m. alt. Latipu: 5551.

**Colura lyrata* Steph. (det. S. Jovet-Ast) - On twigs in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5361.

Colura rhynchophora Jov.-Ast (det. S. Jovet-Ast) - On dead wood in rainforest, 500 m. alt. Jawalla: 4923.

Colura tortifolia (Nees & Mont.) Trevis. (det. S. Jovet-Ast) On log in rainforest, 500 m. alt. Jawalla: 4845a.

Crossotolejeunea crenata (Nees & Mont.) Lacout. (det. R. Grolle) - On logs and roots in riverine rainforest, 500-550 m. alt. Roraima: 5021; Kamarang: Robinson 85-0071.

- Crossotolejeunea paucispina* (Spruce) Steph. (det. J. Bekker) On liana in riverine rainforest, 550 m. alt. Roraima: 5054d.
- Cyclolejeunea chitonina* (Tayl.) Evans (det. J. Bekker) - On living leaves in rainforest, 600 m. alt. Latipu: 5658, 5659b.
- Cyclolejeunea convexistipa* (Lehm. & Lindenb.) Evans (det. J. Bekker) - Common on living leaves and twigs in lowland and montane rainforest, 500-1600 m. alt. Roraima: 5150, 5434a, 5438 p.p.; Jawalla: 4837a, 4862; Latipu: 5660.
- Cyclolejeunea peruviana* (Lehm. & Lindenb.) Evans - Common on living leaves (and twigs) in lowland and montane rainforest, occasionally also outside the forest in villages, 500-1600 m. alt. Roraima: 5434; Jawalla: 4833, 4837; Kamarang: 4784, Robinson 85-0084; Latipu: 5530, 5658, 5659.
- **Cystolejeunea lineata* (Lehm. & Lindenb.) Evans - On trunks among *Plagiochila* in submontane rainforest, 700 m. alt. Roraima: 5142.
- Previously known only from the West Indies.
- Drepanolejeunea crucianella* (Tayl.) Evans - On living leaves in rainforest, 600 m. alt. Latipu: 5660.
- Drepanolejeunea fragilis* Bischler (det. J. Bekker) - On twigs in montane scrub, 2000-2300 m. alt. (probably also at lower altitudes). Roraima: 5347.
- Drepanolejeunea lichenicola* (Spruce) Steph. (det. J. Bekker) On rotten poles of old hammock camp in montane rainforest, 1400 m. alt. Roraima: 5335.
- **Drepanolejeunea palmifolia* (Nees) Steph. - On decorticated log in scrub, 1000 m. alt. Latipu (summit): 5630.
- **Drepanolejeunea pinnatiloba* Schiffn. - On dead bark in mesic rainforest on white sand, 800 m. alt. Waramadan: 5701.
- Previously known only from the Greater Antilles (Cuba, Puerto Rico).
- **Echinocolea spec.* - Common on dead wood in submontane rainforest, with *Prionolejeunea* spp., 700 m. alt. Roraima: 5101, 5148, 5149 p.p.
- Similar to *Echinocolea dilatata* but with a different perianth (fide R. Grolle).
- Lejeunea flava* (Sw.) Nees - On trees in mesic rainforest and isolated along rivers, 500 m. alt. Kamarang: 4775, 4781; Latipu: 5584; Waramadan: 5707.
- Lejeunea glaucescens* Gott. (det. J. Bekker) - On trees in mesic rainforest and in village, 500 m. alt. Jawalla: 4925a, 4948a.
- Lejeunea laetevirens* Nees & Mont. (det. J. Bekker) - On smooth bark in rainforest, 600 m. alt. Latipu: 5545.
- Lejeunea reflexistipula* (Lehm. & Lindenb.) Gott. et al. - Epiphyte in savannah bush, 650 m. alt. Waramadan: 5669.
- **Lejeunea trachygona* Spruce (det. R. Grolle) - On rotten trunk in riverine rainforest, 550 m. Roraima: 5023.
- Lepidolejeunea ornata* (Robins.) Schust. - On log in rainforest, 500 m. alt. Jawalla: 4894.
- Leptolejeunea elliptica* (Lehm. & Lindenb.) Schiffn. (det. J. Bekker) - On living leaves in rainforest, probably common, 500-600 m. alt. Latipu: 5659.
- Leucolejeunea xanthocarpa* (Lehm. & Lindenb.) Evans - On twigs and rock in scrub, 1000 m. alt. Latipu (summit): 5617.
- **Omphalanthus filiformis* (Sw.) Nees - Pendent epiphyte in rather dry savannah bush and scrub, also creeping over litter, 500-1000 m. alt. Kamarang: 4805 (leg. Aptroot & Sipman); Latipu: 5619; Waramadan: 5677, 5681, 5688.
- **Omphalanthus paramicola* (Herz.) Gradst. (= *Aureolejeunea paramicola* (Herz.) Schust.) - On dry bark of *Clusia* sp. in montane scrub, with *Anoplolejeunea conferta*, *Leptoscyphus cuneifolius*, *Telaranea nematodes*, *Pleurozia heterophylla* and *Drepanolejeunea* sp., 2000-2300 m. alt. Roraima (ridge): 5400.
- **Prionolejeunea elegans* Spruce (det. R. Grolle) - On twig in montane rainforest, 1200-1600 m. alt. Roraima: 5443.
- **Prionolejeunea innovata* Evans (det. R. Grolle) - On trunks, logs and living leaves in rainforest, ca. 500 m. alt. Kamarang: Robinson 85-0014, 85-0024, 85-0067a.
- Prionolejeunea trachyodes* (Spruce) Steph. (det. R. Grolle) On dead trunk in submontane rainforest, 700 m. alt. Roraima: 5149.
- Pycnolejeunea callosa* (Lindenb.) Steph. - On trunks in mesic rainforest and dry savannah

bush, with *Acrolejeunea torulosa*, *Frullania gibbosa* and *Cheilolejeunea trifaria*, 500-650 m. alt. Kamarang: 4822 (leg. Aptroot & Sipman); Jawalla: 4872; Waramadan: 5666, 5668a.

Pycnolejeunea contigua (Nees) Grolle (det. J. Bekker) - On trunk in dry savannah bush, 650 m. alt. Waramadan: 5667.

Pycnolejeunea decurviloba Steph. (det. R. Grolle) - On trunks and shrubs in submontane rainforest and scrub, 700-1150 m. alt. Roraima: 5112, 5147; Latipu: 5655, Maas & Westra 4197; Aymatoi: Maas et al. 5737.

Pycnolejeunea macroloba (Mont.) Schiffn. (det. J. Bekker) - On poles and branches in open places in rainforest and in submontane scrub, 500-1000 m. alt. Roraima: 5020, 5031; Kamarang: 4807; Latipu: 5631.

Rectolejeunea berteriana (Gott.) Evans (det. J. Bekker) - On smooth bark in rainforest, 600 m. alt. Latipu: 5545b.

Trachylejeunea pandurantha (Spruce) Steph. (det. J. Bekker) - On dead wood in rainforest, 500-600 m. alt. Jawalla: 4840; Latipu: 5579.

Codoniaceae

****Fossombronina*** sp. - On steep, shaded clay soil along Mazaruni river, 500 m. alt. Jawalla: 4936.

Pallaviciniaceae

by G.B.A. van Reenen, Utrecht

****Symphyogyna aspera*** Steph. - On logs, dead wood and stream boulders in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5212, 5267, 5274, 5338; Waramadan: 5739.

****Symphyogyna brasiliensis*** Nees - On moist soil and rotten logs in rainforest, 500-800 m. alt. Jawalla: 4937; Kamarang: 4808 (leg. Aptroot & Sipman); Latipu: 5600; Waramadan: 5729.

****Symphyogyna marginata*** Steph. - On wet rock and trunk bases in montane rainforest, 1200-1600 m. alt. Roraima: 5265, 5377, 5463.

Aneuraceae

Part of the Aneuraceae material remains unidentified.

Riccardia amazonica (Spruce) Schiffn. ex Gradst. - On rotten trunks, logs and roots in riverine, submontane and montane rainforest, 550-1600 m. alt. Roraima: 5036, 5096, 5263, 5430, 5431.

****Riccardia andina*** (Spruce) Herz. - On shaded base of trunk in montane rainforest, 1200-1600 m. alt. Roraima: 5254.

****Riccardia cervicornis*** (Spruce) Herz. ex Gradst. & Hekking - Common on logs, humus, wet soil and rock in riverine and montane rainforest, 550-1500 m. alt. Roraima: 5060, 5249, 5256, 5453, 5460.

****Riccardia fucoidea*** (Sw.) Schiffn. - Common on humose soil, dead wood, roots and rotten logs in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5135, 5186, 5232, 5257, 5285, 5429, 5448.

****Riccardia cf. plumaeformis*** (Spruce) Meenks - On humose soil in montane rainforest, 1200-1600 m. alt. Roraima: 5243.

****Riccardia schwaneckeii*** (Steph.) Pagán - On wet rock in montane rainforest, 1200-1600 m. alt. Roraima: 5381.

Metzgeriaceae

****Metzgeria decipiens*** (Mass.) Schiffn. - On trunk in montane rainforest, 1200-1600 m. alt. Roraima: 5275.

Metzgeria innovans Steph. (= *M. radicans* Steph., fide Kuwahara 1986: 224) - On dead trunk in rainforest, 600 m. alt. Latipu: 5573.

****Metzgeria procera*** Mitt. - On humose trunk bases and on wet rock in montane rainforest, 1200-1600 m. alt. Roraima: 5227, 5334, 5387.

Monocleaceae

Monoclea gottschei Lindb. - On soil and moist rock in montane rainforest, occasionally on boulders in streams at lower altitudes, 700-1600 m. alt. Roraima: 5255, 5312; Waramadan: 5740.

Pending the results of a biosystematic study of the genus *Monoclea* (Mues et al. in prep.), the name

M. gottschei Lindb. is provisionally retained for the neotropical populations of this genus.

ANTHOCEROTAE

Dendrocerotaceae

**Dendroceros crispus* (Sw.) Nees - On mossy trunks and poles in montane rainforest, 1200-1600 m. alt. Roraima: 5241, 5273, 5342.

MUSCI

Sphagnaceae

**Sphagnum magellanicum* Brid. - Terrestrial or pendulous from epiphyte nests in montane rainforest and scrub, 1000-1600 m. alt. Roraima: 5238, 5412a; Latipu: Maas et al. 2666.

**Sphagnum negrense* Mitt. (det. H. Crum) - On moist soil and rock in montane savannah, 2000-2300 m. alt. Roraima (ridge): 5372.

Sphagnum perichaetiale Hampe s.l. - On moist soil, logs and tree bases in savannah, scrub and rainforest, also on periodically inundated riverbanks, 500-1600 m. alt. Roraima: 5009, 5078, 5248; Mayoripai: 4981a; Latipu: 5609, 5625.

**Sphagnum tenerum* Sull. & Lesq. (det. H. Crum) - On moist soil in savannah, 500 m. alt. Mayoripai: 4981.

Fissidentaceae

Fissidens prionodes Mont. - Common on periodically inundated substrates (soil, rock, tree roots) along rivers, creeks and in riverine forest, 500-600 m. alt. Roraima: 4967, 4869, 5061; Jawalla: 4875; Latipu: 5569, 5575.

Fissidens scariosus Mitt. - On rock along river, periodically inundated, 500 m. alt. Confluence of Arobaru river and Kako river: 4968.

**Fissidens donnellii* Aust. (det. R. Pursell) - On trunk base in rainforest, 500 m. alt. Jawalla: 4928.

Dicranaceae

See also Frahm & Gradstein (1987).

Bryohumbertia filifolia (Hornsch.) Frahm - On wet soil along creek in rainforest, 700 m. alt. Waramadan: 5718.

Campylopus cubensis Sull. - On soil, dead logs and rock in montane rainforest and scrub, 700-1600 m. alt. Roraima: 5382; Latipu: 5593, 5610, 5615, 5653, Maas & Westra 4212, 4219; Membaru: 4269, 4277; Waramadan: 5742.

**Campylopus luteus* (C. Müll.) Par. (det. Frahm) - On wet rock in montane rainforest, 1400-1600 m. alt. Roraima: 5336, 5379.

**Campylopus pilifer* Brid. - On rotten log in montane rainforest, 1200-1600 m. alt. Roraima: 5293.

**Campylopus richardii* Brid. (det. Frahm) - On exposed rock, 2000-2300 m. alt. Roraima (ridge): 5358.

Campylopus savannarum (Müll.) Mitt. - Common on sandy soil in dry savannahs and forest clearings, 500-650 m. alt. Roraima: 4986; Jawalla: 4953, 4954; Latipu: 5544; Waramadan: 5676.

Campylopus subcuspidatus (Hampe) Jaeg. - Common on humose, sandy soil in montane scrub, 700-2300 m. alt. Roraima (ridge): 5350; Latipu (summit): 5606, 5626, 5654, Maas & Westra 2653 & 4194; Aymatoi: Maas et al. 5795.

Campylopus surinamensis C. Müll. - On wet sand along river, 550 m. alt. Roraima: 5077.

Dicranella hilariana (Mont.) Mitt. - On sand and rock along rivers, periodically inundated, 500-550 m. alt. Confluence of Arobaru river and Kako river: 4970; Roraima: 5072.

**Dicranoloma brittonae* Bartr. (det. Griffin) - Common epiphyte on logs and mossy trunks in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5095, 5116, 5155, 5157, 5219, 5239.

Eucamptodontopsis pilifera (Mitt.) Broth. - On logs and mossy trunks in submontane rainforest, 700-1000 m. alt. Roraima: 5107, 5156.

Holomitrium arboreum Mitt. - Epiphyte in submontane scrub, 1150 m. alt. Aymatoi: Maas et al. 5793.

Leucoloma cruegerianum (C. Müll.) Jaeg. - On trunk bases and periodically submerged boulders in river, 800 m. alt. Latipu: 5601; Waramadan: 5737.

Leucoloma serrulatum Brid. - On log in rainforest, 500 m. alt. Jawalla: 4869.

Leucobryaceae

Leucobryum albidum (Brid.) Lindb. - On rock in rather dry, submontane scrub, 1000 m. alt. Latipu: 5643.

Leucobryum crispum C. Müll. - On rotten logs, roots and rock in rainforest, and on soil in submontane scrub, 500-1150 m. alt. Roraima: 5037; Latipu: 5540, 5588; Kamarang: 4793, Maas & Westra 4303, Robinson 85-0025; Aymatoi: Maas et al. 5721, 5795a.

****Leucobryum giganteum*** C. Müll. - On wet, shaded ground under boulders, 1200-1600 m. alt. Roraima: 5225, 5261.

****Leucobryum laevifolium*** Broth. - Forming large balls on trunks high up in the canopy of submontane and montane rainforest; also forming dense cushions on litter in wet montane savannah, 700-2300 m. alt. Roraima: 5097, 5153, 5259, 5346, 5450.

Leucobryum martianum (Hornsch.) C. Müll. - Common on logs, tree bases and soil in riverine forest, also on wet rock, 500-800 m. alt. Roraima: 4984, 5070, 5086A; Kamarang: Maas et al. 2547; Latipu: 5603.

Octoblepharum albidum Hedw. - On isolated trees along river, 500 m. alt. Kamarang: 4779, Aptroot 17052.

Octoblepharum cocuiense Mitt. - On trunks (rough bark), 550-700 m. alt. Roraima: 5015, 5153a, Aptroot 17091.

Octoblepharum cylindricum Mont. - On white sand in dry savannah, 650 m. alt. Waramadan: 5663, 5683.

Octoblepharum erectifolium Mitt. - On dead log in submontane scrub, ca. 1000 m. alt. Latipu (summit): Maas & Westra 4222.

Calymperaceae

Calymperes erosum C. Müll. - On log in mesic rainforest, 500 m. alt. Jawalla: 4912.

Calymperes guildingii Hook. & Grev. - On trunk (smooth bark) in montane rainforest, 1400 m. alt. Roraima: 5458.

Calymperes lonchophyllum Schwaegr. - On trunks in rainforest, 500-600 m. alt. Jawalla: 4908; Latipu: 5586.

Calymperes nicaraguense Ren. & Card. - On trunk in riverine forest, 550 m. alt. Roraima: 4997.

Calymperes smithii Bartr. - On pole in submontane rainforest, 750 m. alt. Roraima: 5154.

Calymperes venezuelanum (Mitt.) Pitt. ex Broth. - On trunks, poles and rotten logs in rainforest, 500-600 m. alt. Roraima: 5087; Jawalla: 4909; Kamarang: Maas & Westra 4301.

Syrrhopodon gaudichaudii Mont. - On soil, rock and trunk bases in rather dry savannah woodland and scrub, 650-1000 m. alt. Latipu: 5605a, 5611, 5632, Maas & Westra 4221; Membaru: Maas & Westra 4288; Waramadan: 5672.

****Syrrhopodon helicophyllum*** Mitt. - On twigs and orchid roots in rainforest, 500-800 m. alt. Roraima: 5054; Kamarang: 4802; Waramadan: 5700.

Syrrhopodon hornschurchii Mart. - On trunks in rainforest, 500-600 m. alt. Jawalla: 4933.

Syrrhopodon incompletus Schwaegr. var. ***luridus*** (Par. & Broth.) Florsch. - On trunks in rainforest, 500 m. alt. Jawalla: 4895.

Syrrhopodon leprieurii Mont. - On trunk in riverine rainforest, 550 m. alt. Roraima: 5034.

Syrrhopodon ligulatus Mont. - On dead wood in rainforest, 600 m. alt. Latipu: 5577.

****Syrrhopodon lycopodioides*** (Brid.) C. Müll. (det. W.D. Reese) - Common on mossy trunks in montane rainforest, 1200-1600 m. alt. Roraima: 5218, 5329, 5384, 5446.

Syrrhopodon parasiticus var. ***disciformis*** (C. Müll.) Florsch. In canopy of rainforest, with var. *parasiticus*, 500 m. alt. Kamarang: Aptroot 17063.

Syrrhopodon parasiticus (Brid.) Besch. var. ***flexifolius*** (Mitt.) Reese - On trunk in mesic rainforest, 800 m. alt. Waramadan: 5712, 5730.

Syrrhopodon parasiticus (Brid.) Besch. var. ***parasiticus*** - In canopy of rainforest, 500 m.

alt. Kamarang: Aptroot 17064.

Syrrhopodon prolifer Schwaegr. var. ***cinnatus*** (Hampe) Reese - On trunks and saplings in montane rainforest, 1400 m. alt. Roraima: 5325, 5447.

Syrrhopodon prolifer Schwaegr. var. ***papillosus*** (C. Müll.) Reese - On tree base and litter in mesic rainforest, 650 m. alt. Waramadan: 5687.

Syrrhopodon rigidus Hook. & Grev. - Common on bark and shaded rock in submontane and montane rainforest, 550-1600 m. alt. Roraima: 5024, 5083, 5200, 5264, 5297, 5318, 5423.

Pottiaceae

by R.H. Zander, Buffalo

****Trichostomum duidense*** Bartr. - On old trunks, lianas and on rock in mesic and moist rainforest, 500-1600 m. alt. Roraima: 5158, 5214, 5240; Latipu: Maas & Westra 4201, 4223; Waramadan: 5673.

Funariaceae

****Funaria bonplandii*** (Hook.) Broth. - On sandy, periodically inundated bank of the Waruma river, 550 m. alt. Roraima: 5073.

Funaria hygrometrica Hedw. var. ***calvescens*** (Schwaegr.) Mont. On wet soil in submontane savannah, 1150 m. alt. Aymatoi (summit): Maas et al. 5778.

Bryaceae

Bryum billardieri Schwaegr. - On dead wood and rock in submontane and montane rainforest and in savannah woodland, also boulders in river, 600-1200 m. alt. Roraima: 5170, 5231; Waramadan: 5675, 5745.

Bryum coronatum Schwaegr. - On sand in rather dry savannah, sometimes on burned soil, 650 m. alt. Waramadan: 5662, 5684.

Bryum argenteum Hedw. - On wooden fence in village, 500 m. alt. Kamarang: Aptroot 17054.

Phyllocladaceae

Mniomalia viridis (Mitt.) C. Müll. - On trunk base in rainforest, 500 m. alt. Jawalla: 4928a.

Phyllocladum falcifolium (Schwaegr.) Crosby - On logs and branches of trees in riverine rainforest, 550 m. alt. Roraima: 5046, 5058.

Rhizogoniaceae

Pyrrhobryum spiniforme (Hedw.) Mitt. (***Rhizogonium spiniforme*** (Hedw.) Bruch) - Epiphytic, on dead logs and on rock in steep hillside rainforest, 500-800 m. alt. Latipu: 5591, Maas & Westra 2658, 4155.

Bartramiaceae

****Breutelia tomentosa*** (Brid.) Jaeg. - On wet rock in montane rainforest, 1500 m. alt. Roraima: 5385.

****Leiomela bartramioides*** (Hook.) Par. - On trunk in montane rainforest, 1200-1600 m. alt. Roraima: 5313.

Orthotrichaceae

Groutiella obtusa (Mitt.) Florsch. - On trunks and branches in rather dry scrub and in orchards, 500-1000 m. alt. Jawalla: 4945; Kamarang: Maas & Westra 3963; Latipu (summit): 5642.

****Leiomitrium scaberrimum*** (Broth.) Wijk & Marg. - On pole in mesic rainforest, 800 m. alt. Waramadan: 5703.

Macromitrium cirrosum (Hedw.) Brid. - Common epiphyte on bark and on dead logs in rainforest and submontane scrub, 500-1000 m. alt. Roraima: 5057; Jawalla: 4942; Latipu (summit): 5637, 5638, Maas & Westra 4218; Waramadan: 5706.

Macromitrium lepreurii Mont. - On trunks and lianas in submontane and montane rainforest and scrub, 750-1600 m. alt. Roraima: 5102, 5166, 5228; Latipu: Maas & Westra 4195.

Macromitrium perichaetiale (Hook. & Grev.) C. Müll. - On logs, trunks and branches in submontane rainforest and scrub, 700-1200 m. alt. Roraima: 5168, 5230; Latipu (summit): 5641.

Macromitrium punctatum (Hook. & Grev.) Brid.

- On bark in mesic scrub and rainforest, also in orchards, 500-1000 m. alt. Jawalla: 4848, 4949; Latipu (summit): 5640.

**Macromitrium standleyi* Bartr. - On branches in montane scrub, 2000-2300 m. alt. Roraima (ridge): 5406.

Macromitrium trinitense Williams - On bark in rainforest, 500 m. alt. Kamarang: 4801.

**Macromitrium ulophyllum* Mitt. (det. D. Griffin) - On wet rock in montane rainforest, 1200-1600 m. alt. Roraima: 5392.

Schlotheimia torquata (Hedw.) Brid. - On branches in riverine rainforest and submontane scrub, 500-1150 m. alt. Kamarang: Maas & Westra 4140; Latipu (summit): 5639; Aymatoi (summit): Maas et al. 5794.

Racopilaceae

Racopilum tomentosum (Hedw.) Brid. - On litter over boulders in savannah woodland, 650-800 m. alt. Waramadan: 5674, 5705.

Hedwigiaceae

**Rhacocarpus purpurascens* (Brid.) Par. - On exposed rock in wet, montane savannah, 2000-2300 m. alt. Roraima (ridge): 5348, 5405.

Leucodontaceae

Leucodontopsis geniculata (Mitt.) Crum & Steere - On trees in village, 500 m. alt. Jawalla: 4952.

Meteoriaceae

Meteoridium remotifolium (C.Müll.) Manuel - On rock in savannah woodland, 650 m. alt. Waramadan: 5671.

Squamidium leucotrichum (Tayl.) Broth. - Pendent from branches and poles in rainforest and scrub, 600-1000 m. alt. Latipu: 5623, Maas & Westra 4202; Waramadan: 5692.

Zelometeorium patulum (Hedw.) Manuel - On bark in rainforest, 500-600 m. alt. Jawalla: 4819, 4855; Latipu: 5580.

Pterobryaceae

**Renauldia paradoxica* Allen (det. B.H. Allen) - Pendent from branches in submontane rainforest, 700-1000 m. Roraima: 5187, Aptroot 17077.

R. paradoxica was recently described from western Panama (Allen 1987a). The Roraima materials constitute the first record of this remarkable species of uncertain generic affinity from mainland South America.

Orthostichopsis crinita (Sull.) Broth. - On twigs and poles in rainforest, 500-900 m. alt. Roraima: 5071a; Jawalla: 4836; Latipu: 5558, Maas & Westra 2667; Waramadan: 5708.

Phyllogoniaceae

Phyllogonium fulgens (Hedw.) Brid. - On trunks and poles in rainforest, scarce, 500-1600 m. alt. Roraima: 5413a; Jawalla: 4888.

Neckeraceae

Isodrepanium lentulum (Wils.) Britt. - On twigs and lianas in rainforest, 500-550 m. alt. Roraima: 5053; Jawalla: 4858a, 4878.

Hookeriaceae

Callicosta bipinnata (Schwaegr.) C. Müll. - Common epiphyte on poles, saplings and lianas in rainforest, 500-600 m. alt. Kamarang: 4788, Robinson 85-0019, 85-0099; Jawalla: 4905, 4908a, 4929; Roraima: 5064; Latipu: 5562.

Callicostella pallida (Hornsch.) Aongstr. - On logs in rainforest, 500-600 m. alt. Jawalla: 4902; Latipu: 5578; Waramadan: 5726.

**Callicostella cf. rivularis* (Mitt.) Jaeg. (det. W.R. Buck) - On roots along creek in rainforest, 600 m. alt. Latipu: 5534.

**Crossomitrium calomicron* (Broth.) Welch - On trees in village, 500 m. alt. Jawalla: 4951.

Crossomitrium patrisiae (Brid.) C. Müll. - On living leaves in rainforest, 600 m. alt. Latipu: 5539.

**Daltonia longifolia* Tayl. - On twigs and living

leaves in the upper canopy of the montane rainforest, 1200-1600 m. alt. Roraima: 5469.

Hemiragis aurea (Brid.) Kindb. - Common on mossy trunks and boulders in montane rainforest, 1200-1600 m. alt. Roraima: 5216, 5245, 5289, 5422.

****Hookeriopsis crispa*** (C. Müll.) Jaeg. - On logs in montane rainforest, 1200-1600 m. alt. Roraima: 5217, 5284.

****Hookeriopsis diffusa*** (Mitt.) Jaeg. (det. W.R. Buck) - On rotten logs in montane rainforest, 1200-1600 m. alt. Roraima: 5244, 5271.

Hookeriopsis falcata (Hook.) Jaeg. - On mossy trunks and dead wood in montane rainforest, 1200-1600 m. alt. Roraima: 5237, 5322, 5444.

Hookeriopsis parkeriana (Hook. & Grev.) Jaeg. - Common epiphyte, pendent from twigs and saplings in rainforest, also in scrub on dead log, 500-750 m. alt. Roraima: 4994, 5039, 5068; Jawalla: 4891, 4918; Latipu: 5571; Membaru: Maas & Westra 4282; Waramadan: 5695.

****Hookeriopsis undata*** (Hedw.) Jaeg. (det. W.R. Buck) - On rotten log in submontane rainforest, 700 m. alt. Roraima: 5109.

Hypnella pallescens (Hook.) Jaeg. - Very common on bark, logs and rotten wood in riverine, submontane and montane rainforest, also on rock, 500-1600 m. alt. Roraima: 5007, 5026, 5094, 5105, 5108, 5160, 5164, 5165, 5167, 5172, 5183, 5191, 5201, 5208, 5235, 5306, 5314, 5386, 5433, 5457.

Small and large forms and forms with papillose and with smooth cells occur in the area.

****Hypnella diversifolia*** (Mitt.) Jaeg. - On rotten logs in submontane and montane rainforest, 700-1600 m. alt. Roraima: 5299, 5311, 5408.

Lepidopilidium portoricense (C. Müll.) Crum & Steere - On pole in rainforest, 600 m. alt. Waramadan: 5717.

****Lepidopilum purpurascens*** Schimp. ex Besch. - On twigs and saplings in montane rainforest, also on rock, 1200-1600 m. alt. Roraima: 5221, 5383, 5454.

Lepidopilum scabrisetum (Schwaegr.) Steere - On liana in rainforest, 500 m. alt. Jawalla: 4867.

Lepidopilum surinamense C. Müll. - On trunk in rainforest, Jawalla: 4885.

****Lepidopilum* sp.** (aff. *L. polytrichoides* (Hedw.) Brid.) - On trunk base in montane rainforest, ca. 1300 m. alt. Roraima: 5242.

****Leskeodon cubensis*** (Mitt.) Thér. - On pole in montane rainforest, 1400 m. alt. Roraima: 5268.

Thamniopsis killipii (Williams) Bartr. - On trees and rotten logs in rainforest, 500-700 m. alt. Kamarang: 4796, Maas & Westra 4143, Robinson 85-0068a, 85-0080; Roraima: 5047, 5089.

Leucomiaceae

by B.H. Allen, St. Louis and K. Veling, Utrecht

Leucomium strumosum (Hornsch.) Mitt. - On dead logs and old trunks in rainforest, 500-600 m. alt. Jawalla: 4865; Latipu: 5525, 5557.

****Leucomium steerei*** Allen & Veling - On twigs and roots in montane rainforest, 1200-1600 m. alt. Roraima: 5286, 5421.

This recently described species (Allen 1987) is only known from the eastern section of the Guayana Highlands (Chimantá, Roraima).

Thuidiaceae

Thuidium antillarum Besch. - Common on humose soil and rotten wood in rainforest, 500-1600 m. alt. Roraima: 5278, 5317; Jawalla: 4882, 4962; Latipu: 5564.

Brachytheciaceae

by D. Griffin III, Gainesville

****Lepyrodontopsis trichophylla*** (Hedw.) Broth. - On steep rock in hillside rainforest, 800 m. alt. Latipu: 5592.

Plagiotheciaceae

Pilosium chlorophyllum (Hornsch.) C. Müll. - On rotten logs, trunk bases and soil in rainforest, 500-800 m. alt. Jawalla: 4915; Latipu: 5542; Waramadan: 5720, 5727, 5732.

Sematophyllaceae

Acroporium pungens (Hedw.) Broth. - Very common epiphyte in rainforest and scrub, 500-2300 m. alt. Roraima: 4995, 5103, 5161, 5162, 5163, 5277, 5398, 5417; Jawalla: 4898; Kamarang: 4817; Latipu: 5581, 5651; Waramadan: 5694.

Sematophyllum galipense (C. Müll.) Mitt. - Common on rotten logs, dead wood and litter in rainforest and savannah woodland, also on trunks, 500-700 m. alt. Roraima: 5113; Jawalla: 4846a, 4865a; Kamarang: 4809; Waramadan: 5678, 5690.

Sematophyllum subpinnatum (Brid.) Brid. - On branches and rotten wood in riverine rainforest, also on periodically submerged rock in river, 500-550 m. alt. Roraima: 5025, 5049; Confluence of Arobaru river and Kako river: 4964; Kamarang: 4783.

Sematophyllum subsimplex (Hedw.) Mitt. - Common on rotten logs in rather mesic rainforest, also on liana in riverine forest, 500-800 m. alt. Roraima: 5088; Jawalla: 4884, 4958; Kamarang: Maas & Westra 2593 & 4479; Waramadan: 5723, 5725; Paruima: Maas et al. 5588.

Taxithelium planum (Brid.) Mitt. - On roots, logs and rock in rainforest, 500-600 m. alt. Jawalla: 4926; Kamarang: Maas & Westra 3996; Latipu: 5529, 5583.

Trichosteleum fluviale (Mitt.) Jaeg. - On periodically submerged rock at riverbank, 500 m. alt. Confluence Arobaru river and Kako river: 4970a.

Trichosteleum papillosum (Hornsch.) Jaeg. - On trunk bases and roots in riverine and montane rainforest, also on boulders in stream, 500-1600 m. alt. Roraima: 5159, 5316; Kamarang: 4810; Waramadan: 5736.

Hypnaceae

by K. Veling and J. Florschütz-de Waard, Utrecht

Chrysohypnum diminutivum (Hampe) Buck - On log in mesic rainforest and on trees in village, 500 m. alt. Jawalla: 4902a, 4944.

Ectropothecium leptochaeton (Schwaegr.) Buck - On trunks and logs in mesic rainforest

and on trees in village, 500 m. alt. Jawalla: 4932, 4947, 4960; Kamarang: Maas & Westra 4144, Robinson 85-0035.

Isopterygium tenerum (Sw.) Mitt. - On roots and gravelly soil near creeks in savannah woodland and rather mesic rainforest, 500-650 m. alt. Latipu: 5568; Waramadan: 5664.

Mittenothamnium reptans (Hedw.) Card. - On trunks, logs and litter in mesic rainforest, 500-800 m. alt. Jawalla: 4854; Waramadan: 5704, 5715.

Rhacopilopsis trinitensis (C. Müll.) Britt. - On branches and living leaves in rainforest, 500-700 m. alt. Kamarang: Robinson 85-0081; Latipu: Maas & Westra 2661a.

Vesicularia vesicularis (Schwaegr.) Broth. - On boulders in river, 800 m. alt. Waramadan: 5733.

Polytrichaceae

****Polytrichum juniperinum*** Hedw. - On disturbed soil at former camp site, ca. 2100 m. alt. Roraima (ridge): 5397.

CONCLUDING REMARKS

This paper on the bryophyte flora of the Upper Mazaruni District, Guyana, lists about three hundred species (180 liverworts, 117 mosses). A considerable number of floristic novelties are reported: 130 species are new to the Guianas and at least 11 species and 2 genera (*Haesselia* Grolle & Gradst., *Vanaea* (Inoue & Gradst.) Inoue & Gradst.) are new to science. Some of the new taxa were described elsewhere (Allen 1987, Grolle & Gradstein 1988, Inoue & Gradstein 1988, Grolle 1989). The following species proved undescribed: the moss *Leucomium steerei* Allen & Veling and the liverworts *Adelanthus squarrosus* Grolle, *Haesselia acuminata* Gradst., *Haesselia roraimensis* Grolle & Gradst., *Marsupidium gradsteinii* Grolle, *Plagiochila gymnocalyx* Inoue, *Radula gradsteinii* Yamada, *Radula guyanensis* Yamada, *Radula mazarunensis* Yamada, *Stenorrhypis grollei* Gradst., *Vanaea plagiochiloides* (Inoue & Gradst.) Inoue & Gradst., and a species of

Echinocolea (fide R. Grolle in litt.).

Stenorrhypis grollei constitutes the first New World record of this poorly known rheophytic genus, previously known from eastern Africa and Borneo. Noteworthy are also some species, which were previously known from only one or two localities: *Renauldia paradoxa* Allen, previously known from western Panama (Allen 1987a), *Dicranoloma brittonae* Bartr. recorded once from Panama and from the Guayana Highlands of Venezuela, *Micropterygium tumidulum* Fulf., previously known from the Ayan tepui, Venezuela (Fulford 1966), and *Pleurozia heterophylla* Fulf., the only New World species of *Pleurozia* and restricted to the Guayana Highlands where it was collected twice (Fulford 1971).

The north slope of Mount Roraima proved to be the richest area for bryophytes, especially liverworts, and most of the novelties were found there. In total we collected here over 180 species (115 liverworts, 60 mosses), about half of them new to the Guianas. In comparison, the lower tepuis investigated (e.g. Latipu, Membaru) lack a montane forest, are dryer and have a much less spectacular bryophyte flora. The slope of Mt. Roraima is very cloudy and humid and harbours a very mossy montane forest. The high humidity is presumably due to the presence at the base of the mountain of vast areas of untouched rainforest, extending over most of the Upper Mazaruni District.

The 'Waruma trail', along which collecting at Mt. Roraima was done, runs for about 20 km. through a dense, periodically flooded rainforest bordering the Waruma river, at an altitude of about 550 m. The riverine forest consists of trees with relatively thin trunks, rising to a height of about 20-30 m. There is a well-developed understory of shrubs and numerous saplings. The ground is densely covered by sclerophyllous leaves and generally devoid of plants. Epiphytes are rather common, especially where the tree cover is lessened and the forest more open. The bryophytes form thin mats 1-4 cm. thick on the trunks, in which *Bazzania* spp. (o.a. *B. stolonifera*) and *Plagiochila* spp. (*P. depressa*, *P. divaricata*, *P. echinella*, *P. rubescens*) dominate. Rotten logs are covered by Hookeriaceae (e.g. *Hypnella pallescens*), *Sematophyllum* spp. (*S. galipense*, *S. subpinnatum*, *S. subsimplex*),

Leucobryum crispum, *L. martianum*, *Micropterygium trachyphyllum* and *Anomoclada portoricensis*. On the sandy riverbank an interesting pioneering community occurs of *Dicranella hilariana*, *Campylopus surinamensis*, *Funaria bonplandii*, *Kurzia capillaris*, *Arachniopsis pecten*, *Paracromastigum bifidum*, *Pteropsiella serrulata* and *Marsupidium gradsteinii*.

The gently rising, lower slopes of the mountain are covered by a submontane forest (ca. 600-1200 m.) not very different in aspect and species composition from the riverine forest, except for the somewhat increased 'mossyness' of the forest. The bryophyte cover is much less prominent as in the montane forest, however, and mats covering the trunks are maximally 5 cm. in thickness (10-20 cm. thick in the montane forest). Common epiphytes are the liverworts *Plagiochila abrupta*, *P. bursata*, *Bazzania gracilis*, *B. glaziovii*, *Calypogeia venezuelana*, *Herbertus pensilis*, *Cheilolejeunea fragrantissima*, *Cystolejeunea lineata*, *Cyclolejeunea* spp. (epiphyllous) and the mosses *Acroporium pungens*, *Dicranoloma brittonae*, *Eucamptodontopsis pilifera* and *Syrrhopodon rigidus*. High up on the trunks *Leucobryum laevifolium* forms conspicuous 'balls'. Rotten logs harbour the species of the riverine forest as well as *Haesselia roraimensis* (very common!), *Riccardia fucoidea*, *R. amazonica* and *Hypnella diversifolia*. On decorticated logs *Nowellia evansii*, *Prionolejeunea trachyodes*, *Drepanolejeunea* spp. and an undescribed species of *Echinocolea* form a characteristic community. *Marsupidium gradsteinii* is common on trunk bases as well as on rocks in small creeks.

The montane forest occurs on the steeper slopes, from 1200 m. upwards to the base of the lower cliffs at 1600 m. The ground is very rocky and uneven, and the tree layer is slightly lower than in the submontane forest and probably composed of different species. The montane forest is also considerably more 'mossy' and huge bryophyte 'furs', 1-2 dm. thick, cover trunks and branches, while long garlands hang from twigs and saplings of the understory. The bryophyte cover consists mainly of large quantities of liverworts, especially *Bazzania* spp. (*B. stolonifera*, *B. gracilis*, *B. glaziovii*, *B. cf. longistipula*), *Plagiochila* spp. (*P. bidens*, *P. bursata*, *P. esmer-*

aldana, *P. pearceana*, *P. rutilans*) and *Herbertus pensilis*. In addition, there are many montane neotropical species not usually found at lower elevations: e.g. the mosses *Hemiragis aurea*, *Syrrophodon lycopodioides*, *Calymperes guildingii*, *Leucobryum giganteum*, several species of *Hookeriopsis* (*H. crispa*, *H. diffusa*, *H. falcata*, *H. undata*), *Lepidopilum purpurascens*, and the liverworts *Lepidozia macrocolea*, *Scapania portoricensis*, *Lophocolea trapezoidea*, *Tylimanthus striolatus*, *Radula involvens*, *Frullania pendulostyla* (in the forest canopy), *Symphygyna marginata*, *Metzgeria procera*, and several species of *Riccardia*. The newly described *Leucomium steerei* and *Adelanthus squarrosus* proved rather common in the montane forest. The wet cliffs are covered by extensive mats of *Alobiella husnotii* and *Micropterygium* spp. (*M. carinatum*, *M. pterygophyllum*), whereas stream boulders harbour a rheophytic bryophyte community consisting of *Isotachis multiceps*, *Neesioscyphus argillaceus* and *Stenorrhypis grollei*. In the Guianas virtually all of these species are known only from Mount Roraima.

The north ridge below the summit (ca. 2000-2300 m.) is covered by a 3-4 m. high scrub which, in the lower, broadest portion of the ridge gives way to a wet, white-sand savannah, the 'El Dorado swamp' (MacInnes 1974). At its upper end the ridge meets the upper cliff: the 'Prow' of Mount Roraima. The flowering plants of this vegetation belt are very interesting and include many taxa endemic to the Guayana Highlands. The cryptogamic flora is poorer but includes interesting species including several endemics. In the savanna two widespread species of *Campylopus*, *C. subcuspidatus* and *C. richardii*, and *Leucobryum laevifolium* form large, peat-moss-like cushions. Creeping among these cushions and over litter occur at least three hepatics endemic to the Guayana Highlands: *Micropterygium tumidulum*, *Trabacellula tumidula* and *Haesselia acuminata*. Unusual species are also seen on twigs, e.g. *Anastrophyllum plagiochiloides*, *Micropterygium campanense*, *Odontoschisma atropurpureum*, *Leptoscyphus cuneifolius*, *Leptoscyphus ovatus*, *Pleurozia heterophylla*, *Colura lyrata*, and *Omphalanthus paramicola*, a species previously known from a few stations in the páramos of

Venezuela and Colombia. On rocks another páramo species, *Rhacocarpus purpurascens*, is seen.

Previous knowledge of the bryophyte flora of Mount Roraima was based largely on lists by Brotherus and Stephani (in Brown 1901), which included 26 mosses and 40 liverworts. All of these species came from the Venezuelan side of the mountain. Our records from the north slope include all the species previously recorded except for the mosses *Atractylolcarpus longisetus*, *Breutelia scoparia*, *Ctenidium malacodes*, *Hypnum amabile*, *Leptodontium* sp., *Plagiomnium rhynchophorum*, *Rhizogonium lindigii*, and the liverworts *Dumortiera hirsuta*, *Eopleurozia paradoxa*, *Frullania mirabilis*, *Herbertus grossispinus*, *Herbertus subdentatus*, *Jensenia erythropus*, *Lepidozia patens* and *Leptoscyphus intermedius*. Apparently, all of these species had been collected on the ledge or the summit of Mount Roraima in the ascent area, at altitudes between 2300-2700 m. Their absence in the materials from the Guyana side may in part be due to the fact that the vegetation on that slope ends at 2300 m., where the ridge meets the bare upper cliff.

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