

New liverworts from the Peruvian Andes. I. *Colura ochyrana* and *Drepanolejeunea halinae* (Lejeuneaceae, Marchantiophyta)

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Abstract: During an intensive ecological and biodiversity research project in the eastern Andes of central Peru large number of bryophytes were collected including many species new to Peru and a few even to science. The present paper describes two new species of Lejeuneaceae, *Colura ochyrana* and *Drepanolejeunea halinae*, which seem to be endemic to the Andes.

Key words: Andes, endemism, Lejeuneaceae, new species, Peru.

Introduction

The exploration of the liverworts in Peru until the end of last century is well summarized by Menzel (1984), starting with the collecting activities of Eduard Friedrich Poeppig as early as 1829-1830 (Frahm & Eggers 1995) and culminating in the long South-American collecting journey of Richard Spruce in the mid-19th century, of which he spent 6 months in Perú. This resulted in his monumental opus (Spruce 1884, 1885), followed by Ernst Heinrich Georg Ule and August Weberbauer. During the last century bryological research in Peru was carried out by Alexander William Evans, Fortunato Luciano Herrera, Eberhard and Pirkko Hegewald, and by the 5-membered Bryotrop Expedition organized by Jan-Peter Frahm and Wolfgang Frey during August-September 1982 (e.g., Frey 1987) in northern Peru focusing on floristics, zonation and ecology along an elevation transect from 500-3500 m. Japanese researchers studied south Peruvian cryptogams (Inoue, 1987) and Kürschner and Parolly (1998) described the epiphytic bryophyte communities and their life strategies and life forms along the Bryotrop transect. In the meantime important monographs were published from genera widespread in the Andes. Then the first guide to the bryophytes of Tropical America was written by Gradstein *et al.* (2001), helping orientation among the numerous neotropical genera. Local illustrated floras of Brazil (Gradstein & da Costa, 2003) and of central French Guiana (Gradstein & Ilkiu-Borges, 2009) were published, with many species occurring also in Peru but sure the most important work for the identification of Andean liverwort species will be the hepatic flora of Columbia and Ecuador by Gradstein (submitted).

During the present century, Peruvian universities also extended their interest towards bryophytes. Yasmin Alexandra Opisso Meija and Steven P. Churchill (Universidad San Marcos, Lima and Bolivian Program of the Missouri Botanical Garden, USM) published the first bryophyte records from the Yanachaga-Chemillén National Park, including 13 species new to Peru (Opisso & Churchill, 2008). Bryan Espinoza-Prieto (also from Universidad San Marcos, Lima) started to deal with Peruvian *Frullania* (Atwood *et al.*, 2018). Prof. James G. Graham (Herbario Forestal, Universidad Nacional Agraria La Molina, Lima, Perú, MOL and Field Museum, Chicago, F), during his botanical, ecological and landscape studies collected large amount of bryophytes in a remote, botanically less known area in the Amazonian outpost of the eastern Andes, in the Cordillera el Sira. The specimens were sorted out by Margaux Fischer (Field Museum). Tamás Pócs (Eszterházy University, Eger, EGR) started to identify the liverworts of them. As a result, a joint paper was published (Graham *et al.*, 2016)

recording 178 species including 38 new to Perú, with observations on their climatic, edaphic and microhabitat heterogeneity.

These results suggested further investigation in the area and a joint project was initiated called "Bryological investigation of the Central Jungle (Selva Central) Region of Peru". The first collecting expedition took place between 13 and 27 May 2016, with the support of the Field Museum, Chicago (F), Herbario Forestal in Molina (MOL), Herbario Selva Central in Oxapampa (HOXA), the Eszterházy Károly University, Eger (EGR) and the Hungarian Academy of Sciences. There were 6 participants (Jim Graham, Lars Söderström, Matt von Konrat, Carl Rothfels, Juan Larraín and Tamás Pócs), including experts of liverworts, mosses, ferns and phanerogams. The team visited and collected in Reserva Puyu Sacha (Dept. Junín), Sho'let Municipal Reserve of Oxapampa, Cañon Huancabamba in the Yanachaga-Chemillén Nat. Park, Santa Barbara and at Catarata Rio Tigre, Mesapata (Dept. Pasco). The collection resulted in approximately 1200 bryophyte specimens and 373 ferns and fern allies, most collected in duplicates enough to be distributed between Field Museum, HOXA and the herbaria of the collector or identifier.

In 2017 a similar expedition was organized by James G. Graham, from 20 July to 5 August (Pócs 2017), parallel to a course to train Peruvian bryologists, during 20–25 July. The participants of the expedition included James G. Graham, Margaux Fischer, Judit Havasi and Tamás Pócs. The locations visited were La Florida Forest Reserves in Distr. Chontabamba near Oxapampa (together with the course), Santuario Nacional Pampa Hermosa (Prov. Chanchamayo, distr. San Ramon) where much time was spent, the limestone area around Huapapo Cave NW of Palcamayo, and finally the dry puna at the altiplano near Condorcocha and San Pedro de Casas, Dept. Junin, prov. Tama.

Methods

From the rich material collected by J.G. Graham and by the two expeditions, liverworts are being identified by T. Pócs (EGR) except for members of genus *Plagiochila*, which will be determined by Margaux Fischer (F). The collected specimens will be deposited Herbario Forestal (MOL), Univ. Nacional Agraria La Molina, Lima Perú, in the Herbarium of Eszterházy University, Eger, Hungary (EGR) and in the Herbarium of Field Museum, Chicago (F). The ecological and phytogeographical evaluation of all taxa is carried out by J. G. Graham (MOL and F). A great part of Lejeuneaceae and Lepidoziaceae are already identified by the author, of which a few turned out to be new to science. Two of these new taxa are described below to the honor of prof. Ryszard Ochyra and of Prof. Halina Bednarek-Ochyra.

Results

Colura ochyrana Pócs, **sp. nov.** (sect. *Colura*)

Figs. 1–10

DIAGNOSIS: *Unique among members of sect. Colura by its very large, conical sac and by its long, papillose perianth horns. The conical sac reminds of some members of sect. Harmophyllum, but the five horns of perianth and the 2 triangular basal median cells of valve indicate its proper placement in sect. Colura.*

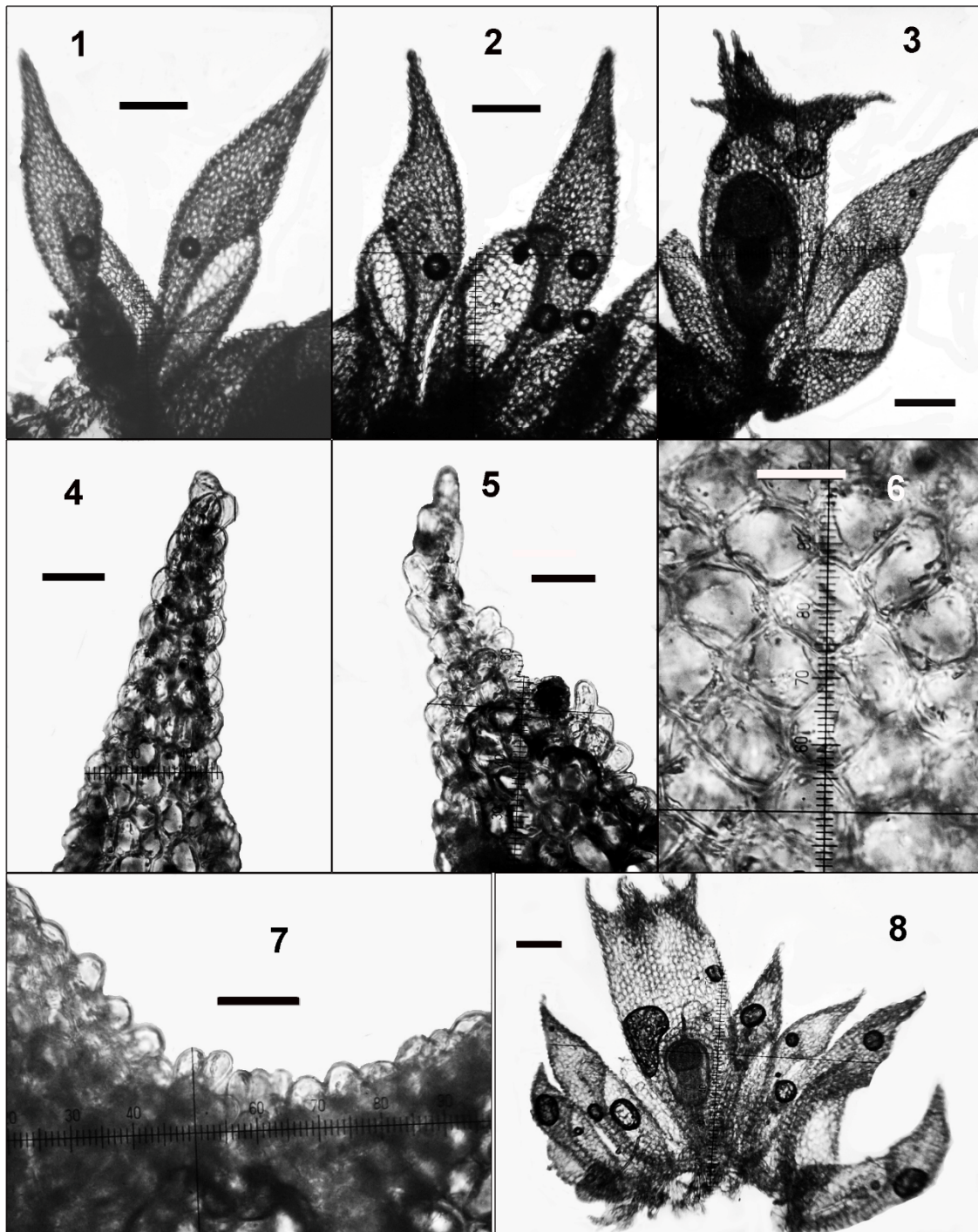
TYPE: PERU, Junín, Prov. Chanchamayo, Distr. San Ramón, Bosque de Puyu Sacha, bosque montano con *Weinmannia*, *Podocarpus*, *Ceroxylum*, *Cinchona*, *Cecropia*, *Saraouya*, *Lauraceae* y *Myrtaceae*, sendero a la cascada. 11°05'40"S; 75°25'34"W. Alt. 2190–2200 m. Sobre hojas. Coll. T. Pócs & M. von Konrat No. 1601/BU, Juan Larraín No. 39741/AA, accompanied by 38 other epiphyllous liverwort species (Holotype HOXA, Isotype EGR, F).

DESCRIPTION: **Plants** medium-sized, pale green, epiphyllous, forming irregular colonies of 2–7 mm, shoots 2–3 mm long, stems 30–50 µm thick. **Leaves** erect, 1–1.5 mm long, lobe 160–240 µm wide with auriculate base. Lobe cells irregular or isodiametric 5- or 6-gonal, 20–40 µm diameter with evenly thin walls. Lobule lanceolate, prolonged in a cone-shaped, long, acute sac, occupying 2/5–1/2 length of the leaf and usually ending in two parallel cells. Both the lobe and lobule cells are mamillose on the outer surface, each cell bulging into a hemispheric mamilla (visible only in wet state). Valve (Fig. 9) 80×62 µm, with 13–14 hyaline marginal and with 10 median cells, of which the two basal are triangular in shape. **Underleaves** asymmetric, widely V-shaped, the lobes spreading from the stem at an angle of 60–80°. One of the underleaf lobes about 200, the other one 160 µm long, 2–3 cells wide in the lower half, 1 cell wide in the upper half, usually ending in an ovate, rounded cell. **Rhizoids** colorless, unicellular, with coral-like branching. Perichaetial leaves obtuse, with crenulate apex. **Perianth** urn-

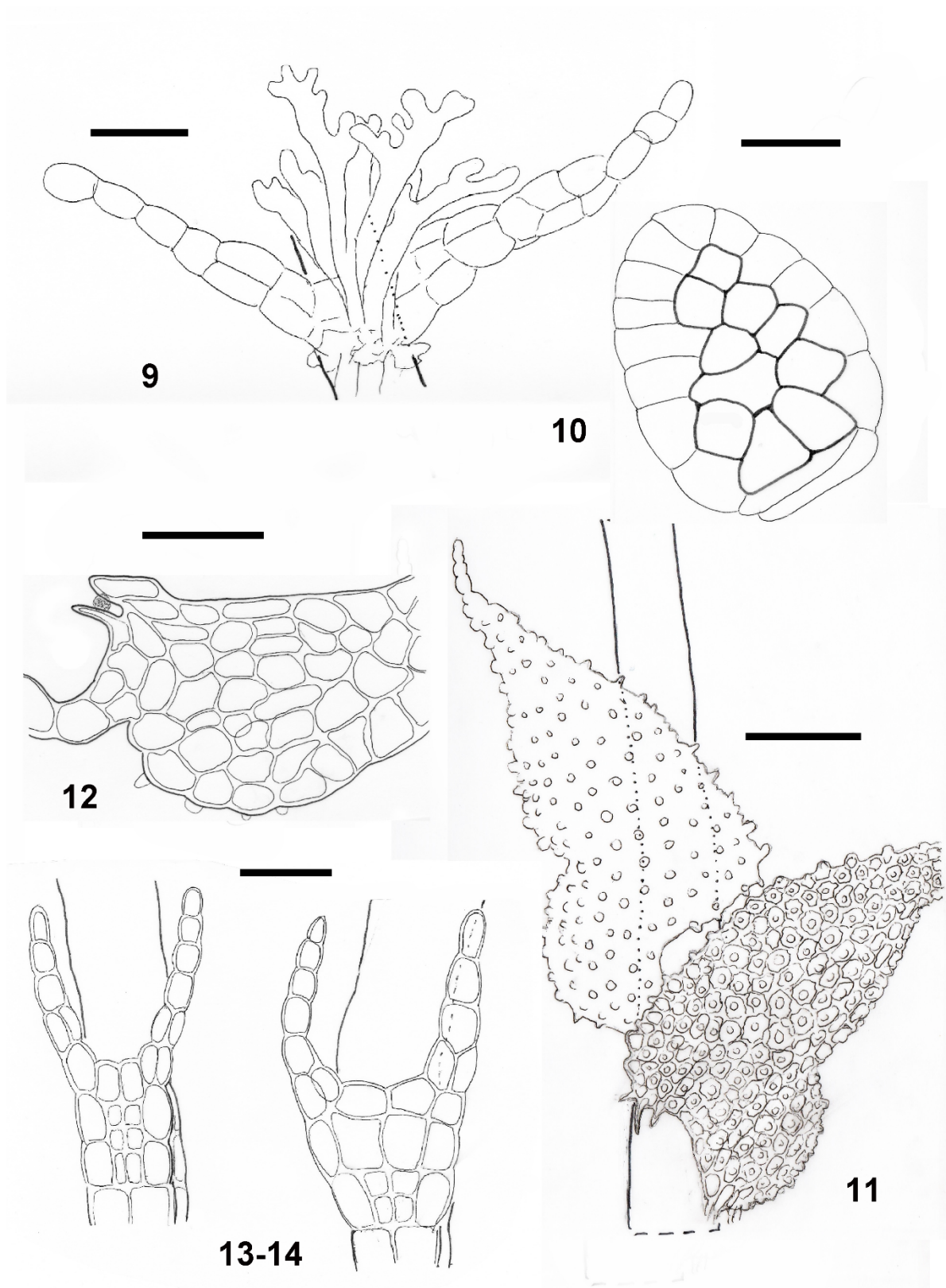
shaped, 1000–1120 μm long and 330–420 μm wide, without the 5 acute horns. Beak not emerging, one cell high, formed by somewhat elongated cells (Fig. 7). Perianth cells quadrate, 20–25 μm large, mamilliose similarly to the lobe and lobule cells, but cells at the tip of horns and around the beak more bulging than the rest. **Androecia** and vegetative reproduction unknown.

ETYMOLOGY: the new species is named in the honor of Prof. Ryszard Ochyra, the author's friend since 40 years and expert of the mosses of Eurasia, Africa and the Subantarctic and Antarctic regions.

RANGE: PERU. Known only from the type locality (Fig. 21).



Figs 1–8: *Colura ochyrana* Pócs, sp. nov. 1–2 – leaves, ventral view. Scale bar 200 μm . 3 – Perianth. Scale bar 100 μm . 4 – Apex of sac. Scale bar 50 μm . 5 – Apex of perianth horn. Scale bar 50 μm . 6 – Cells of perianth wall. Scale bar 25 μm . 7 – Perianth mouth with immerse beak. Scale bar 25 μm . 8 – Habit of a shoot with perianth. Scale bar 200 μm .



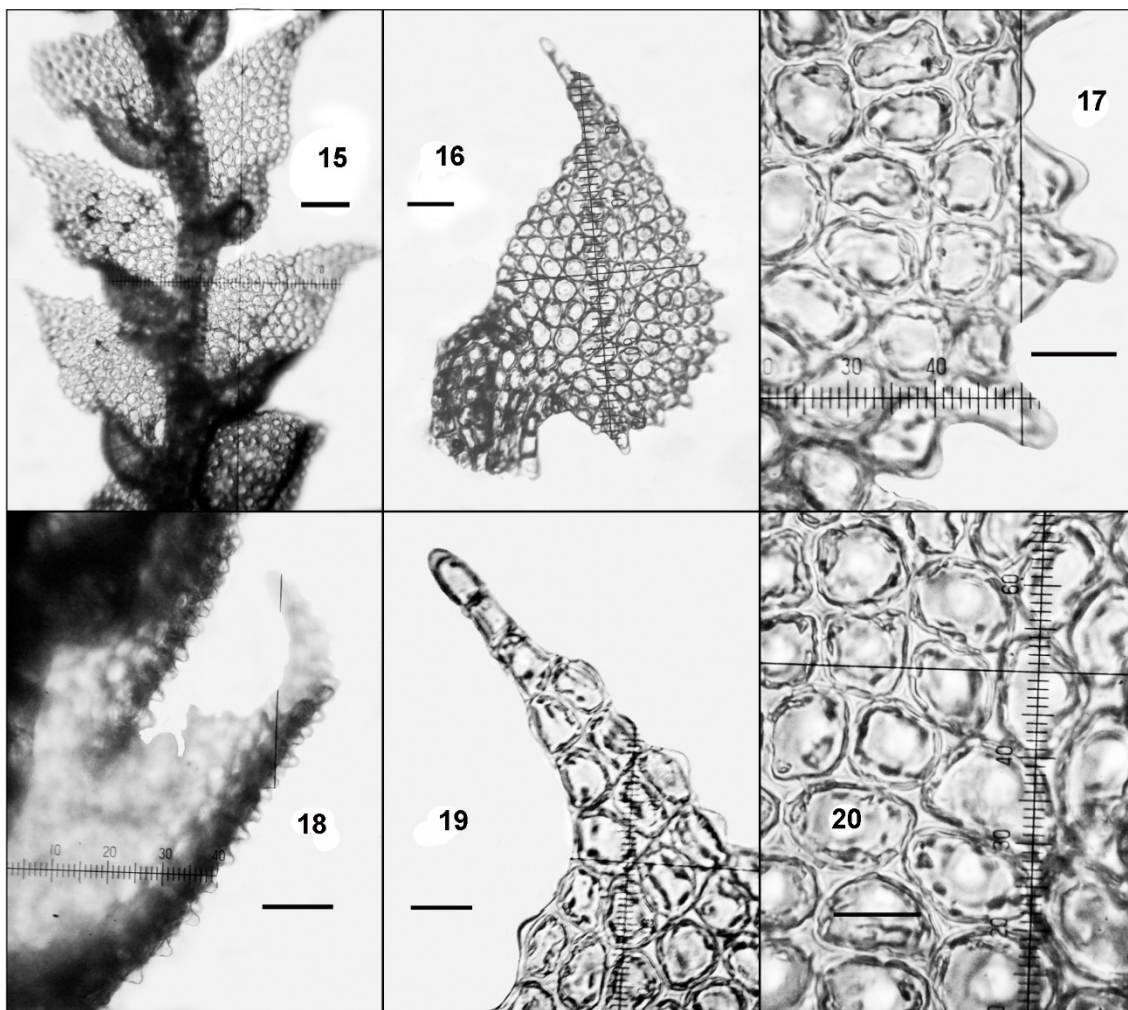
Figs 9–10: *Colura ochyrana* Pócs, sp. nov. **9** – Underleaf and rhizoids. Scale bar 25 μ m. **10** – Valve. Scale bar 25 μ m. **11–14:** *Drepanolejeunea halinae* Pócs, sp. nov. **11** – Dorsal view of leaves, with their shoulder covering the stem. Scale bar 100 μ m. **12** – Lobule, ventral view. Scale bar 50 μ m. **13–14:** Underleaves. Scale bar 25 μ m.

Drepanolejeunea halinae Pócs, sp. nov. (subgen. *Drepanolejeunea*)

Figs. 11–20

DIAGNOSIS: By its strongly papillose leaves with an auriculate and spinose shoulder, which overlaps on the dorsal side of the stem and by the two parallel lobule teeth with a narrow slit in which the hyaline papilla is situated, this species seems quite isolated among Neotropical *Drepanolejeunea* species. It can be classified in the sect. *Auritae* R.M. Schust., where it resembles the Andean *D. cutervoensis* (Loitl.) Grolle (= *D. navicularis* Steph.) in the lobule teeth but differs clearly in having 1-cell wide underleaf lobes. In its lobule teeth and leaf papillosity the species also resembles *Drepanolejeunea submuricata* R.M.Schust. ex L.Söderstr. et A.Hagborg (sect. *Anoplanthae* R.M. Schust.) from Dominica but clearly differs from the latter by the strongly dentate lobe margin and by the lack of the two big basal ocelli in a row, typical for this section.

TYPE: PERU, Ucayali, Prov. Coronel Portillo, Dist. Iparia, Alturas del cerro Ariapo, Reserva Comunal el Sira, Cabecera de la cuenca (oeste) del Rio Ariapo, afluente del Rio Ucayali. 9° 28' 29" S; 74° 35' 04" W. Alt. 2000–2050 m. Bosque enano, con abundante luz solar. Crece por suelo en campo abierto. Coll. J.G. Graham No. 5407 p.p., in cushion of *Syzygiella rubricaulis* (Nees) Steph. and *Bazzania roraimensis* (Steph.) Fulford (Holotype F, Isotypes MOL and EGR, in form of microslide).



Figs 15–20: *Drepanolejeunea halinae* Pócs, sp. nov. **15** – Habit, ventral view. Scale bar 100 µm. **16** – Leaf, dorsal view. Scale bar 50 µm. **17** – Dorsal lobe margin. Scale bar 20 µm. **18** – Dorsal leaf papillae. Scale bar 50 µm. **19** – Lobe apex. Scale bar 20 µm. **20** – Median lobe cells. Scale bar 20 µm.

DESCRIPTION: **Plants** very small, yellowish brown in dry state, creeping in a cushion of other bryophytes. Shoots 6–8 mm long and 0.4–0.7 mm wide, stems with hyalodermis, 50–60 µm thick, irregularly branched. **Leaves** spreading at an angle of 40–60° to the stem, about 500 µm long, lobe 200–250 µm wide with dentate margin, falcate, acute apex ending in a row of 2–3 cells. Antical lobe base auriculate and spinose, dorsally overlapping the stem. Lobe cells isodiametric or slightly elongate, 20–30 µm in diameter, cell walls with concave trigones and intermediate thickenings. Each cell of the lobe and the keel is tipped dorsally by one large papilla. Ocelli on

the herbarium specimens could not be observed. Lobule ovate, prolonged in a wide angle to the ventral and in a very sharp angle to the dorsal lobe margin. There are two equally long lobule teeth with a narrow slit in between, holding the hyaline papilla. The ventral lobule cells are smooth, without papillae. **Underleaves** 90–100 µm long, U-shaped with a base as wide as the stem, composed of 6–10 large and a few smaller, median cells. The almost parallel, forward directed underleaf lobes consist of 6–8 cells in one row except at their base. **Gametoecia** not known. Vegetative reproduction by branch propagules.

ETYMOLOGY: This peculiar *Drepanolejeunea* species is named in the honor of Prof. Halina Bednarek-Ochyra, renowned monographer of rhacomitrioid mosses and skilled bryophyte illustrator.

RANGE: PERU. Known only from the type locality. It seems to be a characteristic species of mossy elfin woodlands.



Fig 21: Peru, type locality of *Colura ochyrana* Pócs.

Discussion

The genus *Colura* is represented by fewer species in the New World tropics than in other continents: some 15 species in America, 20 in Africa and more than 40 in Asia, Australasia and the Pacific (Jovet-Ast 1953, 1954, Pócs 1996, Grolle & Zhu 2002). Therefore it has a great significance that a new species of the genus was found in Perú. The new species seems to be identical to the plant illustrated in the "Guide to the Bryophytes of Tropical America" (Gradstein *et al.* 2001: 177, Fig. A–E; figures also published in Gradstein & da Costa 2003) under the name *C. tortifolia* (Nees & Mont.) Steph., originally described from French Guiana (Jovet-Ast 1953, Gradstein & Ilkiu-Borges 2009) and widespread in tropical America in lowland rainforest areas. The latter species sharply differs from *C. ochyrana* by having 3 short perianth wings instead of 5 horns and a valve with 1-2 subquadrate median basal cells (not triangular), and belongs in *Colura* sect. *Harmophyllum*. Although the origin of the plant illustrated by Gradstein *et al.* (2001) was not indicated, it suggests that *C. ochyrana* is more widespread in the Neotropics and that further records of the new species may be hidden in herbaria under the name *C. tortifolia*. A revision of the neotropical collections of *C. tortifolia* is recommended. Possibly, *C. ochyrana* is restricted to the montane forest belt.

The tiny *Drepanolejeunea* species are common in montane habitats of the Neotropics and usually occur on different substrates, as bark, decaying wood and on living leaves, on rocks or on peaty soil. Obviously the Andes are one of their diversity center with at least 35 species (Bischler 1964, 1968, 1968a, Schuster 1996). Although several attempts were made to produce an infrageneric classification for the genus (Herzog, 1930, Bischler 1964, Grolle, 1976, Schuster, 1996, Grolle *et al.* 2000), this subject remains problematic until it can be unequivocally established which characters are results of homoplasy. Leaf and lobule shape, dentition, underleaf and perianth characters are in many cases randomly distributed, not forming parallel groups. Only future molecular investigation can clarify the real infrageneric relationships in *Drepanolejeunea*.

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