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Tamás Pócs

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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 gynoecia 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 synonymyzed *Lejeunea arnelliana* with *Lejeunea villaumei* (Steph.) Grolle (= *Otigoniolejeunea villaumei* Steph.) and placed *L alata* Gott. (Lejeunea mitracalyx (Eirig) Mizut.) also into the *Lejeuna 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

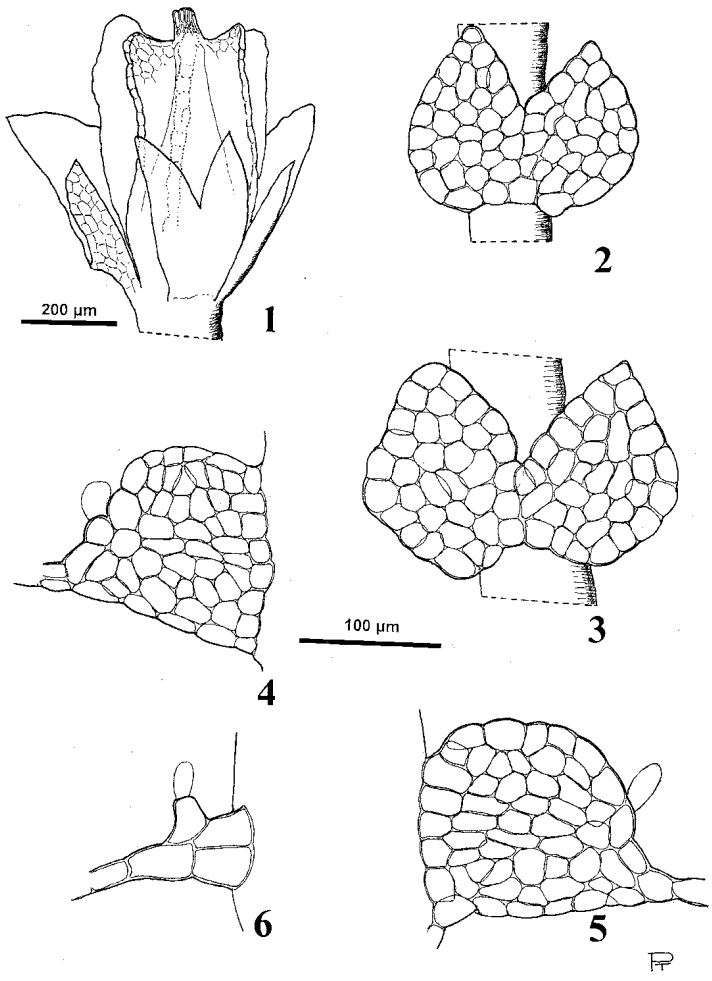
the stem along 6–8 cells. The first tooth is low, consisting of a rounded cell or obsolete. The large, club shaped hyaline papilla is at its proximal base, directed more or less forward. The second tooth is usually not differentiated. The sporophyte has a short seta just emerging from the perianth, the 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 wavyness. 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 developen, 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.

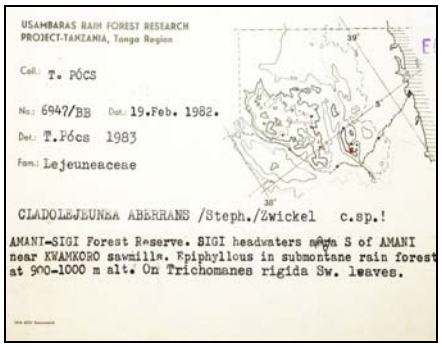
With the transfer of *Cladolejeunea* to *Lejeunea* none of liverwort genera considered endemic to the African continent remain, with the possible exception of *Evansiolejeunea*. *Capillolejeunea, Ciliolejeunea* and *Inflatolejeunea* have been transferred to *Lejeunea*, Anomalolejeunea to *Cheilolejeunea*, *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 Word 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 became 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.



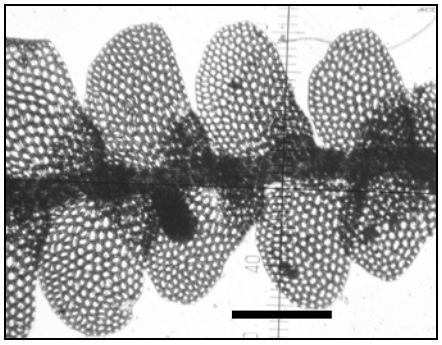
Lejeunea gradsteiniana Pócs. **Fig. 1:** Perichaetium with mature perianth. **Fig. 2-3:** Underleaves. **Fig. 4-6:** Leaf lobules. All from *Pócs 6947/BB.*



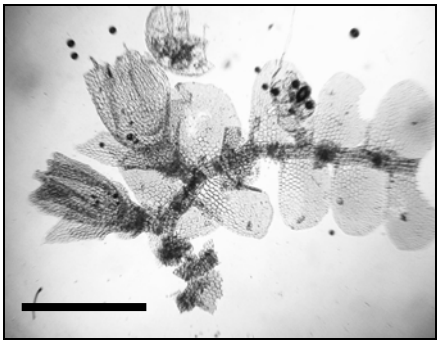
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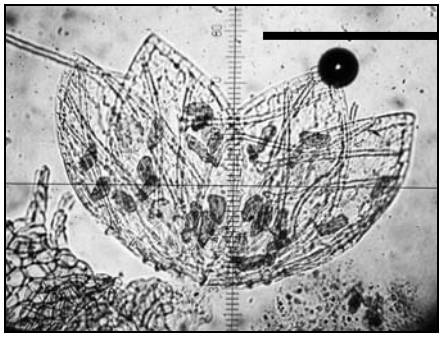
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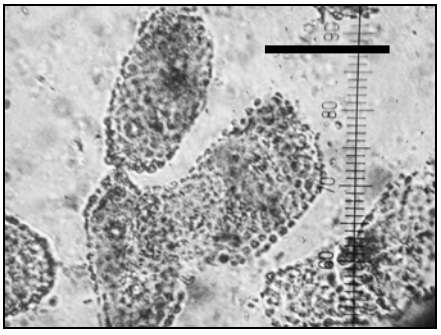
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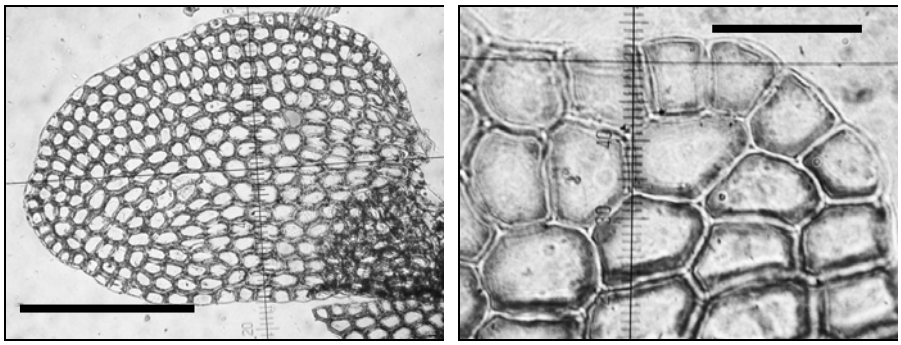


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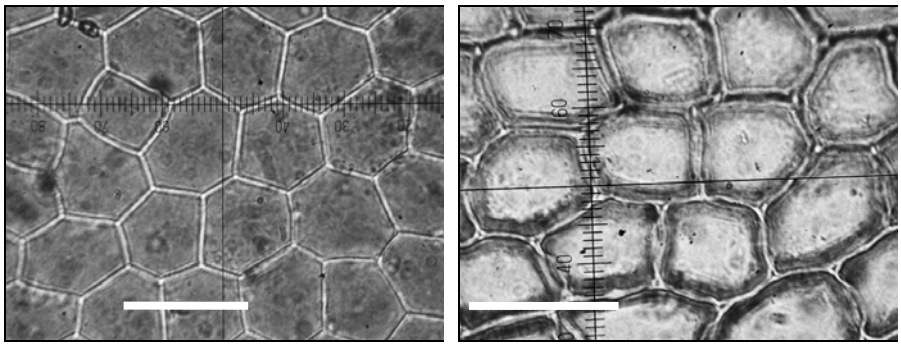


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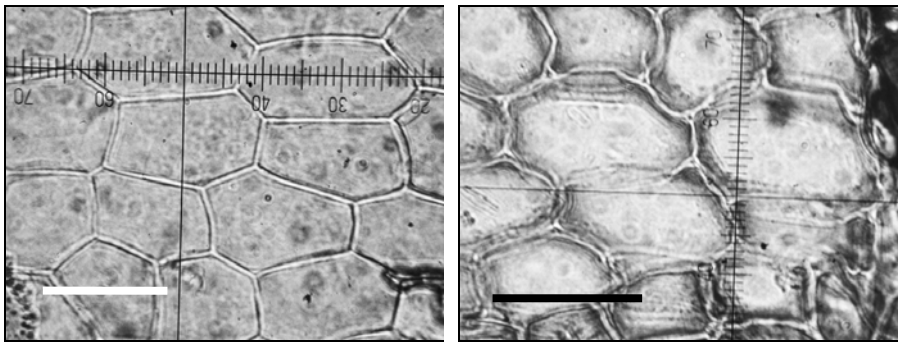
Lejeunea gradsteiniana Pócs. **Fig. 6:** The herbarium label of *Cladolejeunea aberrans* specimen collected by the author. **Fig. 7:** *Trichomanes rigidum* leaf densely covered by the epiphyllous *Lejeunea gradsteiniana.* The scale bar represents 5 mm. **Fig. 8:** The general habit of the species. Scale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



12 **13**



14 **15**



16 **17**

Lejeunea gradsteiniana Pócs. **Fig. 12:** Leaf, ventral view. Scale bar 200 μm. **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 μm. Int he left column cells of young leaf, int he right those of mature leaf are pictured. All from *Pócs 6947/BB.*

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