

# Additions and correction for Chinese Lejeuneaceae (Hepaticae)

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**Abstract.** *Cheilolejeunea mariana* (Gottsche) B. Thiers & Gradst. is excluded from China. *Taxilejeunea crassiretis* Herzog, which was known only from the type locality (Yunnan, China), is proposed as a synonym of *Lejeunea flava* (Sw.) Nees. *Cololejeunea rotundilobula* (P. C. Wu & P. J. Lin) Piippo is newly reported for Taiwan. *Cololejeunea indosinica* Tixier, *C. mackeeana* Tixier, and *Lopholejeunea sikkimensis* Steph. are new to China. The former two were found in Hainan and Taiwan respectively, the latter in Yunnan. Illustrations of *C. mariana*, *L. flava*, and *Lopholejeunea javanica* (Nees) Schiffn. are provided. A lectotype for *Physocolea crenulata* Herzog was designated.

**Keywords:** *Cheilolejeunea mariana*; China; *Cololejeunea indosinica*; *Cololejeunea mackeeana*; *Cololejeunea rotundilobula*; *Lejeunea flava*; *Lopholejeunea javanica*; *L. sikkimensis*; *Taxilejeunea crassiretis*; Taiwan.

## Introduction

Lejeuneaceae is the largest family of Hepaticae in China. He (1997) listed 190 species of 37 genera. The family is still poorly known, and has not been monographed. The present paper aims to provide new information on Chinese Lejeuneaceae. *Cheilolejeunea mariana* (Gottsche) B. Thiers & Gradst. was reported as *Archilejeunea mariana* (Gottsche) Steph. for Taiwan (Herzog and Noguchi, 1955), Zhejiang (Liu, 1985), and Anhui (Guo et al., 1988). Our studies show *C. mariana* has to be excluded from China, because these records were based on erroneous identifications. *Lopholejeunea sikkimensis* Steph. was previously known from Bhutan, India, and Nepal. It is here reported for the first time for China. *Taxilejeunea crassiretis* Herzog was originally described by Herzog (1930), based on a collection of Handel-Mazzetti from Yunnan. Our recent studies on the type specimens of *Taxilejeunea crassiretis* revealed that it is conspecific with *Lejeunea flava* (Sw.) Nees.

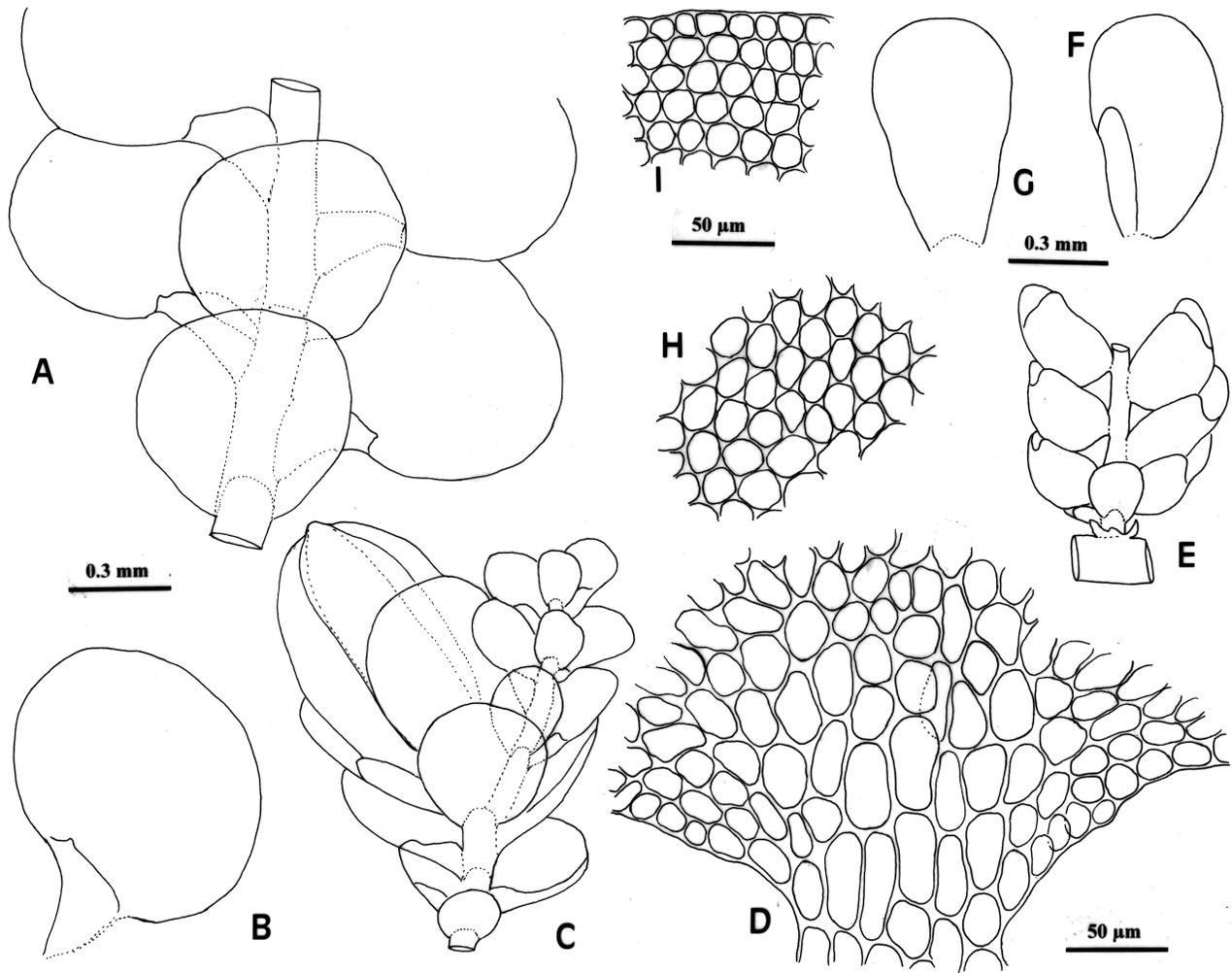
*Cololejeunea* is a large genus with 67 species and varieties in China, of which 32 species occur in Taiwan (Zhu and So, 1998a,b, 1999). During our examination of Chinese specimens from Hainan and Taiwan, we have found three *Cololejeunea* species new to China and Taiwan. *Cololejeunea mackeeana* Tixier, a species known previously from Indonesia, Malaysia, New Caledonia, Papua New Guinea, and the Philippines, is newly found in Taiwan; *C. indosinica* Tixier, known previously from Kampuchea and Vietnam, is now found in Hainan; and *C. rotundilobula* (P. C. Wu & P. J. Lin) Piippo, known previously from mainland China, is now found in Taiwan.

***Cheilolejeunea mariana*** (Gottsche) B. Thiers & Gradst., Mem. New York Bot. Gard. 52: 75. 1989. *Lejeunea mariana* Gottsche, Syn. Hepat. 337. 1845. *Archilejeunea mariana* (Gottsche) Steph., Spec. Hepat. 4: 729. 1911.—TYPE: CAROLINE IS. “Marianen”, *Mertens s.n.* (holotype: B [destroyed, fide Thiers and Gradstein, 1989]; isotypes: BM, FH!, G, W). Figure 1

Thiers and Gradstein (1989) studied the type of *Lejeunea mariana* and found that the species has a narrow stem, a marginal hyaline papilla, and male bracteoles borne only in the basal portion of the androecium. Therefore they assigned the species to the genus *Cheilolejeunea*, based on the hyaline papilla distal to the blunt proximal tooth of the leaf lobule, and the lejeuneoid gynoeceal innovation. Herzog and Noguchi (1955), Liu (1985), and Guo et al. (1988) reported *Archilejeunea mariana* from Taiwan, Zhejiang and Anhui, respectively. Liu et al. (1993) and He (1997) followed Thiers and Gradstein's (1989) placement. The former gave its range in Anhui, Jiangxi, and Zhejiang, whereas the latter listed it only in Taiwan. According to our studies on the voucher specimens from the herbaria HSNU, JE, W, and WU, all previous records of *A. mariana* or *C. mariana* from China were based on erroneous identifications. The Taiwan specimen actually is assignable to *Lopholejeunea javanica* (see under *L. javanica*), as shown in Figure 3. The voucher specimens from Anhui, Jiangxi, and Zhejiang actually are assignable to *Archilejeunea amakawana* H. Inoue. Because none of the specimens include *Cheilolejeunea mariana*, it has to be excluded from China.

Thiers and Gradstein (1989) provided a synopsis of the key features of *Cheilolejeunea mariana*. Unfortunately no illustration is available except for Stephani's Icones Inedit. We examined the isotype of *Lejeunea mariana* in FH, which contains only an autoicous fragment with a

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**Figure 1.** *Cheilolejeunea mariana* (Gottsche) B. Thiers & Gradst. A, Portion of plant, ventral view; B, Leaf, ventral view; C, Portion of plant with an atypical gynoecial innovation (innovation leaf sequence lejeuneoid); D, Base of underleaf, ventral view; E, Androecium, ventral view; F, Female bract, ventral view; G, Female bracteole; H, Median cells of leaf lobe; I, Marginal cells of leaf lobe. All drawn from *Mertens s.n.* (isotype of *Lejeunea mariana*, FH).

single androecium and two gynoecia. The diagnostic characters are illustrated in Figure 1, based on this isotype.

As mentioned by Thiers and Gradstein (1989) and Gradstein (1991), *Cheilolejeunea mariana* had often been confused with *Archilejeunea planiuscula* (Mitt.) Steph. The latter, however, is immediately separated by obcordate underleaves with an almost straight transverse insertion, 6- to 8-cell-wide ventral merophytes of stem, and male bracteoles present throughout the androecium.

*Cheilolejeunea mariana* is characterized and easily separated from other members of *Cheilolejeunea* by entire underleaves inserted across four stem cells, autoicous sexuality, relatively robust stem, large underleaves with a strongly arched insertion, and very large trigones.

*Representative Chinese specimens reported as Archilejeunea mariana or Cheilolejeunea mariana.* **CHINA.** ANHUI: Guniujiang Nature Reserve, on tree trunks, 760 m, 4 Nov 1983, *Guo 830770* (HSNU). JIANGXI: Sanqingshan, between Fengmen and Jinsha, on tree

trunks, 1,060 m, 16 May 1988, *Shao 1336* (HSNU). ZHEJIANG: Jiulongshan, Yangmaoyuanao, 1,200 m, on soil, 12 Oct 1981, *Liu 1565* (HSNU). Taiwan specimen is given under *Lopholejeunea javanica*.

*Habitat and distribution.* No habitat information was available from the type material of *Lejeunea mariana*. *Cheilolejeunea mariana* has been previously reported as *Spruceanthus marianus* and *Archilejeunea mariana* from Africa, Asia, and Oceania (Grolle and Piippo, 1984; Joshi et al., 1992; Miller, 1968; Mizutani, 1978a,b; Verdoorn, 1934). The species strongly needs further revision to clarify its range, because it has been confused with *A. planiuscula*, a widespread species in the Indopacific regions. *Cheilolejeunea mariana* was excluded from Africa by Grolle (1995), from Australia by Thiers and Gradstein (1989), and from Japan by Furuki and Mizutani (1994). The illustrations given by Miller et al. (1963), Amakawa (1964), and Miller (1968) as *A. mariana*, all belong to *A. planiuscula*.

**Cololejeunea mackeeana** Tixier, Bot. Not. 128: 426. 1975. —TYPE: NEW CALEDONIA. “Nouvelle Calédonie. Forêt de montagne sur terrain serpentineux, épiphyllé sur *Rapanea*, 900 m, 15 May 1975, *Mc Kee 30117*” (holotype: PC).

*Physocolea crenulata* Herzog in Mitt. Inst. Allg. Bot. Hamburg 7: 215. 1931. ≡ *Cololejeunea crenulata* (Herzog) Benedix, Feddes Rept. Beih. 134: 15. 1953 (*nom. inval.*, cf. Tan and Engel, 1986). ≡ *Cololejeunea crenulata* (Herzog) J. J. Engel & B. C. Tan, J. Hattori Bot. Lab. 60: 333. 1986 (*non Cololejeunea crenulata* (Pearson) H. A. Mill. in Phytologia 47: 321. 1981). —TYPE: MALAYSIA. “West-Borneo. Auf dem Bukit Mehipit, um 500 m, *Winkler 3131* p.p. (lectotype, designated here: JE!).

For description and illustration, see Herzog (1931, as *Physocolea crenulata*), Tixier (1975), Tixier (1985, as *Cololejeunea crenulata*), and Pócs et al. (1994).

*Cololejeunea mackeeana* is easily separated from the other Chinese species of this genus by its long ovate leaves usually with an acute apex, usually strongly inrolled free lateral margin of leaf lobule, crenulate margin of leaf lobe, ovate leaf lobules with (1-) 2 cells long first tooth, discoid gemmae originating from dorsal surface of leaf lobe, and distinct trigones of leaf cells.

The protologue of *Physocolea crenulata* Herzog contains two syntypes: *H. Winkler 3360* p.p. and *H. Winkler 3131* p.p. The latter contains androecia and gynoecia as well as relatively rich material. Therefore, it was chosen as lectotype.

*Specimen examined.* TAIWAN. TAITO: Shinsuiei-Shuchokyokai, 3 Jan 1933, *Horikawa 10767* (HIRO, mixed with *Drepanolejeunea grossidentata* Horik.).

*Habitat and distribution.* In Taiwan, *Cololejeunea mackeeana* grows on leaves of shrubs, associated with *Drepanolejeunea dactylophora* (Nees et al.) Schiffn., *Cololejeunea dozyana* (Sande Lac.) Schiffn., *C. ocellata* (Horik.) Benedix, *Rhaphidolejeunea* sp. etc. Now *C. mackeeana* is known from Indonesia (Mizutani, 1986 as *Cololejeunea crenulata*), Malaysia (Mizutani, 1966 as *C. crenulata*), New Caledonia, Papua New Guinea (Pócs et al., 1994), the Philippines (Mizutani, 1975 as *C. crenulata*), and Taiwan, which is the northernmost known locality of the species.

**Cololejeunea indosinica** Tixier in Bryoph. Biblioth. 27: 63. 1985. —TYPE: VIETNAM. “Tuyên Duc, forêt de Manline, épiphyllé en forêt, 1,400 m, 10 Oct 1957, *Tixier 2666* (holotype: PC).

For description and illustration, see Tixier (1985).

The distinctive features of *Cololejeunea indosinica* are (1) oblong leaf lobule ca. ½ as long as the leaf lobe, (2) 2-cell-wide ventral merophytes of stem, (3) autoicous sexuality, (4) oblong female bract lobules without lobular teeth, (5) very short second tooth of leaf lobule, (6) unicellular stylus, and (7) hyaline marginal cells not developed at ventral and dorsal basal margins of the leaf lobe.

*Cololejeunea indosinica* may be confused with *C. planissima* (Mitt.) Abeyw., which differs in its variable leaf lobule which is ovate, triangular or ligulate, and ca. 1/3 as long as the leaf lobe.

*Specimen examined.* CHINA. HAINAN: Bawangling Nature Reserve, 1,100 m, *Zhu 89304* (HSNU).

*Habitat and distribution.* In China *Cololejeunea indosinica* grows on ferns at ca. 1,100 m. The known range includes China (Hainan), Kampuchea, and Vietnam (Tixier, 1985).

**Cololejeunea rotundilobula** (P. C. Wu & P. J. Lin) Piippo, J. Hattori Bot. Lab. 68: 134. 1990. *Pedinolejeunea rotundilobula* P. C. Wu & P. J. Lin, Acta Phytotax. Sin. 16: 69. 1978. —TYPE: CHINA. HAINAN: Jianfengling, Tianchilinchang, 1,150 m, on the leaves of *Symplocos viridissima* Brand, 6 Feb 1962, *Chen et al. 456* (holotype: IBSC!; isotype: HSNU!).

For description and illustration, see Wu and Lin (1978).

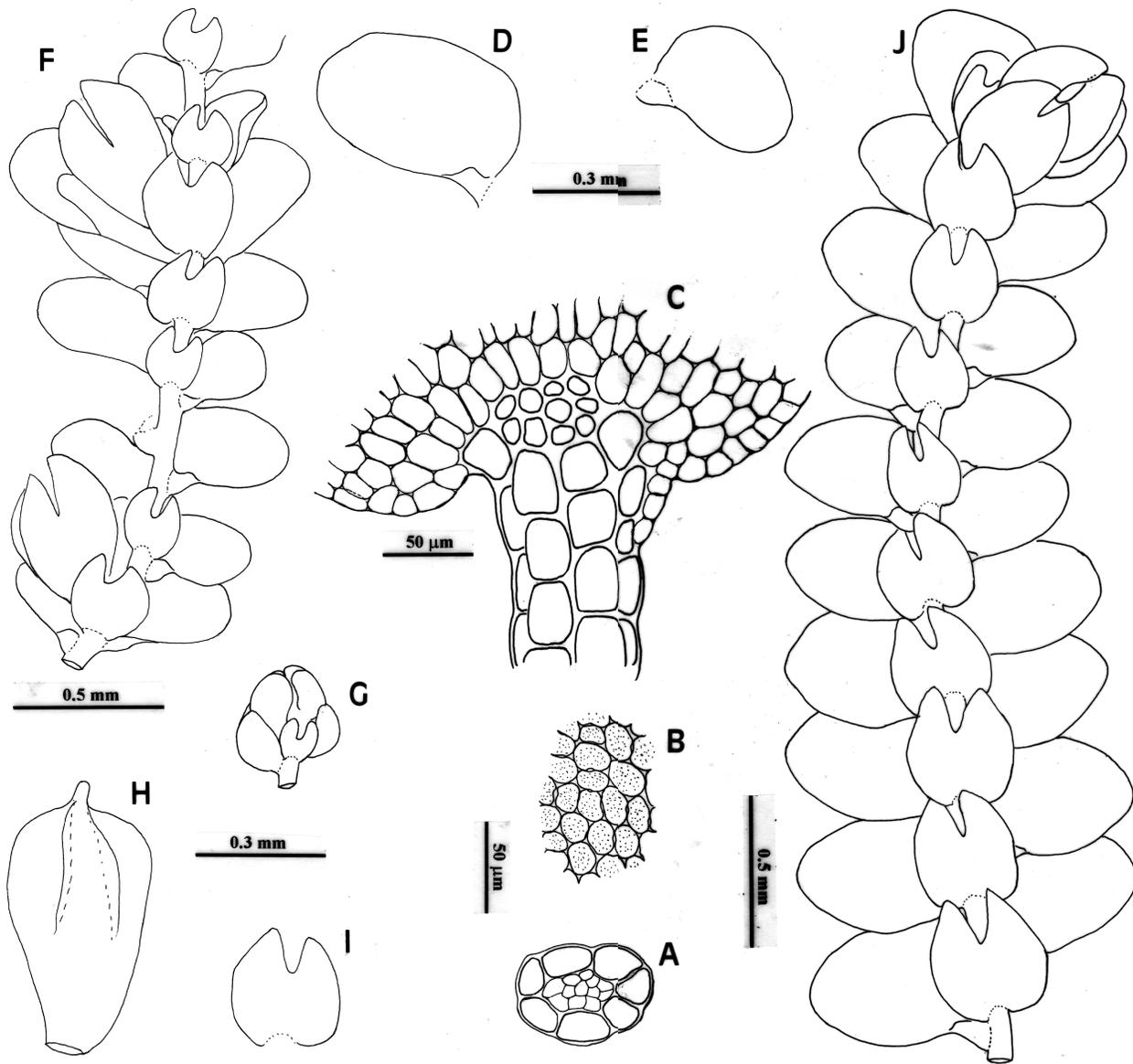
*Cololejeunea rotundilobula* is characterized by sigmoid marginal cells of the leaf lobe, suborbicular leaf lobule with two lobular teeth (sometimes leaf lobule strongly reduced), asymmetric, broadly ovate leaves with strongly arched dorsal margin, and more or less rotundate basal appendage of the leaf lobe. It is very closely related to *C. sigmoidea* Ast & Tixier, which is known from India, Indonesia, Japan (Ryukyu), Kampuchea, Malaysia, Taiwan, Thailand, and Vietnam (Zhu and So, 1998a). However, the latter differs in its nearly symmetric leaves and unicellular leaf lobules.

*Specimens examined.* CHINA. GUANGDONG: Babaoshan Nature Reserve, 1,260 m, 11 Dec 1989, *Zhu 89031* (HSNU). HAINAN: Wuzhishan, 1,400 m, 15 Nov 1977, *Li 05490* (HSNU, SHM). YUNNAN: Daweishan Nature Reserve, 1,800 m, Nov 1988, *Zhu 88050* (HSNU). TAIWAN. TAITUNG (“TAITO”): Shinsuiei-Shuchokyokai, 3 Jan 1933, *Horikawa 10733* (HIRO, mixed with *Cololejeunea ocelloides*).

*Habitat and distribution.* *Cololejeunea rotundilobula* is epiphyllous. It is known from Guangdong, Hainan, Taiwan, and Yunnan (Zhu and Wang, 1992; Zhu et al., 1992; Zhu and Hu, 1993 as *Pedinolejeunea rotundilobula*).

**Lejeunea flava** (Sw.) Nees, Naturg. Europ. Leberm. 3: 277. 1838. *Jungermannia flava* Sw., Nov. Gen. Spec. Plant. Prodrumus: 144. 1788. —TYPE: JAMAICA. *Swartz s.n.* (lectotype designated by Grolle (1976): UPS; isolectotypes: BM!, S). Figure 2

*Taxilejeunea crassiretis* Herzog, Symb. Sin. 5: 51. 1930; *syn. nov.* —TYPE: CHINA. YUNNAN: “An Stämmen von *Illicium yunnanense* in der wtp. St. des Taohwa-shan bei Beyendjing halbwegs zwischen Tschuhsiung und Yungbei (Yungpeh)”, 2,600 m, 11 May 1915, *Handel-Mazzetti 6261* (holotype: W!; isotypes: JE!, WU!).



**Figure 2.** *Lejeunea flava* (Sw.) Nees. A, Transverse section of stem; B, Median cells of leaf lobe; C, Underleaf base and portion of stem, ventral view; D, E, Leaves, D, ventral view; E, dorsal view; F, Portion of plant with two young gynoecia, ventral view; G, Androecium, ventral view; H, Perianth, ventral view; I, Underleaf; J, Portion of sterile plant, ventral view. All drawn from *Handel-Mazzetti 6261* (holotype of *Taxilejeunea crassiretis*, W).

For other synonyms see Schuster (1980) and Grolle (1981).

For description and illustration see Mizutani (1961) and Schuster (1980).

Not only is *Lejeunea flava* a polymorphic species, it is also the most common member of *Lejeunea* in Yunnan, China. Herzog (1930) described *Taxilejeunea crassiretis* from Yunnan. In the protologue, however, no illustration was given. The isotypes of *Taxilejeunea crassiretis* in JE (slide preparation only) and W contain scanty female plants with several mature perianths, whereas the holotype in WU contains few autoicous plants. The type material kept in JE is slightly larger than that in WU and W, but no other differences could be found. Chinese *L. flava* is very variable, not only in size of plants, but also in

trigones and cuticle of leaf. In Chinese specimens, plants are 0.65–1.3 mm wide with leaves; dorsal cuticle of leaf is more or less punctate (Figure 2); trigones and intermediate thickenings are usually distinctly developed, only occasionally indistinct. The cell walls are usually somewhat thickened in the type material of *Taxilejeunea crassiretis* in JE, but thin walls are also seen in the type specimens in W and WU, as well as in plants from Yunnan.

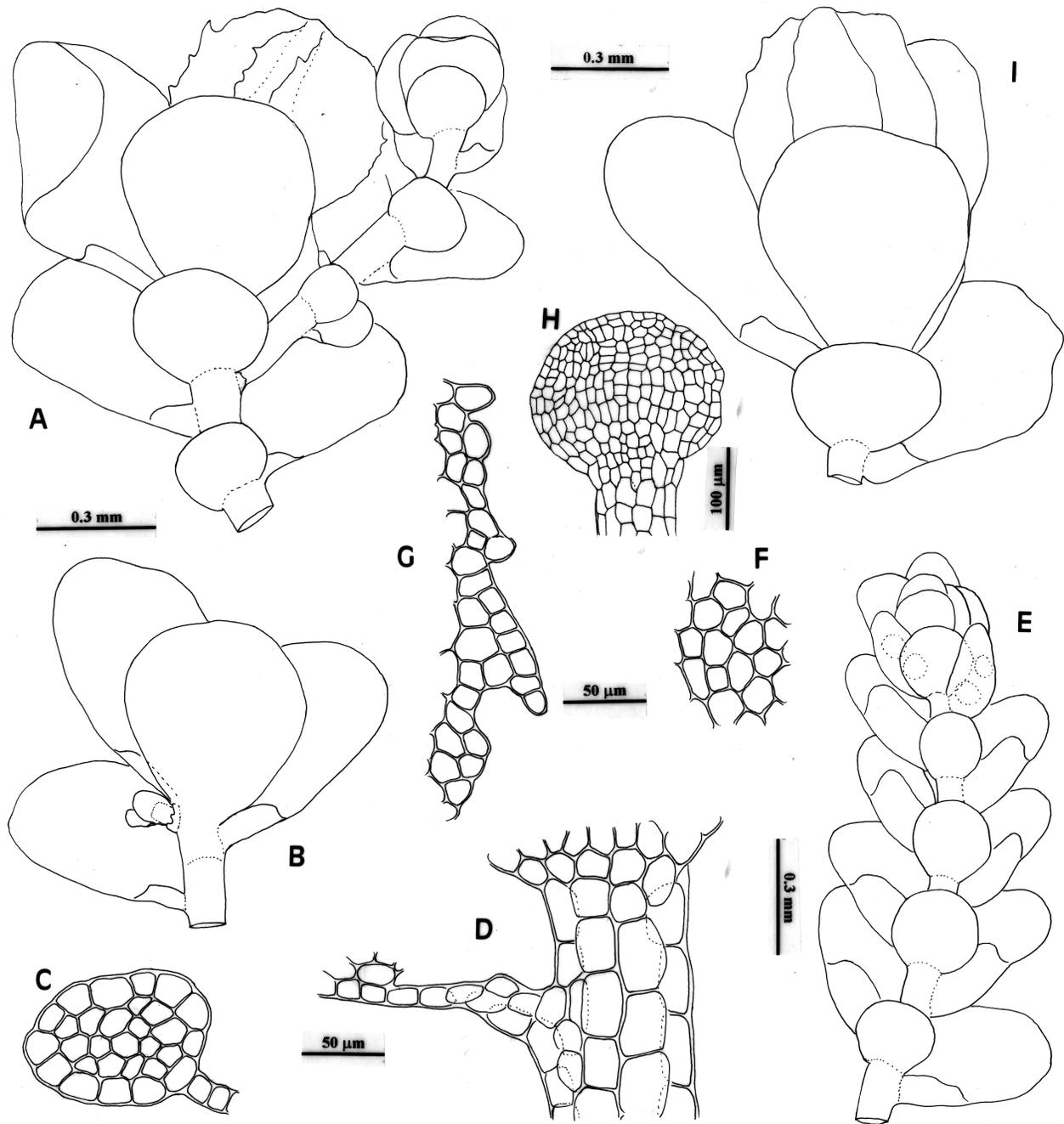
*Lejeunea flava* is easily recognized by the ovate-oblong leaves with small leaf lobules, large, usually imbricate underleaves, often somewhat cordate at the base, and often gynoecial innovations of the *Taxilejeunea*-type.

*Representative specimens examined.* **CHINA.** FUJIAN: Chongan Co. (Wuyishan City), Wuyishan, *Li 6294* (HSNU, SHM). GUANGDONG: Ruyuan Co., Babaoshan Nature

Reserve, *Zhu 89038* (HSNU). GUIZHOU: Suiyang Co., Kuankuoshui, *Gao & Feng 32780(b)* (HSNU, IFP). HAINAN: Qiongzong Co., Wuzhishan, *Li 04533* (HSNU, SHM). HONG KONG: Tai Mo Shan, north slope, *So & Zhu 95328L12* (HSNU). JIANGXI: Sanqingshan, between Fengmen and Jinsha, *Shao 1314* (HSNU 016942). SICHUAN: Emeishan, between Fuhusi and Hongchunping, *Gao et al. 18969* (HSNU, IFP). XIZANG: Motuo, near

Dejigong, *Su 4687* (HSNU, KUN). YUNNAN: Yuanyang Co., *Zang 835* (HSNU, IFP). ZHEJIANG: Qingyuan Co., Baishanzu Nature Reserve, *Zhu 90461* (HSNU). TAIWAN, NANTOU (“TAICHU”): Sunmoonlake (“Zitsugetsutan”), *Horikawa 8938* (HIRO).

*Habitat and distribution.* *Lejeunea flava* occurs in diverse habitats, growing on tree trunks, tree bases, rocks, and twigs of shrubs. However, it can also be found on



**Figure 3.** *Lopholejeunea javanica* (Nees) Schiffn. A, Portion of plant showing a thecal gynoecial innovation (innovation leaf sequence lejeuneoid) and adult perianth, ventral view; B, Young gynoecium showing a very young athecal gynoecial innovation, ventral view; C, Transverse section of stem; D, Leaf lobule and portion of stem, ventral view; E, Androecium, ventral view; F, Median cells of leaf lobe; G, Margin of perianth keel; H, Underleaf and portion of stem, ventral view; I, Gynoecium with no gynoecial innovation, ventral view. All drawn from Schwabe 62 (JE).

ferns and leaves of seed plants (Zhu et al., 1994). The known range of *L. flava* includes Africa, Asia, the Americas, Europe (Ireland) and Oceania. In China, *L. flava* is known from Fujian, Guangdong, Guizhou (nov.), Hainan, Hong Kong, Jiangxi, Sichuan, Taiwan, Xizang (nov.), Yunnan, and Zhejiang.

**Lopholejeunea javanica** (Nees) Schiffn., Natürl. Pflanzenfam. 1, 3: 129. 1893.—TYPE: INDONESIA. Java, exact locality and collector unknown (holotype: W; isotype: G-17898). *Lopholejeunea mitis* Herzog, J. Hattori Bot. Lab. 14: 43. 1955.—TYPE: CHINA. TAIWAN. TAITUNG: Lanyu ("Botel Tobago"), 2 Jun 1947, Schwabe 72 (holotype: JE!). Figure 3

For further synonyms, see Mizutani (1985).

*Lopholejeunea javanica* is characterized by autoicous sexuality, entire female bracteole, small female bract lobule, thecal gynoecial innovation (if present), small leaf lobule, less than ca. 1/4 length of leaf lobe, thin-walled leaf cells, and nearly smooth to dentate keels of perianth. *Lopholejeunea javanica* is easily confused with *Archilejeunea*, due to its thin-walled leaf cells, sometimes nearly smooth keels of perianth, entire female bract lobe and bracteole, and presence of gynoecial innovations. *Lopholejeunea javanica*, however, can be distinguished by the thecal gynoecial innovations (Figure 3: A, B); gynoecial innovations of *Archilejeunea* are always athecal.

*Specimen examined.* TAIWAN. TAITUNG: Lutao ("Kwashyoto"), Bachrinne, Schwabe 62 (JE; Herzog and Noguchi (1955) reported as *Archilejeunea mariana* (Gottsche) Steph.).

*Habitat and distribution.* *Lopholejeunea javanica* grows on tree trunks, decaying logs, soil, and wet rocks. It is known from Borneo, Java, New Guinea, the Philippines, Samoa, Sri Lanka, Taiwan, and Thailand (Mizutani, 1985).

**Lopholejeunea sikkimensis** Steph., Spec. Hepat. 5: 87. 1912.—TYPE: INDIA. Sikkim, exact locality unknown, in 1897, *Bretandeu s.n.* (holotype: G-1693).

For description and illustration, see Mizutani (1976).

The distinctive features of *Lopholejeunea sikkimensis* are autoicous sexuality, large female bract lobule, entire and usually recurved margins of the female bracteole, sinuate insertion of underleaf, and usually incurved apex of the leaf lobe. As noted by Mizutani (1976), *L. sikkimensis* is easily confused with *L. subfusca* (Nees) Schiffn., a widespread pantropical species. However, the two can be distinguished by the following key:

1. Apex of leaf lobule connate to leaf lobe across 1 cell; female bract lobule large, 2/3-4/5 as long as the lobe; female bracteole usually recurved at least at apex .....  
..... *L. sikkimensis*
1. Apex of leaf lobule connate to leaf lobe across (1-) 2-3 cells; female bract lobule very small, less than 1/4 length of the lobe; female bracteole usually plane at apex .....  
..... *L. subfusca*

*Lopholejeunea sikkimensis* also resembles *L. nigricans* (Lindenb.) Schiffn., which is considered to be pantropical by Gradstein (1994). However, the latter differs in its small underleaves, more or less apiculate apex of the leaf lobe, and strongly reduced female bract lobules.

*Representative specimens examined.* CHINA. YUNNAN: Cangyuan, Bakadaheishan, Zeng 80-1393 (HSNU, IFP, KUN), Li 1606 (HSNU, IFP, KUN).

*Habitat and distribution.* All specimens of *Lopholejeunea sikkimensis* from south Yunnan are epiphytic. Known from Bhutan (Long and Grolle, 1990), China (southern Yunnan), India (Mizutani, 1976), and Nepal (Mizutani, 1976; Mizutani et al., 1995).

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## 中國細鱗苔科（苔網）的增加及修正

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本文刪除了瑪璃唇鱗苔 *Cheilolejeunea mariana* (Gottsche) B. Thiers & Gradst. 在中國的分佈，建議僅在模式產地（中國雲南）有分佈的厚壁整鱗苔 *Taxilejeunea crassiretis* Herzog 作為黃色細鱗苔 *Lejeunea flava* (Sw.) Nees 的一個異名。圓瓣疣鱗苔 *Cololejeunea rotundilobula* (P. C. Wu & P. J. Lin) Piippo 為台灣新記錄種。長瓣疣鱗苔（新擬）*Cololejeunea indosinica* Tixier，麥氏疣鱗苔（新擬）*Cololejeunea mackeeana* Tixier 和錫金冠鱗苔（新擬）*Lopholejeunea sikkimensis* Steph. 為中國新記錄種，各自在海南、台灣及雲南發現。本文提供了瑪璃唇鱗苔，黃色細鱗苔及織枝冠鱗苔的詳盡圖解，也指定了 *Physocolea crenulata* Herzog 的選模式。

**關鍵詞：**瑪璃唇鱗苔；中國；長瓣疣鱗苔；麥氏疣鱗苔；圓瓣疣鱗苔；黃色細鱗苔；織枝冠鱗苔；錫金冠鱗苔；厚壁整鱗苔；台灣。