

**ACTA BIOLOGICA PLANTARUM AGRIENSIS  
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SEPARATUM

**THE HERBARIUM OF THE BOTANICAL DEPARTMENT IN  
KÁROLY ESZTERHÁZY COLLEGE (EGER)**

*Andrea Sass-Gyarmati and András Vojtkó*

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EGER, 2010

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# THE HERBARIUM OF THE BOTANICAL DEPARTMENT IN KÁROLY ESZTERHÁZY COLLEGE (EGER)

*Andrea Sass-Gyarmati and András Vojtkó*

Botanical Department, Faculty of Science, Károly Eszterházy College, EGER

## **1. Short history of the Herbarium**

Certain collections as well as the herbarium as a whole, because of their uniqueness, are indispensable to scientific study, and have become a valued part of our national heritage. Some collections are irreproducible while others are treasured for their comprehensiveness – covering certain areas or complete taxonomic groups. The Eger herbarium also includes one of the largest cryptogamic collections in Central Europe.

The Botanical Department was founded in 1949, by Tibor Hortobágyi, a prominent Hungarian algae researcher. This course of development was followed under the direction of Tamás Pócs, appointed in 1961, who founded the herbarium with his fern, lichen, bryophyte and vascular plant collections. A year later János Suba joined the department, who obtained for the Herbarium the Márton Vrabélyi vascular collection, previously preserved at Dobó István Jesuitical Secondary School. This valuable collection includes 19<sup>th</sup> century source material of the flora of Bükk and Mátra mountains from Vrabélyi's own collections as well as exchange material from prominent botanists (Haynald, Holuby, Janka, Kerner, Vágner, etc...) of the time.

In 1963 and 1965-66, owing to its Vietnam partnership the College received tropical material in larger amounts for the first time, collected by Tamás Pócs. From the 60's a more rapid development of the collections can be observed. The herbarium now incorporated its staff's own collection of vascular and non-vascular material from Northern Hungary and the Carpathians. The college provided significant funds for the Department to purchase herbarium materials as well literature. This is how bryophyte collections of Árpád Károlyi and László Vajda and Ferenc Fórius's comprehensive lichen herbarium, as well as the majority of Ádám Boros's professional library could be obtained. It also allowed for smaller contributions to the travels of Dénes Balázs geographer in exchange for valuable bryophyte collections from around the world. The herbarium also includes very rich bryophyte material from India, Vietnam and Argentina

collected by György Topál and from Papua New Guinea collected by János Balogh (both zoologists).

To date the herbarium includes contributions from 210 botanists and incorporates 10000 vascular, 8000 lichen and 200000 bryophyte specimens. It cultivates active partnership with many herbaria of the world. Specialists of various taxa from abroad and Hungary frequently visit the herbarium to study unrevised material. Maintaining the main profile the cryptogamic collection has become the largest within the herbarium. Specimens from all around the world can be found in the bryophyte collection with remarkable collections by the staff on expeditions in East Africa, Tunisia, the Indian Ocean islands, Australia, Cuba, Venezuela, Vietnam, the Fiji Islands and other territories.

From within the Carpathian basin the collection of the cryprogamic vegetation of loess cliffs is unique in its comprehensiveness. Vascular and cryptogamic plants were both collected in different areas of Hungary: Órség, the Bükk and Mátra mountains; and from the Carpathians: the Lower Tatra, Bihar, Retezát, Hargita,, Tarcu, Parâng and Fogaras mountains. We also preserve material from outside the Carpathians: from the Julian Alps, the Spitzbergen, Greece and Bulgaria.

We aim to assemble comprehensive compilations of various taxa in our special collections like the *Calymperaceae* family, ordo *Hookeriales*, from the genera of *Fissidens*, *Colura*, *Cololejeunea*, *Lejeunea*, *Lopholejeunea* and *Frullania*. to make their revisions possible.

Lichen specimens have also been collected all over Hungary. We also have a considerable tropical collection from Kenya, Tanzania, Indian Ocean Islands, Ruanda, Argentina, Brasil, Vietnam, Australia, and the Fiji Islands.

A database of lichen collections (ISIS 2.3) and an update of bryophyte types has been developed.

## **2. International Relations**

Our Herbarium operates within the international network of herbaria. We exchange material with more than 60 herbaria worldwide. Numerous exsiccata series are preserved a list of which is appended below. Our type material of over 500 specimens is recognised and cited worldwide. We lay great emphasis on the development and maintenance of our academic library, assembling periodicals, biogeographical publications, flora works and coenological works among which rarities can also be found.

The Hungarian National Office of Cultural Heritage declared the Eger College Herbarium protected in 2007 (resolution no. 401/0055/004/2007). Since the declaration the most important development has been the relocation of the cryptogamic collection in one of the buildings of Eszterházy College Faculty of Science. The two spacious state-of-the-arts-halls are adjoined by two research rooms equipped with microscopes, computers and a cryptogamic library facilitating the study, revision and exchange of materials (formerly stored in five separate locations). The new facilities allow the labelling and integration of the large amounts of previously identified material making it possible to send them out to the specialists concerned for revision.



Fig.2. The European bryophyte collection



Fig. 2. One open cupboard in the overseas hepatic collection

### 3. List of Exsiccata or their parts preserved in the Herbarium of the Botanical Department of Eszterházy College, Eger (EGR):

- Bryophyta Africana Selecta*. Ed. R. Ochyra and T. Pócs  
*Bryophyta Arctica exsiccata*. Ed. W. C. Steere and Kjeld A. Holmen  
*Bryophyta Exsiccata Generis Plagiochilae*. Ed. J. Heinrichs & H. Anton  
*Bryophyta Exsiccata*. Z. Iwatsuki and M. Mizutani  
*Bryophyta Hawaiica Exsiccata*. Ed. W.J.Hoe  
*Bryophyta Neotropica Exsiccata*. Ed. S.R. Gradstein  
*Bryophyta Selecta Exsiccata*. Ed. H. Inoue  
*Bryophyta Vogesiaca Exsiccata*. Ed. J.-P. Frahm  
*Bryophytes of Asia*. Ed. H. Deguchi & T. Yamaguchi  
*Bryophytes of Asia*. Ed. Z. Iwatsuki & M. Higuchi  
*Bryophytes of South China*. Ed. B.J. Lin & L. Zhang  
*Bryophytorum Typorum Exsiccata*. Ed. W.R. Buck.  
*Bryotheca Brasiliensis*. Ed. E. Ule  
*Bryotheca Europaea*. Ed. Rabenhorst, Winter  
*Bryotheca Gottingensis*. Ed. I. Holz & J. Heinrichs.  
*Bryotheca Polonica*. Ed. S. Lisowski Kraków, 1954  
*Camyloporodes Centrali-Africanae*. Ed. J.-P. Frahm  
*Camyloporodes Peruviana Exsiccatae*. Ed. J.-P. Frahm  
*Collection of Juncaceae, Cyperaceae, Typhaceae and Sparganiaceae*. Ed. Á. Dégen  
*Cryptogamas exsiccatas*. Ed. F. Petrak  
*Fontinalaceae Exsiccatae*. Ed. B. Allen  
*Hepaticae et Musci URSS exsiccati*. Ed. I. Abramov  
*Hepaticae et Musci URSS exsiccati*. Ed. L.I. Savicz-Ljubitzkaja  
*Hepaticae Europaeae Exsiccatae*. Ed. V. Schiffner  
*Hepaticae Exsiccatae S.O.Lindbergii*. Ed. S. Piipo  
*Hepaticae Japonicae Exsiccatae*. Ed. S. Hattori  
*Hepaticae macroregioni meridionali Poloniae exsiccati*. Ed. K. Jedrzejko, H. Klama, A. Stebel, J. Arnowiec  
*Hepaticae macroregioni meridionali Poloniae exsiccati*. *Liverworts of Southern Poland*. Ed. K. Jedrzejko  
*Hepaticae macroregioni meridionali Poloniae exsiccati*. *Mosses of Southern Poland*. Ed. K. Jedrzejko  
*Herbier Bryologique*. Ed. J.L. De Sloover  
*Iter Indicum 1839/94*. Ed. V. Schiffner  
*Moss exsiccati*. Ed. T.C.Frye  
*Musci Australasiae Exsiccati*. Ed. H. Streimann  
*Musci et Hep. Novae Caledoniae Exsiccati*. Ed. I. Thériot  
*Musci Frondosi Archipelagici Indici et Polynesiaci*. Ed. M. Fleischer

*Musci Frondosi Archipelagici Indici. Ed. M. Fleischer*  
*Musci japonici Exsiccati. Ed. Z. Iwatsuki and A. Nouchi & S. Hattori*  
*Musci Turkestanici. Ed. V.F. Brotherus*  
*Société d'Échange des Muscinées (S.E.M.)*  
*Sphagotheca Boreali-Americana. Ed. R.E. Andrus and D.H. Vitt*  
*Svenska Pacific Expeditionen 1917-17. Ed. Carlo Inga Skottsberg*  
*Flora exsiccata Austro-Hungarica, a Museo universitatis Vindobonensis edita*  
*Flora Hungarica exsiccata, a sectione botanica Musei Nationalis Hungarici edita*  
*Lichenes Bükkenes Exsiccati. Ed. F. Főriss*  
*Lichenes Regni Hungarici Exsiccati. Ed. Ö. Szatala*  
*Lichenes saxonici exsiccati. Ed. Schade, Stolle & Riehmer*  
*Lichenes Selecti Exsiccati. Editi ab Instituto Botanico Academiae Scientiarum Cechoslovacae, Pruhonice prope Pragam. Ed. A. Vězda*  
*Lichenotheca Rossica Exsiccata. Ed. P. Savicz*  
*Plantae Exsiccatae Carpatorum. Ed. A. Margittai*  
*Plantae Hungariae Exsiccatae. Ed. Á. Boros*  
*Plantae Hungariae Exsiccatae. Ed. Dr. Á. Dégen*

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**BAZZANIA ORBANII (LEPIDOZIACEAE), A NEW SPECIES  
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*Tamás Pócs*

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*Tamás Pócs*

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*Bazzania orbanii* from Madagascar

Key words: *Bazzania*, endemism, Isalo National park, Lepidoziaceae, Madagascar

Abstract: *A new species of Bazzania is described from Isalo National Park in the Toliara Province of south central Madagascar. The new species was collected from a very isolated wet spot of the otherwise dry area, notorious for its endemic succulent plants. The new species differs from all known African taxa by its recurved underleaf margin consisting of elongate cells with incrassate, brownish walls.*

### **Introduction**

Members of the Botany Department of Eszterházy College (Eger) participated in a collecting expedition organized by Missouri Botanical Garden in Madagascar, during September and early October of 1994, to investigate the bryological diversity of the island. One group of them, Sándor Orbán, András Szabó and András Vojtkó, visited the dry southeast part of the island, poor in bryophytes. But even in this area there are small pockets of ecologically different habitats. Such was the so called “Piscine Naturelle” in the otherwise dry, rocky Isalo National Park, where a brook, leading through a sandstone gorge in a depression forms this natural pool surrounded by a riverine forest large specimens of *Pandanus pulcher* (plates I–II). On the shady rocks and soil of the banks some ferns and bryophytes are abundant, like *Calypogeia longifolia* Steph. (Pócs 2005). At this place collected S. Orbán also a sample of *Bazzania* which is peculiar for the first sight, having recurved underleaf margins, which are conspicuous under dissecting microscope, also by their brown colour (see plate III). Jones (1975) in his revision of African *Bazzania* discusses in details the great variability and difficult delimitation of the taxa within section *Connatae*, where also this species belongs, but none of the other African taxa

has recurved margin of the aphigastria with incrassate, brownish cell walls. On this base the Madagascar plant collected at the “Piscine Naturelle” of Isalo National Park is described as new to science.

### **Description of the new species**

#### ***Bazzania orbanii* Pócs, sp. nov. (Figs. 4: 1 and 3-7; 5)**

*Differt a Bazzania decrescens* (Lehm. et Lindenb.) Trevis *marginibus recurvis amphigastrii et a B. recurvolimbata* (Steph.) Kitagawa *parietibus incrassatis et brunneis cellularum marginis amphigastrii.*

**Typus:** SW Madagascar, Toliara Province, Isalo National Park, “Piscine naturelle”, a deep pool of a brook in a sandstone gorge, shaded by *Pandanus pulcher* trees, at 800 m alt., under overhanging streambank rocks, on soil. Coll. S. Orbán, 9455/J (Holotype EGR, Isotypes MO, TANA).

Pale green, weft forming plant with 10-20 mm long, slightly branching, 1.5 mm wide, in dry state quite julaceous shoots. Stem 250  $\mu\text{m}$  thick, medullary cells in about 8 layers and evenly incrassated walls. Flagelliform vertical intercalary branches 3–5 mm long, 150  $\mu\text{m}$  thick. Side leaves falcato-ovate, imbricate, 700–750 $\times$ 480–500  $\mu\text{m}$ , in dry state incurved, with rounded or slightly 1–3 apiculate apex. Cells with nodulose trigones, at the leaf apex with incrassate walls. Apical cells 10–28  $\times$  10–20, the median 30–35 $\times$ 25–28 and the basal ones 30–50 $\times$ 25–30  $\mu\text{m}$  in size. Underleaves imbricate or contiguous, reniform oval, wider than long, 250–300 $\times$ 350–460  $\mu\text{m}$ , with rounded or sunuose-truncate or seldom slightly bilobed apex and with partly or wholly recurved margin. Marginal cells elongated parallel to the margin, 25–32 $\times$ 15–20  $\mu\text{m}$ , with strongly and evenly incrassate, brown tinged walls, in 1–4 rows without chloroplasts. The other cells are similar to those of the side leaves. Sterile.

**Etymology:** It is named after its collector, prof. Sándor Orbán, renowned bryologist.

### **Discussion**

*Bazzania orbanii* is a member of Sectio *Connatae* (Steph.) Fulford and seems to be related to the widespread *Bazzania decrescens* (Lehm. et Lindenb.) Trevis, which is a very polymorphic taxon (Jones 1975, Grolle 1995). Especially in Madagascar and in the neighbouring islands several uncertain taxa of this group were already described, which badly need revision. There are some small sized forms of *Bazzania decrescens* with entire leaves and underleaves, collected at many localities, also in Isalo National Park, which can be compared with the new species (see fig. 1: 2). Anyhow, none of them has this peculiar

amphigastral margin, on which base the species easily can be separated. Similar recurved underleaf margin is observed in certain Asian species, like in *Bazzania recurvolimbata* (Steph.) Kitagawa of Thailand and Vietnam (Kitagawa 1967, Pócs 1969). It differs even from this species by its thick, brown walled marginal underleaf cells, which are in *B. recurvolimbata* hyaline and thin walled. The generally dry and very rocky Isalo National Park have several endemic species, both in the xeric habitats (e.g. the succulent *Adenia isaloensis*, *Aloe isaloensis*, *Euphorbia primulifolia* var. *begardii*, *Pachypodium rosulatum* ssp. *gracilius* and a legume with phyllocladia, *Mundulea phylloxylon*, according to Rauh 1995) and in the gorges with permanent running water (*Ravenea rivularis*, a tall palm tree, see Dransfield & Beentje, 1995). The new *Bazzania* species seems to be a nice addition to these Isalo endemics.

### Acknowledgements

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**Fig. 1:** Dry rock vegetation in Isalo National Park with *Mundulea phylloxylon* (Fabaceae) in the foreground. (Photo by S. C. Kozma)

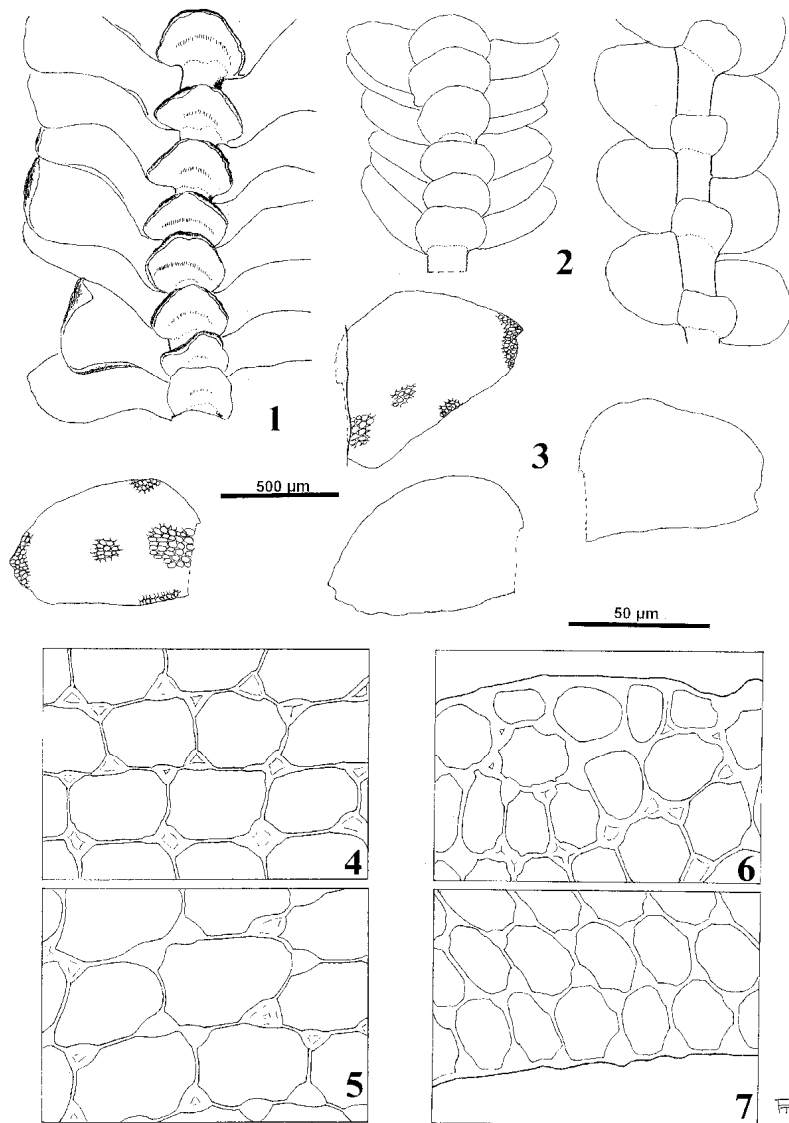


**Fig. 2:** The “Piscine Naturelle” in Isalo National Park. (Photo by S. C. Kozma)

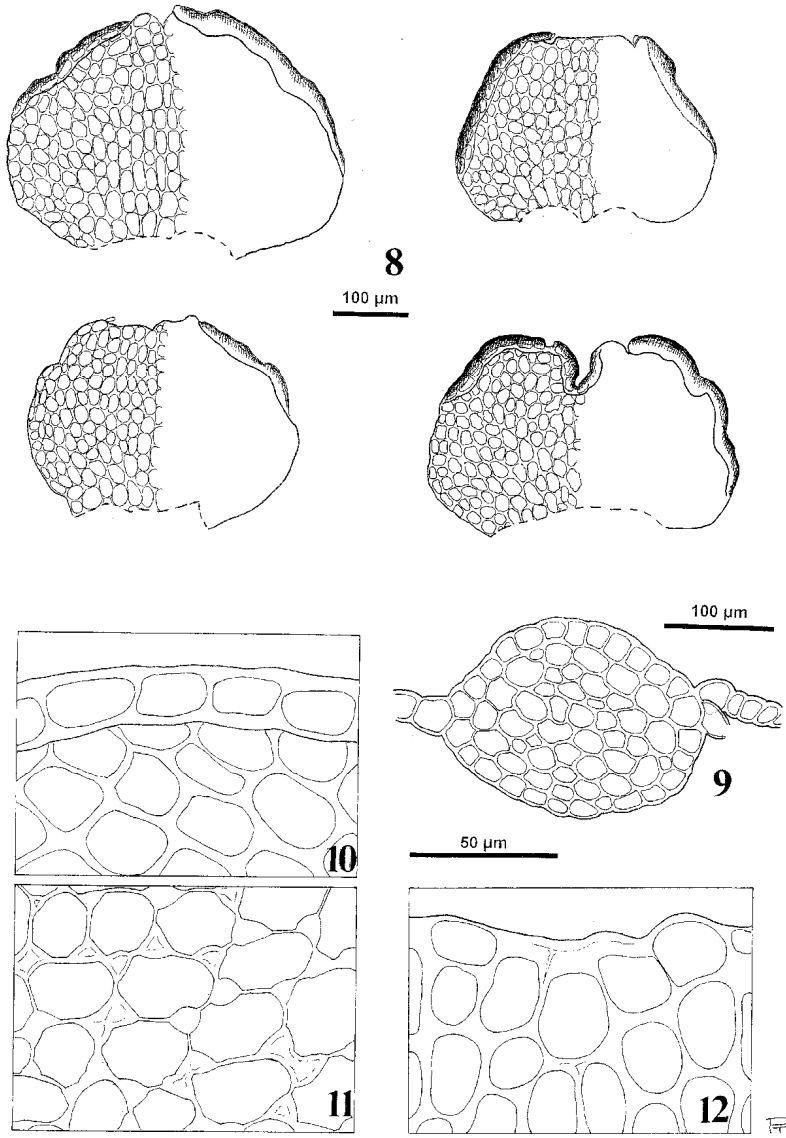




**Fig. 3:** The habit of *Bazzania orbanii* sp. nov. (Photo by T. Pócs)



**Fig.4.** 1 and 3-7: *Bazzania orbani* Pócs, drawn from the type, Orbán 9455/J. 2: Small forms of *Bazzania decrescens* (Lehm. & Lindenb.) Trev. collected by Orbán, 9456/C and F, also from the area of Isalo National Park, in the sandstone gorge high above the “Piscine Naturelle”, under shady sandstone cliffs.  
 1-2: Habit. 3: leaves. 4: Median, 5: basal, 6: apical and 7: marginal leaf cells.



**Fig.5.** *Bazzania orbanii* Pócs, drawn from the type. 8: Underleaves. 9: Stem section. 10: Marginal, 11: median and 12: apical underleaf cells.

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**A NEW SPECIES FROM TANZANIA**

***Itambo Malombe*<sup>1</sup>, *Eberhard Fischer*<sup>2</sup> and *Tamás Pócs*<sup>3</sup>**

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Validation of *Cheilolejeunea ulugurica*  
*Cheilolejeunea*, conservation, Eastern Arc, endemism, Uluguru, Tanzania

**Abstract**

*Cheilolejeunea ulugurica* Malombe, Eb.Fisch. & Pócs is a new species affiliated to subg. *Cheilolejeunea*. One of its closest relatives seems to be *Cheilolejeunea chenii* from Asia. It is described from the Uluguru Mountains, members of the crystalline Eastern Arc of Tanzania, notorious for its richness in endemic species.

**Introduction**

Tamás Pócs presumed the possibility of a new species collected by him with his son Bence on the Bondwa peak of Uluguru Mountains in Tanzania in 1985. The two other authors studied carefully the scanty material and confirmed his assumption, describing and illustrating this species. In an account on some new *Cheilolejeunea* species Malombe (2009) mentioned the name of *Cheilolejeunea ulugurica* Malombe, Eb. Fisch. et Pócs and published its detailed illustration with some annotation but without a diagnosis and a detailed description, referring to a paper of the three authors to be published later. The present paper will validate the new species, adding the necessary details.

The new species of *Cheilolejeunea* (Spruce) Schiffn. is described on the basis of the following morphological characters: the obovato-spathulate nature of the lobe with a lobule occupying its  $\frac{2}{3}$  to  $\frac{3}{4}$  length with strongly incurved keel apex, forming very narrow sinus with postical lobe margin, which clearly give the new species an identity from any other known species from continental Africa. The

circumscription of the species from other allied members of subg. *Cheilolejeunea*, especially of the closely related Asian *Ch. chenii* is provided, with some remarks on its ecology and conservation status.

***Cheilolejeunea ulugurica*** Malombe, Eb. Fisch. et Pócs, *sp. nov.* (Fig. 1, 2)

*Differt a Cheilolejeunea chenii* R.L. Zhu & M.L. So *foliis falcatis angulis acutioribus inter carina et apice lobi, lobulis angustioribus marginibus liberis cellulis pluribus et marginibus distalibus solum 2-3 cellulis composita.*

**Typus :** TANZANIA, Uluguru Mts, N side of Bondwa peak, 1650–1880 m, 26 Dec. 1985, B. & T. Pócs, 8565/S, (Holotype: EGR, microslide!).

### **Description**

Plants green *in situ* turning brown in herbarium, up to 12 mm long. Shoots always mixed with other species, 560–776 µm wide, with few seldom branches. Stem 64–84 µm in diameter. Ventral merophytes of the stem 2 cells (31.5 × 21.7 µm in average) wide. Leaves usually imbricate, obovato-spathulate, slightly falcate, spreading from the stem at an angle of 80–130°, 378–488 µm long, 340–392 µm wide, apex broadly rounded, plane, bends outwards, margin smooth, base flat, running parallel along the central line of the stem. Lobe cell walls slightly thickened, usually with reduced mammillae, trigones very small, triangular, up to 2.6 µm in length, mid cells hexagonal, 32–64 µm long and 22.4–27.2 µm wide, marginal cells rectangular, 20.0–2.6 µm long and 16–32 µm wide. Lobule large, usually over 2/3 (up to 3/4) of the lobe length, elongate, antical free margin flattened, bordered by *ca.* 10 cells. A strongly conspicuous fold which runs diagonally to nearly the entire length of the lobule to join the much incurved keel apex. The keel forms a very narrow sinus (<45°) with postical lobe margin. The distal lobule apex only 2-3 cells wide, truncate, except for the mid cell which sometimes tends to bulge. Apical tooth usually incurved to form a club-like appendage with the incurved keel side, rarely straight, 64–105 µm long, spiniform. Hyaline papilla small, obovate, distal, at the very base of apical tooth. Underleaves distant, appressed completely to the stem, transversely inserted, orbicular, 304–488 × 336–484 µm, with sometimes slightly decurrent base and very shallow sinus as to appear like a notch, maximum 0.08 times the length of the underleaves or completely absent. Gametangia and vegetative reproductive organs not seen.

### **Ecology, distribution and conservation**

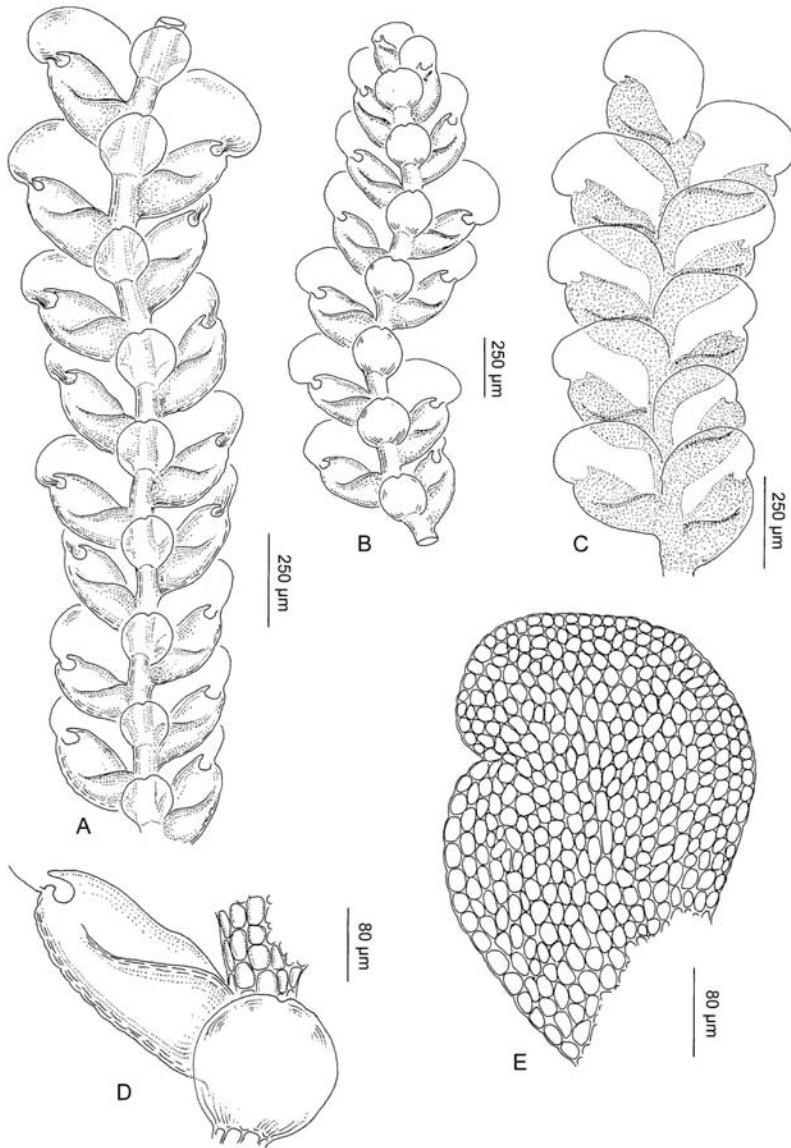
Ramicolous on ericaceous stems at the edge of montane forest in Uluguru Mountains between 1650 to 1800 m altitude. It appears endemic to the locality

as no other material has been collected elsewhere despite intensive bryological explorations in the Eastern Arc Mountains. The Eastern Arc Mountains are notorious for their richness in endemics and in species common with Madagascar and the other Indian Ocean islands. From the 500 bryophytes known from Uluguru Mountains 8 species are narrow endemics, 10 species are restricted to the Eastern Arc and 40 are shared between the Eastern Arc and Indian Ocean islands (Pócs 1999, 2000). These elements are concentrated in the montane forest belt of this crystalline arc. This habitat is highly endangered owing to deforestation. The narrow forested ridge and plateau of Uluguru Mountains above 1400 m level, with its high diversity of cryptogamic and vascular plants and in animal life as well, deserves better protection.

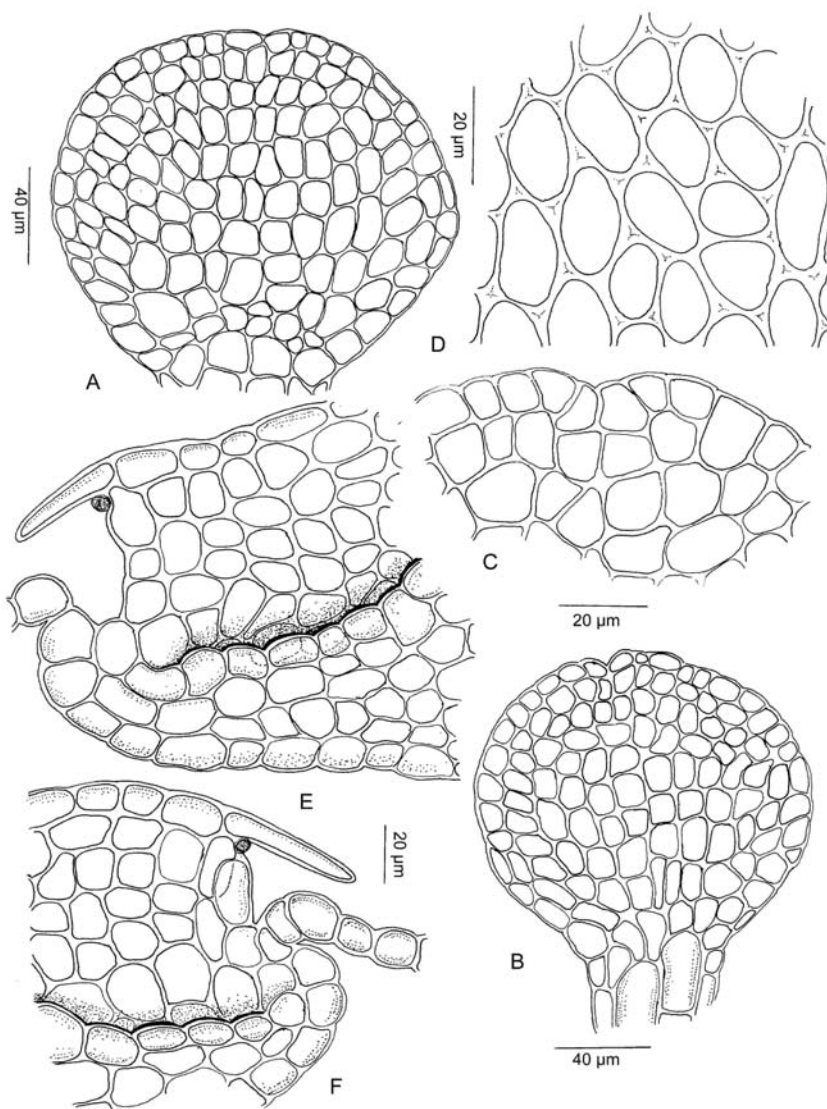
### **Circumscription from other associated species**

*Cheilolejeunea ulugurica* belongs to the subgen. *Cheilolejeunea* (Spr.) Schiffn. (Schuster, 1992) owing to its small size, its unicellular, spiniform apical tooth of lobule and flattened lobes (Zhu, So & Wang, 2002). The new taxon is closest to the Asian *Ch. chenii* R.L. Zhu & M.L. So, which is a rare species occurring only in southern China (Fujian and Taiwan). *Cheilolejeunea ulugurica* however differs from this species by having a longer and narrower lobule, which forms a narrow sinus with postical lobe margin. Also the free margin of the lobule is flat, bordered by about 10 elongated cells (7–8 in *Ch. chenii*). The truncate lobule apex is only 2–3 cells wide (6–8 cells wide in *Ch. chenii*). The inner base of lobule forms a conspicuous fold (which can be mistaken to a vitta) running diagonally towards the apex almost to join the keel.





**Figure 1.** *Cheilolejeunea ulugurica* A, B. Part of shoot, ventral view. C. Part of shoot, dorsal view. D. Lobule with underleaf. E. Leaf, dorsal view. Drawn from the holotype by E. Fischer.



**Figure 2.** *Cheilolejeunea ulugurica*. A, B. Underleaves. C. Apex of underleaf. D. Cells from mid-lobe. E, F. Details of lobule. Drawn from the holotype by E. Fischer.

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SEPARATUM

***LEJEUNEA GRADSTEINII* (LEJEUNEACEAE), A NEW  
LIVERWORT SPECIES FROM MT . KINABALU, SABAH**

*Lee G. E., T. Pócs, A. Damanhuri & A. Latiff*

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# **LEJEUNEA GRADSTEINII (LEJEUNEACEAE), A NEW LIVERWORT SPECIES FROM MT . KINABALU, SABAH**

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*Lejeunea gradsteinii* sp. nov.

*Lejeunea*, endemics, Malaysia, Marchantiophyta, Mt. Kinabalu

**Abstract:** *Lejeunea gradsteinii* is described and illustrated as a new species from Mt. Kinabalu, Sabah. The plant stands out by 1) lobules with flat free margin and 2 teeth, the first tooth consisting of (1)-2 cells, 2) whitish-green plant color, 3) weakly crenulate margins of leaves, underleaves, female bracts and bracteoles, 4) basal cells of leaf lobes forming a weak vitta, 5) well-developed trigones and scarce intermediate thickenings, 6) deeply bifid underleaves (to 2/3) with rounded tips, 7) long male shoots with up to 13 pair of bracts, and 8) long-exserted, obovate-clavate perianths with 5 sharp keels ending into short auricles. *Lejeunea gradsteinii* is most closely related to *L. kodamae* Ikegami et Inoue and *L. bidentula* Herzog, all of which have 2-toothed lobules.

## **Introduction**

A whitish *Lejeunea* species with two teeth on the leaf lobule, one very distinct and the other weakly developed, was found on Mt. Kinabalu, Sabah, in the course of the ongoing revision of the genus *Lejeunea* (Marchantiophyta: Lejeuneaceae) in Malaysia (Lee et al. 2011a, 2011b). By the characteristic 2-toothed, never-reduced lobule the species did not match any of the Malaysian *Lejeunea* species studied thus far, all which have lobules with only one tooth and often being reduced. A 2-toothed lobule is otherwise also known only among Asian *Lejeuneas* in *Lejeunea kodamae* Ikegami et Inoue (Inoue 1961) and *L. bidentula* Herzog (Herzog 1930), and in some members of *Papillolejeunea* Pócs (see below). However, none of these matched the species from Mt Kinabalu.

Other characteristic features of the species from Mt Kinabalu were the deeply bifid underleaves with rounded tips and, especially, the long first tooth of the lobule (2 cells long). By the latter character the species resembled the genus

*Papillolejeunea* Pócs (Pócs 1997; this genus was reduced by Schuster 1998 to a subgenus of *Lejeunea* [as *Lejeunea* subg. *Papillolejeunea* (Pócs) Schust.]). In his treatment of *Papillolejeunea*, Pócs (1997:1), he mentioned, “The striking feature of the plant [*Papillolejeunea*] is the special development of first (distal) lobule tooth, which is papilliform, elongate, with blunt apex, consisting of two cells and standing perpendicular to the free lobe margin which is usually involuted with the blunt second (proximal) tooth.” However, the plant from Mt. Kinabalu differed essentially by the flat free margin of the leaf lobule, which was not involuted with the second tooth.

Since none of the described species of *Lejeunea* match our plant from Mt. Kinabalu, it is described here as a new species. The species is named in the honor of Prof. Dr. S. Robbert Gradstein, who is the expert of the Lejeuneaceae family and has encouraged our study of the genus *Lejeunea* in Malaysia.

### Description

*Lejeunea gradsteinii* G.E. Lee, A. Damanhuri & A. Latiff **sp. nov.** (Figs. 1,2)

Planta dioica, lobuli bidentati, amphigastria usque ad 2/3 bifida lobis obtusis.

Type: Malaysia, Sabah, Mt. Kinabalu, trail from Mempoening shelter to Layang-Layang staff quarters, montane forest, on tree trunk, 2500-2800 m alt., 12 November 2010, *G.E. Lee 1891* (holotype, UKMB; isotype, PC). *Ibid.*, *G.E. Lee 1884, 1885, 1886, 1887, 1888, 1889, 1890* (paratypes, UKMB).

**Plants** dioicous, 1.3–1.4 mm wide, whitish green in the field, irregularly and densely branched with branches erect-spreading to spreading. **Stems** ca. 0.1 mm in diameter, ventral merophyte on the stem 2 cells wide, cross-section of the stem about 6 cells high, consisting of 7 epidermis cells with thin walls surrounding 15–17 medullary cells, epidermis cells distinctly larger than the medullary cells, epidermis cells 37.5–62.5 µm wide, medullary cells 12.5–25.0 µm wide. **Leaves** approximate to imbricate, when dried plants occasionally crispate, strongly convex, not crossing the stem, when moist leaves usually plane, erect-spreading to spreading, rarely convex. **Leaf lobes** 0.3–0.4 mm long and 0.2–0.3 mm wide (when flattened), ovate, leaf apex obtuse, leaf margin weakly crenulate, the ventral margin almost straight with the keel, weakly arched, when flattened forming an angle of 120<sup>0</sup>–140<sup>0</sup> with the keel, the line of insertion J-shaped, along 10–11 lobe cells with 1 celled stylus on the uppermost cell of the insertion. **Leaf cells** round to oblong, abruptly become smaller towards the median cells (Fig. 1: O) and gradually become smaller towards the leaf margin, basal portion of cells are more or less elongate, apical cells 20–25 µm long and 12.5–17.5 µm wide, median cells 25–30 µm long and 17.5–20 µm wide, basal cells 25–42.5 µm long and 20–25 µm wide, cell walls hyaline,

trigones large, infrequently with intermediate thickenings. Cuticle rough, each cell covered by numerous minute papillae. Oil bodies not seen. **Leaf lobules** relatively large, never reduced, 0.3–0.4 mm long and 0.2–0.3 mm wide, up to 1/3 as long as the lobe, at an angle of about  $90^{\circ}$  to the stem, orbicular, strongly inflated along the keel, the keel curved, smooth, free margin flat (Fig. 1: N), apex obliquely truncate, with two teeth (Figs. 1: J, K, L), the first tooth conspicuous, 1–2 cells long and 2 cells wide at base, with a hyaline papilla on the proximal side, the second tooth small and indistinct, 1-celled, obtuse. **Underleaves** 0.2–0.4 mm long, 0.2–0.4 mm wide, 2 times as wide as the stem, distant, orbicular, covering 1/3 of the lobules, bilobed to 2/3 of underleaf length, tips narrowly rounded, lobes triangular, sinus broad, obtuse, U-shaped, margin weakly crenulate, attached to the stem by two large basal cells, base straight. Rhizoids hyaline in numerous loose fascicles, at the base of underleaves, secondary rhizoids disc lacking. **Androecia** terminal on short or long lateral branches, androecial shoot 0.4–0.7 (1.10) mm long, 0.3–0.4 mm wide with bracts. Male bracts in 4–13 pairs, hypostatic, lobules almost same size as the lobe, apex obtuse, free margin always flat, keels strongly inflated, arched, curved and smooth. Male bracteole 0–1, slightly smaller than the underleaf, margin crenulate, present only at the base of the androecial shoot. Antheridia 2 per bract, 70–85  $\mu\text{m}$  in diameter, somewhat yellowish with a short and hyaline stalk, 40–50  $\mu\text{m}$  in length. **Gynoecia** terminal on short or long branches, bracts loosely arranged with one innovation, 1–3 gynoecia in a lateral row due to repeatedly fertile innovations, leaf sequence of innovation lejeuneoid. Female bracts smaller than the leaf, erect-spreading when moist. Lobes 0.5–0.6 mm long, 0.2–0.3 mm wide, ovate to lanceolate, apex obtuse, margin weakly crenulate. Lobules 0.3–0.4 mm long, 0.1–0.2  $\mu\text{m}$  wide, 1/2 the width of the lobe, 3/4 the length of the lobe, almost same length as the lobe, ovate to linear, apex acute to obtuse, keels straight, smooth, 0.1–0.2 mm long. Female bracteoles 0.4–0.5 mm long, 0.2–0.3 mm wide, 1/2 as long as the perianth length, larger than the underleaf, gradually tapering toward the base, ovate with tips acute, lobes approximate, sinus narrow, acute, almost equally bifid, 1/3 bilobed, margin weakly crenulate. Cells of the female bracts and bracteoles are almost similar throughout, without intermediate thickenings, occasionally with small trigones. Perianths 0.8–1.0 mm long, 0.5–0.6 mm wide, emergent up to 1/3 of its bract length, obovate-clavate, with 5 sharp, 0.10–0.15 mm wide keels, sometimes the keels extended above more or less as auricles, perianth with a 2–3 cells long beak, cells of the perianth at the keels mammillose, perianth base straight and without any stalk-like elongation. **Sporophyte** not seen. **Vegetative reproduction** not observed.

This new species is characterized by 1) whitish green color of the plant in the field, 2) crispate and strongly convex leaves when dried, 3) weakly crenulate margin of leaves, underleaves, female bracts and bracteoles, 4) rather large,



strongly inflated, never-reduced lobules, with conspicuously flat free margins, 5) apex of lobules with 2 teeth, 6) basal cells more or less elongate, ending abruptly towards median cells, forming a short and ill-defined vitta, 7) well-developed trigones and scarce intermediate thickenings, 8) obovate-clavate perianths with 5 sharp keels, 9) long male shoot with up to 13 pair of male bracts.

Lobule characters have been accepted as a significant character in the taxonomy of Lejeuneaceae (Evans 1902, Gradstein 1994, He 1996). The large lobules with two teeth at apex (Figs. 1: J, K, L) are the most significant characteristic of this new species. This peculiar feature as well as the deeply bifid underleaves with rounded tips and the obovate-clavate perianth with sharp keels is unique among all the Malaysian *Lejeunea*. The leaf lobules in this species is always strongly inflated, however, the free margin appeared to be always flat throughout and visible without flattening the leaf, and the erect or suberect first tooth of the lobule is usually of 2 cells long and with 2 large cells at base (Figs. 1: J, L), the tooth pointing toward leaf apex. At times, the first tooth is only 1 cell long and with 2 large cells at base (Fig. 1: K). The second tooth is not so distinct and always blunt.

On immature or weaker plants, the shoots may be only ca. 0.7–0.8 mm wide, the perianth, then, is somewhat reduced (0.6–0.8 mm long, 0.4–0.5 mm wide) and becoming obovate instead of obovate-clavate. In this situation, the perianth is only slightly emergent from its bracts (Fig. 2: g). On vigorous plant, however, the perianth is larger (0.8–1.0 mm long and 0.5–0.6 mm wide) and obovate-clavate in shape with 5 sharp keels, sometimes the keels extended above as slight auricles. The perianth is visibly emergent beyond the bracts, up to 1/3 of its length.

*Lejeunea gradsteinii* may be confused with *L. alata*. In both species the leaves are usually crispate when dry, long branches are very rare and perianths are somewhat clavate with five sharp keels. However, *L. gradsteinii* can be easily separated from *L. alata* by the large lobules with two teeth at apex. Superficially, *L. gradsteinii* is also similar to *L. pallide-virens*, but the latter is autoicous and its male bracteoles are present throughout the androecial shoot.

Generally, the species *Lejeunea* has inflated, well-developed lobule which the first tooth is usually 1-celled and the second tooth is usually reduced and invisible (He 1996). However, exceptionally there are two distinct teeth. The latter character is shared with genera such as *Cheilolejeunea* and *Leucolejeunea* (the latter genus has recently been reduced to synonymy under *Cheilolejeunea*; Malombe 2009, Yu et al. 2010). The first *Lejeunea* with two distinct teeth on the leaf lobule was described by Herzog (1930) from Yunnan, China, as *L. bidentula*. Subsequently, Inoue (1961) described a new species, *L. kodamae* from Japan with the same characteristic. The two species shared many features and were considered possibly conspecific (Inoue 1961). However, Mizutani (1971) revealed a number of differences between *L. bidentula* and *L. kodamae*,

including the length of the perianth beak, the number of medullary cells of the stem in cross-section, the width of the stem with leaves, the shape of the leaf lobe, and the width of underleaf. Mizutani (1971) also reported *L. bidentula* from India and Nepal. The present new species is quite different from these two taxa as is shown in Table 1.

Table 1. Morphological comparison of *L. gradsteinii*, *L. kodamae* and *L. bidentula*.

Characters	<i>L. gradsteinii</i>	<i>L. kodamae</i>	<i>L. bidentula</i>
Sexuality	dioicous	autoicous	autoicous and paroicous
Leaf size (long x wide)(mm)	0.3–0.4×0.2–0.3	0.5–0.8×0.4–0.6	0.7×0.45
Number of medullary cells of stem in cross-section	15–17	6–7	10–12
Lobes of underleaf	rounded to obtuse	acute	acute
First teeth of leaf lobules (cells long x cells wide)	1–2×1	3–4×1–2	2–3×1
Androecia (bracts)	4–13 pairs	3–6 pairs	3 pairs
Perianth shape	obovate-clavate	pyriform	pyriform
Perianth size (long x wide)(mm)	0.8–1.0×0.5–0.6	0.5–0.6×0.35–0.4	0.8–0.9×0.55–0.6
Perianth beak (cells long)	2–3	3–4	7–8
Position of perianth	emergent up to 1/3	not emergent	emergent up to 1/2

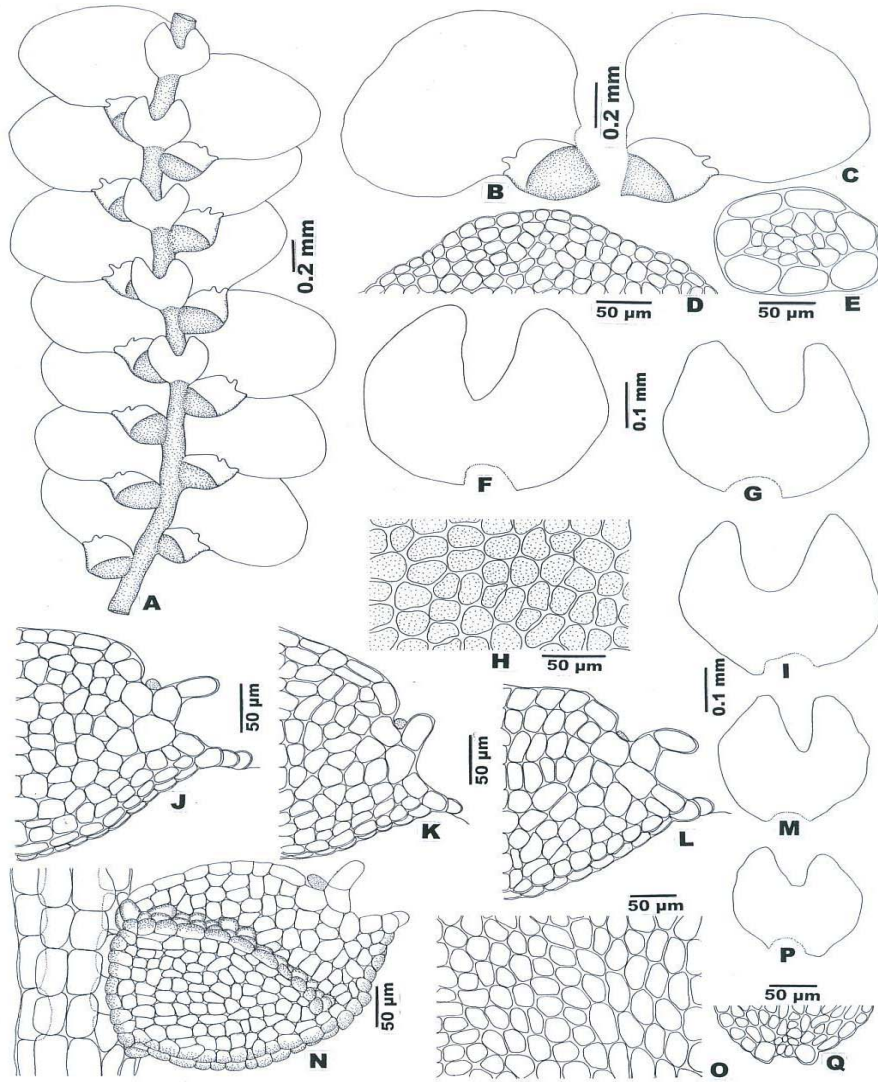


Figure 1. *Lejeunea gradsteinii* G.E. Lee, A. Damanhuri & A. Latiff sp. nov.: **A**: Part of plant; **B,C**: Leaves; **D**: Apical cells of leaf lobe; **E**: Cross section of stem; **F,G,I,M,P**: Underleaves; **H**: Median cells of leaf lobe; **J,K,L**: Lobule apices; **N**: Leaf lobule; **O**: Basal cells of leaf lobe; **Q**: Basal cells of underleaf. (All from holotype G.E. Lee 1891).

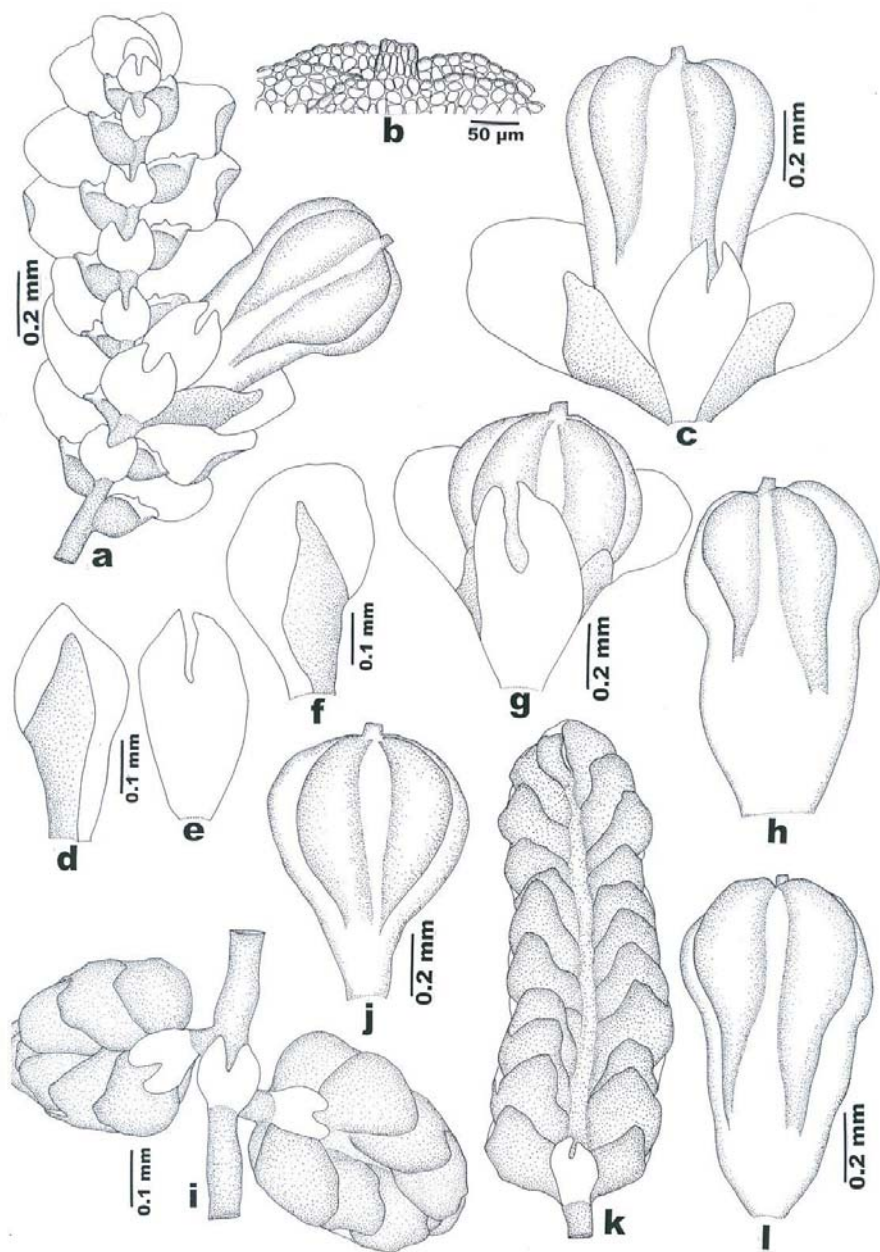


Figure 2. *Lejeunea gradsteinii* G.E. Lee, A. Damanhuri & A. Latiff sp. nov.: **a**: Part of plant, with perianth-bearing branch; **b**: Apical cells of perianth; **c,g**: Perianths with bracts and bracteoles; **d,f**: Female bracts; **e**: Female bracteole; **h,j,l**: Perianths; **i,k**: Androecial shoot. (All from holotype G.E. Lee 1891).

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We would like to thank Sabah Parks for allowing the collection of *Lejeunea* in Kinabalu Park and to Dr. Mizutani, curator of NICH for the loan of type specimens of *L. kodamae* and *L. bidentula*. The first author is grateful to her fiancé, Daniel Tang for accompany and assistance during the Mt. Kinabalu fieldwork, to Prof. Dr. Tamás Pócs for providing the *Papillolejeunea* reprints, and to Dr. Boon Chuan for sending some of the literatures. This research is supported financially by National Science Foundation (NSF), Malaysia and Dana Operasi UKM-OUP, research fund awarded to Emer. Prof. Dato' Abdul Latiff Mohamed.

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SEPARATUM

**A TAXONOMIC TREATMENT OF *LEJEUNEA DISCRETA*, *L.*  
*EIFRIGII* AND *L. SORDIDA*, NEW TO PENINSULAR  
MALAYSIA**

*Lee G. E., A. Damanhuri, A. Latiff & S. Robbert Gradstein*

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# A TAXONOMIC TREATMENT OF *LEJEUNEA DISCRETA*, *L. EIFRIGII* AND *L. SORDIDA*, NEW TO PENINSULAR MALAYSIA

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**Abstract:** *Lejeunea discreta* Lindenb., *Lejeunea eifrigii* Mizut. and *Lejeunea sordida* (Nees) Nees, reported for the first time from Peninsular Malaysia, are fully described and illustrated.

**Keywords:** *Lejeunea discreta*, *Lejeunea eifrigii*, *Lejeunea sordida*, Lejeuneaceae, taxonomy, Peninsular Malaysia

## Introduction

*Lejeunea* is a large, pantropical genus, with over 100 species. It is also the largest genus in the Lejeuneaceae which is the most speciose family of liverworts with about 1000 species in 90 genera (Gradstein et al. 2003). Most of the species of *Lejeunea* in Malaysia are yet to be studied, hence the genus is still very poorly known and the circumscription of the genus is still unsettled. Twenty seven species of *Lejeunea* have been reported from Malaysia, mainly from Mount Kinabalu, Sabah (Mizutani 1966, 1969, 1970, Tixier 1971, 1980). In this paper, we report three species of *Lejeunea*, i.e. *Lejeunea discreta* Lindenb., *L. eifrigii* Mizut. and *L. sordida* (Nees) Nees, which are newly discovered in Peninsular Malaysia. All the descriptions and illustrations are based on fresh materials. The species were discovered in the framework of a study on the 2 genus *Lejeunea* in Malaysia, which is in progress. We expect that further new discoveries will be made in the future.



**1. *Lejeunea discreta* Lindenb., in Gottsche, Lindenb. & Nees, Syn. Hepat.: 361 (1845). Figures 1 & 2.**

*Hygrolejeunea discreta* (Lindenb.) Schiffn., Consp. Hepat. Archip. Indici: 266 (1898) *Taxilejeunea discreta* (Lindenb.) R.M. Schust., Beih. Nova Hedwigia 9: 138 (1963). TYPE: Indonesia. Java. “inter *L. thymifolium*  $\beta$  *discretam*”, collector unknown (not seen).

= *Lejeunea vaginata* Steph., Sp. Hepat. 5: 791 (1915). TYPE: Japan. Kochi Pref., 1904, S. Okamura 186 (holotype: G!).

For further synonyms see Mizutani (1961, 1970) and Grolle (1981).

Dioicous. **Plants** relatively large, 1.1–1.2 mm wide, usually yellowish green when fresh to dark brown when dried, irregular and densely pinnate to bipinnate with branches widely to obliquely spreading. **Stems** 0.1–0.2 mm in diameter, ventral merophyte on the stem 2 cells wide, cross-section of stem about 5 cells high, consisting of 7 epidermis cells with thick walls surrounding 10 medullary cells, epidermis cells distinctly larger than medullary cells, epidermis cells 33–40  $\mu\text{m}$  wide, medullary cells 16–30  $\mu\text{m}$  wide. **Leaves** closely imbricate to contiguous, widely spreading when moist, sometimes somewhat convex when dried. **Leaf lobes** 0.7–0.8 mm long and 0.5–0.6 mm wide (when flattened), ovate, leaf apex obtuse, occasionally recurved, leaf margin entire, the ventral margin arched, when flattened forming an angle of 1000–1200 with the keel, the line of insertion rather short, J-shaped, along 10 lobe cells. **Leaf cells** rather uniform, gradually become smaller towards the leaf margin, usually pentagonal, 3 irregular quadrate to rectangular towards the leaf margin, apical cell 13–33  $\mu\text{m}$  long and 6.7–13  $\mu\text{m}$  wide, median cell 40–53  $\mu\text{m}$  long and 33–53  $\mu\text{m}$  wide, basal cell 53–86  $\mu\text{m}$  long and 33–66  $\mu\text{m}$  wide, cell walls hyaline, with large trigones and occasionally intermediate thickenings, 1–2 per cell, 0–1 between 2 adjacent trigones. Oil bodies not observed. Cuticle rough, each cell covered by numerous minute papillae. **Leaf lobules** large, sometimes reduced, 0.2–0.4 mm long and 0.10–0.16 mm wide, up to 1/2 as long as the lobe, ovate-rectangular, inflated along the keel, apex truncate, constricted, keel curved, smooth, free margin strongly incurved, sometimes flat, the hyaline papilla on the proximal side of the apical tooth, margin between tooth and sinus 4 cells long, with a distinct rectangular cell, 50  $\mu\text{m}$  long and 33  $\mu\text{m}$  wide, below the apical tooth. **Underleaves** 0.4–0.5 mm long, 0.40–0.43 mm wide, 3–4 times as wide as the stem, contiguous to imbricate, suborbicular (slightly longer than broad), covering half of the lobules, bilobed to 1/2 of underleaf length, tips obtuse to acute and sometimes ending with solitary cell, lobes straight, sometimes slightly connivent, sinus narrow and deep, acute, V-shaped, margin entire, base shallowly curved. **Androecia** 0.7–0.9 mm long, 0.5–0.6 mm wide with bracts, terminal on short or long branches, with bracts closely imbricate. Male bracts in

5–6 pairs, lobule strongly inflated, almost same size as the lobe. Male bracteoles 0–2, smaller than the underleaf, present only at the base of the androecia. Antheridia not seen. **Gynoecea** terminal on short or long branches, sometimes on the main stem, bracts loosely arranged, sometimes somewhat crowded, with one innovation, 1–2 gynoecea in a lateral row due to repeatedly fertile innovations, leaf sequence of innovation lejeuneoid. Bracts larger than the leaves, erect spreading when moist, not enveloping the perianth, bracts and bracteoles in 2 series. Lobes 0.7–0.8 mm long, 0.5–0.6 mm wide, ovate, apex obtuse to acute. Lobules 0.5–0.6 mm long, 0.1–0.2 mm wide, 1/2 the width of the lobe, 2/3 the length of the lobe, linear, apex obtuse to truncate, attached to the lobe by a short and straight keel, 0.3–0.4 mm long. Bracteole 0.6–0.7 mm long, 0.4–0.6 mm wide, 1/2 as long as the perianth, larger than the underleaf, ovate with the tips acute, lobes connivent, sinus narrow, acute, almost equally bifid, 1/2 bilobed. Perianth 1.0–1.2 mm long, 0.5–0.6 mm wide, emergent up to 1/2 of its leaf length, elliptical, with 5 keels and a 3–4 cells long beak, the beak large, trumpet-shaped, cells of the lower part of the perianth flat, base of the perianth straight and without any stalk-like elongation.

*Lejeunea discreta* is recognized by the obtuse leaf apex, large leaf lobules (to 1/2 as long as the lobe), large, rectangular disc cell below the apical tooth, incurved free margin of leaf lobule, rough cuticle, and leaf cells with large trigones and nodulose intermediate thickenings. Besides this, the perianth with a large trumpet-shaped beak is peculiar to this species.

Specimens examined. **PENINSULAR MALAYSIA. Pahang:** Genting Highlands, Genting theme park, open area, 1500 m alt., 2008, *G.E. Lee 1146* (UKMB); Genting theme park (outdoor), 1500 m alt., 2008, *G.E. Lee 1037* (UKMB); summit area of Gunung Ulu Kali, 1600 m alt., 1996, *N. Ohnishi 2514* (HIRO); Fraser Hill, along the street, open area, 1275 m alt., 2008, *G.E. Lee 1181, 1423, 1427* (UKMB). **Perak:** Gunung Korbu, summit area of Gunung Korbu, 2183 m alt., 2009, *Damanhuri s.n.* (UKMB). **BORNEO. Malaysia, Sabah:** Mount Kinabalu, between Tenompok Pass and Kamaranga Radio Station, 1400–1900 m alt., 1963, *M. Mizutani 2110e* (NICH); between Kamaranga Radio Station and Waterfalls, 2000–2146 m alt., 1963, *M. 5*

*Mizutani 2396* (NICH); around Kamaranga Radio Station, south slope of Mount Kinabalu, 2140 m alt., 1963, *M. Mizutani 2601* (NICH); mossy forest between Tenompok Pass and Ulu Damaian, S slope of Mount Kinabalu, 1463–1500 m alt., 1963, *M. Mizutani 3239* (NICH); Kinabalu area, in a virgin forest near Forest Department Bungalow, Sosopodon, Kundasang, 1350 m alt., 1963, *M. Mizutani 6123, 6142* (NICH). **JAVA. Preanger:** Mt. Patuha SW of Bandung, Montane forest along road to crater, 2000–2100 m alt., 2009, *Afiatri Putrika 2* (GOET).

Distribution: Australia, Bhutan, Borneo (Sabah), Cambodia, China, India, Indonesia (Java, Maluku, Sulawesi, Sumatra), Japan, Korea, Nepal, New Caledonia, Papua New Guinea, Peninsular Malaysia, Philippines and Sri Lanka.

Ecology: The five specimens collected in Peninsular Malaysia were found growing on tree trunks and branches, on tree fern (*Cyathea* sp.) trunks, and on shrubs, at 1200–2000 m alt. Mizutani (1970) reported this species from Mount Kinabalu, Sabah, on tree trunks, shrubs, branches of fallen trees and lianas at almost the same altitudinal range, 1500–2000 m. Zhu and So (2001) reported this species from China on tree trunks, branches, decaying logs, sometimes on ferns and the leaves of shrubs at 1050–2200 m alt. In Himalayan National Park, India, the species has been reported growing on soil at 1950 m alt. (Singh & Singh 2008). In general, *Lejeunea discreta* seems to have a preference for tree trunks at high elevations, above 1000 m alt. 6

## 2. *Lejeunea eifrigii* Mizut., J. Hattori Bot. Lab. 33: 244 (1970). Figures 3 & 4.

*Taxilejeunea acutiloba* Eifrig, Ann. Bryol. 9: 94 (1936) (non *Lejeunea acutiloba* (Tayl.) Tayl. 1845). = *Taxilejeunea acutiloba* forma *major* Eifrig, Ann. Bryol. 9: 96 (1936). LECTOTYPE (fide R. Grolle, in sched.): Indonesia. Java, Salak, *Schiffner* 3223 (JE!). Since the type material of *Taxilejeunea acutiloba* Eifrig (Indonesia, *Schiffner* 2962a), kept in the herbarium of the university of Jena (JE), only contains *Taxilejeunea apiculata* (Sande Lac.) Eifrig, Dr. Grolle has proposed (in sched.) to select the type of *Taxilejeunea acutiloba* forma *major* Eifrig (Java, *Schiffner* 3223) as the lectotype of *T. acutiloba*. Since the latter material fits the original description and illustration of *T. acutiloba*, the choice of Dr. Grolle is followed here.

Autoicous. **Plants** relatively large, 1.7–2.0 mm wide, usually yellowish green to pale green in the field to dark green when dried, irregularly and densely branched with branches widely spreading, sometimes with loosely pinnate branched. **Stems** 0.13–0.17 mm in diameter, ventral merophyte on the stem 2 cells wide, cross-section of the stem about 6 cells high, consisting of 7 epidermis cells with thin walls surrounding 16 medullary cells, epidermis cells distinctly larger than the medullary cells, epidermis cells 30–60 µm wide, medullary cells 20–40 µm wide. **Leaves** approximate, sometimes somewhat contiguous, erect spreading when moist, slightly convex, not crossing the stem, occasionally crispate when dried. **Leaf lobes** 0.4–0.8 mm long and 0.6–0.7 mm wide (when flattened), ovate, leaf apex apiculate, sometimes slightly obtuse, leaf margin entire, the ventral margin almost straight with the keel, weakly arched, when flattened forming an angle of 1200–1700 with the keel, the line of insertion rather short, J-shaped, 7

10 lobe cells. **Leaf cells** rather uniform, gradually become smaller towards the leaf margin, usually quadrate to hexagon, rectangular towards the leaf margin, apical cells 20–30  $\mu\text{m}$  long and 12–17  $\mu\text{m}$  wide, median cells 50–58  $\mu\text{m}$  long and 20–30  $\mu\text{m}$  wide, basal cells 62–80  $\mu\text{m}$  long and 20–33  $\mu\text{m}$  wide, cell walls hyaline, with small trigones, intermediate thickenings not differentiated. Oil bodies 3–8 per cell, finely segmented, round to oblong. Cuticle smooth. **Leaf lobules** rather small, sometimes reduced, 0.13–0.16 mm long and 0.09–1.10 mm wide, up to 1/4 as long as the lobe, ovate-oblong, inflated along the keel, apex obliquely truncate, sometimes constricted, keel curved, sinuate, free margin flat, the hyaline papilla on the proximal side of the apical tooth, margin between tooth and sinus 3 cells long, with a rather large, rectangular cell, 40  $\mu\text{m}$  long, 20  $\mu\text{m}$  wide, below the apical tooth. **Underleaves** 0.1–0.3 mm long, 0.6–0.7 mm wide, 2 times as wide as the stem, very distant, reniform (not longer than broad), covering half of the lobules, bilobed to 1/2 underleaf length, tips acute to obtuse, lobes almost straight, sinus narrow, acute to obtuse, U-shaped to narrow V-shaped, margin entire, base straight. **Androecia** 0.3–0.8 mm long, 0.3–0.5 mm wide with bracts, terminal on short or long lateral branches, along the stem, with bracts closely imbricate. Male bracts in 3–6 pairs, lobule strongly inflated, almost same size as the lobe. Male bracteole 0–1, smaller than the underleaf, present only at the base of the androecia. Antheridia not seen. **Gynoecia** terminal on short or long branches, bracts loosely arranged and sometimes somewhat crowded, with one innovation, 1–3 gynoecia in a lateral row due to repeatedly fertile innovations, leaf sequence of innovation lejeuneoid. Bracts smaller or sometimes almost same size as the leaf, erect-spreading when moist, not enveloping the perianth, bracts and bracteoles in 2 series. Lobes 0.6–0.8 mm long, 8 0.24–0.26 mm wide, linear to lanceolate, apex acute. Lobules 0.20–0.23 mm long, 13–15  $\mu\text{m}$  wide, very small, sometimes reduced, 1/6 the width of the lobe, 1/3 the length of the lobe, linear, apex round to obtuse, attached to the lobe by a short and straight keel, 1.5–1.6 mm long. Bracteoles 0.5–0.6 mm long, 0.40–0.43 mm wide, 1/2 as long as the perianth length, larger than the underleaf, obovate with tips rounded, lobes approximate, sinus narrow, acute, almost equally bifid, 1/4 bilobed, margin entire. Perianth 1.0 mm long, 0.5 mm wide, emergent up to 1/3 of its leaf length, clavate, with 5 keels and a 2 cells long beak, cells of the perianth at the keels strongly mammillose, the base straight and without any stalk-like elongation.

The most remarkable feature of *Lejeunea eifrigii* is the long clavate perianth with 5 mammillose keels. The species can also be distinguished by the apiculate apex of the leaf lobe, the small, reniform underleaves, small trigones and lack of intermediate thickenings.

Specimens examined. **PENINSULAR MALAYSIA. Pahang:** Cameron Highlands, Mentigi trail, 1360 m alt., 2009, *G.E. Lee 1168, 1170, 1185* (UKMB); Parit falls, 1340 m alt., 2009, *G.E. Lee 1367* (UKMB); Genting

Highlands, along the road to Gunung Ulu Kali, 1650 m alt., 2009, *G.E. Lee 1192, 1194* (UKMB). **BORNEO. Malaysia, Sabah:** Mount Kinabalu, between Kamaranga Radio Station and Waterfalls, 2000–2146 m alt., 1963, *M. Mizutani 2482* (NICH); mossy forest between Tenompok Pass and Ulu Damaian, S slope of Mount Kinabalu, 1463–1500 m alt., 1963, *M. Mizutani 3244* (NICH).

Distribution: Borneo (Sabah), China, Indonesia (Java, Sumatra), Japan, New Caledonia, Papua New Guinea, Peninsular Malaysia and Philippines. 9

Ecology: Among the six collections from Peninsular Malaysia, two specimens are collected on branches of tree at 1650 m alt. while the remaining specimens were from living leaves, fungi and rotten log at 1340–1365 m alt. Mizutani (1970, 1977) reported this species from Mount Kinabalu, Sabah, on rock and tree trunks at 1350–2150 m alt. and from Luzon, Philippines, on boulders, tree trunk, root and rock at 800–2300 m alt. Specimens from China are mostly epiphyllous (Zhu & So 2001). In general, *Lejeunea eifrigii* occurs mostly at higher elevations, about 800–2300 m alt., on various substrates. 10

### **3. *Lejeunea sordida* (Nees) Nees, Nat. Eur. Leberm. 3: 278 (1838). Figures 5 & 6.**

*Jungermannia sordida* Nees, Enum. Pl. Crypt. Jav.: 41 (1830). *Hygrolejeunea sordida* (Nees) Steph., Sp. Hepat. 5: 570 (1914). *Taxilejeunea sordida* (Nees) Eifrig, Ann. Bryol. 9: 101 (1937) “1936”. TYPE: Indonesia. Java. “in tumulis Baduorum sanctis”, *Blume* s.n. (holotype: STR!).

For further synonyms see Mizutani (1970).

Dioicous. **Plants** relatively large, 1.0–1.3 mm wide, usually glossy green to pale green in the field, dark brown when dried, irregularly and loosely pinnate with branches erect spreading. **Stems** 0.10–0.13 mm in diameter, ventral merophyte on the stem 2 cells wide, cross-section of stem about 6 cells high, consisting of 7 epidermis cells with thin walls surrounding 11 medullary cells, epidermis cells distinctly larger than medullary cells, epidermis cells 23–46 µm wide, medullary cells 13–20 µm wide. **Leaves** closely imbricate, obliquely spreading when moist. **Leaf lobes** 0.6–0.7 mm long and 0.5–0.6 mm wide (when flattened), orbicular, leaf apex broadly rounded, always flat, leaf margin entire, slightly sinuate, the ventral margin strongly arched, when flattened forming an angle of 600–900 with the keel, the line of insertion long, J-shaped, along 13 lobe cells. **Leaf cells** rather uniform, gradually become smaller towards the leaf margin, usually quadrate to pentagon, sometimes somewhat round, irregularly quadrate to rectangular towards the leaf margin, apical cell 20–27 µm long and 13–27 µm wide, median cell 33–40 µm long and 26–33 µm wide, basal cell 53–80 µm long and 26–53 µm wide, cell walls hyaline, with large trigones and occasionally intermediate thickenings, 1–2 per cell, 0–1 between 2 adjacent trigones. Oil bodies 4–8 per cell, finely segmented, oblong, 11 sometimes ovate.

Cuticle rough, each cell covered by numerous minute papillae. **Leaf lobules** rather small, 0.1–0.2 mm long and 0.13–0.16 mm wide, up to 1/3 as long as the lobe, ovate, inflated along the keel, apex constricted, curved, U-shaped, keel curved, somewhat sinuate, free margin involute, the hyaline papilla on the proximal side of the apical tooth, margin between tooth and sinus 2 cells long, with not so indistinct, rectangular cell, 33  $\mu$ m long and 20  $\mu$ m wide, below the apical tooth. **Underleaves** 0.4–0.5 mm long, 0.6–0.7 mm wide, 7 times as wide as the stem, approximate to contiguous, reniform (wider than broad), always covering the lobules, bilobed to 1/4 underleaf length, tips acute to obtuse, lobes oblique, sometimes somewhat oblique, sinus broad, round to obtuse, U-shaped to V-shaped, margin entire, somewhat sinuate, base cordate without auricle. **Androecia** 0.5–0.7 mm long, 0.3–0.4 mm wide with bracts, terminal on short or long branches, with bracts closely imbricate. Male bracts in 3–5 pairs, lobule strongly inflated, almost same size as the lobe. Male bracteole 0–1, smaller than the underleaf, present only at the base of the androecia. Antheridia not seen. **Gynoecia** terminal on short branch, bracts loosely arranged, with one innovation, usually with 1–2 gynoecia in a lateral row, leaf sequence of innovation lejeuneoid. Bracts slightly larger than the leaf, erect spreading when moist, not enveloping the perianth, bracts and bracteoles in 2 series. Lobes 0.6–0.7 mm long, 0.3–0.4 mm wide, ovate, apex obtuse, margin entire. Lobules 0.4–0.5 mm long, 0.1–0.2 mm wide, 1/3 the width of the lobe, 2/3 the length of the lobe, lanceolate, apex obtuse, attached to the lobe by a short and straight keel, 0.2–0.4 mm long. Bracteoles 0.6–0.7 mm long, 0.4–0.5 mm wide, 1/2 as long as the perianth length, larger than the underleaf, ovate with the tips acute, lobes distant to overlapping, sinus acute, almost equally bifid, 1/2 bilobed, margin entire. 12

Perianth 1.0 mm long, 0.5 mm wide, emergent up to 1/3 of its leaf length, obovate, with 5 keels and a 2–3 cells long beak, cells of the perianth at the keels bulging, the base straight and without any stalk-like elongation.

*Lejeunea sordida* is the most common species of the genus *Lejeunea* in Peninsular Malaysia and is easily recognized by the large, reniform underleaves which always cover the lobule, the small leaf lobule, and distinct trigones and intermediate thickenings.

Specimens examined. **PENINSULAR MALAYSIA. Johor:** Kluang, Gunung Belumut, expedition base camp, 80 m alt., 2009, *G.E. Lee 1231, 1232* (UKMB); Expedition trail no. 4, 80 m alt. 2009, *G.E. Lee 1233* (UKMB); Tangkak, Gunung Ledang, along the trail to the summit of Gunung Ledang, 200 m alt., 2009, *G.E. Lee 1203, 1204* (UKMB). **Kedah:** Kulim, Sungai Sedim, expedition base camp, 50 m alt. 2009, *G.E. Lee 1416* (UKMB). **Pahang:** Fraser Hill, main entrance in open area, 820 m alt., 2008, *G.E. Lee 1154* (UKMB); Genting Highlands, along the road to the Noah Mosque, open area, 1650 m alt., 2009, *G.E. Lee 1195* (UKMB). **Penang:** Bukit Panchor, along the river trail,

2008, *G.E. Lee 1054* (UKMB); Penang Hill, ‘broken staircase’ trail in the mossy area, 750 m alt., 2008, *G.E. Lee 1088, 1095, 1182* (UKMB). **Selangor:** Ulu Langat, Sungai Congkak, along the trail to Sungai Congkak waterfall, 30 m alt., 2009, *G.E. Lee & H.Y. Tang 1179* (UKMB). **BORNEO. Malaysia, Sabah:** Radau, N of Jesselton, coastal region of West Coast, 1963, *M. Mizutani 6078* (NICH); Limestone area around Madai Cave, SW of Lahad Datu, East Coast, 60–100 m alt., 1963, *Z. Iwatzuki 5722* (NICH). **Sarawak:** Kuching, Sungai Lalang, along the road to Bau, open area, 30 m alt., 2009, *G.E. Lee 1159* (UKMB). 13

Distribution: Australia, Borneo (Sabah, Sarawak), Caroline Is., China, Fiji, Indonesia (Java, Sumatra), Japan, Micronesia, New Caledonia, Papua New Guinea, Peninsular Malaysia, Philippines, Samoa, Solomon Is. and Thailand.

Ecology: The 14 specimens collected in Peninsular Malaysia were found growing on tree trunks, leaves and branches, at about 30–1650 m alt. Mizutani (1970) reported this species from Radau and Madai Cave, Sabah, 10–100 m alt., mostly on tree trunks; two specimens were on rock. Mizutani (1977) recorded this species from Luzon, Philippines on lianas, branches, tree trunks and stumps at 500–2000 m alt. Zhu and So (2001) recorded this species from China, on tree trunks and, very rarely, on living leaves. In general, *Lejeunea sordida* grows mostly on tree trunks at a wide elevational range, from sea level to 2000 m. 14

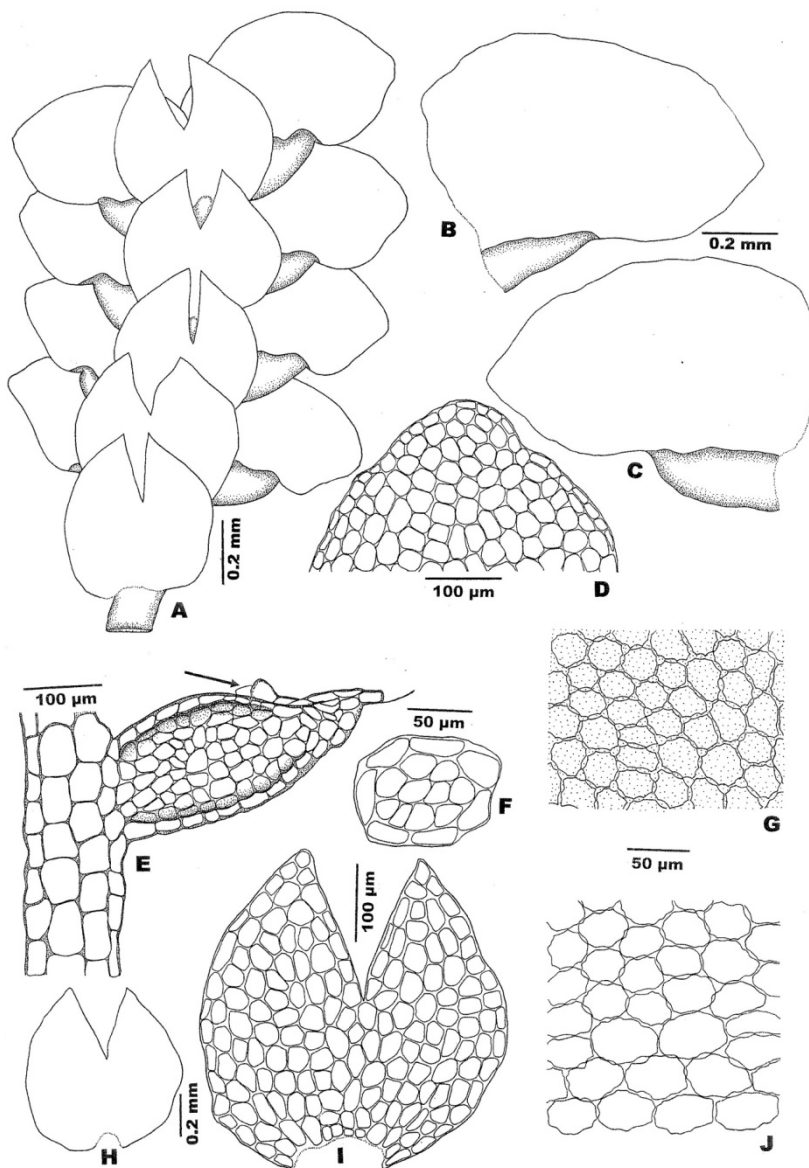


Figure 1. *Lejeunea discreta* Lindenb.: A: Part of plant; B-C: Leaves; D: Apical cells of leaf lobe; E: Leaf lobule; F: Cross section of stem; G: Median cells of leaf lobe; H: Underleaf; I: Cells of underleaf; J: Basal cells of leaf lobe; : hyaline papilla. All figures were drawn from G.E. Lee 1146.



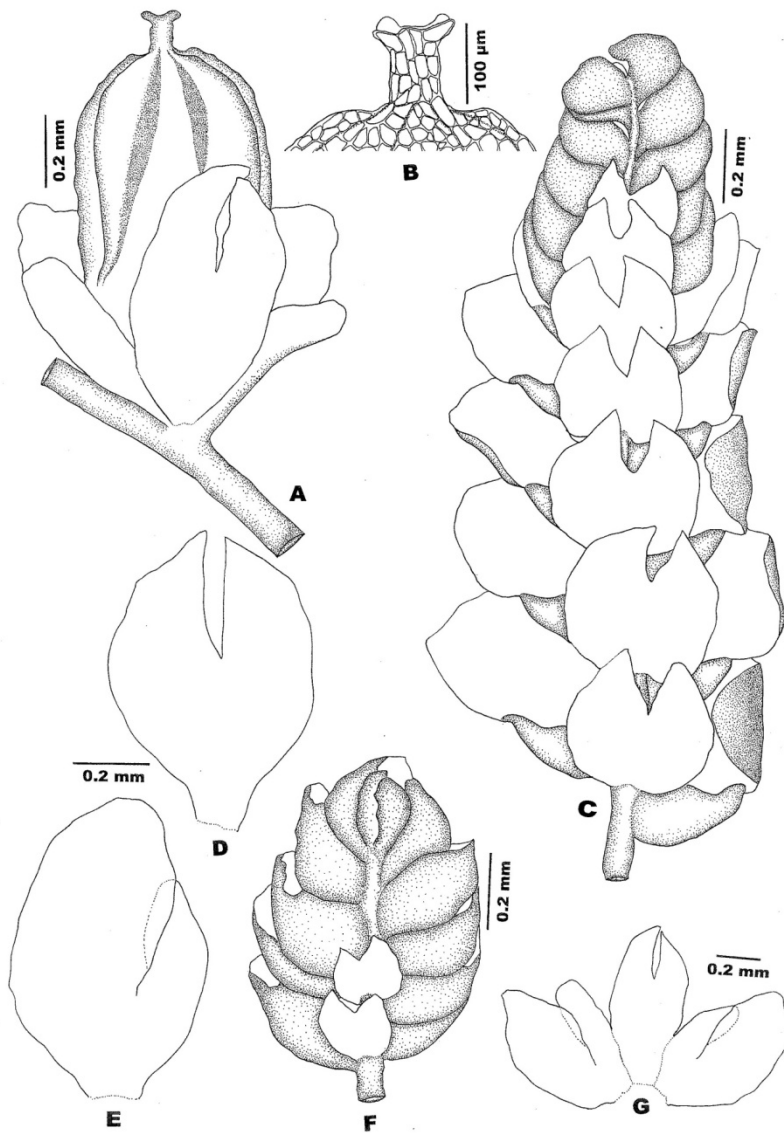


Figure 2. *Lejeunea discreta* Lindenb.: a: Perianth; b: Apical cells of perianth; c: Part of plant with androecium; d: Female bracteole; e: Female bract; f: Androecium; g: Female bracts and bracteole. a,b were drawn from G.E. Lee 1037, c-g from G.E. Lee 1146.

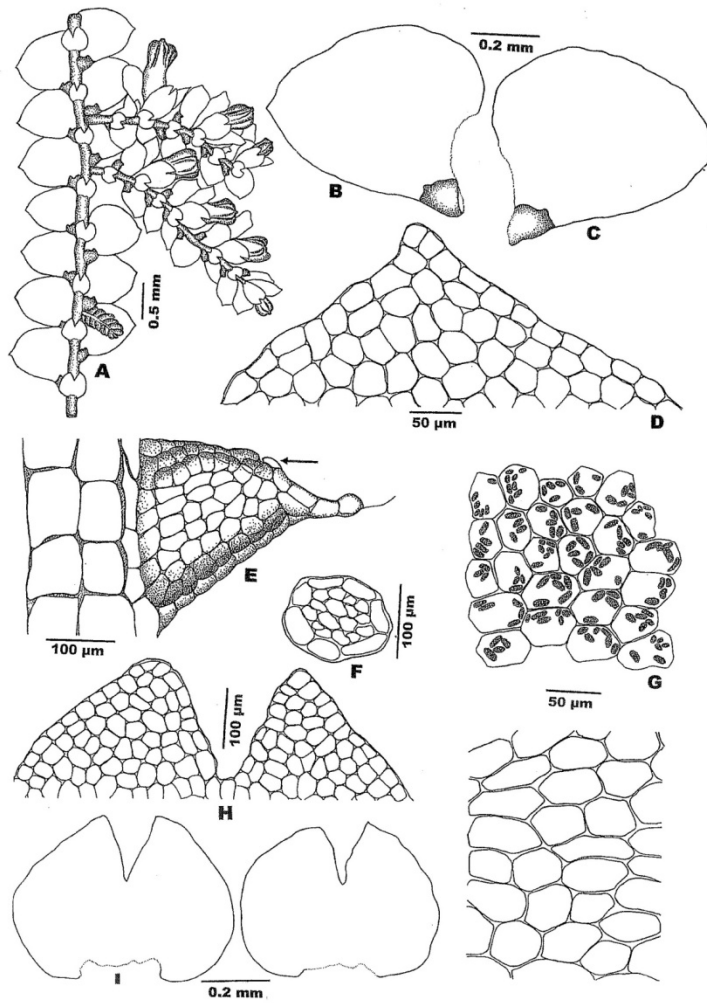


Figure 3. *Lejeunea eifrigii* Mizut.: **A**: Part of plant; **B,C**: Leaves; **D**: Apical cells of leaf lobe; **E**: Leaf lobule; **F**: Cross section of stem; **G**: Median cells of leaf lobe with oil bodies; **H**: Apical cells of underleaf; **I,J**: Underleaf; **K**: Basal cells of leaf lobe; : hyaline papilla. All figures were drawn from G.E. Lee 1185.

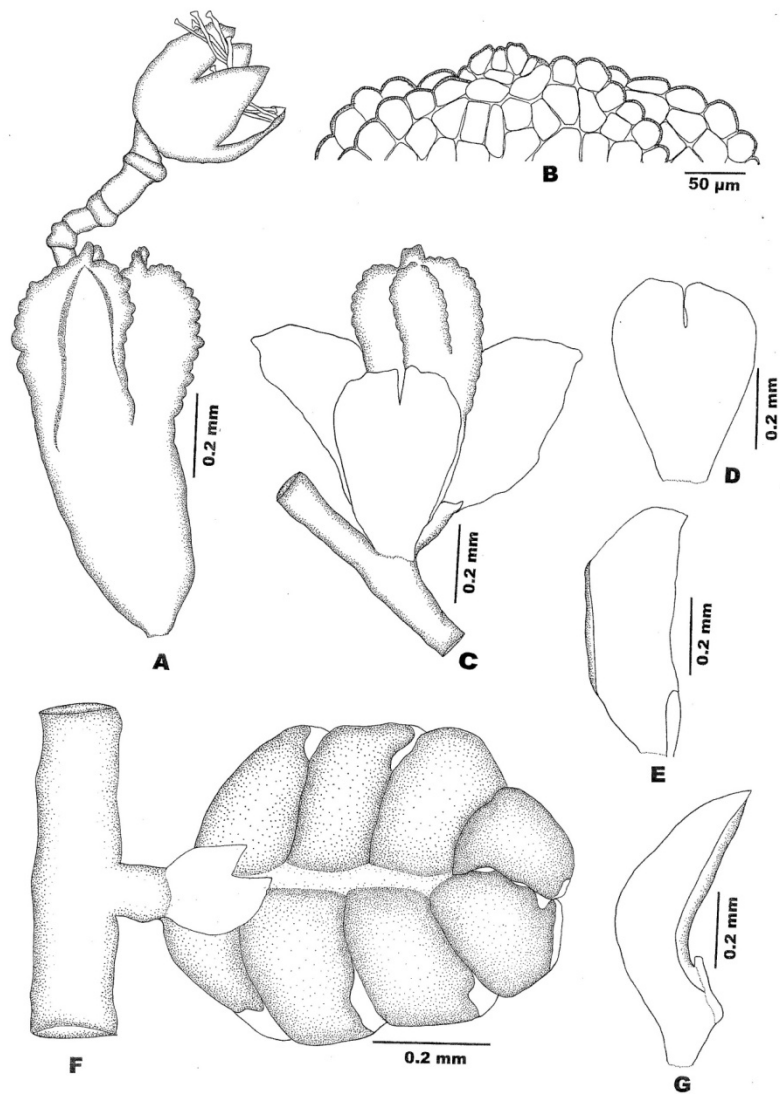


Figure 4. *Lejeunea eifrigii* Mizut.: **a,c**: Perianth; **b**: Apical cells of perianth; **d**: Female bracteole; **e,g**: Female bracts; **f**: Androecium. All figures were drawn from G.E. Lee 1185.

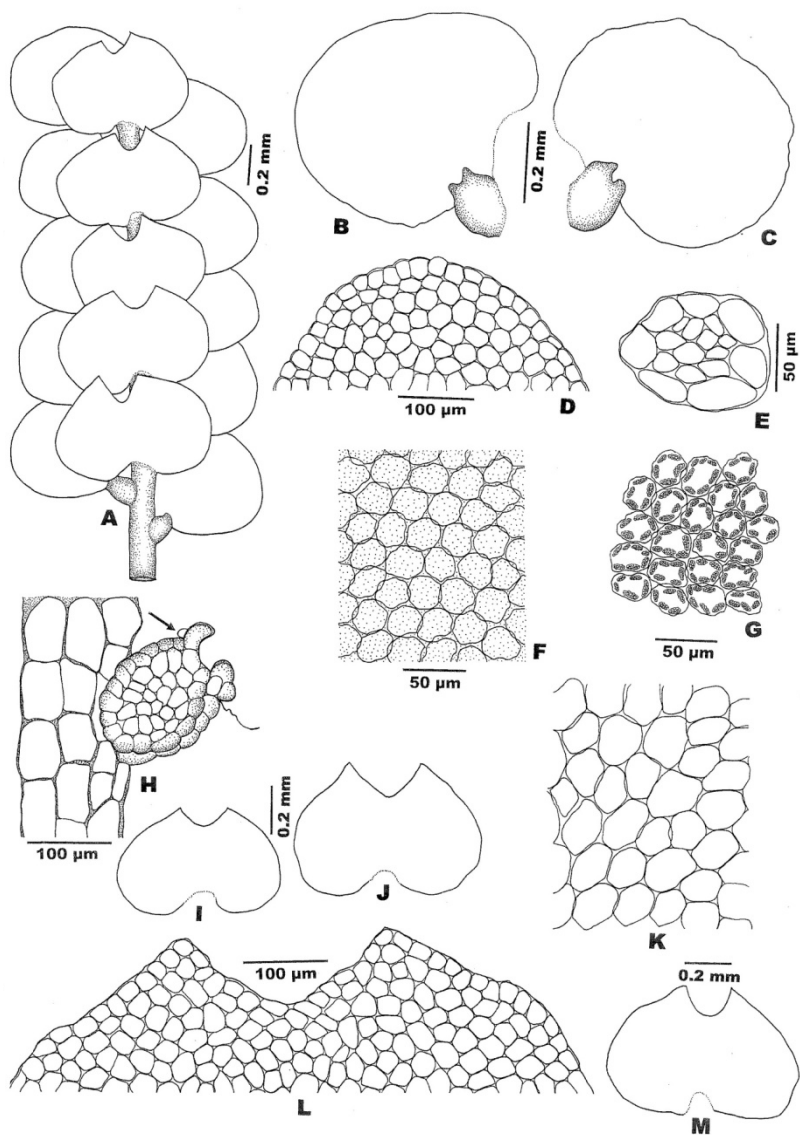


Figure 5. *Lejeunea sordida* (Nees) Nees: **A**: Part of plant; **B**, **C**: Leaves; **D**: Apical cells of leaf lobe; **E**: Cross section of stem; **F**: Median cells of leaf lobe; **G**: Median cells of leaf lobe with oil bodies; **H**: Leaf lobule; **I**, **J**, **M**: Underleaves; **K**: Basal cells of leaf lobe; **L**: Apical cells of underleaf; : hyaline papilla. G was drawn from G.E. Lee 1159, A, J, M were drawn from M. Mizutani 5722, the rest of the figures were drawn from G.E. Lee 1154.

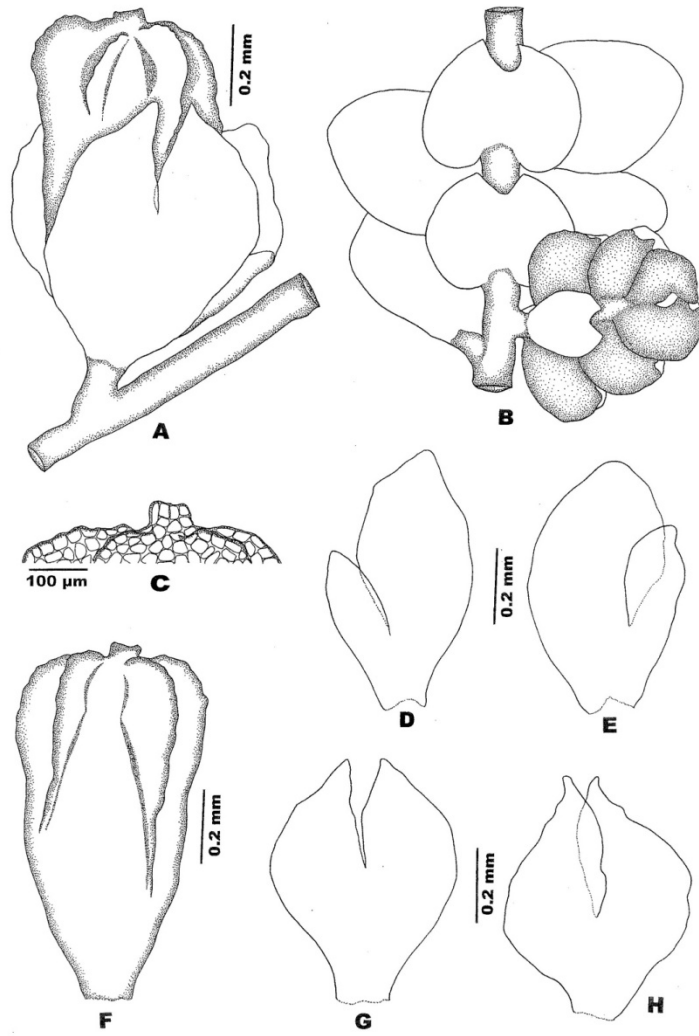


Figure 6. *Lejeunea sordida* (Nees) Nees: **a,f**: Perianth; **b**: Part of plant with androecium; **c**: Apical cells of perianth; **d,e**: Female bracts; **g,h**: Female bracteoles. All figures were drawn from G.E. Lee 1154.

## Acknowledgments

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SEPARATUM

**WHAT IS *CLADOLEJEUNEA* ZWICKEL?  
NEW OR LITTLE KNOWN EPIPHYLLOUS LIVERWORTS, XV.**

*Tamás Pócs*

53–62

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## WHAT IS *CLADOLEJEUNEA* ZWICKEL? NEW OR LITTLE KNOWN EPIPHYLLOUS LIVERWORTS, XV.

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What is *Cladolejeunea*  
*Cladolejeunea*, *Ceratolejeunea*, conservation, endemism, *Lejeunea*,  
Usambara, Tanzania

**Abstract:** *The liverwort genus Cladolejeunea, described for a species of Lejeuneaceae from Tanzania with horned perianth keels as Cladolejeunea aberrans (Steph.) Zwickel, and long considered closely related to the members of the “Lejeunea eckloniana complex”, is reduced to synonymy under Lejeunea. As the name Lejeunea aberrans (=Acanthocoleus aberrans) already exists, a new name is proposed, Lejeunea gradsteiniana. The latter species is a rare and endangered endemic of the Usambara Mountains and its habitat needs protection. With the transfer of Cladolejeunea to Lejeunea virtually none of liverwort genera considered endemic to the African continent remain.*

### Introduction

*Cladolejeunea aberrans* (Steph.) Zwickel (1933) was based on *Ceratolejeunea aberrans* Steph. (1923), a species described from the East Usambara Mountains, Amani, Tanzania (= former German East Africa), found growing as an epiphyll on a large species of the filmy fern genus *Trichomanes*. Stephani's decision to assign the species to *Ceratolejeunea* was certainly based on the hornlike prolongation of the perianth keels, as is evident from his illustration of the species which was published by Bonner (1953).

Zwickel (1932) established a new classification of ocellus types and on this basis clarified the generic characters of *Ceratolejeunea* (Dauphin 2003). Based on the absence of ocelli and other characters, Zwickel (1933) recognized that *Ceratolejeunea aberrans* could not belong to this genus, and created a new genus for its inception, *Cladolejeunea* Zwickel, characterized by the horned perianth, the gynoeceia on short lateral branches without innovations, and the lack of brownish pigmentation and ocelli. Its status as a separate genus related to *Ceratolejeunea* was accepted for long time (e.g. Vanden Berghen 1945, Schuster 1963) and Schuster (1963: 65) even described a “*Cladolejeunea* Complex with

presumed affinities to the *Leptolejeunea-Harpalejeunea* Complex, and to the *Ceratolejeunea* Complex”, distinguishing it from the latter complex by the lack of fuscous pigmentation, ocelli and utriculi.

Jones (1974) was the first who called attention to the similarity of *Cladolejeunea aberrans* to certain species of *Lejeunea* (and *Taxilejeunea*) from Africa and America, which he called the “*Lejeunea eckloniana* complex”. These species are characterized by a large suite of characters such as 1) complanate leaves little altered by drying and with an opalescent gloss, 2) orbicular or broadly ovate underleaves halfway bilobed, 3) thin cell walls often with trigones and intermediate thickenings, 4) numerous minute and simple (*Massula* type) oil bodies; “the cell contents browning and chloroplasts breaking down very readily on drying, often with the production of minute orange- or ochre coloured bodies which often impart to the whole plant a characteristic ‘brassy’ tinge” (Jones 1974: 77), 5) monoecious sexuality, 6) subgynoecial innovations weak or absent, 7) female bracts with lobules very unequal in width, and 8) perianth inflated and equally 5-keeled, often with appendices (horns, teeth, tuberculae) near the apex of keels or at least winged. Members of this complex included *Lejeunea eckloniana* Lindenb., *L. arnelliana* Schust. (= *Ciliolejeunea capensis* S. Arnell), *L. cyathearum* E.W. Jones, and possibly *Cladolejeunea aberrans* (oil bodies unknown). Jones (1974) even considered the possibility to create a separate genus for these species. Grolle (1977) furthermore synonymized *Lejeunea arnelliana* with *Lejeunea villaumei* (Steph.) Grolle (= *Otigoniolejeunea villaumei* Steph.) and placed *L. alata* Gott. (*Lejeunea mitracalyx* (Eirig) Mizut.) also into the *Lejeunea eckloniana* group. Jones provided a good drawing (Jones 1974: 89, fig. 7) and a supplementary description of *Cladolejeunea aberrans*, in which he mentioned that presumed absence of innovations as one of the distinguishing characters of *Cladolejeunea* was not fully correct and that short sterile subgynoecial innovations are occasionally produced. However, he hesitated to make the transfer as has not seen the ochre-coloured bodies in the species known by him only from (old) herbarium material, including *Cladolejeunea aberrans*.

In 1982, I was lucky enough to collect *Cladolejeunea aberrans*, the second collection of the species and the first one with sporophytes (Pócs 1985; see figs 1–17). The species was found just 6 km SSW of the type locality, in the Kwamkoro Forest Reserve of East Usambara Mountains, at 960 m altitude (Fig. 1–2). Interestingly, the plants were again found growing on a large species of *Trichomanes* (*T. rigidum*). In this freshly collected material the *Massula* type, small, numerous oil bodies and the ochraceous bodies produced after oil body disintegration were well visible (Pócs 1985: 118, Pócs 1993: 115, Kis & Pócs 1997: 196 and figs. 108–110 on page 227). On the basis of this observation, Pócs (1985) supported Jones’ anticipation that *Cladolejeunea aberrans* belonged to

the “*Lejeunea eckloniana* complex”. No further taxonomic decision was taken, however.

### **Discussion and conclusions**

In view of the close relationship of *Cladolejeunea aberrans* to the members of the *Lejeunea eckloniana* complex, the generic status of *Cladolejeunea* needs to be questioned. Since neither the oil bodies nor any of the other morphological characters of the *Lejeunea eckloniana* complex (see list above) warrant separation of this group from the large genus *Lejeunea* as currently defined (e.g. Gradstein et al. 2001, Reiner-Drehwald 2010, Reiner-Drehwald & Goda 2000, Reiner-Drehwald & Schäfer-Verwimp 2008, Wigginton 2004, Wilson et al. 2007), it is concluded that *Cladolejeunea* Zwickel should be placed in the synonymy of *Lejeunea* and that *Cladolejeunea aberrans* (Steph.) Zwickel must be transferred to *Lejeunea*.

*Lejeunea* Libert (1820)  
*Cladolejeunea* Zwickel (1933), **syn. nov.**

Because of the existence of the name *Lejeunea aberrans* Lindenb & Gottsche 1847 (= *Acanthocoleus aberrans* (Lindenb. & Gottsche) Kruijt 1988; see also Gradstein 1994), a new name must be established for *Cladolejeunea aberrans*, as follows:

*Lejeunea gradsteiniana* Pócs, **nom. nov.**

= *Ceratolejeunea aberrans* Steph., Spec. Hepat. V: 399 (1923);  
*Cladolejeunea aberrans* (Steph.) Zwickel, Annales Bryol. 6: 112 (1933).

**Type:** Tanzania, Eastern Usambara Mountains, Amani, on a large species of *Trichomanes*, K. Braun s.n., 1911 (holotype: G ex hb. Munich, not seen, fide Bonner 1953, Jones 1974; isotype: JE, not seen).

**Etymology:** named in the honour of Prof. Stephan Robbert Gradstein, renowned hepaticologist, who encouraged the author to publish this paper.

Descriptions of the species were provided by Stephani (1923) and Zwickel (1933), supplemented by Jones (1974) and by Bischler (1966: 615). Here, some additional data are presented to the description of the lobule and sporophyte. The subgynoecial innovations when present, are very clearly of the *Lejeunea* type, often producing new gynoecia or androecia. The lobules of leaves are reduced in most cases to a small rudiment consisting of 1–3 cells with an apical hyaline papilla (Fig. 6). When well-developed (Figs 4–5), the lobule may reach to one third of the lobe length and is slightly inflated, but the free margin is not incurved. The shape of lobule is ovate with truncate apex and the base fused to

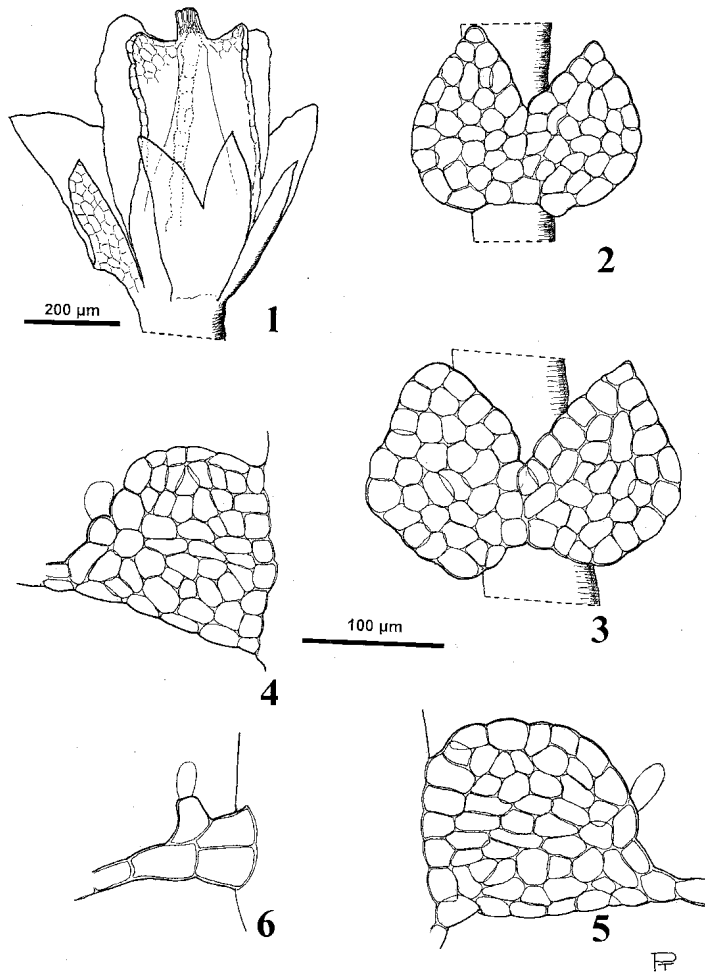
the stem along 6–8 cells. The first tooth is low, consisting of a rounded cell or obsolete. The large, club shaped hyaline papilla is at its proximal base, directed more or less forward. The second tooth is usually not differentiated. The sporophyte has a short seta just emerging from the perianth, the capsule is globose, ca. 4–500 µm in diameter and the capsule wall is translucent and has very weak nodular thickenings. Elaters are 4–5 per capsule valve, altogether 18, straw coloured, 6–10 µm thick and 200–210 µm long, without visible cell wall thickenings, except for some waviness. Spores are yellow when dry, unicellular, irregular in shape, mostly elongate, (30–) 40–60 (–70) x 10–28 µm, with 2–3 rosettes on each side and with densely warty surface by ca. 1 µm high globular tubercles.

*Lejeunea gradsteiniana* differs mainly in its perianth characters from the other African members of “*L. eckloniana*” group, being the only species with horned perianth keels (see Fig. 1). The perianth keels of *L. eckloniana* are winged, those of *L. alata* auriculately winged, of *L. villaumei* are dentate to ciliato-spinose and of *L. cyathearum* are tuberculate. There are differences also in the vegetative characters. The lobe cell walls in mature leaves may have small trigones but never intermediate thickenings, as in the case of other species of the group (Figs. 13–17). In *L. gradsteiniana* the first lobular tooth is always rounded or obsolete, whenever the lobule developed at all, while in the other species the first tooth is well developed, straight or falcate. The underleaves are not auriculate as in *L. cyathearum* and the lobule of bracts are usually acute and much narrower than the lobe.

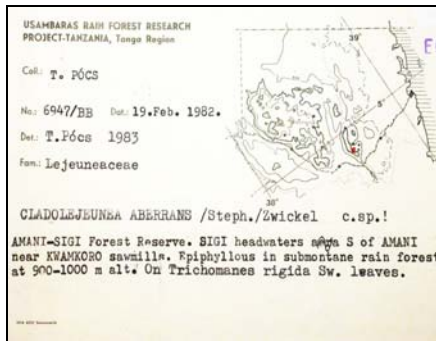
With the transfer of *Cladolejeunea* to *Lejeunea* none of liverwort genera considered endemic to the African continent remain, with the possible exception of *Evansiolejeunea*. *Capillolejeunea*, *Ciliolejeunea* and *Inflatolejeunea* have been transferred to *Lejeunea*, *Anomalolejeunea* to *Cheilolejeunea*, *Sprucella* to *Lepidozia*, and *Cephalojonesia* was recently discovered in Mexico (Burghardt & Gradstein 2006). *Evansiolejeunea* is nested in *Cheilolejeunea* and should probably be transferred to the latter genus based on molecular evidence (Wilson et al. 2007).

Even though *Lejeunea gradsteiniana* has lost its status as a monotypic endemic genus, the species retains its conservational value by being a narrow endemic known from only a very limited area. The habitat of the species, as that of all members of “*Lejeunea eckloniana*” species complex, is dense, wet tropical rain forest. Some of them are epiphylls, others live on tree fern stems. This kind of habitat is shrivelling in the Usambara mountains due to deforestation, intercropping and introduction of alien trees in the canopy (in our case *Maesopsis eminii* Engl. and *Eucalyptus* species) Therefore, the existence of *Lejeunea gradsteiniana*, hitherto known only at two localities 6 km from each other, is highly endangered, and has been registered as such in the IUCN World Red List of Bryophytes (Pócs in Tan et al. 2000: 84, under the name

*Cladolejeunea aberrans*). The epiphyllous community on *Trichomanes* leaves to which *C. aberrans* belongs contains further endemic or rare species, such as *Cololejeunea amaniensis* Pócs (type locality) and *Cololejeunea appressa* (A. Evans) Benedix. They share the habitat within a 20 m radius with a very rich epiphyllous vegetation, including *Cheilolejeunea surrepens* (Mitt.) E.W. Jones, *Caudalejeunea lewallei* Vanden Berghen, *Ceratolejeunea calabariensis* Steph., *Cololejeunea distalopapillata* (E.W. Jones) R.M. Schust., *C. microscopica* var. *exigua* (A. Evans) Bernecker & Pócs, *C. crenatiflora* Steph., *C. leloutrei* (E.W. Jones) R.M. Schust., *C. obtusifolia* (E.W. Jones) Tixier, *C. tanzaniae* Pócs, *Colura digitalis* (Mitt.) Steph., *Diplasiolejeunea cornuta* Steph., *D. kraussiana* (Lindenb.) Spruce, *D. villaumei* Steph., *Drepanolejeunea cultrella* (Mitt.) Steph., *Frullania apicalis* Mitt., *Leptolejeunea maculata* (Mitt.) Schiffn. and *Odontolejeunea lunulata* (F. Web.) Schiffn. (= *O. tortuosa* (Lehm. et Lindenb.) Steph.). In contrast, on the west side of the forest road just at 2-300 m distance the canopy of primary rainforest is intermixed with the alien tree *Maesopsis eminii*, introduced from Uganda and at places completely dominating, being easily and widely spread by hornbills. As a consequence, the canopy has become more open here, and the habitat lighter and drier. No epiphyllous liverworts are found any more in this site and oligophotic phanerogams have also disappeared, with only euphotic bryophytes surviving on the lower parts of *Maesopsis* trunks (Pócs 1989). Epiphylls are very sensitive indicators of human disturbances in tropical rain forests (Pócs 1996). Therefore, for conservation of endangered epiphylls is imperative to preserve larger blocks of undisturbed rainforest stands in their original structure and composition.



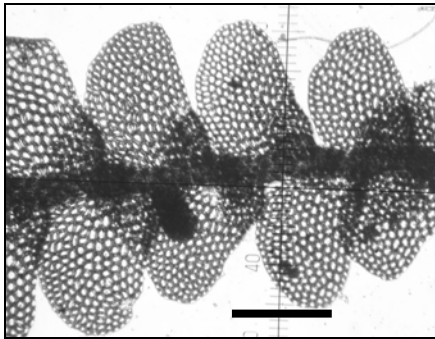
*Lejeunea gradsteiniana* Pócs. **Fig. 1:** Perichaetium with mature perianth. **Fig. 2-3:** Underleaves. **Fig. 4-6:** Leaf lobules. All from Pócs 6947/BB.



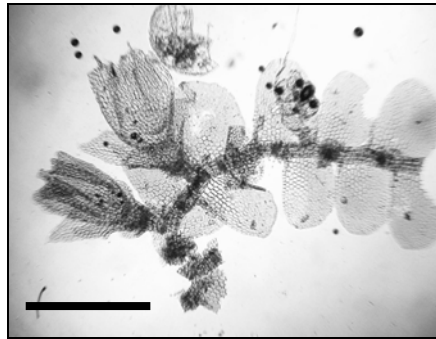
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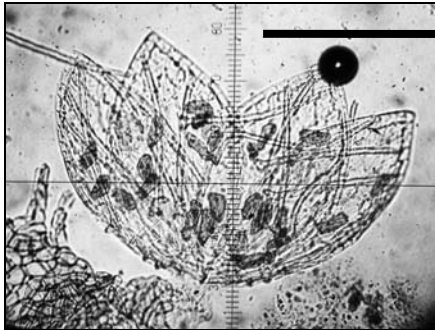
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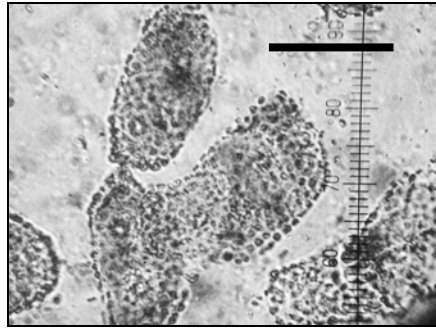
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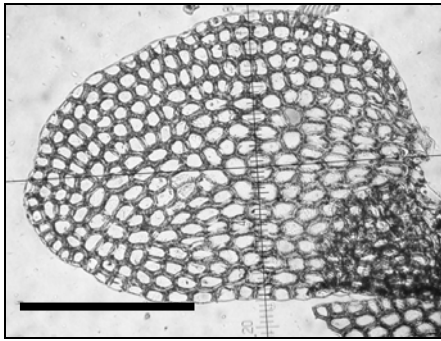


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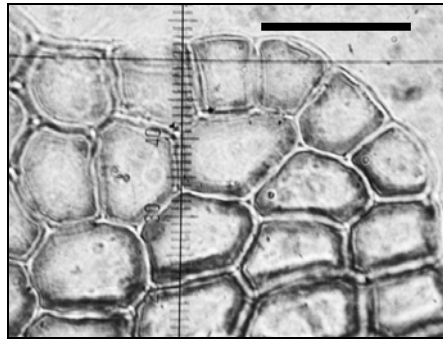


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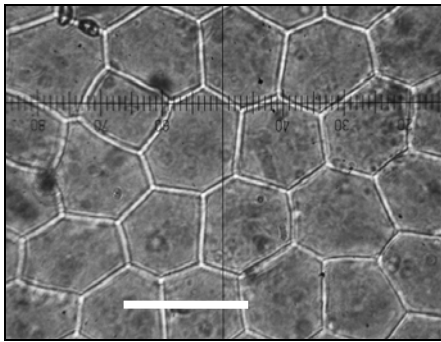
*Lejeunea gradsteiniana* Pócs. **Fig. 6:** The herbarium label of *Cladolejeunea aberrans* specimen collected by the author. **Fig. 7:** *Trichomanes rigidum* leaf densely covered by the epiphyllous *Lejeunea gradsteiniana*. The scale bar represents 5 mm. **Fig. 8:** The general habit of the species. Scale bar 250  $\mu$ m. **Fig. 9:** Fertile shoot with gynoecia, sporophyte and with a male branch. Scale bar 500  $\mu$ m. **Fig. 10:** Open capsule with elaters and mature spores. Scale bar 200  $\mu$ m. **Fig. 11:** Mature spores. Scale bar 25  $\mu$ m. All from Pócs 6947/BB.



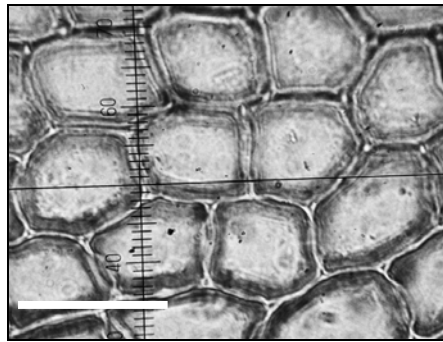
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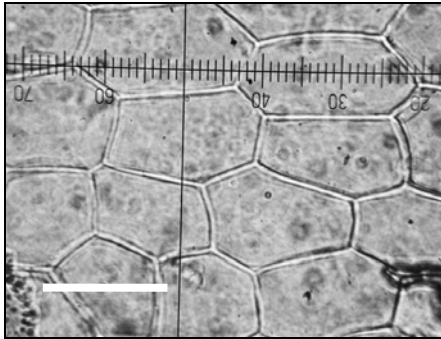
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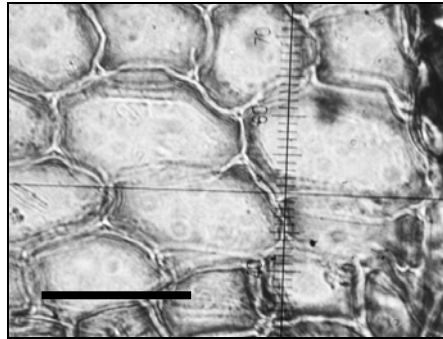
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*Lejeunea gradsteiniana* Pócs. **Fig. 12:** Leaf, ventral view. Scale bar 200  $\mu\text{m}$ . **Fig. 13:** Apical lobe cells. **Figs 14-15:** Median lobe cells. **Figs 16-17:** Basal lobe cells. In figs 13-17 the scale bar represents 30  $\mu\text{m}$ . In the left column cells of young leaf, in the right those of mature leaf are pictured. All from Pócs 6947/BB.



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