Two Species of *Cheilolejeunea* (Family Lejeuneaceae) Newly Recorded to Taiwan

臺灣產唇鱗蘚屬(細鱗蘚科)2 個新紀錄種

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Abstract

Eleven species of the genus *Cheilolejeunea* (Lejeuneaceae) have been reported from Taiwan. This paper describes and illustrates *C. khasiana* and *C. obtusifolia* as two new records of the island, and provides with information on their habitats and distribution, and a key to the species of *Cheilolejeunea* in Taiwan for identification.

摘　要

唇鱗蘚屬隸屬於細鱗蘚科，臺灣本屬原記載有 11 種。本文增加 2 個新紀錄種，克詼西亞唇鱗蘚(新擬中名)及鈍葉唇鱗蘚，文中附有此 2 種新紀錄種之形態描述、圖片及棲地與分布等資料，以及臺灣產本屬物種之檢索表。

Key words: *Cheilolejeunea*, *C. khasiana*, *C. obtusifolia*, liverworts, Taiwan

關鍵詞：唇鱗蘚屬、克詼西亞唇鱗蘚、鈍葉唇鱗蘚、蘚類、臺灣

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Introduction

The genus *Cheilolejeunea* is comprised of 70–80 species, a large pantropical genus of the family Lejeuneaceae (Zhu *et al*. 2002; Gradstein and Costa 2003). It is characterized by having (1) bilobed underleaves with rarely entire or very shallowly emarginated at apex, (2) leaf lobule usually with an obsolete first tooth and a distinct second tooth with a hyaline papilla at the distal side, and (3) leaf cell with large, sausage-shaped and coarsely segmented oil bodies, 1–3 (–6) per cell. *Cheilolejeunea* is closely related to *Leucolejeunea* but distinguishable by having entire underleaves (Yang 2009). The divided underleaf as the sole generic delimitation character has long been questioned (Ye and Zhu 2010). Malombe (2009) in his study of African *Cheilolejeunea* considered that *Leucolejeunea* synonymous to *Cheilolejeunea* based on morphological characters and molecular evidence. Ye and Zhu (2010) treated *Leucolejeunea* as a new synonym of *Cheilolejeunea* formally.

There are 11 speceis of *Cheilolejeunea* (= *Leucolejeunea*) that have been reported from Taiwan. They are *C. ceylanica* (Gottsche) R. M. Schust. and Kachroo, *C. chenii* R.L. Zhu and M.L. So, *C. eximia* (Ast and Tixier) R.L. Zhu and M.L. So, *C. falsinervis* (Sande Lac.) Kachroo and R.M. Schust., *C. intertexta* (Lindenb.) Steph., *C. Obtusilobula* (S.Hatt.) S.Hatt., *C. kitagawae* W. Ye and R.L. Zhu (*Leucolejeunea paroica*), *C. trapezia* (Nees) Kachroo and R.M. Schust. (*C. imbricata*), *C. trifaria* (Reinw. *et al.*) Mizut., *C. turgida* (Mitt.) W.Ye and R.L. Zhu (*L. turgida*), and *C. xanthocarpa* (Lehm. & Lindenb.) Malombe (*L. xanthocarpa*) (Piippo 1990; Lin 2000; Zhu and So 2001; Malombe 2009; Yang 2009; Ye and Zhu 2010; Wang *et al.* 2011).

In our recent plant inventory survey of Taiwan, we collected *C. khasiana* (Mitt.) N.Kitag. and *C. obtusifolia* (Steph.) Hatt., two newly recorded species of *Cheilolejeunea*. This paper briefly describes their characters with illustrations and provides information on their habitats and distribution, and also a key to the species of *Cheilolejeunea* in Taiwan for identification. The voucher specimens are deposited at the Herbarium of Endemic Species Research Institute (**TAIE**).

Taxonomic Treatment

Cheilolejeunea (Spruce) Schiffn. in Engler and Prantl, Nat. Pflanzenfam. 1, 3: 118, 124. 1893 (= *Leucolejeunea* A.Evans, Torreya 7: 225. 1907). 唇鱗蘚屬

Key to the Species of *Cheilolejeunea* in Taiwan (Yang 2009, modified)

1. Ocelli present, in 1 or 2 rows like the vitta reaching near the apex of leaf lobe..... *C. falsinervis*
1. Ocelli absent.
   2. Underleaves with entire or very shortly bifid to shallowly emarginated apex.
      3. Second tooth of leaf-lobule unicellular; underleaves with very shortly bifid to shallowly emarginated at apex…….. *C. chenii*
      3. Second tooth of leaf-lobule 1–4-celled; underleaves entire.
         4. Plant autoicous or paroicous; apex of leaf lobe and ventral margins strongly involute to plane; leaves not falcate.
            5. Apex and ventral margins of leaf lobe plane to slightly involute; oil-bodies 2-3 per cell; trigones of leaf cells large; male inflorescence usually just below female inflorescence..... *C. kitagawae*
            5. Apex and ventral margins of leaf lobe strongly involute; oil-bodies typically one per cell; trigones of leaf cells small or indistinct; male inflorescence usually on a lateral branch..... .....*C. xanthocarpa*
         4. Plant dioicous; apex of leaf lobe incurved and ventral margins plane; leaves falcate.....*C. turgida*
   2. Underleaves bilobed.
      6. Leaf lobule about 1/3 of the length of leaf lobe.
         7. Leaf lobe ovate or oblong; apex obtuse or acute..... *C. khasiana*
         7. Leaf lobe orbicular, apex rounded.
            8. Underleaves ca. 5 times as wide as the stem..... *C. trifaria*
            8. Underleaves ca. 3 times as wide as the stem..... *C. intertexta*
      6. Leaf lobule 1/2–2/3 as long as leaf lobe.
         9. Free lateral margin of leaf lobule strongly inrolled; its apex attached to the leaf lobe by 3–8 cells .....*C. eximia*
         9. Free lateral margin of leaf lobule not or slightly inrolled; its apex attached to the leaf lobe by a single cell.
            10. Plants small, with leaves less than 0.6 mm wide; the second tooth of leaf lobule unicellular, its length 3–6 times as long as width.....*C. obtusifolia*
            10. Plants large, with leaves wider than 1 mm; the second tooth of leaf lobule 1–6-celled, its length 1–2 times as long as width.
               11. Leaf lobule length almost as long as its width when flat; second tooth of leaf lobule indistinct ..... *C. obtusilobula*

11. Leaf lobule length over twice of its width when flat; second tooth of leaf lobule distinct.
    12. Leaf lobes with vitta-like elongated cells; second tooth usually with 5–6 cells.....
    .....*C. ceylanica*
    12. Leaf lobes vitta never developed; second tooth usually with less than 4 cells.....
    .....*C. trapezia*

Cheilolejeunea khasiana (Mitt.) N.Kitag., Hikobia suppl. 1: 68. 1981.

Cheilolejeunea giraldiana (Mass.) Mizut., J. Hattori Bot. Lab. 27: 141.1964.

Cheilolejeunea ontakensis (Steph.) S.Hatt., Misc. Bryol. Lichenol. 1 (14): 1. 1957.

Strepsilejeunea gomphocalyx Herz. in Handel-Mazzetti, Symb. Sin. 5: 47. 1930.

克詼西亞唇鱗蘚 Figs.1 & 3a–b

Description: Plants small, pale green to yellowish green in color when fresh, brown or brownish yellow when dried. Stems up to 15 mm long, 49–100 μm in diameter, with leaves 0.59 –1.0 mm wide, irregularly branched; ventral merophyte of the stem 2 cells wide; cross-section of the stem consisting of 7 epidermal cells and 10–12 much smaller medullary cells. Leaf-lobes imbricate, obliquely spreading, ovate to oblong-ovate, 0.34–0.46 mm long, 0.27–0.34 mm wide, apex obtuse to acute, incurved; margin entire. Cells of leaf lobes thinly walled, trigones small to large and intermediate thickening absent; marginal cells 11–14 × 11–15 μm, median cells 17–22 × 15–18 μm, basal cells ca. 37 × 23 μm. Cuticle smooth or slightly mammillose. Oil-bodies up to 6 per cell, oblong to orbicular, granular, coarsely segmented. Leaf lobule ovate, 1/3–2/5 as long as the lobe, inflated; free margin slightly incurved; apex constricted; the first tooth indistinct; the second tooth unicellular with hyaline papilla at the distal side; keel arched. Underleaves distant to slightly imbricate, 2–3 times as wide as the stem, 0.11–0.18 mm long, 0.16–0.21 mm wide, bilobed to 1/4–1/3 of the underleaf length, transversely to subtransversely inserted. Autoicous. Androecium usually on lateral short branches; bracts 1–5 pairs, closely imbricate; bracteole restricted to the base. Gynoecium usually terminal on long branches, with 1 subfloral innovation or lacking; bract lobes oblong, ca. 0.6 mm long, 0.3 mm wide, with acute apex and entire margin; bract lobule sublinear, ca. 1/3–1/2 as long as bract lobe; bracteole oblong to ovate, ca. 0.4 mm long and 0.3 mm wide, with entire margin. Perianth obovate, inflated, with 4–5 smooth keels. Vegetative reproduction not seen.

Habitat: *C. khasiana* is usually found on tree trunks, tree branches and rocks, occasionally on leaves, and rarely on soil. In China it is distributed in the southwest region at elevations of 700–3,200 m (Zhu *et al.* 2002). In Japan, it is distributed from Hokkaido to Kyushu at elevations of 120–1,400 m (Mizutani 1982). In Taiwan, the specimens were collected from the

Central Mountain Range at 2,300–2,800 m in elevations.

Distribution: Bhutan, China, India, Japan, Nepal, and the Philippines (Kitagawa 1981; Mizutani 1964, 1982; So and Zhu 1996b; Zhu *et al.* 2002). New to Taiwan.

Specimens examined :

Nantou County: Renai, Nengao Cross-Ridge Historic Trail, between 14 km–15 km, near the Guang-bei-ba-biao Monument. In the Yushania bamboo grassland, on the wall of rock-slab just beside the trail in filtered light, mixed with *Frullania* sp., and *Lopholejeunea nigricans*, at an elevation of 2,800 m, 121°16'47" E, 24°01'53"N; December 29, 2006, *J.-D. Yang 3281a* (**TAIE**).

Hualian County: Sioulin, 820 Forest Trail, on wet tree trunk in partial shade, mixed with *Cololejeunea longifolia*, *C. pseudofloccosa*, *Frullania* sp., *Drepanolejeunea vesiculosa*, *Lejeunea japonica*, *Mastigolejeunea auriculata*, and *Ptychanthus striatus*, at an elevation of ca. 2,500 m, 121°18'30"E, 24°10'58"N; August 16, 2007, *J. -D. Yang 4104g* (**TAIE**).

Chiayi County: Mt. Ali, Alishan Railroad Mian-yue branch 6.5 km, on the wall of seeping rock-slab just beside the trail and without any shade, mixed with *Radula* sp., at an elevation of 2,350 m, 120°47'44"E, 23°32'07"N; August 28, 2008, *J. -D. Yang 5409b* (**TAIE**). Mt. Ali, Alishan, Giant Trees Trail, on the leaves of *Cryptomeria japonica* (L.f.) D.Don, mixed with *Cololejeunea grossepapillosa*, *C. longifolia*, *C. macounii*, *C. ocellata*, *C. ocelloides*, *C. peraffinis*, *C. planissima*, *C. pseudofloccosa*, *Colura tennuicornis*, *Drepanolejeunea angustifolia*, *D. erecta*, *Frullania* sp., *Lejeunea flava*, *Leptolejeunea elliptica*, and *Mastigolejeunea auriculata*, at an elevation of 2,320 m, 120°48' 26"E, 23°31'05"N; March 12, 2008, *J.-D. Yang 4942q* (**TAIE**). Mt. Ali, Alishan Railroad Jhu-shan branch, near the Jhu-shan Station, at the base of trees beside the trail and exposing to filtered light, mixed with *Frullania* sp. and *Lejeunea flava*, at an elevation of 2,450 m, 120° 49'24"E, 23°30'35"N; April 17, 2008**,** *J. -D. Yang 5010b* (**TAIE**).

Remarks: *C. khasiana* is distinguishable from other species of *Cheilolejeunea* in Taiwan by having 1) an obtuse to acute, incurved apex of leaf lobe, 2) a small leaf lobule with constricted apex and an unicellular apical tooth, 3) smooth or slightly mammillose cuticle of leaf cells, and 4) the bracteole of androecium restricted to the base. It is closely related to *C. osumiensis* (Hatt.) Mizut. of China and Japan (Inoue 1976; Mizutani 1980, 1982; Zhu and So 2001; Zhu *et al.* 2002). However, *C. osumiensis* differs from *C. khasiana* by the presence of male bracteoles throughout the androecium, and having oil bodies usually only one per leaf cell (Mizutani 1980,1982; So and Zhu 1996a; Zhu and So 2001; Zhu *et al.* 2002).

Cheilolejeunea obtusifolia (Steph.) S.Hatt., Misc. Bryol. Lichenol. 1 (14): 1. 1957.

Harpalejeunea obtusifolia Steph., Spec. Hepat. 5: 265.1913.

Euosmolejeunea obtusifolia (Steph.) Hatt., Journ. Hattori Bot. Lab. 5: 85. 1951.

鈍葉唇鱗蘚 Figs. 2 and 3c–d

Description: Plants minute, pale green or yellowish green to olive green in color when fresh, light brown to brown when dried. Stems up to 12 mm long, 47–70 μm in diameter, with leaves 0.47 –0.59 mm wide, irregularly branched; ventral merophyte of the stem 2-celled wide; cross-section of the stem consisting of 7 epidermal cells and 6–7 smaller medullary cells. Leaves imbricate, obliquely spreading, squarrose when moist; lobes obliquely ovate, 0.28–0.33 mm long, 0.21–0.29 mm wide; apex rounded or sometimes obtuse, slightly incurved, margin entire. Cells of leaf lobes thinly walled; trigones large and intermediate thickenings absent; marginal cells 11–14 × 7–10 μm, median cells 16–23 × 12–14 μm; and basal cells 20–30 ×10–14 μm. Cuticle smooth. Oil-bodies 2–5 per cell, oblong to orbicular, granular. Leaf lobules obliquely ovate; the length 1/2–3/5 as long as the lobe, inflated; free lateral margin bordered with elongated rectangular cells; apex constricted, ring-like, with the first tooth indistinct and the second tooth unicellular, elongated, 3–6 times as long as wide, with hyaline papilla at the distal side of second tooth; keel arched. Underleaves distant, the length 2–3 times as wide as the stem, 0.14–0.17 mm long, 0.11–0.13 mm wide, bilobed to 1/3–1/2 of the underleaf length, transversely inserted. Androecia and gynoecia absent.

Habitat: *C. obtusifolia* is an epiphyte. In Japan, it grows on bark of trees and rocks, often creeping on large mosses in the deciduous forests from Hokkaido to southernmost Japan at elevations less than 1,800 m (Mizutani 1961,1982). In China, it is found on wet rocks, soils, and decaying logs in evergreen broad-leaved forests and needle-broad-leaved mixed forest of Fujian and Zhejiang at elevations of 670 to 1,430 m (So and Zhu 1996b ; Zhu *et al.* 2002). In Taiwan, the specimens were collected from the conifer forests of Central Taiwan at 2,350–2,480 m in elevations.

Distribution: China, India, Japan, Korea and Nepal (Mizutani 1961,1982; Hattori *et al.* 1962; So and Zhu 1996b; Zhu *et al.* 2002). New to Taiwan.

Specimens examined :

Nantou County: Renai, Nengao Cross-Ridge Historic Trail, on the bark of tree trunk of *Pinus taiwanensis* Hayata, mixed with *Cololejeunea grossepapillosa, C. macounii, C. ocellata, Drepanolejeunea angustifolia, D. vesiculosa, Frullania moniliata, Lejeunea ulicina, Nipponolejeunea pilifera,* and *Radula cavifolia,* at an elevation of 2,480 m, 121°14'39"E, 24°03' 15"N; December 28, 2006, *J.-D. Yang 3242d* (**TAIE**).

Chiayi County: Mt. Ali, Alishan Railroad at 6.5 km on Mian-yue Branch, on the wall of seeping rock-slab just beside the trail and exposing to the full sun, mixed with *Herbetus aduncus* and *Scapania* sp., at an elevation of 2,350 m, 120°47'44"E, 23°32'07"N; August 28,

2008, *J. -D. Yang 5410b* (**TAIE**).

Remarks: *Cheilolejeunea obtusifolia* is easily distinguishable from all other congeners by having 1) the unicellular, strongly elongated second tooth, 2) the constricted, ring-like apical portion of the leaf lobule, and 3) obliquely ovate leaf-lobes that are squarrose when moist. According to So and Zhu (1996b), the collection from the Wuyanling Nature Reserve , China (118°52'E, 27°41'N) was considered as the southernmost range of *C. obtusifolia*. The finding of this species at Mt. Ali in Chiayi County, Taiwan (120°47'44" E, 23°32'07"N) represents an extension of its southward range of the distribution.

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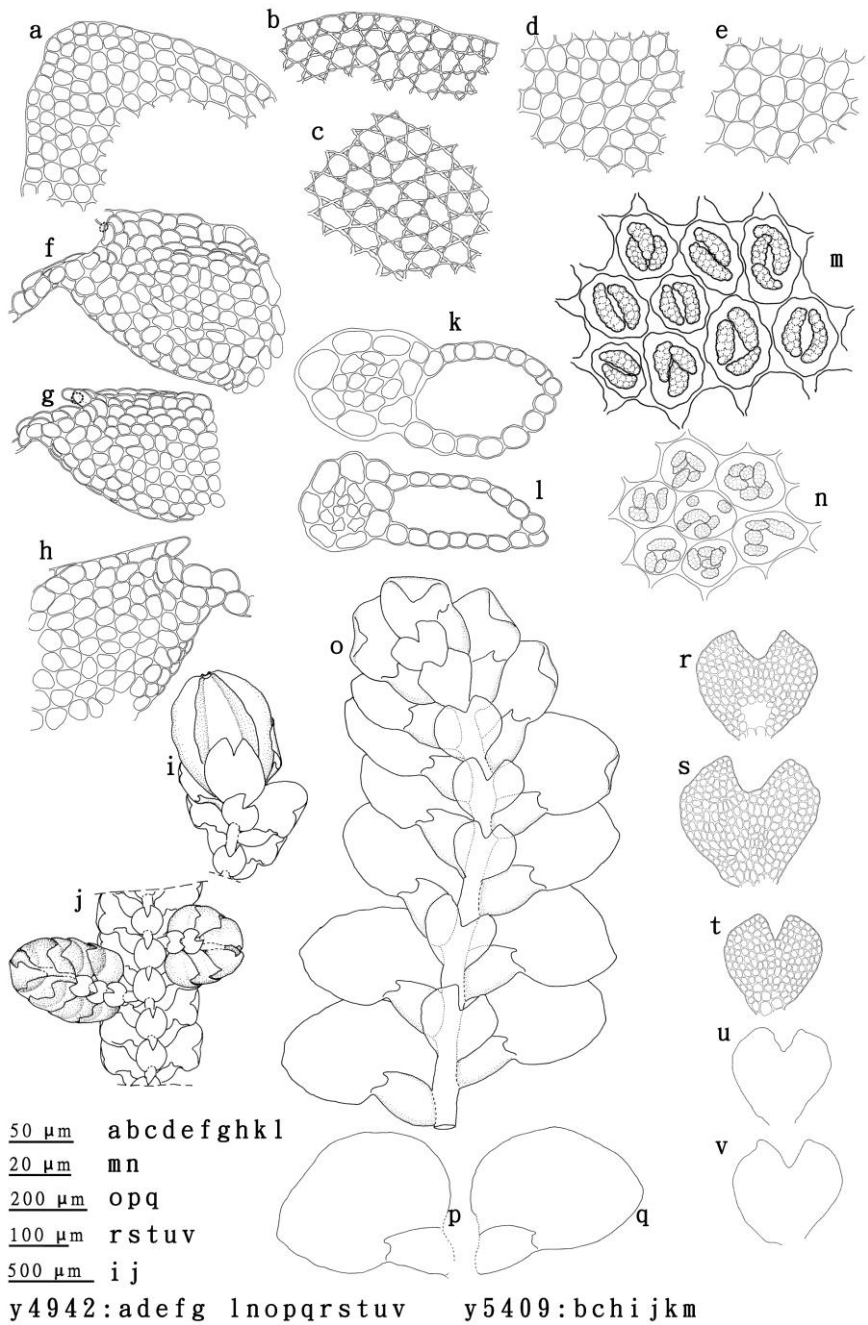


Fig. 1. *Cheilolejeunea khasiana* (Mitt.) N.Kitag.(a, cells near the leaf apex; b, marginal cells of leaf lobe; c and d, median cells of leaf lobe; e, cells near the leaf base; f–h, leaf-lobules; i, female branch and perianth; j, ventral view of male branches; k and l, cross-sections of stems; m, cells near the leaf base with oil-bodies; n, median cells of leaf lobe with oil-bodies; o, ventral view of a portion of sterile plant; p and q, ventral view of leaves; r–v, underleaves).

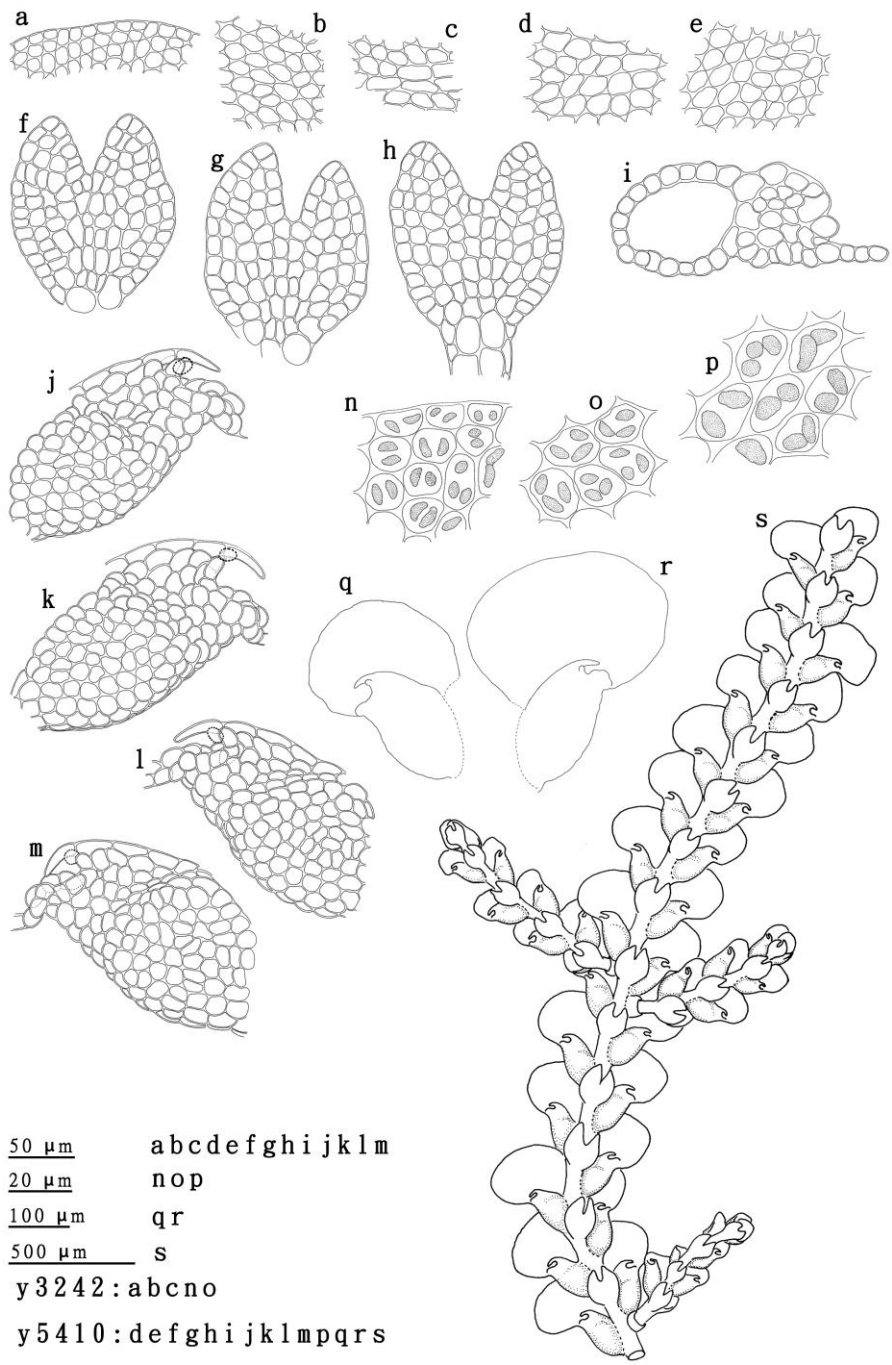
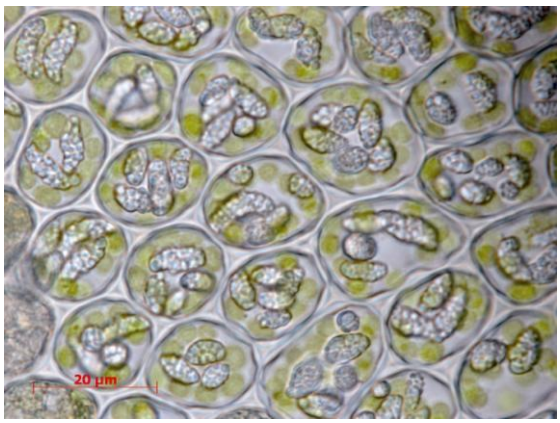


Fig. 2. *Cheilolejeunea obtusifolia* (Steph.) S.Hatt. (a, marginal cells of leaf lobe; b and e, median cells of leaf lobe; c and d, cells near the leaf base; f–h, underleaves; i, cross-section of stem; j–m, leaf-lobules; n, marginal cells of leaf lobe with oil-bodies; o, median cells of leaf lobe with oil-bodies; p, cells near the leaf base with oil-bodies; q and r, ventral view of leaves; s, ventral view of a portion of sterile plant).



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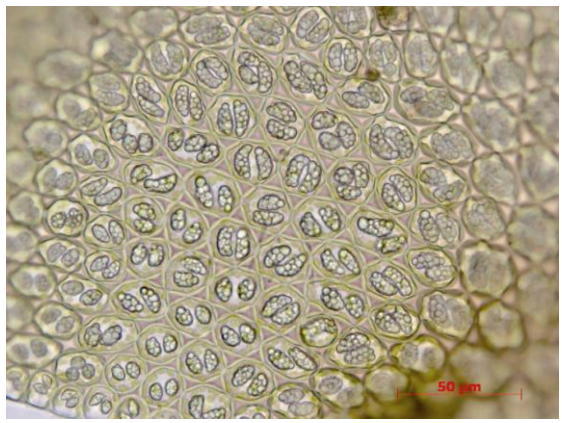

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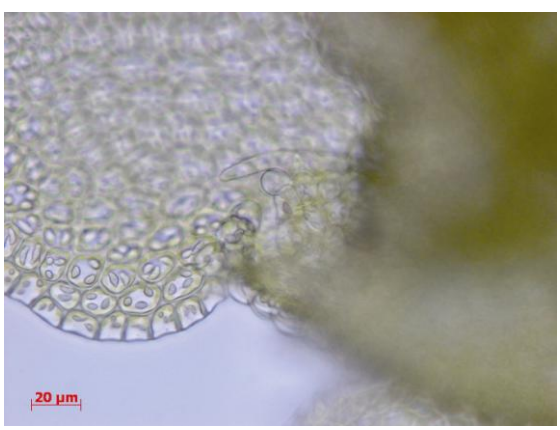

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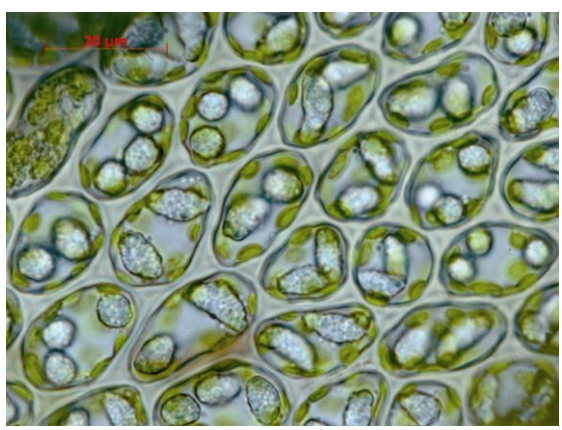

d

Fig. 3. Cells near the leaf base with oil bodies (a) and marginal and median cells of leaf lobe with oil bodies (b) of *Cheilolejeunea khasiana* (Mitt.) N.Kitag.; the unicellular, elongated second tooth of leaf lobule with the hyaline papilla at its distal side (c) and cells near the leaf base with oil bodies (d) of *Cheilolejeunea obtusifolia* (Steph.) S.Hatt.