

STUDIES ON COLOMBIAN CRYPTOGRAMS XVII. ON A NEW ANTIPODAL ELEMENT IN THE NEOTROPICAL PÁRAMOS – *DENDROCRYPHAEA LATIFOLIA* SP. NOV. (MUSCI)

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SUMMARY

Dendrocryphaea latifolia sp. nov. from the Páramo de Chisacá, Colombia is described and illustrated. It is allied to *D. cuspidata* from austral South America but differs from that species in the broader leaves, globose capsules and the basally smooth exostome teeth. A key to the four species of *Dendrocryphaea* and a conspectus of the genus are provided. *D. ramosissima* is reduced to synonymy under *D. lechleri*. *Dendrocryphaea* is a rheophytic genus with antipodal distribution. Its discovery in the high Andes of Colombia extends to 34 the number of genera of bryophytes with similar antipodal affinities known from the páramos of the northern sector of the Andean cordillera. The nature and origin of these distribution patterns is discussed. In the case of *Dendrocryphaea* wind and birds may have played a role in the transport of spores and the establishment of its present distribution.

1. INTRODUCTION

Dendrocryphaea Broth. is a rheophytic member of the Cryphaeaceae with a restricted distribution. Although believed originally to be confined to austral South America (VAN DER WIJK et al. 1959–1969) it has now been discovered in the high Andes of Northern South America (fig. 6). In August of 1980 the two junior authors, while on expedition with the ECOANDES project (cf. AGUIRRE & VAN REENEN 1980), collected a species of *Dendrocryphaea* from rock in a páramo stream at 3400 m in the Páramo de Chisacá, south of Bogotá (Dept. of Cundinamarca). An examination of type and topotype material of the other known species of the genus supports the conclusion that the Colombian plants represent a heretofore undescribed species. A description of this new species (including protonemal data from spores germinated on agar in the laboratory of Dr. B. O. van Zanten, University of Groningen) along with a key to the species of *Dendrocryphaea* are provided, together with a few phyto-geographical notes on the antipodal element in the páramo bryophyte flora.

2. DESCRIPTION

Dendrocryphaea latifolia Griffin, Gradstein et Aguirre sp. nov. – figs. 1–3.

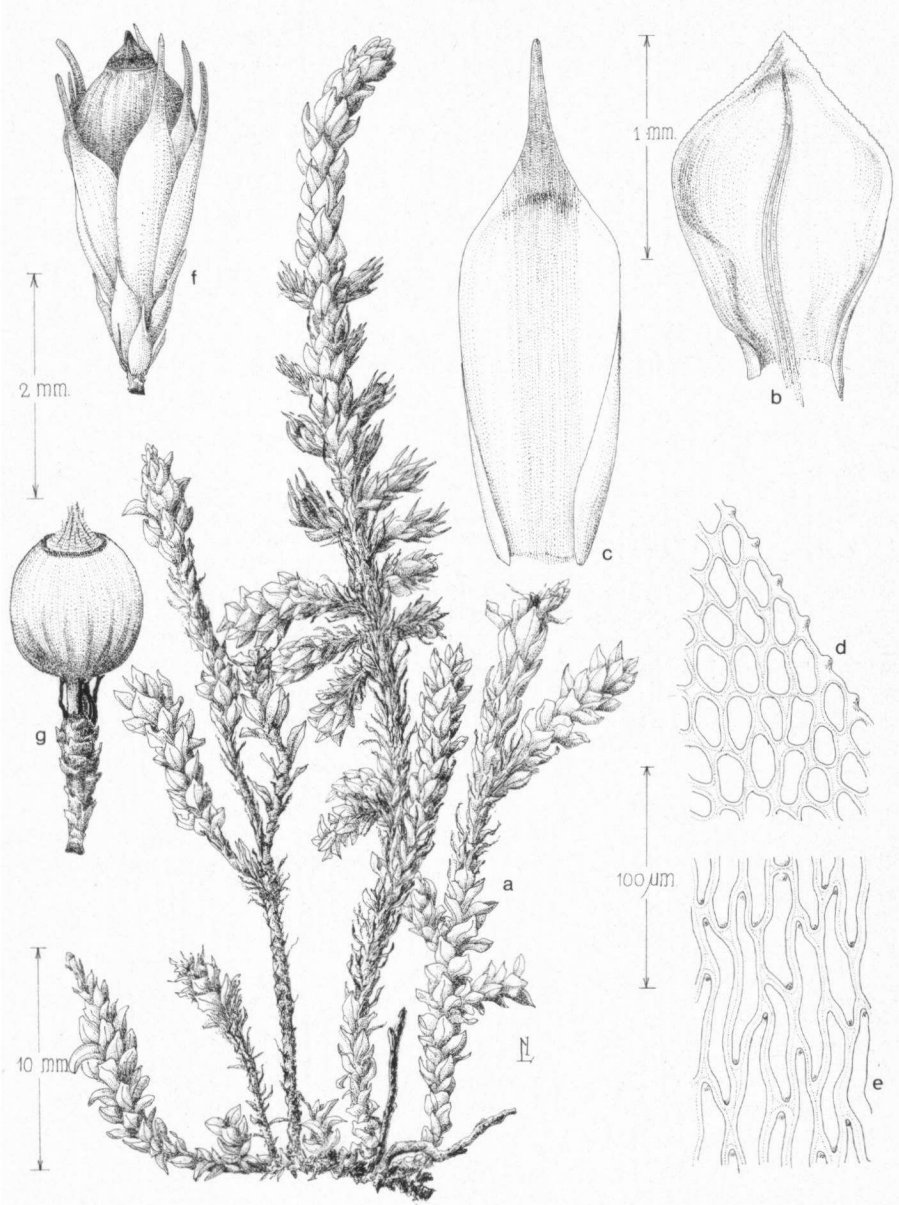
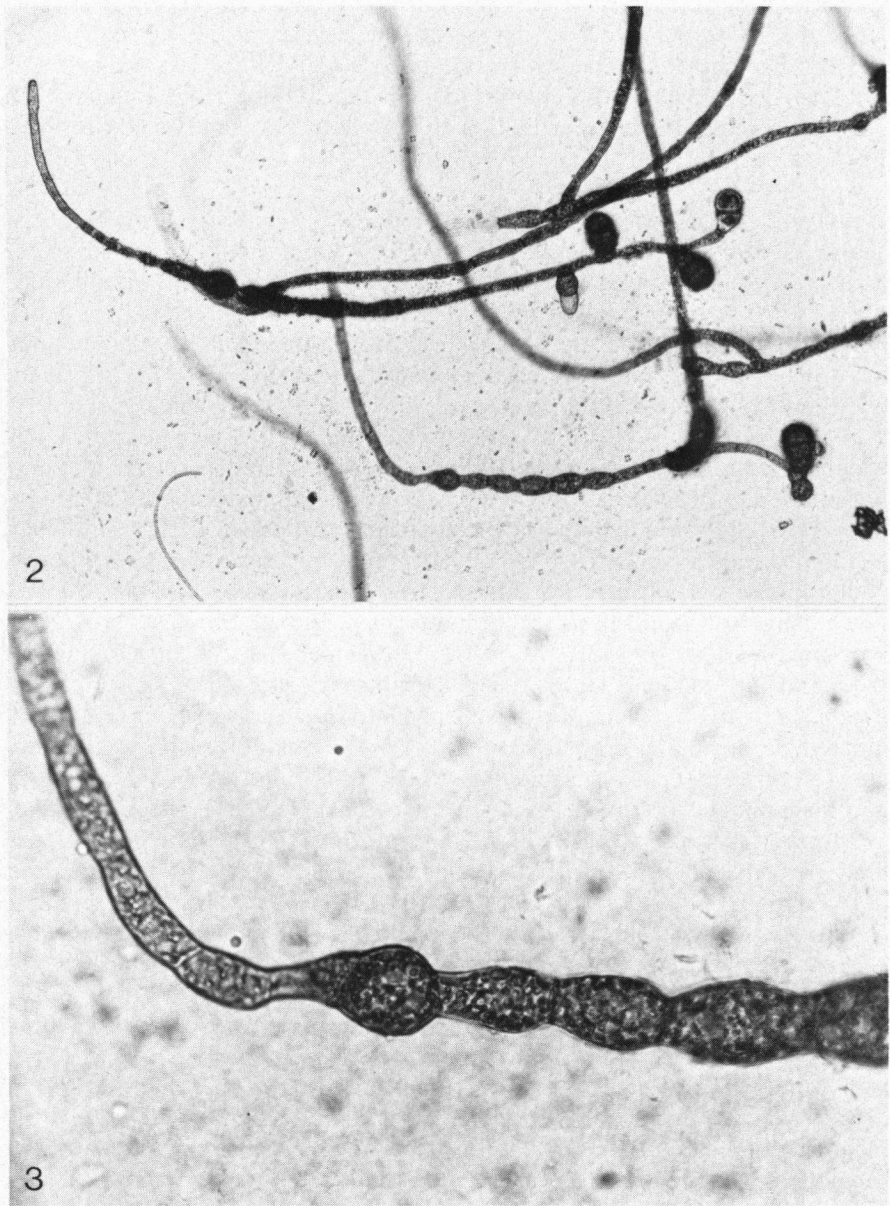


Fig. 1. *Dendrocryphaea latifolia* Griffin, Gradst. et Aguirre – a. habit. b. vegetative leaf. c. perichaetial leaf. d. marginal cells of upper leaf lamina. e. cells of mid-lamina. f. perichaetium with mature sporophyte. g. detail of mature capsule.



Figs. 2-3. Protonema of *Dendrocryphaea latifolia* cultured from spores on agar. 2. habit, c. 125 \times ; 3. detail, showing cell dimorphism in a filament, c. 350 \times .

Species haec ab *D. cuspidatum* (Sull.) Broth. differt foliis latioribus capsula globosa et exostomii dentes lanceolatis inferne laevis.

TYPE: Colombia, Cundinamarca, Páramo de Chisacá, on wet rocks in the río Santa Rosa, 3400 m, 6th August 1980, S. R. Gradstein and J. Aguirre C. 3664 (*holotype* COL; *isotypes* B, FH, FLAS, GRO, H, L, MO, NICH, NY, PC, U, US).

Plants dark-green to blackish, regularly pinnate, to 7 cm long, fertile branches short, 2–3 mm long, sterile branches longer, to 8 mm long. Leaves imbricate, laxly erect to erect-spreading when dry, spreading or with some leaves wide-spread when moist, broadly ovate to suborbicular, narrowed at the base, 1.5–2 mm long, 1–1.2 mm wide, often biplicate above, margins plane, entire or minutely and bluntly serrulate by projecting cell walls, apex cuspidate, broadly acute or obtuse. Costa strong, subpercurrent, 50–75 μm wide at base, weakly scabrous on back above. Cells of upper lamina rhomboidal or elliptic, 5–9 μm wide, to 25 μm long, moderately incrassate, typically smooth, cells of mid and lower lamina somewhat longer, sinuous and often faintly papillose at one or both ends, cells of leaf margin not distinct from intramarginal cells, cells of alar region quadrate to short-rectangular, vacant in older leaves, chlorophyllous in young leaves, cells of inner basal area linear to linear-sinuous, 5 μm wide, to 70 μm long. Autoicous. Perigonia gemmiform, perigonal leaves ovate, 0.7–0.8 mm long, ecostate or with costa weakly developed; perichaetia terminating short branches, perichaetial leaves green, elliptic to ovate, abruptly subulate in long acuminate tip, 2.5 mm long, apex acute to blunt, costa strong, excurrent in subulate tip, filling most of acumen, smooth to faintly scabrous on back above. Capsule globose to subglobose, 1–1.3 mm long, 1 mm wide, seta 0.5 mm long, annulus prominent, revolubile, operculum conic. Peristome double, exostome of 16 lanceolate teeth inserted below the mouth, smooth below, sparingly papillose above on inner face, 400–425 μm long, endostome segments nearly equalling those of exostome, filiform, coarsely papillose, cilia not observed. Spores green, spherical, faintly papillose, 20–25 μm . Calyptra not seen.

Protonemal notes: protonemata were obtained from spores desiccated for periods of 2, 5 and 11 months after collecting and subsequently exposed to wet or dry freezing at -30°C for 1–4 days. Germination rates were over 50% after 2 months and 10–50% after 5 and 11 months resp. Spore germination appeared to be slightly more successful after the wet-freezing treatment than after the dry-freezing treatment. The protonemata consist of long, greenish to brownish filaments composed of cylindrical cells alternating with short chains of swollen, subglobose cells (*figs. 2, 3*). Similar protonemata were obtained from spore cultures of *Bryhnia novae-angliae* by NISHIDA (1978). Following Nishida's sporeling typology, the protonemata found in *Dendrocryphaea* probably represent the common *Bryum*-type sporeling as modified by culture conditions.

Distribution: known only from the type specimen.

Ecology: dense patches of *D. latifolia* were found on the sides of stones in the swiftly flowing shallow water of the stream. Sporophytes were produced

on the emergent plants only, as is typical of rheophytic bryophytes (GRADSTEIN & VITAL 1975). Associated with this species were small patches of *Grimmia alpicola* var. *rivularis* (Gradstein & Aguirre 3664a) and extensive mats of *Platyhypnidium riparioides* (= *Rhynchostegium riparioides*) (Gradstein & Aguirre 3664c). The above species combination is considered to constitute a specialized rheophytic páramo moss community, the *Dendrocryphaeo-Platyhypnidietum* Cleef & Gradst. (CLEEF 1981), of which *Dendrocryphaea latifolia* is the local character species. In the páramos of Colombia this community is not uncommon on rocks in streams, where it is usually made up of monotypic strands of *Platyhypnidium* (CLEEF 1981). We assume, however, that a careful searching in the habitats where the community occurs might reveal additional localities for *D. latifolia*.

3. TAXONOMIC NOTES

The new species is allied to *Dendrocryphaea cuspidata* (Sull.) Broth. from Southern Chile ((Valdivia to Aysén) and adjacent Argentina, in the lack of a leaf border of elongated cells. It differs from *D. cuspidata* in the broader leaves, the ± globose capsules (vs. oblong-ovoid) and the basally smooth exostome teeth which are lanceolate (vs. teeth papillose throughout and drawn into a long, filiform tip). *Dendrocryphaea* Broth. comprises four species (see below). The genus is most closely related to the genus *Cyptodon*. Both genera have perichaetia terminating short branches but differ in the alar cells, which are small and chlorophyllous in *Cyptodon* and large and hyaline (at least in mature leaves) in *Dendrocryphaea*. The species of *Cyptodon* are corticolous for the most part, and are associated with humid forests. With the single exception of *C. crassinervis* from Juan Fernández Is. (Chile), the remaining species of *Cyptodon* occur in the Old World, ranging from Eastern Australia northward to the Samoan Islands.

The species of *Dendrocryphaea* are distinguished by the following key:

- 1. Leaves bordered by several rows of elongated cells distinct from intramarginal cells 2
- 1. Leaves not bordered, marginal cells ± similar to intramarginal cells 3
 - 2. Leaves acute, costa percurrent, calyptra basally lobed to shallowly lacinate b. *D. gorveana*
 - 2. Leaves broadly acute to obtuse, costa percurrent, calyptra deeply lacinate d. *D. lechleri*
 - 3. Leaves ovate to oblong-ovate, < 1 mm wide, capsules oblong-ovoid, exostome teeth lanceolate-filiform, papillose throughout a. *D. cuspidata*
 - 3. Leaves broadly ovate to suborbicular, > 1 mm wide, capsules ± globose, exostome teeth lanceolate, smooth below, sparingly papillose above on inner side c. *D. latifolia*
- a. *Dendrocryphaea cuspidata* (Sull.) Broth. ex Par., Collatio Nom. Broth. p. 9. 1909. (*Cryphaea cuspidata* Sull., Proc. Am. Acad. Arts Sci. 3: 80. 1854.)

Type: Chile, U.S. Sci. Exped. Wilkes s.n. (US).

Other specimens examined: CHILE. Lac Panguipulli, Frère Claude Joseph 2994b (US); Corral, Thaxter s.n., as *D. gorveana* (US); prope Corral, Krause s.n., as *Cryphaea* (US); Corral, Thaxter 14, 15, 66, as *D. gorvena* (FH); los Perales, Bertho s.n., Musci Selecti et Critici 211, ed. Verdoorn (FH, US). WESTERN PATAGONIA. río Aysen, Dusen A 23, as *D. gorveana* (US), 478 as *D. gorveana* (FH, US). ARGENTINA. Lac Nahuel Huapi, Dusén 784, as *Cryphaea pulchella* (FH).

- b. *Dendrocryphaea gorveana* (Mont.) Par. et Schimp., in Broth., Nat. Pflanzenfam. 1(3): 744. 1905 (*Cryphaea gorveana* Mont., Ann. Sci. Nat. Bot. ser. 3,4: 99. 1845). *Type:* Chile, Lechler s.n. isotype (NY).

Other specimens examined: CHILE. Valdivia, Krause s.n. (FH); "Chile infericas", unknown col. (NY); unknown loc., Gay s.n., as *Cryphaea ramosissima* (NY).

- c. *Dendrocryphaea latifolia* Griffin, Gradst. et Aguirre. COLOMBIA.

- d. *Dendrocryphaea lechleri* (Fleisch.) Par. et Schimp. ex Thér., Rev. Bryol. Li-chénol. 7: 178. 1935 (*Dendrocryphaea gorveana* var. *lechleri* Fleisch., Hedwigia 55: 285. 1914). *Type:* Chile, Lechler 474 (holotype P; isotypes FH, NY).

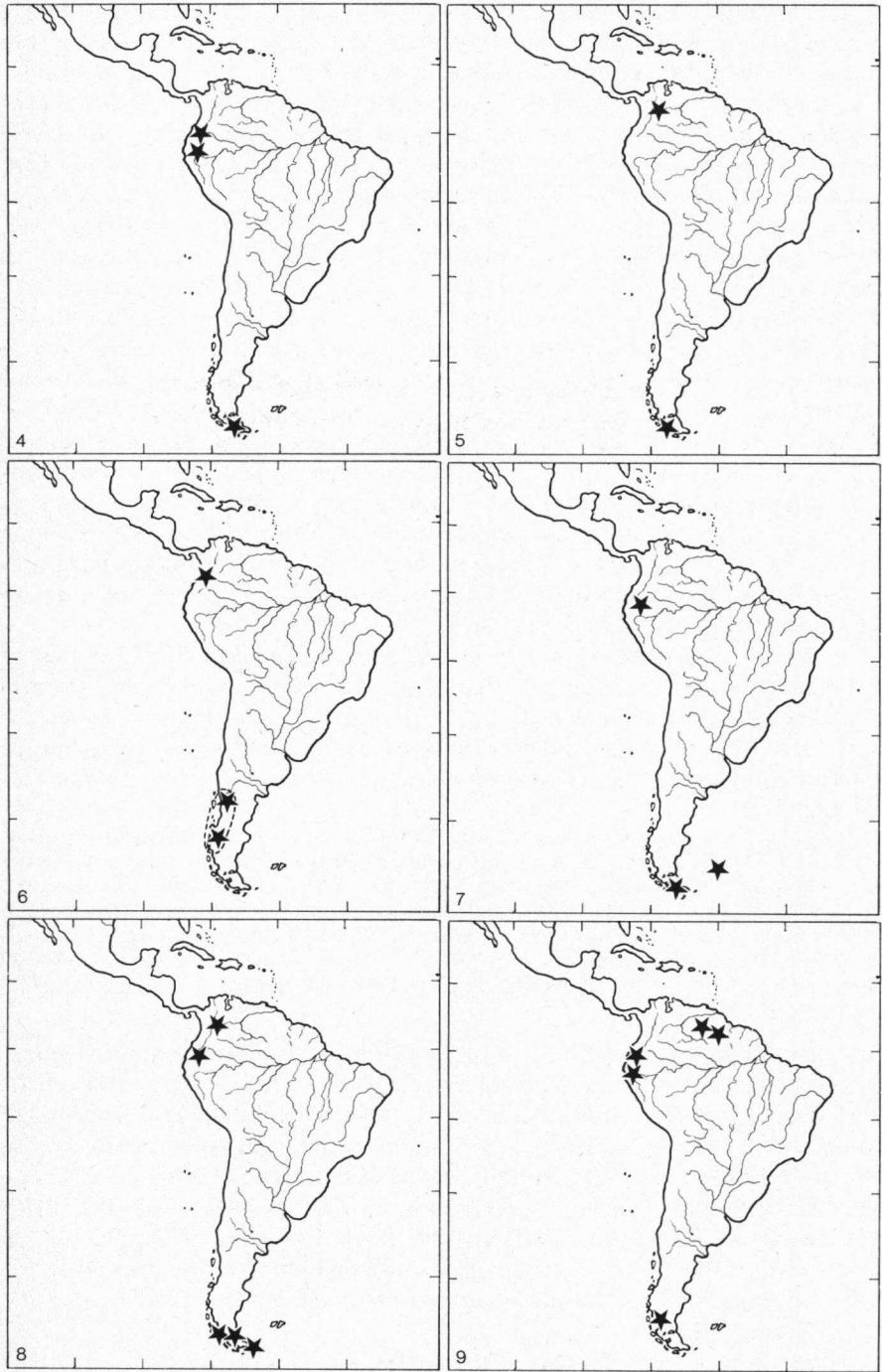
Dendrocryphaea ramosissima (Par.) Wijk et Marg., Taxon 8: 73. 1959 *syn. nov.* (*Cryphaea ramosissima* Par., in Jaeg., Ber. S. Gall. Naturwiss. Ges. 1874-75: 184. 1876 *nom. nov.* for *Cryphaea tenella* Mitt. non Hornsch. ex C. Muell.). *Type:* Chile, Arique, Lechler s.n. (NY). Putatively the type for *D. ramosissima* and labelled under this name. The original collection by Lechler, described by MITTEN (1869) as *Cryphaea tenella*, was nr. 654. This number is not written on the packet of the NY specimen. All the remaining data and the morphological features of the plants fit the original description for *C. ramosissima*, a species placed in synonymy here under *D. lechleri*.

Other specimens examined: CHILE. Valdivia, Herb. de Thümen, as "*D. lechlerianum* Schp." (NY); Lechler s.n., as *Cryphaea ramosissima* (NY); an Bäumen, Lechler s.n., as *D. gorveana* var. *lechleri* (FH).

4. PHYTOGEOGRAPHICAL NOTES AND DISCUSSION

The occurrence in the neotropical páramos of an essentially antipodal genus of bryophytes, with its main distribution at temperate southern latitudes, is not without precedent.

Figs. 4-9. Distribution patterns of disjunct antipodal bryophytes of the páramos of northern South America. 4. *Andreaea wilsonii* (cf. DUSÉN 1903; STEERE 1948). 5. *Blindia magellanica* var. *inundata* (cf. HERZOG & SCHWABE 1939; FLORSCHÜTZ-DE WAARD & FLORSCHÜTZ 1979). 6. *Dendrocryphaea* (this paper). 7. *Ditrichum strictum* (cf. VAN ZANTEN 1971). 8. *Colura patagonica* (cf. SOLARI 1976; GRADSTEIN & HEKING 1979; JOVET-AST 1980). 9. *Eopleurozia paradoxa* (HÄSSEL DE MENÉNDEZ & GREENE 1980; this paper).



Dendrocryphaea latifolia can be added to a small, but increasingly better known, group of taxa with similar distributions (CLEEF 1978). Among the mosses of the antipodal element in the páramos are: *Andreaea nitida*, *A. subulata*, *A. wilsonii*, *Fissidens rigidulus*, *Blindia magellanica* var. *inundata*, *Ditrichum strictum*, *Cheilothela chilensis*, *Dicranella cardotii*, *Chorisodontium*, *Rhacomitrium crispulum*, *Rhacocarpus purpurascens*, *Bryum laevigatum*, *Rhizogonium mnioides*, *Breutelia integrifolia*, *Conostomum pentastichum*, *Philonotis scabrifolia*, *Lepyrodon tomentosus* and *Leptodontium longicaule* var. *microruncinatum*. Among the liverworts are: *Adelanthus lindenbergianus*, *Clasmatocolea vermicularis*, *Colura patagonica*, *Cryptochila grandiflora*, *Eopleurozia paradoxa*, *Hymenophyllum flabellatum*, *Isotachis* sect. *Subaequifolia*, *Jamesoniella* sect. *Coloratae*, *Jensenia*, *Lepicolea*, *Lethocolea*, *Marchantia berteriana*, *Pseudocephalozia quadriloba*, *Telaranea* subg. *Neolepidozia*, *Triandrophyllum subtrifidum* and *Temnoma*.

While some of the above taxa are rather widespread and evenly distributed along the Andean chain (the major gap in their present distribution corresponding to the arid regions of the Atacama Desert), others, such as *Dendrocryphaea*, are much more restricted disjuncts in South America with stations limited to the southern tip of the continent and the northern páramos or, rarely, including also the tops of the Venezuelan tepuis (figs. 4–9). Examples among the mosses of these disjuncts include:

Andreaea wilsonii (fig. 4), *Blindia magellanica* var. *inundata* (fig. 5) and *Ditrichum strictum* (fig. 7). Among the hepatics examples with similar disjuncts patterns include: *Colura patagonica* (fig. 8), *Eopleurozia paradoxa* (fig. 9) (see below), *Hymenophyllum flabellatum* (SCHUSTER 1969), *Pseudocephalozia quadriloba* (ENGEL & SCHUSTER 1974), *Telaranea* subg. *Neolepidozia* and *Temnoma* (SCHUSTER 1979).

Eopleurozia Schust. is a highly disjunct genus with 2 species in the high mountains of tropical Asia and *E. paradoxa* (Jack) Schust. in the Colombian páramos, on Mt. Roraima in Venezuela and in Southern Chile (HÄSSEL DE MENENDEZ & GREENE 1980). To the two northern South American localities, reported in the 19th century, three new stations may now be added: Venezuela. Edo. Bolívar, Kukenantepui, 2600 m, Delascio & Brewer 4932, I. 1977 (FLAS, U). Colombia. Depto. de Huila-Cauca, Macizo Colombiano, Páramo de las Papas, on rocks and soil, 3530–3630 m, Bischler 759, 858, IX. 1958 (COL, PC, U). Ecuador. Loja-Zamora, 3500 m, E. André 4524, XII. 1874 (NY, U).

Austral bryophytes which occur in the páramos of northern South America, but which are reported also from intermediate stations along the Andean chain include, for mosses: *Andreaea subulata* (HERMANN 1976; FLORSCHÜTZ-DE WAARD & FLORSCHÜTZ 1979), *Breutelia integrifolia* (HERMANN 1976; HEGEWALD & HEGEWALD 1975; STEERE 1948; FLORSCHÜTZ-DE WAARD & FLORSCHÜTZ 1979) and *Philonotis scabrifolia* (VAN ZANTEN 1971; HERMANN 1976; HEGEWALD & HEGEWALD 1975; STEERE 1948; FLORSCHÜTZ-DE WAARD & FLORSCHÜTZ 1979) and for liverworts: *Adelanthus lindenbergianus* (GROLLE 1969), *Clasmatocolea vermicularis* (ENGEL 1980) and *Triandrophyllum subtrifidum* (GROLLE 1969).

Thus, the antipodal element in the páramos of South America, insofar as

bryophytes are concerned, can be described as a heterogeneous grouping, representing diverse taxa which, in turn, occupy a comparably diverse spectrum of microhabitats (aquatic, terrestrial, corticolous). The geographical ranges of these species reveal also great differences in terms of continuity of distribution. Some occur all along the Andean Cordillera with disruptions of, at most, a few hundred kilometers. Others include disjunctions of over 1,000 kilometers. The possibility that these disjunctions are, at least in part, artifacts caused by insufficient collecting in intermediate areas should of course not be ruled out.

Obviously, no one explanation will clarify the question of how this element came to inhabit the páramos. Speculation concerning the origin needs to address both time and mode of arrival. Given that the páramo life zone has existed for, at most, 1.8–2 millions of years (VAN DER HAMMEN 1974), it seems probable that these bryophytes evolved elsewhere, migrating to the páramos concurrent with or following the development of the páramo environment. The relatively recent appearance of the páramos does not exclude the possibility of an earlier arrival to the area by at least some of these taxa. Several species, e.g. *Rhizogonium mnioides*, *Lepyrodon tomentosus*, *Jamesoniella rubricaulis*, *Triandrophyllum subtrifidum*, also occur in the high Andean forests, suggesting that their appearance in northern South America may not have depended entirely upon a páramo life zone. As botanists with field experience will attest, the conditions of the páramos grade, at times imperceptibly, slope down into the upper reaches of the Andean forests. The tolerances of some of these species quite clearly allow them to exist in both types of habitats.

As to the mode of arrival, few concrete data are at hand. The experiments on spore viability and germination by VAN ZANTEN (1978) suggest that for certain austral latitude moss-species strong, directional winds may have carried viable spores from one area to another (e.g. from New Zealand to southern Chile), and, if so, then no more complicated vector need to be sought. According to Dr. Van Zanten (oral comm.) the data on spore germination for *Dendrocryphaea latifolia* indicate a moderate drought resistance of its spores and a capacity for air travel over longer distances. It is not certain, however, that winds of the required force and duration have ever persisted between, say, Patagonia and Colombia or that spores could withstand airborne passage over the arid Atacama barrier.

JOVET-AST (1980) concluded, in reference to the Gondwanic *Colura* sect. *Oidocorys* (which includes *C. patagonica*, fig. 8), that wind and birds could account for dispersal over short distances, but that disjunctions across oceans would be explained better by continental drift. In some of these disjunct taxa, however, e.g. *Eopleurozia paradoxa* (fig. 9), neither sporophytes nor any other obvious means of propagation have been found. Thus, their geographical ranges would seem to represent very ancient migrations and relict occurrences. When and by what route these migrations occurred is difficult to say. Via the eastern slopes of the Andes? The remarkable neotropical occurrence of *Eopleurozia paradoxa* in such disparate localities as the northern Andes and the tepui district of eastern Venezuela invites reflection on this possibility.

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