

Notes on the taxonomy and distribution of *Lejeunea neelgherriana* and *Tuyamaella serratistipa* (Hepaticae, Lejeuneaceae)

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The East Asian *Lejeunea claviflora* (Steph.) S. Hatt. is synonymous with *L. neelgherriana* Gottsche, known from Bhutan, China, India, Nepal, Sikkim, and Sri Lanka. *Tuyamaella veillonii* Tixier, previously reported only from New Caledonia, is proposed as a synonym of *T. serratistipa* S. Hatt., a species widespread in SE Asia. A detailed description and illustration of *L. neelgherriana* is provided. Taxonomic notes and distribution of *L. neelgherriana* and *Tuyamaella serratistipa* are presented.

Key words: Hepaticae, *Lejeunea claviflora*, *L. neelgherriana*, Lejeuneaceae, new synonyms, *Tuyamaella serratistipa*, *T. veillonii*, taxonomy

Lejeunea neelgherriana Gottsche was described by Gottsche (1845), based on a collection from India. It was a poorly described and illustrated taxon, which was also reported from Bhutan (Long & Grolle 1990), India, Nepal and Sikkim (Mitten 1861“1860” as *Lejeunea nilgiriana*, Grolle 1966 as *Strepsilejeunea neelgherriana*), Sri Lanka (Eggers & Schäfer-Verwimp 1987), and Yunnan of China (Zhu & So 1999). Our studies showed that the East Asian *Lejeunea claviflora* (Steph.) S. Hatt. is conspecific with *L. neelgherriana*. *Tuyamaella*

veillonii Tixier was hitherto the only *Tuyamaella* known to occur in Oceania. Examination of its type specimens showed it to be conspecific with *T. serratistipa* reported from Borneo, New Guinea, Seram Is., and the Philippines (Zhu & So 1998).

Lejeunea neelgherriana Gottsche (Fig. 1)

in Gottsche, Lindenb. & Nees, Syn. Hepat.: 354. 1845. — *Lejeunea nilgiriana* “Gottsche” ex Mitt., Proc. Linn. Soc., Bot. 5: 115. 1861“1860”; *nom. inval.* — *Lejeunea nilger-*

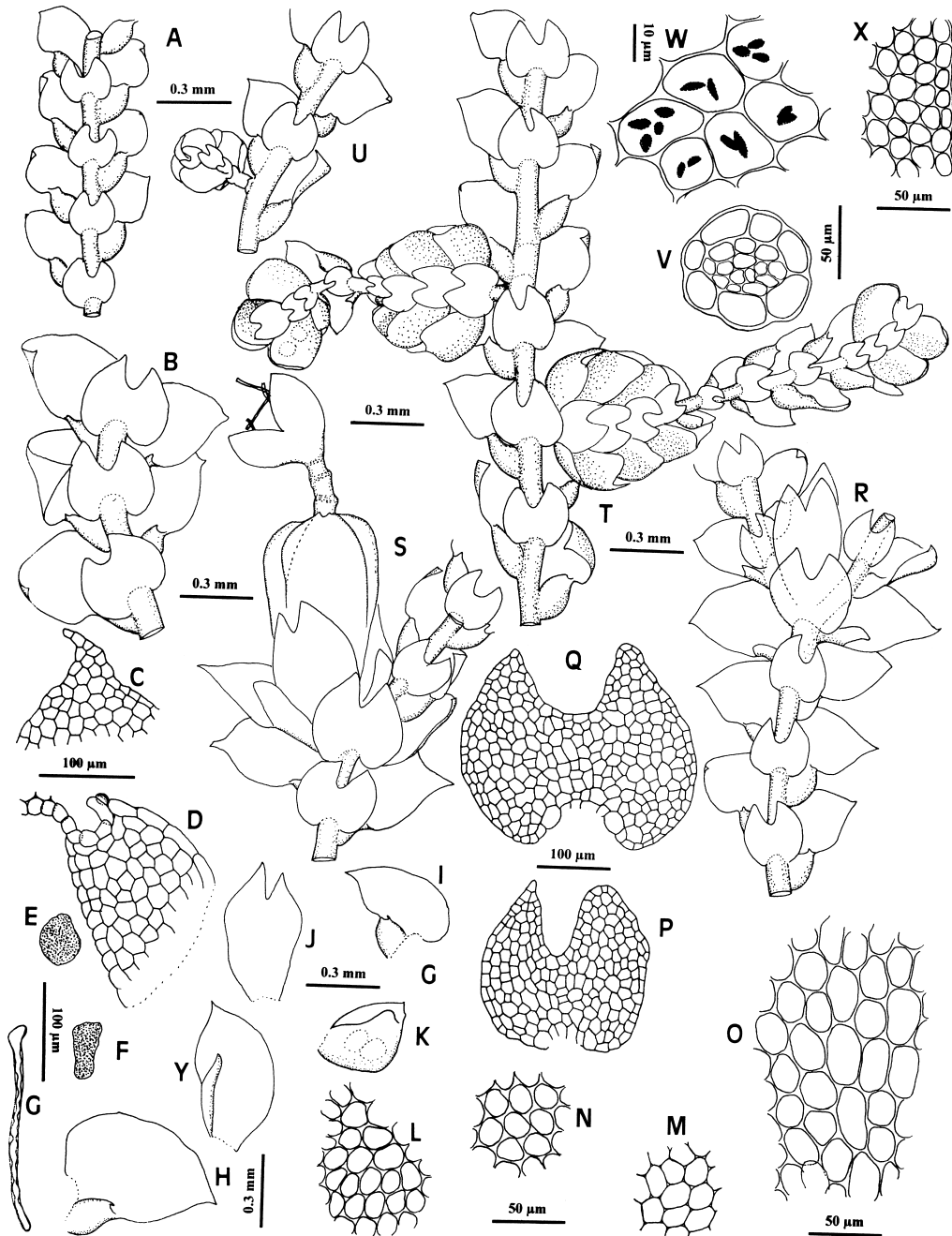


Fig. 1. *Lejeunea neelgherriana* Gottsche (A from Schäfer-Verwimp & Verwimp C222; B, H, N and Q from Faurie 756; I, L, and R from Perrottet s.n.; M from Zhu 88163; W from Zhu 99815L62; U from Beddome 109; the others from Su 4908). — A and B: Portions of plants, ventral view. — C: Apex of leaf lobe. — D: Leaf lobule showing the free lateral margin and a hyaline papilla. — E and F: Spores. — G: Elater. — H and I: Leaves, ventral view. — J: Female bracteole. — K: Male bract, ventral view. — L–N: Median cells of leaf lobe. — O: Basal cells of leaf lobe. — P and Q: Underleaves. — R: Portion of plant showing 2 gynoecial innovations, ventral view. — S: Portion of plant showing intercalary androecia, ventral view. — T: Portion of plant showing a terminal androecium, ventral view. — U: Portion of plant showing a terminal androecium, ventral view. — V: Transverse section of stem. — W: Oil bodies in median cells of leaf lobe. — X: Marginal cells of leaf lobe. — Y: Female bract, ventral view.

riana "Gottsche" ex Steph., Hedwigia 29: 75. 1890; *nom. inval.* — *Strepsilejeunea neelgherriana* (Gottsche) Steph., Sp. Hepat. 5: 288. 1913. — Type: India. "in Insulis Neelgherries". *Perrottet s.n. & s.d.* (holotype B, destroyed; isotypes BM!, G-19509!).

Lejeunea claviflora (Steph.) S. Hatt., Misc. Bryol. Lichenol. 1 (14): 1. 1957; *syn. nov.* — *Strepsilejeunea claviflora* Steph., Sp. Hepat. 5: 287. 1913. — *Euosmolejeunea claviflora* (Steph.) S. Hatt., Bot. Mag. (Tokyo) 57: 357. 1943. — Type: Japan. Kagoshima Pref., Yakushima Isl., VII.1900, *U. Faurie* 756 (holotype G-024699!, isotype FH!).

ILLUSTRATIONS: Hattori 1943: 357 (fig. 1 as *Euosmolejeunea claviflora*); Mizutani 1961: 198 (fig. XVIII: 9–15 as *Lejeunea claviflora*).

Dioicous. Plants green or yellowish green when fresh, pale brown, whitish yellow or pale yellowish green when dry. Stem 7–25(–40) mm long, (64–)80–100(–150) μm in diameter, 0.55–0.90(–1.1) mm wide with leaves, sometimes irregularly branched, branching of the *Lejeunea* type, leaf sequence of branches lejeuneoid, transverse section of stem with 7 cortical cells and 13–20 medullary cells, cortical cells quadrate to rectangular, 24–34(–40) \times 14–28 μm , medullary cells \pm isodiametric, 10–15 \times 8–11 μm . Ventral merophytes of stem 2 cells wide. Leaves remote to imbricate, diverging from stem at an angle of 45–60°. Leaf lobes triangular-ovate, usually falcate, 0.40–0.70 mm long, 0.28–0.40(–0.50) mm wide, apex acute, apiculate or acuminate, usually incurved, margin entire, dorsal margin usually strongly arched. Leaf lobules triangular-ovate or oblong, inflated, ca. 1/3 as long as the leaf lobes, lateral free margin usually somewhat incurved, bordered by 4 rectangular marginal cells, apex obliquely truncate, usually constricted, with a unicellular apical tooth pointing towards leaf apex, hyaline papilla oblong, ca. 16 \times 10 μm , situated at the proximal side of apical tooth, keel arched, smooth. Leaf cells thin-walled to moderately thickened, trigones small to large, intermediate thickenings usually absent. Marginal cells of leaf lobe quadrate to rectangular, 10–16 \times 6–13 μm , median cells \pm isodiametric, 12–24 \times 9–16 μm , basal cells isodiametric to rectangular, 22–44 \times 16–24 μm , dorsal cuticle smooth to finely punctate. Vitta and ocelli absent. Oil bodies 2–7 per leaf cell, translucent, oblong-fusiform, rarely spherical, 3.2–9.6 \times 1.6–4.0 μm , finely segmented, slightly papillose on surface. Underleaves remote, occasionally imbricate, suborbicular to cordiform

in outline, usually slightly wider than long, 0.14–0.37(–0.40) mm long, 0.17–0.40(–0.45) mm wide, 2.5–3.5 times as wide as stem, bilobed to 1/3–2/5 of the underleaf length, sinus U- or V-shaped, lobes triangular, acute to obtuse at apex, margin entire, insertion usually deeply sinuate, base usually cordate. Rhizoids at base of underleaves, few, tufted, usually hyaline, rhizoid disc absent. Androecia terminal or usually intercalary, on very short lateral branches or on main shoots, bracts 2–8 pairs, hypostatic, 0.17–0.40 mm long, 0.15–0.25 mm wide, apex obtuse, rounded or apiculate, bract lobule slightly shorter than bract lobe, antheridia 2 per bract, bracteoles 2–8, borne throughout androecium. Gynoecia usually on long branches, with one or two lejeuneoid innovations, innovation usually not again bearing an innovation, bracts oblong-ovate, 0.52–0.80 mm long, 0.30–0.40 mm wide, margin entire, apex acute or apiculate, bract lobule oblong or ligulate, 2/3–3/4 as long as the bract lobe, keels 1/2–3/4 as long as the bract lobules, apex obtuse or acute, bracteole oblong-ovate, 0.60–0.68 mm long, 0.30–0.40 mm wide, bilobed to 1/4–1/3 its length at apex, entire at margin, sinus acute. Perianth emergent, obovate, ca. 0.75–1.0(–1.1) mm long, 0.40–0.60 mm wide, inflated, with 5 smooth keels, beak usually 2 cells long. Capsule dehiscing from apex down into 4 valves when mature, valves non-recurving, ca. 0.33 mm long, 0.17 mm wide at middle; capsule wall smooth on surface, consisting of 2 layers of cells; seta articulate, ca. 0.9 mm long, with 7 or 8 articulations, 12 outer cells surrounding four inner cells in transverse section. Elaters linear, 180–240 μm long, 7–13 μm wide, wall sinuately thickened. Spores irregular in shape, 40–60 \times 16–36 μm , minutely papillose on surface. Asexual reproductive organs not seen.

Lejeunea neelgherriana is readily separated from other members of *Lejeunea* by the acute to apiculate leaf apices usually strongly incurved, dioicous sexuality, male bracteoles present throughout the androecium, sinuate insertion of underleaf to stem, and more or less cordiform underleaves with slightly to strongly cordate bases. *Lejeunea neelgherriana* is closely related to *L. stevensiana* (Steph.) Mizut., which is known from Bhutan (Long & Grolle 1990), China (Zhu & So 1999), India, Nepal, and Sikkim (Mizutani 1971, 1972). They share several key features: shape of leaves

and underleaves, dioicous sexuality, and male bracteoles present throughout the androecium. *Lejeunea stevensiana*, however, differs in its larger size (1.2–2.0 mm wide with leaves), widely spreading leaves, and small leaf lobules which are only 1/8–1/6 as long as the leaf lobes. In addition, leaf cells of *Lejeunea stevensiana* are larger than those of *L. neelgherriana*, the median cells of leaf lobe of the latter being 20–36(–40) × (18–)20–32 μm.

Lejeunea neelgherriana shows distinct variations in several features. In the type material from India and in most Chinese collections, leaf cells have small trigones and thin walls (Fig. 1L, M and X). However, trigones of leaf cells are usually large, and walls moderately thickened in the type material of *Strepsilejeunea claviflora* Steph. The underleaf shape and size also vary. Underleaves are usually small (less than 0.37 mm long, 0.40 mm wide), and slightly cordate at base (Fig. 1A, P and R–U), but in the type of *S. claviflora* and in some Japanese material, they are up to 0.4 mm long and 0.5 mm wide and strongly cordate at base (Fig. 1B and Q).

In China, *Lejeunea neelgherriana* was reported from Yunnan (Zhu & So 1999), Jiangxi (Liu *et al.* 1993 as *L. claviflora*), Hubei (Hattori 1943, 1952 as *Euosmolejeunea claviflora*), and Zhejiang (cf. Zhu *et al.* 1998). Our study shows that it is one of the most common members of the genus *Lejeunea* in eastern China.

REPRESENTATIVE SPECIMENS EXAMINED. **Bhutan.** S-Deothang, 13 km S of Riserboo, N of Deothang, *Long 8560* (E, JE). **China.** Anhui, She Co., Qingliangfeng, *Zheng 862* (HSNU-013692), Jiuhuashan, 17.VIII.1983, *Hu & Wang 76* (HSNU-011176); Fujian, Wuyishan Nature Reserve, Wanggangshan, 15.VII.1999, *Zhu 99815L62* (HSNU); Guangdong, Babaoshan Nature Reserve, XII.1989, *Zhu 89621* (HSNU); Guangxi, Xinan, Miaoershan, 14.IX.1974, *Gao & Zhang 1338* (HSNU ex IFP); Guizhou, Jiangkou Co., Fanjingshan, 17.XI.1980, *Jiang 00156* (HSNU), Libo Co., Maolan Nature Reserve, 6.VII.1998, *Zhu 98858* (HSNU); Jiangxi, Wuyishan, Zhangmuyuan, 14.X.1993, *Liu 34897* (HSNU ex SHM), Sanqingshan, 18.V.1988, *Shao 1557* (HSNU-017187); Xizang, Motuo Co., Hanmi, 17.VI.1983, *Su 4908* (HSNU ex IFP, KUN-4125); Yunnan, Daweishan Nature Reserve, 1800 m, XI.1988, *R.-L. Zhu 88163* (HSNU); Zhejiang, Baishanzu Nature Reserve, Chegeng, 23.VII.1990, *Zhu 90207* (HSNU). **India.** Nilgiri, N slope, *Beddome 109* (NY). Sikkim. Definite locality and collector

unknown, 1450 (NY). **Japan.** Kyushu, *Mizutani 10292* (NY). **Sri Lanka.** Central Prov., District Nuwara Eliya, 3.I.1985, *Schäfer-Verwimp & Verwimp C222* (JE).

HABITAT. *Lejeunea neelgherriana* grows on the trunks, branches and bases of trees, rotten logs, shrubs, and rarely on living leaves. It is also associated with other bryophytes on moist rocks and soils. According to the labels of examined specimens, its altitudinal range is between 200 m (Japan) and 2 520 m (Xizang of China).

DISTRIBUTION. As 2: China (Anhui (*nov.*), Fujian (*nov.*), Guangdong (*nov.*), Guangxi (*nov.*), Guizhou (*nov.*), Hubei (Hattori 1943), Jiangxi, Xizang (*nov.*), Yunnan, and Zhejiang), Japan, and Korea (Yamada & Choe 1997); As 3: Bhutan, India, Nepal, Sikkim, and Sri Lanka.

Tuyamaella serratistipa S. Hatt.

Bot. Mag. Tokyo 64: 118. 1951. — Type: Indonesia “Dutch New Guinea”. Prafi, flum. Madarai, 21.IV.1943, *Tuyama 1366* (holotype TNS!).

Pycnolejeunea appendiculata Herzog, Mem. Soc. Fauna Flora Fennica 26: 60. 1951. — *Tuyamaella appendiculata* (Herzog) R. M. Schust. & Kachroo., J. Linn. Soc. (Bot.) 56: 508. 1961. — Type: Malaysia. Borneo, Mt. Kinabalu, 10 500', 29.III.1929, *Clemens (32 ?)* (holotype JE!, isotype BO).

Tuyamaella veillonii Tixier, Nova Hedwigia 46: 374. 1988; *syn. nov.* — Type: New Caledonia “Nouvelle Calédonie”. Montagne des Sources, forêt néphéliphile, 950 “1000” m, épiphyllie, 5.XII.1984, *Schmid & Veillon s.n.* (holotype PC, isotypes JE!, NY!).

ILLUSTRATIONS: Herzog 1951: 63 (fig. 37 as *Pycnolejeunea appendiculata*), 64 (fig. 38e as *P. appendiculata*); Tixier 1973: 241 (fig. 14); Tixier 1988: 375 (fig. 1 as *Tuyamaella veillonii*); Zhu & So 1998: 458 (figs. 1–19).

Tuyamaella serratistipa is well characterized and readily distinguished from congeners by a tuyamaelloid leaf sequence of branches, first tooth of leaf lobe being (2–)3–5 cells long, the presence of *Allorgella*-type denticulations at margins of leaf lobes and underleaves, discoid gemmae occurring on ventral surfaces of leaf lobes, and more or less semi-hyaline to hyaline marginal cells of leaf lobes. This species shows slight variation in marginal cells of leaf lobes. In most material, including the type of *T. serratistipa*, the leaf lobe

usually bears 1–2(–3) rows of semi-hyaline to hyaline marginal cells at apex, as shown in Herzog (1951: fig. 37e) and Zhu and So (1998: fig. 15). However, the semi-hyaline to hyaline marginal cells are sometimes poorly developed.

Tixier (1988) described as a new species *Tuyamaella veillonii*, which bears hyaline marginal cells in leaf lobe, based on a collection from New Caledonia. He separated the species from *T. molischii* (Schiffn.) S. Hatt. by the long first tooth (median tooth) of leaf lobule. The type specimens of *T. veillonii*, however, agree well with those of *T. serratistipa*. Hence *T. veillonii* is reduced to a synonym of *T. serratistipa*, which is easily separated from *T. molischii* by the presence of the *Allorgella*-type denticulations at the margins of underleaves and leaf lobes.

A detailed description of *Tuyamaella serratistipa* is given in Zhu and So (1998), where the type locality of *T. serratistipa* was erroneously indicated as “Papua New Guinea”.

REPRESENTATIVE SPECIMENS EXAMINED. **Indonesia.** “West Borneo. Auf dem Bukit Raja”, 1 250 m, 17.XII.1924, *Winkler 3360 p.p.* (JE); “New Guinea”. Hattam, inter Doibeit et Maibri, 1 200–1 400 m, 4.V.1943, *Tuyama 1714 p.p.* (TNS, paratype of *Tuyamaella serratistipa* S. Hatt.). **Malaysia** (British Nord-Borneo). Mt. Poi, 1929, *Clemens 20.160a* (JE). **Papua New Guinea.** Morobe Prov., N slopes of the Sarawaket Range, 13.IX.1981, *Norris 66721* (EGR). **Philippines.** Luzon, Province of Rizal, XII.1912, *Reillo s.n.* (Bureau of Science no. 19328, G-14356).

HABITAT. All specimens examined are epiphyllous. The known altitudinal range of the species is between 950 (New Caledonia) and 3 200 m (Borneo).

DISTRIBUTION. As 4: Borneo, New Guinea, Philippines, Seram Is.; Oc: New Caledonia.

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REFERENCES

- Eggers, J. & Schäfer-Verwimp, A. 1987: Some liverworts new to Sri Lanka (Ceylon). — *J. Bryol.* 14: 531–534.
- Gottsche, C. M., Lindenberg, J. B. W. & Nees, C. G. 1845 (1844–1847): *Synopsis Hepaticarum*. Hamburg, 834 pp.
- Grolle, R. 1966: Die Lebermoose Nepals. — *Ergebn. Forsch.-Untern. Nepal Himal.* 1: 262–298.
- Hattori, S. 1943: Hepaticarum species novae et minus cognitae nipponenses. I. — *Bot. Mag. (Tokyo)* 57: 357–363.
- Hattori, S. 1952: Hepaticae of Shikoku and Kyushu, southern Japan. 2. — *J. Hattori Bot. Lab.* 8: 21–46.
- Herzog, T. 1951: Miscellanea Bryologica. II. Paleotropica. — *Memoranda Soc. Fauna Fl. Fennica* 1949–1950, 26: 37–66.
- Liu, Z.-L., Lai, M.-J. & Gao, C.-H. 1993: Bryophyta. — In: Zhang, M.-Z. & Lai, M.-J. (eds.), [*Checklist of plants of five provinces and one city in Eastern China*]: 47–96. Shanghai Popular Publ. House, Shanghai. [In Chinese.]
- Long, D. G. & Grolle, R. 1990: Hepaticae of Bhutan II. — *J. Hattori Bot. Lab.* 68: 381–440.
- Mitten, W. 1861 (“1860”): Hepaticae Indiae Orientalis. — *J. Proc. Linn. Soc., Bot.* 5: 89–128.
- Mizutani, M. 1961: A revision of Japanese Lejeuneaceae. — *J. Hattori Bot. Lab.* 24: 115–302.
- Mizutani, M. 1971: *Lejeunea* from the Himalayan Region. — *J. Hattori Bot. Lab.* 34: 445–457.
- Mizutani, M. 1972: Studies of little known Asiatic species of Hepaticae in the Stephani Herbarium. 8. Some little known species of the subfamily Lejeuneoideae of the Lejeuneaceae. — *J. Hattori Bot. Lab.* 36: 157–162.
- Tixier, P. 1973: Le genre *Tuyamaella* Hatt. (Lejeunéacées). Monographie. — *Rev. Bryol. Lichénol.* 39: 221–244.
- Tixier, P. 1988: Le domaine lémuuro-australasien intérêt biogéographique de deux espèces nouvelles. — *Nova Hedwigia* 46: 373–383.
- Yamada, K. & Choe, D.-M. 1997: A checklist of Hepaticae and Anthocerotae in the Korean Peninsula. — *J. Hattori Bot. Lab.* 81: 281–306.
- Zhu, R.-L. & So, M. L. 1998: *Tuyamaella serratistipa* S. Hatt. new to the Philippines with a key to the genus *Tuyamaella* (Hepaticae, Lejeuneaceae). — *J. Bryol.* 20: 455–460.
- Zhu, R.-L. & So, M. L. 1999: Additions of Lejeuneaceae taxa to the hepatic flora of Yunnan, China. — *Ann. Bot. Fennici* 36: 219–229.
- Zhu, R.-L., So, M. L. & Ye, L.-X. 1998: A synopsis of the Hepaticae flora of Zhejiang, China. — *J. Hattori Bot. Lab.* 84: 159–174.