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EAST AFRICAN BRYOPHYTES, XXV: BRYOLOGICAL RECORDS FROM THE CHYULU RANGE, KENYA

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Abstract

The authors made the first comprehensive bryological collection on the forest-covered Chyulu Range in south-eastern Kenya. Although these hills are of young volcanic origin and do not belong to the so called “Eastern Arc” mountains, they offer a high diversity of habitats from dry *Acacia-Commiphora* bushland to montane mist forest and thus a relatively rich bryophyte flora: from the 79 species recently recorded, 13 are new to the flora of Kenya. The new combination *Plagiochila kiaeri* var. *myriocarpa* is made.

Keywords: Mosses, Liverworts, *Nanobryum*, *Ptychanthus*, East Africa.

INTRODUCTION

The botanical investigation of the isolated Chyulu Range was initiated by the junior author as a long term, privately funded project as part of his family’s initiation of a tourism venture in 1986. Over the past twenty years the area has been explored, a few days at a time, until a comprehensive plant species inventory has been compiled. This list has been used to search the herbarium in Nairobi to include the specimens collected during the earliest and, until now, only botanical survey, by Peter Bally, whilst on his honeymoon in 1938 (Bally, 1939; van Someren, 1939). These early records have been used to prepare the first annotated checklist of vascular plants for the area by Luke (in prep.). Bally and van Someren were part of the first multi-disciplinary scientific expedition to be carried out by the Coryndon Memorial Museum, now the National Museums of Kenya. The arrival of the senior author and his wife in Nairobi in 2004 provided the ideal opportunity to add the bryophytes to the investigation.

The knowledge on the bryoflora of Chyulu Range in south-east Kenya was very poor. There were only two published liverwort records known from the collection of the Danish phanerogam botanist Ib Friis, on the occurrence of *Leucolejeunea xanthocarpa* (Lehm. & Lindenb.) A. Evans and *Targionia lorbeeriana* Müll. Frib. (Bizot *et al.* 1978). In addition, a further three identified species, collected from the area, were deposited in the East African Herbarium, Nairobi (EA), as *Marchantia pappeana* Lehm. ssp. *pappeana* (det. I. Malombe), *Bryum pseudotriquetrum* (Hedw.) Schwägr. (det. M.S. Chuah-Petiot) and *Porothamnium stipitatum* (Mitt.) Touw ex De Sloover (det. C.C. Townsend).

The Chyulu Range runs roughly northwest-southeast, midway between Nairobi and Mombasa, on the western side of the main highway and railway line connecting the two cities (figure 1). These volcanic hills rise from the surrounding plains at around 1000 m (3250 ft) to a series of rounded peaks and craters, the tallest of which is 2175 m (7070 ft). Some 45 km long and 5 km wide, they lie between the districts of Machakos and Kajiado with the boundary, almost a straight line, running along the peaks and dividing the predominately agricultural Kamba, to the east, from the pastoral Maasai to the west (figures 1 & 2). In 1938, local history held that the hills had been settled sometime earlier by the Chagga, but that these people were expelled by the Kamba, who were then themselves removed during the colonial era (van Someren, 1939). Since Kenya's independence, increasing agricultural settlement in the hills was felt to be a threat to the water-catchment supplying Mzima Springs (and hence the city of Mombasa) and the settlers were evicted. To conserve the catchment, the southern tip was included within the Tsavo West National Park and later, the eastern slopes were declared protected as the Chyulu East National Park in 1983. The western slopes are still owned collectively as part of two Maasai autonomous 'group ranches', Mbirikani to the north and Kuku to the south.

Geology

The Chyulu Range is of fairly recent (geological) origin. Volcanic activity in the area began with the formation of Mount Kilimanjaro, in the lower Pleistocene around 1 mya (Downie & Wilkinson, 1972). The Chyulus are much younger and date from about the same time as Eburru and Mount Longonot in the Upper Pleistocene or 0.026 mya, but with activity continuing until as recent as 500 ± 200 years ago (Wright & Gunston, 1988) with the last eruptions occurring on the southeastern end, at the Sheitani (Italweni of van Someren?) lava flow. The collapse of Mawenzi Peak on Kilimanjaro dates from around 0.5 mya, with the attendant volcanic mudflow (or lahar) that is said to have spread northeast from Loitokitok to Chyulus. There is evidence that the eruptions took place over this period from north to south, with the cones towards the Merueshi River being much older than those in the "Southern" Chyulus (Saggerson, 1963). However this is partially contradicted by evidence of young lava (480 ± 200 years ago) in the North East Chyulus (Dodson, 1960) which appears to be supported by the younger forest in this section (Luke, in prep.). Van Someren (1939) draws attention to the fact that the cones in the north and central area have breaks in their southeastern edge, suggesting a prevailing wind from the southeast at the time of eruption, whereas those in the south are variable, with gaps in the west, south and east, suggesting various wind directions during formation. The form of the range is a series of uneven, rounded, volcanic ash (or lapilli) cones with subsidiary, smaller ones on both sides and numerous lava flows running at intervals out onto the plains. The main soils are lithosols on lava flows, andosols on coarse ash deposits and deep luvisols on the flatter plains. The plains in the central, driest part of Mbirikani feature dark clays with vertic and saline-sodic properties (Touber, 1983).

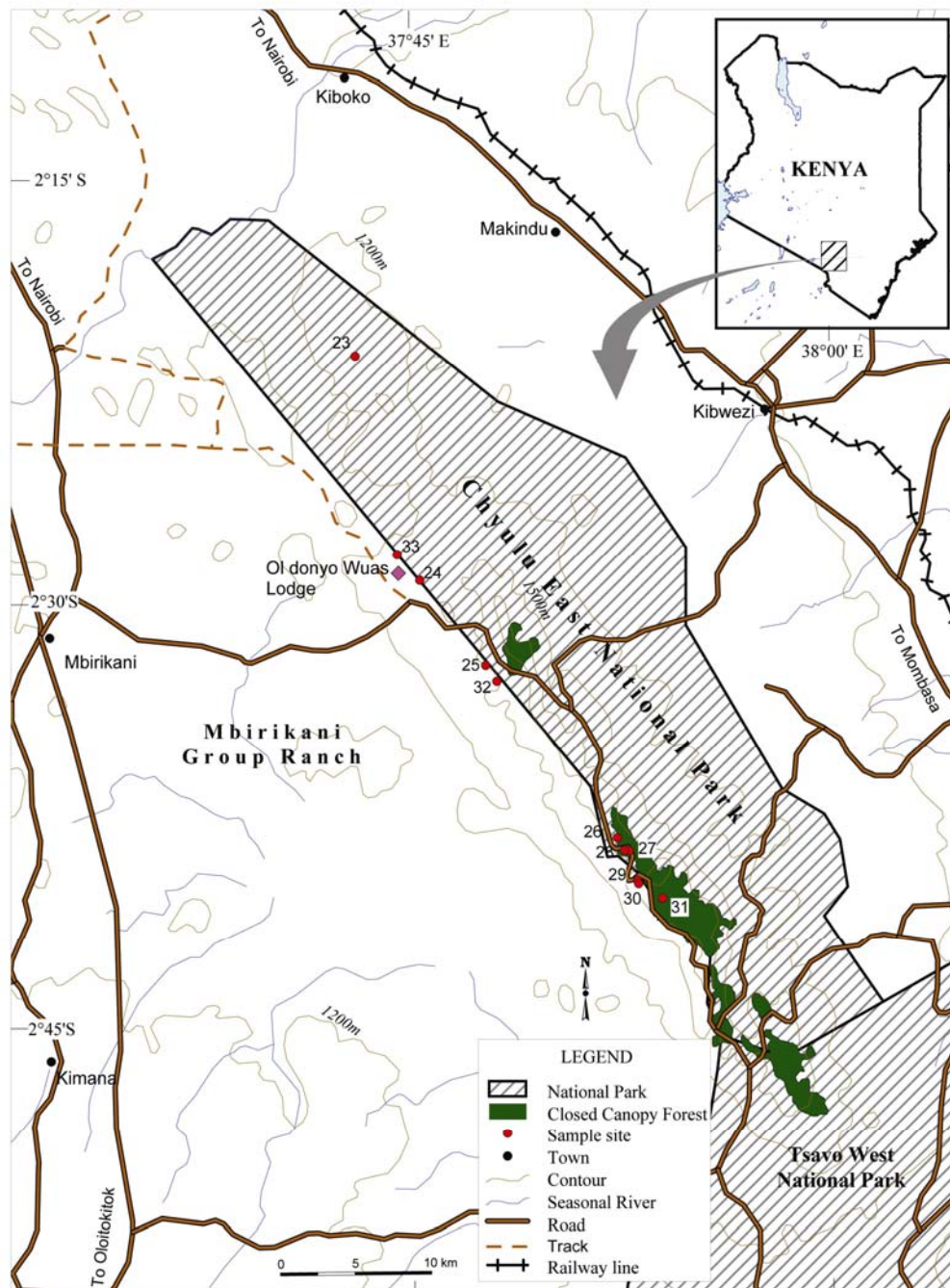


Figure 1. The position of Chyulu Range in Kenya and the collecting localities within the Chyulu Hills (indicated by two last digits of collecting site, cf list of localities).

Climate

Although the entire range is subject to the overall bimodal rainfall pattern that nearly the whole of Kenya experiences, coupled to the prevailing winds determined by the monsoon changes in the Indian Ocean, it is certainly influenced by the massive presence of Kilimanjaro. The range receives its highest rainfall during the ‘short rains’ of Nov–Dec as opposed to the ‘long rains’ of March–May (Wright & Gunston, 1988). The Museum expedition noted the prevailing wind as south-westerly during the period of the expedition (April–July). The moisture laden winds thus strike the western side of the range making them (and the Southern Chyulus) the wettest areas. Observation of the hills suggests that the common presence of mist cover contributes a larger proportion of the moisture than actual rain precipitation. This has an obvious impact on the diversity of the epiphytes and the bryophyte flora. Annual rainfall on the northern end at 1810 m has been measured as 1185 mm (Wright & Gunston, 1988) while the surrounding plains receive around 600 mm.

Vegetation

Broad zones can be recognized as follows (Luke, in prep.):

1. Plains and *Acacia drepanolobium* Sjøstedt grassland, 1000–1100 m (figure 2)
2. *Acacia tortilis* (Forssk.) Hayne woodland, 1100–1500 m
3. Lava flows with *Olea/Cussonia/Commiphora*, 1000–1500 m (1700m)
4. *Ozoroa/Dombeya/Combretum* woodland, 1200–1600 m (figure 3)
5. *Juniperus* forest, 1300–1600 m (figure 4)
6. *Erythrina* islands and wooded grassland, 1600–1800 m (figure 5)
7. Upland grassland, above 1600 m
8. Crater forest *Pistacia/Vepris/Trichocladus*, 1300–1800 m
9. Southern montane forest *Drypetes/Strychnos/Heinsenia*, 1400–1750 m
10. Mist forest *Neoboutonia/Tabernaemontana/Prunus/Ficus*, 1800–2175 m



Figure 2. The central part of Chyulu Range, as seen from the west.

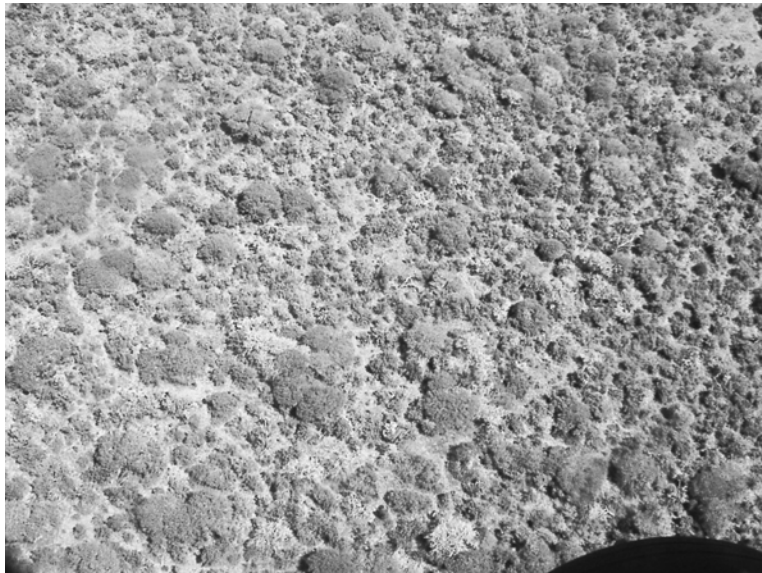


Figure 3: Aerial view of Ozoroa/Dombeya/Combretum woodland at the northern foothills.



Figure 4. Locality 04032 with dry, open Juniperus procera forest.

List of collecting localities

The specimens were collected by S. & T. Pócs and by Q. Luke and the voucher specimens are deposited in the East African Herbarium (EA), the herbarium of the Department of Botany, Eszterházy College (EGR) and some duplicates in the herbarium of the Botany Department, Nairobi University (NAI).



Figure 5. Localities 04027 and 04028, wet evergreen forest on the summit ridge with open *Erythrina abyssinica* woodland alternating with grazed secondary grassland in the foreground.

04023: K4, Chyulu Range in Eastern Province, Machakos District, on the end spur of the range, W of Makindu village, at 1150 m, 02°22.11'S, 37°42.95'E. Dense dry deciduous forest and bush on a sub-recent lava flow, alternating with open lava fields. 20 March 2004.

04024: K6, Rift Valley Province, Kajiado District, on the NW foothills of Chyulu Range, around Ol Donyo Wuas Lodge, at 1220 m, 02°30.11'S, 37°45.22'E. Dry *Acacia* (*Commiphora*) woodland. 20 March 2004.

04025: K6, Chyulu Range in Rift Valley Province, Kajiado District, on the N crater rim of a small extinct volcano, 7 km SSE of Ol Donyo Wuas Lodge, at 1500 m, 02°33.16'S, 37°47.57'E. Lava rocks with *Xerophyta spekei* Baker–*Actiniopteris* vegetation. 20 March 2004.

04026: K6, Chyulu Range in Rift Valley Province, Kajiado District, boundary with Machakos District, on the W slopes of main ridge, at 1900–1980 m, 02°39.36'S, 37°52.25'E. Montane mesic evergreen forest. 21 March 2004.

04027: K6, Chyulu Range in Rift Valley Province Kajiado, district boundary with Machakos District. On summit ridge, at 1980–2030 m, 02°39.82'S, 37°52.67'E. Montane wet evergreen forest with many hanging mosses on the branches. 21 March 2004.

04028: K6, Chyulu Range in Rift Valley Province, Kajiado District, on the W slopes at 1850–1890 m, 02°39.8'S, 37°52.5'E. Scattered *Erythrina abyssinica* Lam. ex DC. trees in secondary grassland. On *Erythrina abyssinica* bark. 22 March 2004.

04029: K6, Chyulu Range in Rift Valley Province, Kajiado District, on the W slopes at 1840 m, 02°40.87'S, 37°52.95'E. Rock outcrops with forest remnants in gullies. 22 March 2004.

04030: K6, Chyulu Range in Rift Valley Province, Kajiado District, on the W slopes at 1850 m. 02°41'S, 37°53'E. Dry montane evergreen forest fragment with old *Juniperus procera* Endl. trees. 22 March 2004.

04031: K4–K6, Chyulu Range in Rift Valley Province, district boundary, on the summit ridge, at 1860–1934 m, 02°41.53–02°41.65'S, 37°53.86–37°54.88'E. Montane mesic evergreen forest with *Afrocarpus usambarensis* Pilger intermixed. 22 March 2004.

04032: K6, Chyulu Range in Rift Valley Province, Kajiado District, 7 km ESE of Ol Donyo Wuas Lodge, in flat valley bottom, at 1555 m, 02°33.74'S, 37°47.97'E. Dry evergreen *Juniperus* forest on sub-recent lava flow, intermixed with many low, broad-leafed bush. 22 March 2004.

04033: K6, W of Chyulu Range in Rift Valley Province, Kajiado District, Mbirikani Plains SW below the Ol Donyo Wuas Lodge, at 1150 m, 02°29.18'S, 37°44.41'E. Dry *Acacia* (*Commiphora*) woodland. 23 March 2004.

ANNOTATED ENUMERATION OF SPECIES

In the enumeration below, the species name is followed by: the last two digits of the number of the locality where it was collected (figure 1); by the first record detailed specimen reference, by the substrate; and finally, in some cases, annotations on its habitat and geographical distribution. The nomenclature and the African distribution of species is based on O'Shea (2003) for the mosses and on Wigginton (2004) for the liverworts, unless otherwise stated. * indicates that the record is new to Kenya. The list below is based on only one collecting trip mentioned above and does not contain members of some unrevised, mostly pleurocarpous moss families, like *Brachytheciaceae*, *Hypnaceae*, *Sematophyllaceae* and some others. It means that the real total of bryophyte species could eventually be about twice as many. However, the intensity of exploration is even lower in many other tropical African localities and we consider our results comparable with them.

LIVERWORTS (MARCHANTIOPHYTA)

Aytoniaceae

**Mannia capensis* (L.) S.W.Arnell - 29 (Pócs & Luke 04029/N: EA, EGR). Terricolous. Southern African species previously known only up to Tanzania. Occurs in open, rocky habitats.

Plagiochasma rupestre (J.R.Forst. & G.Forst.) Steph. - 25 (Pócs & Luke 04025/E: EA, EGR). On shady cliff. A warm temperate subcosmopolite.

Frullaniaceae

Frullania angulata Mitt. - 26 (Pócs & Luke 04026/F: EA, EGR), 29. Ramicolous, mostly on canopy branches. Widespread afromontane species.

Frullania arecae (Spreng.) Gottsche - 26 (Pócs & Luke 04026/C: EA, EGR), 29. Ramicolous & corticolous. Common pantropical, montane forest species.

Frullania caffraria Steph. - 32 (Pócs & Luke 04032/AA: EA, EGR). Ramicolous. Afromontane species preferring relatively dry habitats as *Juniperus* forest or miombo woodland.

Frullania diptera (Lehm) Drège - 26 (Pócs & Luke 04026/G: EGR), 30. Corticolous. Distributed mostly in Southeast Africa and in Madagascar.

Frullania ericoides (Nees) Mont. - 23 (Pócs & Luke 04023/A: EA), 25, 26, 32. Corticolous and on *Xerophyta spekei* (Velloziaceae) stem. Common pantropical, ubiquitous corticolous species.

Frullania obscurifolia Mitt. - 32 (Pócs & Luke 04032/MA: EGR). On decaying bark. Widespread tropical African species, often occurring in drier habitats.

Frullania socotrana Mitt. - 29 (Pócs & Luke 04029/F: EA, EGR). On decaying wood. Rare, scattered all over tropical and southern Africa in relatively dry habitats.

**Frullania spongiosa* Steph. - 26 (Pócs & Luke 04026/D: EA, EGR). Ramicolous. Lowland species, distributed mostly in coastal West and East Africa.

Geocalycaceae

Chiloscyphus martianus (Nees) J.J.Engel & R.M.Schust. (Syn.: *Lophocolea martiana* Nees) - 26 (Pócs & Luke 04026/AY: EA, EGR). Lignicolous. An Afro-American disjunct, widespread in shady tropical forests, living mostly on decaying wood. According to the new generic concept in Geocalycaceae (Engel & Schuster, 1984) *Lophocolea* was merged into the genus *Chiloscyphus*. This opinion was confirmed by the molecular and morphological analysis of He-Nygrén & Piippo (2003) and since widely accepted.

Chiloscyphus concretus (Mont.) J.J.Engel & R.M.Schust. (Syn.: *Lophocolea concreta* Mont., see comment above) - 31 (Pócs & Luke 04031/T, U: EA). On decaying wood. Widespread in tropical Africa.

Lejeuneaceae

**Caudalejeunea dusenii* Steph. (figure 6) - 26 (Pócs & Luke 04026/DK: EA, EGR), 27, 28 (EA). Ramicolous and epiphyllous in the mist forests. Tropical African lowland forest species might be conspecific with the Indomalaysian-Australasian *Caudalejeunea reniloba* (Gottsche) Steph.



Fig. 6: *Caudalejeunea dusenii* Steph., a rare ramicolous species from locality 04028.

Cololejeunea cardiocarpa (Mont.) A.Evans - 26 (Pócs & Luke 04026/ED: EGR), 31 (EA). Ramicolous and epiphyllous. Pantropical species.

Cololejeunea distalopapillata (E.W.Jones) R.M.Schust. - 26 (Pócs & Luke 04026/EB: EA, EGR), 27, 31. Epiphyllous. Widespread in Central and in East Africa including the Indian Ocean islands.

- Cololejeunea malanjae* Steph. - 26 (Pócs & Luke 04026/EA, DJ: EA, EGR), 27, 31. Epiphyllous, ramicolous. Distributed in the Southeast African mountains from Rwanda to Tanzania and Malawi. Dominant among the foliicolous bryophytes on Chyulu Range.
- **Cololejeunea mocambiquensis* S.W.Arnell (figure 7) - 26 (Pócs & Luke 04026/S: EGR). On *Trichomanes* leaf. Rare epiphyllous species usually occurring on filmy ferns. Known only from Southeast Africa and from Madagascar.

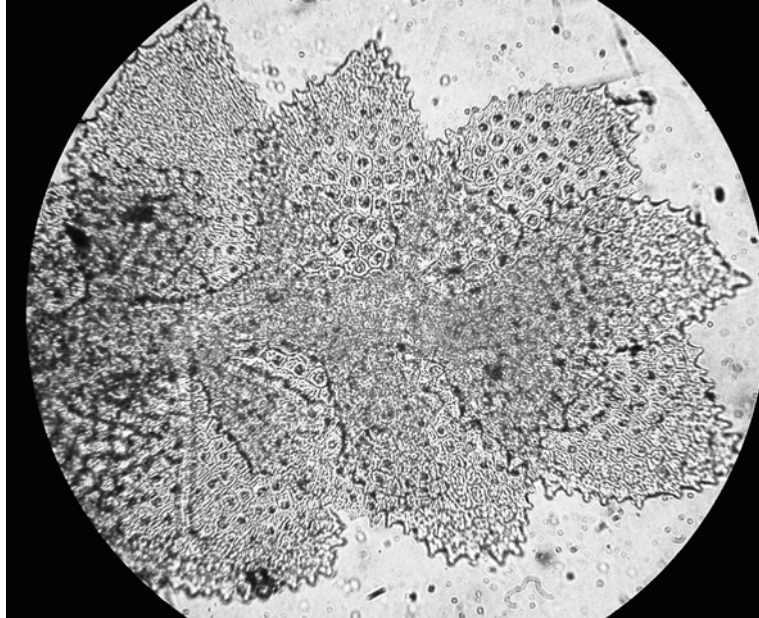


Figure 7. The rare Southeast African *Cololejeunea mocambiquensis* S.W.Arnell from the area.

- Cololejeunea obtusifolia* (E.W.Jones) Tixier (figure 8) - 26 (Pócs & Luke 04026/T: EA, EGR), 27. On *Trichomanes* leaf. Epiphyllous. Widespread in the rainforest areas of tropical Africa.
- Frullanoides tristis* (Steph.) van Slageren - 28 (Pócs & Luke 04028/A: EGR). Corticolous. Widespread pantropical species from tropical America through Africa eastwards to India and Nepal.
- Lejeunea caespitosa* Lindenb. - 26 (Pócs & Luke 04026/DG, DH: EA, EGR), 27, 31. Ramicolous & epiphyllous. A common pantropical forest species.
- Lejeunea helenae* Pearson - 26 (Pócs & Luke 04026/EJ: EA, EGR), 30. Epiphyllous and on *Juniperus procera* bark. Distributed in tropical Africa.
- Lejeunea rhodesiae* (Sim) R.M.Schust. - 32 (Pócs & Luke 04032/J: EGR). Corticolous. Distributed in southeast tropical Africa.
- Lejeunea tabularis* (Spreng.) Gottsche *et al.* - 26 (Pócs & Luke 04026/X: EA, EGR), 27, 31. Corticolous, ramicolous and epiphyllous. Widespread tropical African species or ssp. of the Pantropical *Lejeunea flava* according to certain authors. At the locality 27 (Pócs & Luke 04027/AH: EGR), on tiny acanthaceous twigs a very interesting "tubata" form occurs with trumpet shaped perianth mouth (see figure 9, without taxonomic significance).

according to Wigginton, 2004). This somatic mutant in all other characters agrees with *Lejeunea tabularis*.

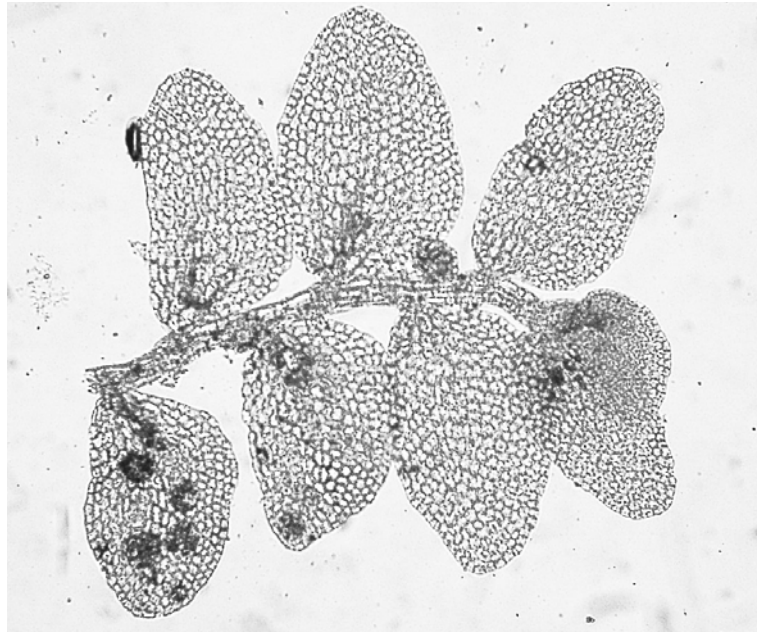


Figure 8. *Cololejeunea obtusifolia* (E.W.Jones) Tixier, one of the common epiphylls in the area.

Microlejeunea africana Steph. - 26 (Pócs & Luke 04026/BA,EF : EA, EGR), - 27, 31.

Epiphyllous and corticolous. Widespread tropical African species. Closely allied to the boreal temperate *Microlejeunea ulicina* A.Evans.

Odontolejeunea lunulata (F.Weber) Schiffn. - 26 (Pócs & Luke 04026/EH: EA, EGR), 27, 31. Epiphyllous, widespread tropical Afro-American disjunct.

Ptychanthus africanus Steph. - 26 (Pócs & Luke 04026/B: EA, EGR), 27, 31. Corticolous. Widespread tropical African forest species differing morphologically from the Asian-Oceanian *Ptychanthus striatus* (Lehm. et Lindenb.) Nees by its *Bazzania* type oil bodies consisting only of 2–5 segments (Kis & Pócs, 1997), the segregation was confirmed also by molecular taxonomic data (Ahonen *et al.*, 2005). Therefore all African records enumerated as *Ptychanthus striatus* (Lehm. et Lindenb.) Nees by Wigginton (2004) refer to this species.

Taxilejeunea pulchriflora Pearson - 26 (Pócs & Luke 04026/U: EGR). On *Trichomanes* leaf. Distributed, but not common in the rainforest areas of tropical Africa.

Taxilejeunea conformis (Mont. et Nees) Steph. - 26 (Pócs & Luke 04026/Y: EA). On buttress. A very widespread afro-montane species.

Metzgeriaceae

Metzgeria consanguinea Schiffn. - 26 (Pócs & Luke 04026/P: EA, EGR), 27 (EGR), 31 (EA). Epiphyllous and on decaying branch. Pantropical montane species.

Metzgeria furcata (L.) Dumort. - 26 (Pócs & Luke 04025/EG: EGR). Epiphyllous. A cosmopolitan forest species.

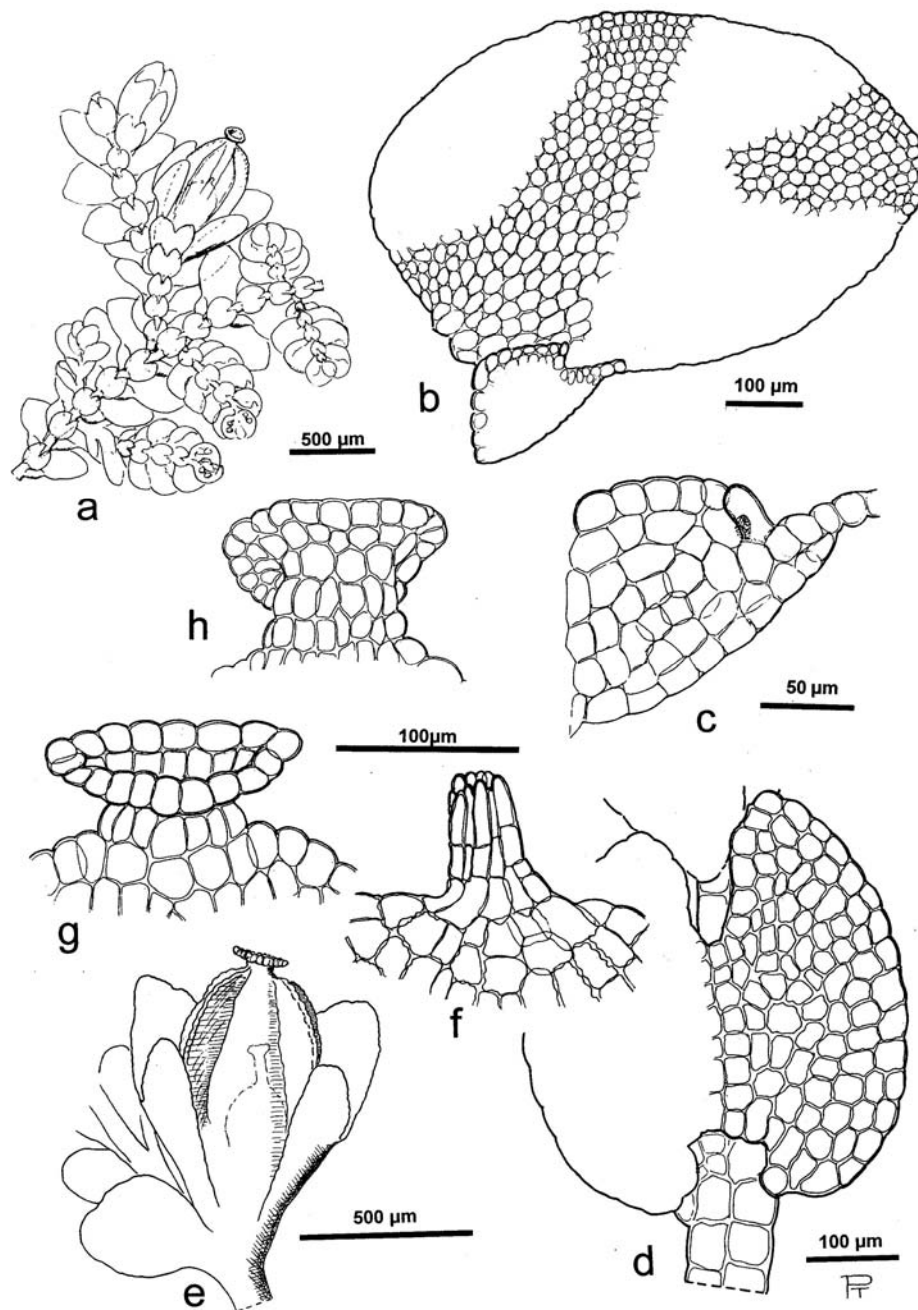


Figure 9. Somatic mutant of *Lejeunea tabularis* (Spreng.) Gottsch et al. with trumpet shaped perianth mouth: a. habit; b. leaf, ventral view; c. lobule; d. underleaf; e. gynoecium; f. the rarely occurring normal perianth mouth; g-h. the overall dominating trumpet shaped perianth mouths on the specimen from locality 04027.

Metzgeria madagassa Steph. - 26 (Pócs & Luke 04026/V: EA, EGR). On canopy branch. Palaeotropical species distributed from tropical Africa to Sikkim in the Himalayas.

Plagiophilaceae

Plagiochila kiaeri Gottsche var. *kiaeri* - 26 (Pócs & Luke 04026/H: EA, EGR). Corticolous. Together with the following variety, widespread in southeast tropical Africa.

Plagiochila kiaeri Gottsche var. *myriocarpa* (Pearson) Pócs. **comb. nov.**

Basionym: *Plagiochila myriocarpa* Pearson, *Ark. Bot.* 19: 5 & fig. 3, 1924. Type: coll. G. Lindblom, Mt. Elgon, Malaba, c. 4000 ft. alt., 3. Aug. 1920 and by the same collector: Kaimosi, 6. Aug. 1920. Both syntypes in S.

Synonym: *Plagiochila divergens* var. *myriocarpa* (Pearson) E.W.Jones, *Trans. Brit. Bryol. Soc.* 4: 315 & fig. 24 k-l, 1962. As *Plagiochila divergens* Steph. 1891 was synonymized with *Plagiochila kiaeri* Gottsche 1882, by Grolle (1995), as Wigginton (2004) already remarked, the status of this taxon is to be reassessed. - 26 (Pócs & Luke 04026/J: EA, EGR). Corticolous, on decaying wood.

Plagiochila squamulosa Mitt. - 26 (Pócs & Luke 04026/K: EA, EGR). Corticolous, ramicolous. Widespread tropical African species.

Porellaceae

Porella abyssinica var. *hoehnelii* (Steph.) Pócs - 31 (Pócs & Luke 04031/R: EA, EGR). On decaying wood. East African montane species.

Radulaceae

Radula fulvifolia (Hook.f. et Taylor) Gottsche *et al.* - 26 (Pócs & Luke 04026/W: EGR). Corticolous. According to Chuah-Petiot (2003) an Afromontane species.

Radula quadrata Gottsche (figure 10) - 30 (Pócs & Luke 04030/C: EA, EGR), 31. Corticolous. Afromontane species.



Figure 10. *Radula quadrata* Gottsche, a typical Afromontane species from locality 04031.

Targioniaceae

Targionia hypophylla L. - 29 (Pócs & Luke 04029/J: EA, EGR). On earth covered rocks. A subcosmopolitan xerophyte.

MOSESSES (BRYOPHYTA)**Bartramiaceae**

Anacolia laevisphaera (Taylor) Flowers in Grout - 29 (Pócs & Luke 04029/AF: EA, EGR). On a volcanic cliff. A pantropical montane species distributed from South America through Africa to India.

Brachytheciaceae

**Aerolindigia capillacea* (Hornsch.) M.Menzel - 27 (Pócs & Luke 04027/AG: EA, EGR). Ramicolous. A rare Afro-American forest species, in Africa previously known from Ethiopia to Zaire and from Madagascar.

Palamocladium leskeoides (Hook.) E.Britton - 26 (Pócs & Luke 04026/AH: EA, EGR). On bark. A widespread, pantropical forest species.

Bryaceae

Brachymenium acuminatum Harv. in Hook. - 26 (Pócs & Luke 04026/AS: EA, EGR). On road bank. A pantropical species distributed mostly on disturbed soil surfaces.

Brachymenium capitulatum (Mitt.) Kindb. - 30 (Pócs & Luke 04030/J: EA, EGR). Corticolous. According to Ochi (1974) a palaeotropical species.

Brachymenium systylium (Müll.Hal.) A.Jaeger (Syn.: *B. angolense* (Welw. & Duby.) A.Jaeger) - 28 (Pócs & Luke 04028/C: EA, EGR), 32. Corticolous. A widespread pantropical epiphyte of relatively drier habitats.

Bryum andicola Hook. - 26 (Pócs & Luke 04026/AU: EA, EGR). On decaying wood. An Afro-American montane species occurring also on the Hawaiian Islands (Haji Mohamed, 1979).

Bryum apiculatum Schwägr. - 26 (Pócs & Luke 04026/AV: EA, EGR). On decaying wood. Widespread pantropical species.

Bryum arachnoideum Müll.Hal. - 29 (Pócs & Luke 04029/H: EA, EGR). Rupicolous, terricolous. Afro-American disjunct.

Bryum argenteum Hedw. - 33 (Pócs & Luke 04033/K: EA, EGR). Terricolous. Cosmopolitan.

Bryum dichotomum Hedw. - 29 (Pócs & Luke 04029/E: EA, EGR). On humus covered rock. Subcosmopolitan.

Bryum huillense Welw. et Duby - 32 (Pócs & Luke 04032/D: EA, EGR). Rupicolous. According to Ochi (1974) a pantropical species widespread in African mountains.

Bryum lanatum (P.Beauv) Hampe - 34 (EA, EGR). Terricolous. A cosmopolitan xerophyte. According to Frahm (2002) and our own view it is a morphologically and ecologically distinct taxon, not a synonym of *Bryum argenteum* Hedw. var. *argenteum*, as stated by O'Shea (2003).

**Bryum subapiculatum* Hampe (Syn.: *Bryum micro-erythrocarpum* Müll.Hal. & Kindb.) - 29 (Pócs & Luke 04029/AE: EA, EGR). Terricolous, bipolar temperate species, in the continent known only from South Africa to Tanzania.

Cryphaeaceae

Forsstroemia producta (Hornsch.) Paris - 26 (Pócs & Luke 04026/AP: EA, EGR). Ramicolous. Pantropical, drought tolerant epiphyte in the continent known from east and southern Africa.

Dicranaceae

Campylopus pilifer Brid. - 25 (Pócs & Luke 04025/K: EA, EGR), 29 (EA, EGR).
Rupicolous. A tropical–warm temperate species distributed from America through Africa and SW Europe to India (Gradstein & Sipman 1978).

Erpodiaceae

Erpodium beccarii Müll.Hal. ex Venturi - 24 (Pócs & Luke 04024/B: EA, EGR).
Corticolous. A widespread xerophytic epiphyte known from the tropical Americas, Africa and Australia.

Erpodium holstii Broth. (figure 11) - 24 (Pócs & Luke 04024/A: EA, EGR), 33. Corticolous.
An East African endemic known only from Kenya and Tanzania.



Figure. 11. *Erpodium holstii* Broth., a rare subendemic species from locality 04019.

Fabroniaceae

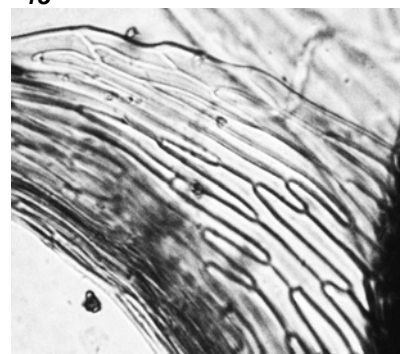
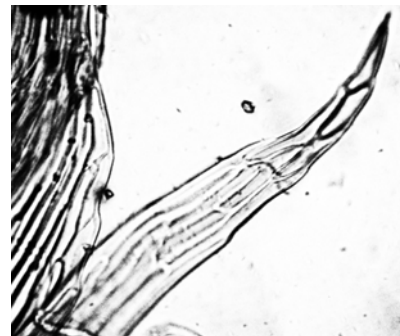
Fabronia pilifera Hornsch. - 32 (Pócs & Luke 04032/W: EA, EGR). On charred trunk. Widespread in tropical and southern Africa.

Fissidentaceae

**Fissidens erosulus* (Müll.Hal.) Paris - 26 (Pócs & Luke 04026/AW: EA, EGR). Terricolous. Rare species known from central to south-eastern Africa.

**Fissidens hoegii* P.de la Varde - 26 (Pócs & Luke 04026/AX: EA, EGR). Terricolous. Rare species known from southern Africa to Tanzania.

**Nanobryum gladiolum* (Mitt.) Bizot. (figure 12–14) (Syn.: *Nanobryum dummeri* Dixon, *Fissidens gladiolus* Mitt., see figures 12–14) - 26 (Pócs & Luke 04026/L: EA, EGR). Terricolous. The classification of this rare species was much discussed by Pursell & Reese (1980), who followed Schultze-Motel (1969) even putting the genus *Nanobryum* Dixon in the separate family of Nanobryaceae, due to its morphology so distinct from *Fissidens*. We agree with the more moderate view of Bizot (1963), Stone (1982) and Goffinet & Buck (2004) who retain the taxon in its separate genus, within Fissidentaceae family. O'Shea (2003) and Bruggeman-Nannenga (2006) treat it, as *Fissidens gladiolus* Mitt. The species was previously known from southern to West and East Africa, northwards only up to Tanzania. In the Chyulu Range it grows together with the previous two Fissidentaceae species.



12 14
 Figures 12–14. The very rare *Nanobryum gladiolum* (Mitt.) Bizot from the shady forest floor (bare soil) of locality 04026. 12. base with persistent protonema and the vaginula surrounded by the costate basal leaves. 13. basal cells of a costate leaf. 14. leaf apex cells.

Funariaceae

Funaria hygrometrica Hedw. - 26 (Pócs & Luke 04026/AR: EA, EGR). On road bank.
Cosmopolitan species.

Hypnaceae

Hypnum cupressiforme Hedw. - 26 (Pócs & Luke 04026/BF: EA, EGR). On bark.
Cosmopolite with montane character in the tropics.

Hypopterygiaceae

Hypopterygium tamarisci (Sw. ex Sw.) Brid. ex Müll.Hal. - 26 (Pócs & Luke 04026/Z: EA, EGR), 31. Ramicolous, on decaying wood. An almost pantropical forest species widespread in tropical and in South Africa.

Meteoriaceae

Aerobryopsis capensis (Müll.Hal.) M.Fleisch. - 27 (Pócs & Luke 04027/D: EA, EGR). On decaying wood. Widespread in the rainforests of tropical and southern Africa.

Papillaria africana (Müll.Hal.) A.Jaeger - 26 (Pócs & Luke 04026/M: EA, EGR).
Ramicolous. Widespread forest species in central, eastern and southern Africa.

Neckeraceae

Neckera remota Bruch & Schimp. ex Müll.Hal. - 26 (Pócs & Luke 04026/AE: EA, EGR), 27. On bark. Forest species distributed in central and in East Africa.

Orthostichella pandurifolia (Müll.Hal.) W.R.Buck (Syn.: *Pilotrichella cuspidata* Broth.) - 27 (Pócs & Luke 04027/C: EA, EGR). Ramicolous. Widespread tropical African forest species.

Orthostichella rigida (Müll.Hal.) B.H.Allen & Magill (Syn.: *Pilotrichella ampullacea* (Müll.Hal.) A.Jaeger (The new synonymy and family placement according to Allen & Magill 2007)) - 26 (Pócs & Luke 04026/AB: EA, EGR), 27, 31. Ramicolous, Corticolous. Widespread Afro-American forest species.

Pinnatella minuta (Mitt.) Broth. - 31 (Pócs & Luke 04031/J, L: EA, EGR). On decaying wood and on *Podocarpus* bark. Widespread in tropical Africa occurring also in southern India (Enroth, 1994).

Orthotrichaceae

**Schlotheimia ferruginea* (Hook & Grev.) Brid. - 25 (Pócs & Luke 04025/L: EA, EGR). On rocks and on Velloziaceae stem. Southeast African species previously known from South Africa to Tanzania.

Pottiaceae

Hyophila involuta (Hook.) A.Jaeger - 29 (Pócs & Luke 04029/G: EA, EGR). Terricolous.
Pantropical, weedy species of shady roadsides, earth banks and artificial substrates.

Syntrichia fragilis (Taylor) Ochyra - 23 (Pócs & Luke 04023/C: EA, EGR), 29, 32.
Corticolous, rupicolous. Pantropical-warm temperate, xerophytic species.

**Tortella* cf. *fragilis* (Hook.f. & Wilson) Limpr. - 27 (Pócs & Luke 04027/F: EGR). On decaying wood. Although reported from several tropical African countries, the occurrence of this boreal species needs further confirmation.

Weissia controversa Hedw. - 29 (Pócs & Luke 04029/K: EA, EGR). Terricolous.
Cosmopolitan species of relatively dry habitats.

**Weissia latiuscula* Müll.Hal. - 29 (Pócs & Luke 04029/O: EA, EGR). Terricolous. A southern African species of arid lands previously known from the Cape to Mpumalanga, Zambia and Zimbabwe.

Pterigynandraceae

Trachyphyllum inflexum (Harv.) A.Gepp in Hiern. - 32 (Pócs & Luke 04032/V: EA, EGR). Rupicolous. Widespread palaeotropic species preferring relatively dry habitats.

Pterobryaceae

**Calyptothecium acutifolium* (Brid.) Broth. var. *acutifolium* - 31 (Pócs & Luke 04031/Z: EA, EGR). Ramicolous. Tropical African forest species with its known northernmost occurrence in Tanzania.

Calyptothecium hoehnelii (Müll.Hal.) Argent - 26 (Pócs & Luke 04026/AT: EA, EGR). Corticolous. Widespread tropical African forest species.

Racopilaceae

Racopilum africanum Mitt. - 23 (Pócs & Luke 04023/B: EA, EGR), 25, 26, 29. On all substrates widespread all over tropical Africa.

Trachypodaceae

Trachypodopsis serrulata (P.Beauv.) M.Fleisch. - 27 (Pócs & Luke 04027/J: EA, EGR). On decaying wood. A pantropical forest species, in the Americas restricted to Mexico and Guatemala (where occurs only the var. *crispatula* (Hook.f.) Zanten: Delgadillo *et al.* 1995).

DISCUSSION

The bryoflora of Chyulu Range, based on the records at hand, is very variable both phytogeographically and ecologically. The proportion of different flora elements (incorporating the previously known five species too) is shown in table 1, compared with that of the Usambara Mountains, based on Pócs (1990).

From the above comparison the main difference of the young volcanic Chyulu Range and the old crystalline Usambara Mountains is very apparent, although they are geographically quite close to each other. The distance in space is hardly 100 km, while the time gap between the development of the two mountain ranges is more than 100 million years! This can be the explanation for the striking differences in the composition of bryofloras: Chyulu Range is very poor in endemics and rich in widespread pantropical and cosmopolitan elements, compared to the Usambaras, member of the Precambrian Crystalline Arc of East Africa. In the latter, the proportion of endemics and the elements related to the ancient land connection with Madagascar is very high. This contrast between the volcanic mountains along the Eastern Rift Valley and the Precambrian crystalline mountains has been demonstrated before (Pócs 1975, 2000). This fact underlines the importance of plate tectonics and old land connections together with the obvious possibility of long range air dispersal within the tropical bryophytes (Zanten & Pócs 1981).

As far as the ecology of the Chyulu bryophytes is concerned, we can see that almost 1/3 of the species are from open, xeric spots and the remainder from shady, moist forest-covered sites. The presence of epiphylls in the montane forest belt compared to extreme arid species,

Table I. The proportion of different bryoflora elements of Chyulu Range compared with that of the Usambara Mountains in north-eastern Tanzania.

	Endemic, +subend.	East African	Southeast African	Southern African	Lemurian (Ind.Ocean)	Afro- montane	Tropical African	Palaeo- tropic	Afro- American	Pan- tropical	Tempe- rate	Cosmo- politan
Chyulu Range	1.20	2.38%	9.20%	4.76%	-	4.76%	28.57%	4.76%	5.95%	26.19%	2.38%	9.20%
Usambara Mountains	8.91%	16.38%	4.53%	0.65%	14.87%	10.34%	20.2/%	6.47%	5.39%	5.82%	2.68%	2.80%

shows the great contrast between the different habitats. The richness of xeric habitats is also reflected in the relatively high proportion of southern African species, compared to the Usambaras.

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