

STUDY ON TYPE SPECIMENS OF ASIAN *BAZZANIA* (MARCHANTIOPHYTA)  
ИССЛЕДОВАНИЕ ТИПОВЫХ ОБРАЗЦОВ АЗИАТСКИХ *BAZZANIA*  
(MARCHANTIOPHYTA)

VADIM A. BAKALIN<sup>1</sup> & YULIA D. MALTSEVA<sup>1</sup>

ВАДИМ А. БАКАЛИН<sup>1</sup>, ЮЛИЯ Д. МАЛЬЦЕВА<sup>1</sup>

Abstract

The morphological descriptions and figures are compiled for 23 type specimens of *Bazzania*, based on the study of type collections in herbaria G (Geneva), NICH (Nichinan) and STR (Strasbourg). Lectotypes are selected for 11 taxa (*Bazzania asperrima*, *B. pearsonii*, *Jungermannia tridens*, *Mastigobryum angustisedens*, *M. assamicum*, *M. faurieanum*, *M. ovistipulum*, *M. philippinense*, *M. revolutum*, *M. sumatranum*, *M. yoshinaganum*).

Резюме

Представлены морфологические описания и иллюстрации для 23 типовых образцов *Bazzania*, на основании изучения коллекций в гербариях G (Geneva), NICH (Nichinan) and STR (Strasbourg). Проведена лектотипификация 11 таксонов (*Bazzania asperrima*, *B. pearsonii*, *Jungermannia tridens*, *Mastigobryum angustisedens*, *M. assamicum*, *M. faurieanum*, *M. ovistipulum*, *M. philippinense*, *M. revolutum*, *M. sumatranum*, *M. yoshinaganum*).

KEYWORDS: Pacific Asia; Lepidoziaceae; *Bazzania*; taxonomy; liverworts; Hepaticae

INTRODUCTION

The genus *Bazzania* Gray is one of the largest among extant liverwort genera. Overall species diversity is difficult to assess, according to Frey *et al.* (2009) it includes 100–150 species distributed mainly in tropical and subtropical regions of both hemispheres, with the center of taxonomic diversity in tropical America (Frey *et al.*, 2009). The World checklist of hornworts and liverworts (Söderström *et al.*, 2016) accepts 258 species in the genus, many of which, however, are of questionable status. The exact number of species known in Pacific Asia is difficult to estimate; apparently, it is at least 60 species, including several undescribed taxa. As we go southward in Indochina, more and more tropical Malesian and Indopacific species appear (Pócs, 2023).

Since representatives of *Bazzania* are mostly large plants (compared to other liverworts), they have been actively collected by vascular plant botanists, plant sociologists and naturalists in Pacific Asia (including Malesia) since the beginning of the 19th century. The accumulated material made it possible to describe in the 19th century and very beginning of 20-th century about 70% of all currently known taxa in Pacific Asia. The most fruitful authors of the new species were Sande Lacoste (1856) and especially Stephani (1908a, 1908b, 1908c, etc). These primary data along with more modern collections were used to create regional treatments, including the most important (although largely outdated) treatments of *Bazzania* of Thailand (Kitagawa, 1967), North

Vietnam (Pócs, 1969), Sino-Himalaya (Mizutani, 1967), Lepidoziaceae Limpr. of Japan (Hattori & Mizutani, 1958), a review (not a true revision) of the Lepidoziaceae of China (Mizutani & Chang, 1986) and the further review for the same country by Zhou *et al.* (2012a, b). Recently Bakalin (2016) provided *Bazzania* treatment for the Russian Far East, including descriptions of two species new to science. The latter was also compiled on the basis of a comparative morphological study, without molecular data. The results of studying some scattered collections and working with type specimens have been published by Kitagawa (1977, 1979). In this way, a significant amount of information was collected, but with no less significant gaps. A notable example is Laos, where, according to a recently published checklist with the telling title “Listing the unknown” (Söderström *et al.*, 2020), there is only one species of Lepidoziaceae for the entire country (*Bazzania tridens*), while the actual number of *Bazzania* species there should be at least 15.

The genus *Bazzania* has been little affected by molecular genetic studies. The creator of the modern phylogenetic scheme of Lepidoziaceae was Cooper, who published a number of works that were a breakthrough in the molecular taxonomy of Lepidoziaceae. The most important of them are devoted to the general multilocus phylogeny of Lepidoziaceae (Cooper *et al.*, 2011) and the transfer and new nomenclatural combinations within the family (Cooper *et al.*, 2013). At the same time, it should be noted that Cooper made the main contribution

<sup>1</sup> – Laboratory of Cryptogamic Biota, Botanical Garden-Institute FEB RAS, Makovskogo Street 142, Vladivostok 690024, Russia. E-mails: vabakalin@gmail.com; maltseva.yu.dm@gmail.com. ORCID: (VB) 0000-0001-7897-4305; (YM) 0000-0002-0275-6819

to the knowledge of the diversity of Lepidoziaceae in Australasia, and only a few of specimens he used come from Pacific Asia. At the moment, there is an urgent need to create a molecular genetic revision of *Bazzania* in Pacific Asia, but for this it is necessary to determine how the sequenced material corresponds to the initial understanding of the species by the authors of original descriptions. The latter is difficult due to many of the original descriptions of species in the papers of the 19th and early 20th centuries are very schematic (and in many cases there are no illustrations at all), and it is impossible to get an idea on the morphology of the taxon from them. In this case, the compilation of more or less detailed descriptions and illustrations of species based on the study of type specimens in leading herbaria acquires special significance. Moreover, even if a number of types were studied earlier (as in the works by Kitagawa (1977, 1979)), the new descriptions based on the study of the same material can provide new information about the variability of the taxon. As it was noted by Gradstein (2017) “species recognition in the genus, however, is troublesome as has repeatedly been pointed out (...), because taxonomically relevant features are often blurred by environmental modification”. In addition, as far as we know, photographs of type specimens have not been previously published, which distinguishes our work from other studies of *Bazzania* type materials known in Pacific Asia. The purpose of this work was to describe and illustrate available type specimens of species found in eastern Asia.

#### MATERIAL AND METHODS

The materials for the present account were the type specimens of *Bazzania*, stored mainly in the herbarium of the Conservatoire et Jardin botaniques de Genève (acronym G), apparently the largest collection of type specimens of liverworts in the world, comprised both by type specimens of species described by Franz Stephani and numerous duplicates of type specimens described by other authors. In addition, we used specimens from the herbarium of the Hattori Botanical Laboratory (NICH) and Strasbourg University (STR). Compilation of morphological descriptions was carried out on within G, NICH and STR using light microscopes and dissecting microscopes not equipped with cameras. Since all specimens examined contain only sterile plants, descriptions of archegonia, antheridia, and sporophytes are not given. The photographs were taken with a Sony portable camera through a microscope ocular. After that, the images were edited and subsequently used either to compile line black-and-white illustrations by superimposing tracing paper on a photograph, or were used to compile plates of photos (mainly for a leaf cell network, but also for other features). Each species is supplied with the full nomenclatural citation of accepted names, basionym, label (both from the original literature source and from the specimen label, in some cases these parameters differ). After that, the type status of the specimen is given, and, where

necessary, the lectotypification is carried out. This is followed by a morphological description with links to drawings (in some cases, the description is not given if it was published relatively recently) and comments (mostly brief list of differentiation features). It should be noted that the color scale in the morphological descriptions is given according to the herbarium specimen, nearly all of which are more than 100 years old and therefore the color of the plants is undoubtedly (and commonly drastically) changed, and often not comparable with the color of recently collected plants. Only the barcodes of specimens that have been studied are provided. The specimen numbers from G usually contains two parts separated by a slash. This stems from the fact that most of the collection was numbered in the pre-digital era and these numbers were widely used in papers until the early 21st century. In the last 15 years, the total digitalization of the Stephani collection in G has been carried out and all accessions have been assigned barcodes with new number, under which the species appears in the database. To avoid confusion and inconsistencies with a number of primary sources, we quote both numbers: ‘old’ and then ‘new’.

The study of type specimens in the Franz Stephani type collection (a large part of the type herbarium of the liverworts in G) has one peculiarity explicable by the method of work of this author. As a rule, Stephani received the original specimens, studied them and returned the material back to sender, keeping a duplicate for himself. At the same time, Stephani himself in his works did not indicate (with very few exclusions) the herbarium in which the holotype is stored. Moreover, in the future, the specimens could be further divided, and then the specimen on which the description is based could be shared between several herbaria. This circumstance results in the incorrectness to interpret the vast majority of specimens stored in the Geneva Herbarium as holotypes. Brown *et al.* (1992: 69) also wrote about this: “This is particularly important for taxa described by Stephani; in his later years he broke up many of his specimens and sold duplicates to BM, FH and other institutions. Some of these duplicates, when they come from mixed collections, are not the taxon referred to in the protologue and great care must be taken when typifying. It is probably unwise and inaccurate, therefore, to cite holotypes and this has not been done, even when Stephani specified a collector’s number”. Thus, even if the specimen number is indicated in the protologue, it is hardly possible to consider the envelope stored in G as a holotype and a lectotypification of such material should be carried out. Another problem is the consideration of the editions of *Index Hepaticarum* prepared by Bonner (1976, etc.) as the literature source lectotypifying all Stephani types. However, Engel & Merrill (2019) argue that Bonner’s types are not lectotypes. Thus, in all cases where lectotypes were not selected before among the specimens (even if there is a single specimen in G), we carry out the lectotypification of taxa.

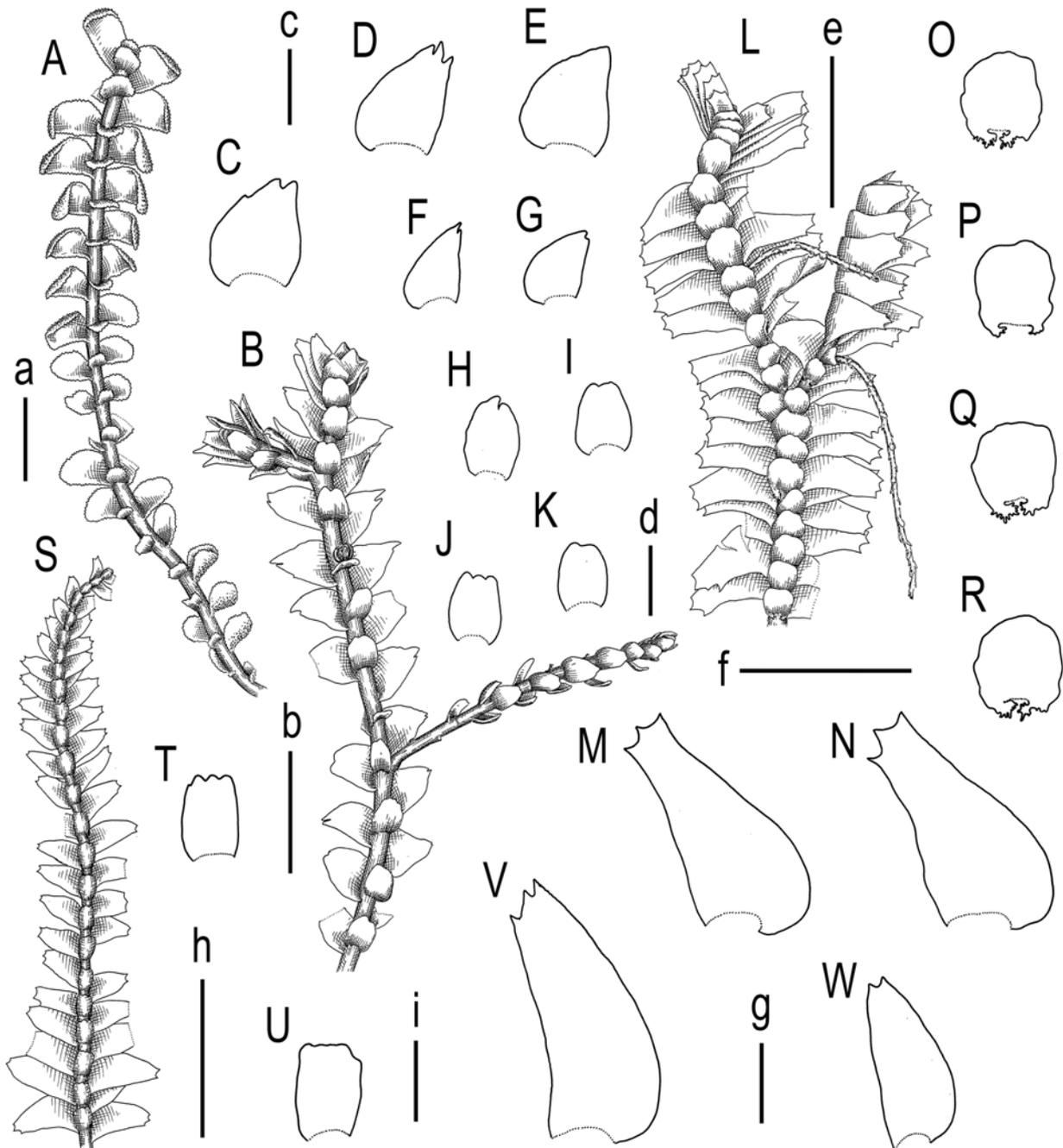


Fig. 1. *Bazzania angustisedens* (Steph.) N.Kitag. (from G0067620/5207): A: plant habit, fragment, ventral view; *Bazzania angustistipula* N.Kitag. (from G00120946): B: plant habit, fragment, ventral view; C–G: leaves; H–K: underleaves; *Bazzania appendiculata* (Mitt.) S.Hatt. (from G00113647): L: plant habit, fragment, ventral view; M, N: leaves; O–R: underleaves; *Bazzania asperima* (from G00069768/11169): S: plant habit, fragment, ventral view; T, U: underleaves; V, W: leaves. Scales: a – 500  $\mu\text{m}$ , for A; b – 1 mm, for B; c – 500  $\mu\text{m}$ , for C–G; d – 500  $\mu\text{m}$ , for H–K; e – 3 mm, for L; f – 2 mm, for M, N; g – 1 mm, for O–R; h – 2 mm, for S; i – 500  $\mu\text{m}$ , for T, U, V, W.

## LIST OF TAXA

***Bazzania angustisedens*** (Steph.) N.Kitag., J. Hattori Bot. Lab. 36: 445, 1972 [1973] (Kitagawa, 1972). Bas.: *Mastigobryum angustisedens* Steph., Bull. Herb. Boissier (sér. 2) 8 (10): 745 (429), 1908 (Stephani, 1908a). Indonesia. "Java, in Monte Salak; leg. ?" Lectotype (selected here) G: 0067620/5207! Note: in the type description it is indicated that collector is unknown, but on the specimen label it is written as E. Nyman). Fig. 1: A, Fig. 2.

Description. Plants pale greenish to pale yellowish, soft, 370–750  $\mu\text{m}$  wide, 8–15 mm long; rhizoids rare, observed only in ventral flagellae; stem 70–100  $\mu\text{m}$  wide, rarely dichotomously branched, ventral flagellae numerous; leaves obliquely inserted, convex, distinctly turned to ventral side, nearly ellipsoidal with one side truncate, 320–450  $\times$  180–260  $\mu\text{m}$ , leaf margin crenulate due to protrudent papillae; underleaves erect spreading, 1.4–2.0 as wide as stem (when attached to the stem,

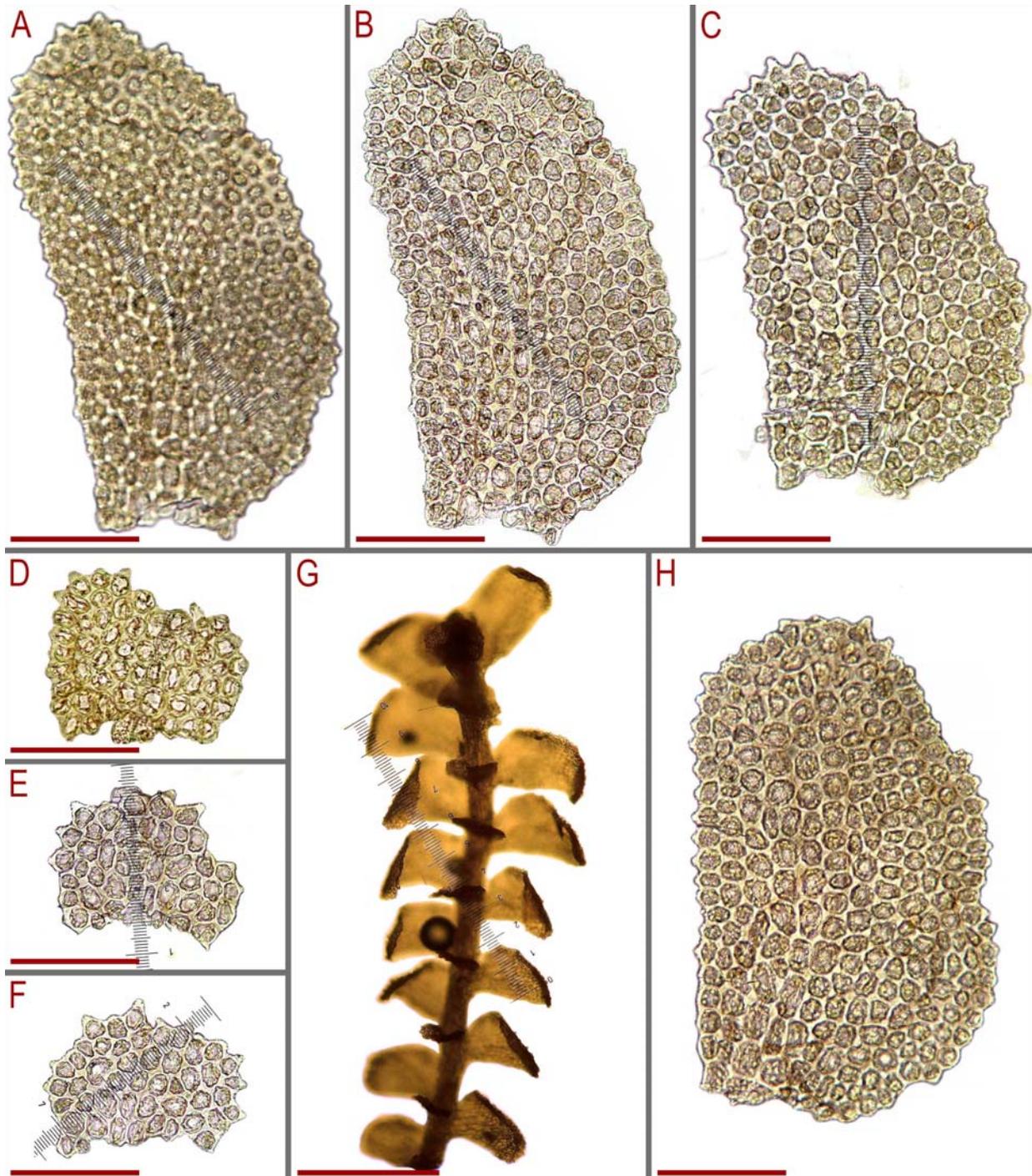


Fig. 2. *Bazzania angustisedens* (Steph.) N.Kitag. (from G0067620/5207): A: papilla of the leaf; B, C, H: leaves; D, E, F: underleaves; G: plant habit, fragment, ventral view. Scales: 100  $\mu\text{m}$  for A, B, C, D, E, F, H; 500  $\mu\text{m}$  for G.

not in the slide), wider than long, reniform to transversely rectangular and widely lingulate, margin crenulate due to large papillae protrudence, apical part roughly crispate to dentate with 2–4 teeth; abaxial surface with each cell of leaf and underleaf (in underleaf commonly not so coarse) have large obtuse-conical papilla above, besides, the middle part of abaxial surface of the leaf (including papilla cones) have additional small papillae throughout, therefore two different size of pa-

pilla are distributed on the same organ (leaf and underleaf), large conical papillae are on dorsal leaf surface only, but small papillae present both on dorsal and ventral surfaces; midleaf cells 15.0–30.0  $\times$  12.5–22.5  $\mu\text{m}$ , thin-walled, with large convex trigones, cells along margin 10.0–17.5  $\mu\text{m}$ , thin-walled or walls unequally thickened due to the trigones confluence.

Comment. The species is distinguishable due to small size and noticeable character of papillae.

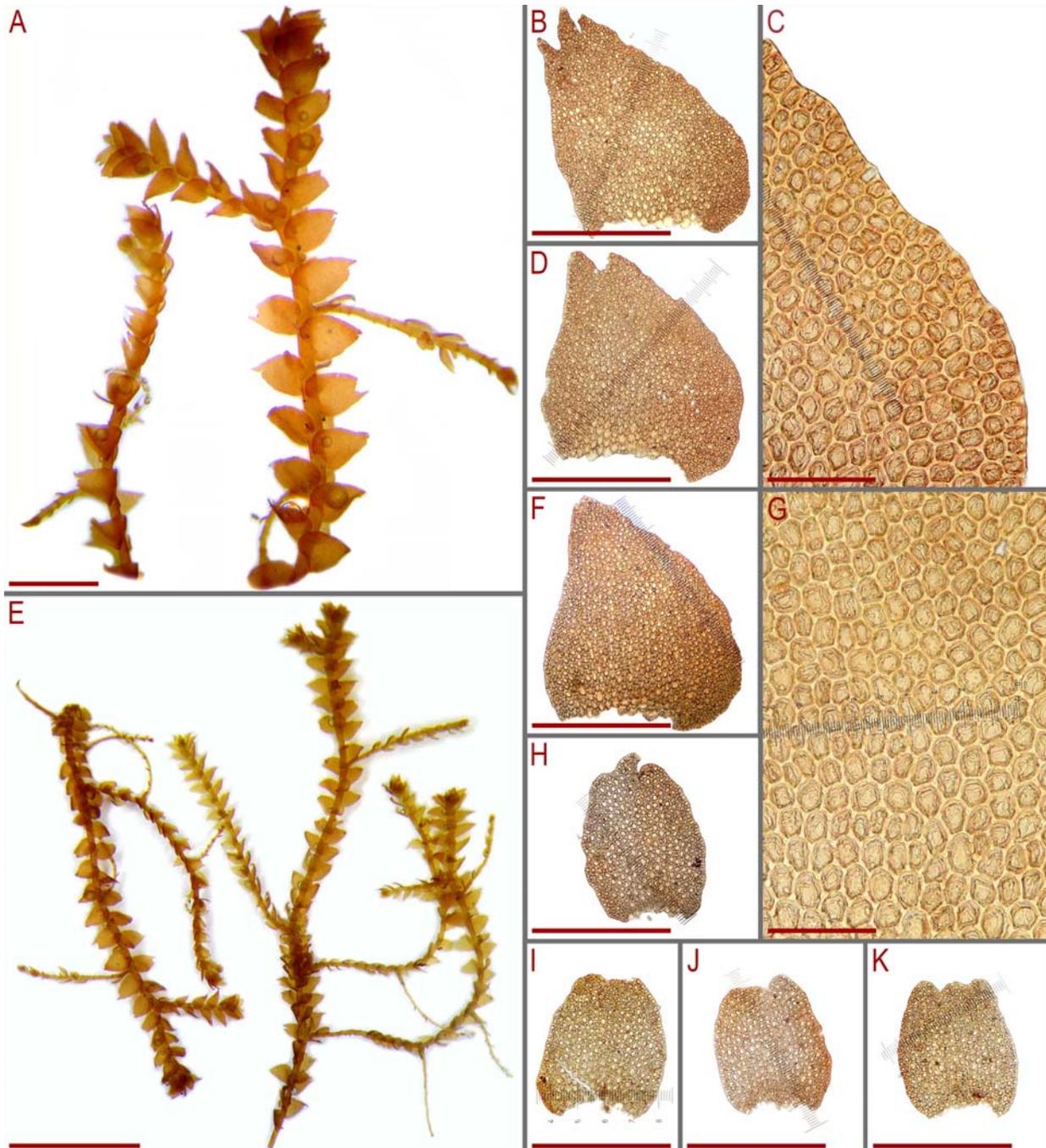


Fig. 3. *Bazzania angustistipula* N.Kitag. (from G00120946): A, E plant habit, fragments B, D, F leaves C leaf margin cells G leaf middle cells H, I, J, K underleaves. Scales: 1 mm for A; 100  $\mu$ m for C, G; 5 mm for E; 500  $\mu$ m for B, D, F, H–K.

***Bazzania angustistipula*** N.Kitag., J. Hattori Bot. Lab. 30: 268, 1967 (Kitagawa, 1967). Thailand. Payap. Chaingmai: higher elevation of Mt. Doi Inthanon, 1900–2595. In dense, moist evergreen forest. On tree trunk. 19 December 1965, M. Tagawa & N. Kitagawa, no. T2965. Isotypes: G00120946!, NICH281268! Note: 1) the habitat of the type specimen in the original description is not provided, only generalized description of ecology is present (Kitagawa, 1967); 2) the specimen in G is labeled as '*Bazzania angustiloba*' that is probable simple misprint. Fig. 1: B–K, Fig. 3.

**Description.** Plants more or less soft, greenish brownish to rusty brownish (the rusty tint is always present and is one of the best characteristic of the species), 1.1–1.5 mm wide and 2–4 cm long; rhizoids not seen; stem 175–250  $\mu$ m wide, freely dichotomously branched, ventral flagellae numerous, noticeable ventral flagella may easily become to ordinary branch after 5–15 pairs of reduced leaves and then produce again ventral flagella from this transformed flagella, once the normal branch transformation into flagella was observed (looks to that similar in *Acromastigum*). Leaves distant, obliquely inserted,

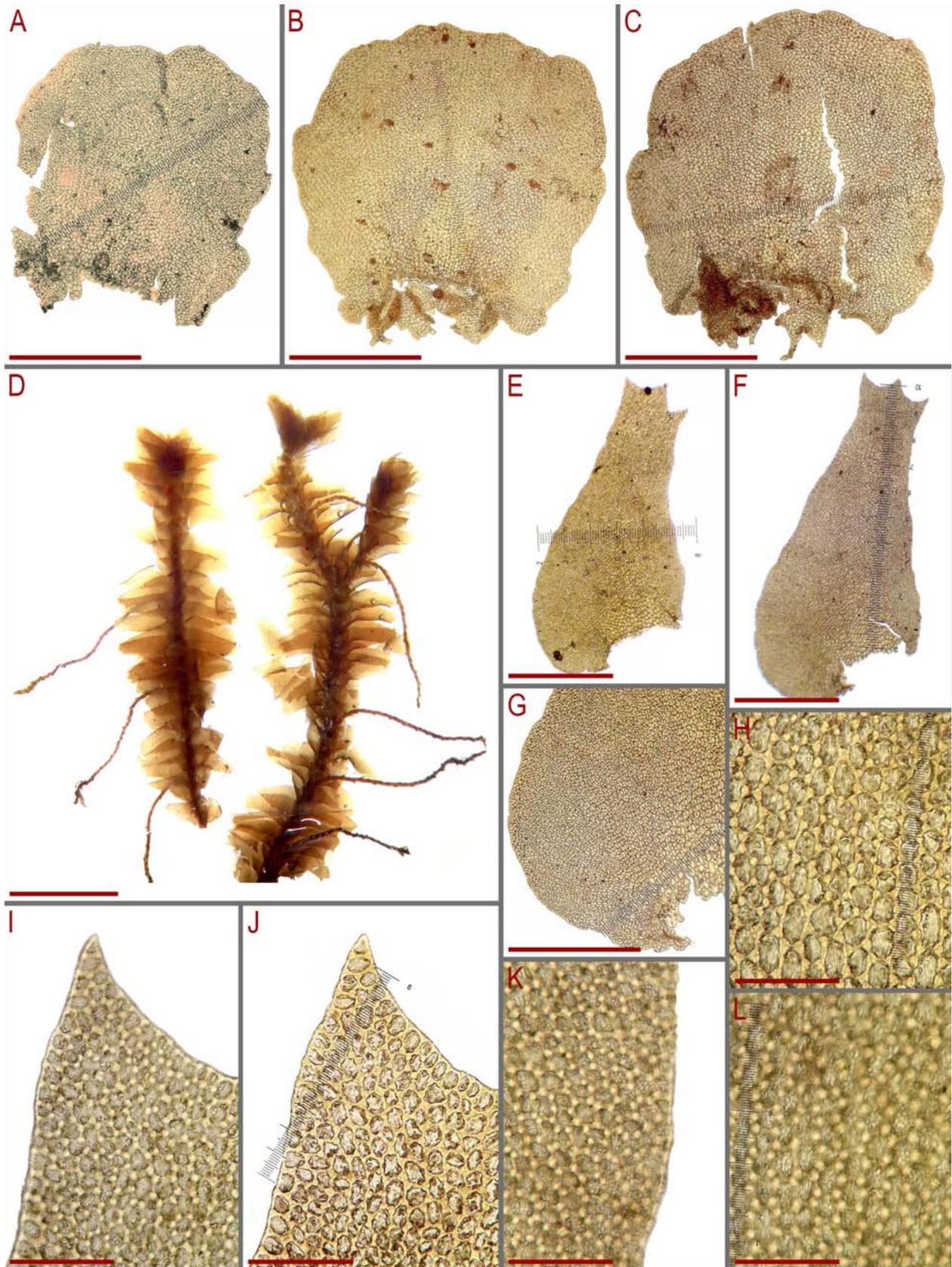


Fig. 4. *Bazzania appendiculata* (Mitt.) S.Hatt. (from G00113647): A, B, C: underleaves; D: plant habit, fragment, ventral view; E, F: leaves; G: cells of lower part of leaf; H: leaf middle cells; I: papilla of the leaf apex; J: leaf apex cells; K: papilla of the leaf margin; L: papilla of the leaf middle. Scales: 500  $\mu$ m for A, B, C, G; 5 mm for D; 1 mm for E, F; 100  $\mu$ m for H–L.

somewhat auriculate in dorsal base, convex, distinctly turned to ventral side, obliquely ovate-triangular, with narrow apex, divided by V- to U-shaped sinus into 2–3 lobes or simply acute, margin entire to loosely crispate and sparsely and shortly dentate, 650–900×450–730 µm. Midleaf cells 20–25×15–25 µm, thin-walled, trigones moderate, slightly concave, cells along margin 12.5–20.0 µm, sometimes tangentially oblong, thin-walled (external wall also thin), trigones adjacent to the outer wall large and convex, inward moderate in size and only slightly convex to concave, cuticle smooth throughout. Underleaves obliquely to erect spreading, 1.6–2.0 as wide as stem (when on the stem, not in the side), lingulate-ovate, margin entire, apex truncate, emarginate to roughly crispate, longer than wide.

Comment. Distinguishable by rusty coloration, distant leaves, leaves turned to ventral side and very narrow leaf apex. The leaf apex shape varies within one shoot from triangular almost as long as wide to triangular-lanceolate, to 1.8 as long as wide.

*Bazzania appendiculata* (Mitt.) S.Hatt., Fl. E. Himalaya: 505, 1966 (Hattori, 1966). Bas.: *Mastigobryum appendiculatum* Mitt., J. Proc. Linn. Soc., Bot. 5 (18): 105, 1860 [1861] (Mitten, 1860). India. “Sikkim, 7–8000 ped., J.D.H (No. 1595). Assam Griffith”. Possible syntype: G00113647! The specimen in G is labeled as “Bhotan 999, Griffith”, not as in original description. Actually Assam of India as adjacent to Bhutan and the second locality cited in original description may be the same with studied in G. Fig. 1: L–R, Fig. 4.

Description. Plants yellowish brownish, 4–5 mm wide and 3–4 cm long (the data are poor because 3 shoots are in the specimen only), more or less rigid; rhizoids at the ends of the ventral flagellae, in brownish obliquely spreading fascicles or separated; stem 370–400 µm wide, dichotomously branched, ventral flagellae common. Leaves obliquely inserted, subhorizontally oriented, slightly obcanaliculate-convex, overlapping 1/2 of the next leaf in the base, but overlapping in upper halves, obliquely narrowly ovate-narrowly trapezoidal, slightly dilated in the apex, with auriculate dorsal base (with crenulate appendage in larger leaves), 2.25–2.75×1.4–1.5 mm, divided by widely V- to crescentic sinus into three distinctly diverging lobes. Midleaf cells 20–42×18–25 µm, thin-walled, with nodulose and large trigones, cells along margin 10–20 µm, with outer wall thickened, other walls thin or slightly thickened due to trigones confluence, trigones large, nodulose, with visible median lamina (as trilete sign), cuticle distinctly papillose throughout (more prominent to the leaf apex). Underleaves loosely appressed to the stem to narrowly spreading, slightly concave-canaliculate (if to view from ventral side), 2.0–2.7 as wide as stem (when on the stem, not in the slide), spatulate to lingulate and rotundate, with loosely to distinctly crispate margin, with auriculate base and distinct appendages, those are sometimes sharply dentate (in other cases roughly crispate).

Comment. The species is distinct due to papillose leaf cuticle, underleaf appendages, large nodulose trigones, and diverging lobes in the leaf apex.

*Bazzania asperrima* Steph., Rev. Bryol. 34 (3): 48, 1907 (Paris, 1907). Vietnam. Souche morte de Diptérocarpe sur les rives du Kamly [dead stump of dipterocarp tree on the banks of the Kamly], 1906, Eberhardt. Lectotype (selected here): G00069768/11169! Note: ‘Kamly’ may mean Cam Ly River (sounds the same in Vietnamese), then it is in Lâm Dong that is a southernmost mountainous province in the Central Highlands (southern part of Annamite Range) region belonging to the Central Vietnam. Fig. 1: S–W, Fig. 5.

Description. Plants greenish, opaque, (1.1–)1.8–2.2 mm wide, 2–4 cm long, more or less soft, with slightly fragile leaves (this is the subject of discussion, because the material is very old, whereas the newly collecting specimens in Annam show not fragile leaves); rhizoids common, brownish, in fascicles or separate, originating in ventral flagellae only; stem 130–200 µm wide, dichotomous branching of the main stem not seen, ventral flagellae rare. Leaves obliquely inserted, subhorizontally oriented, contiguous, rarely distant or somewhat overlapping narrowly the next leaf, nearly plane or very slightly convex, obliquely narrowly trapezoidal to sublinear, slightly falcate, apex divided by U-shaped sinus into three (two in weak leaves) short and acute triangular lobes, 700–1150×350–550 µm. Midleaf cells 17.5–30.0×20.0–45.0 µm, thin-walled, with large and convex trigones with visible median lamina, cells along margin 10–20 µm, thick-walled, with moderate in size, concave trigones, cuticle very distinctly although finely verruculose (= asperulose) throughout, with the most prominent papillae are above cell walls. Underleaves appressed to the stem, 1.5–2.0 as wide as stem (when on the stem, not in the slide), connate (adjacent) with leaf in one side (rarely in two sides), nearly rectangular (longer than wide), with crispate apex and entire lateral margins, hyaline (with the exception of chlorophyllose basal part), in discolored area cell walls thin, with very small to vestigial trigones.

Comment. The species is recognized due to finely verruculose cuticle and hyaline underleaves. With hand lenses the species may be recognized from superficially similar *B. tridens* (Reinw., Blume et Nees) Trevis. by more opaque appearance (never glistening), narrowed leaf apices and shortly incised and sorter leaves. *Bazzania semiopaca* N. Kitag. (= *Bazzania albifolia* Horik.) described from, Thailand (Kitagawa, 1967) is quite similar to *B. asperrima*, but different in smaller size, and ‘rotund-quadrate’ (Kitagawa, 1967: 262) underleaves and only slightly divided apex into the lobes. The listed features may be environmentally induced and should be evaluated in the future studies.

*Bazzania assamica* (Steph.) S. Hatt. J. Hattori Bot. Lab. 2: 15 1947 [1948] = *Bazzania tridens* var. *assamica* (Steph.) Pócs, J. Hattori Bot. Lab. 32: 86, 1969 (Pócs, 1969). Bas.: *Mastigobryum assamicum* Steph., Hedwi-

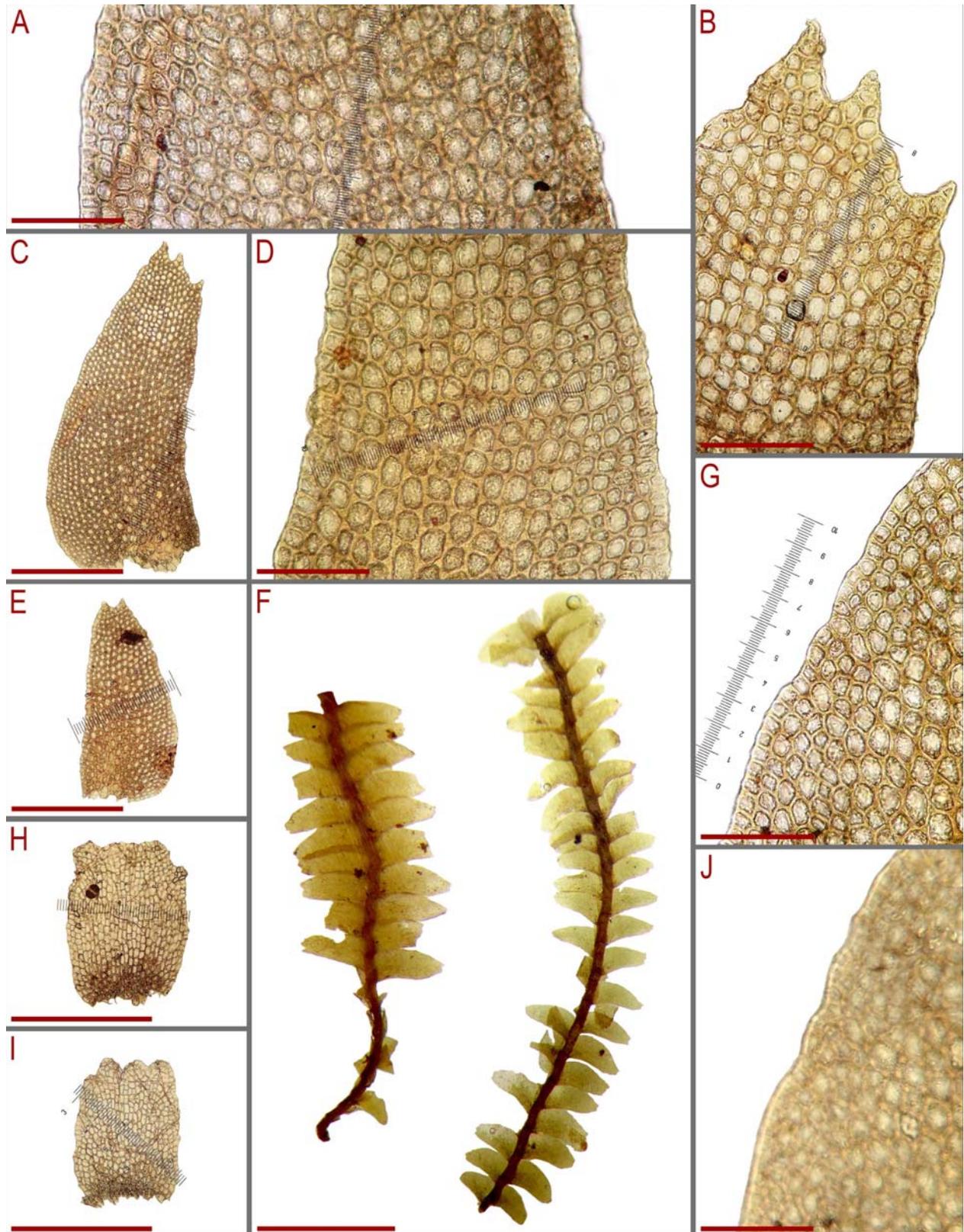


Fig. 5. *Bazzania asperrima* Steph. (from G00069768/11169): A, D: papilla of the leaf middle part; B: leaf apex cells; C, E: leaves; F: plant habit, fragments; G: leaf margin cells; H, I: underleaves; J: papilla of the leaf margin. Scales: 100 μm for A, B, D, G, J; 1 mm for C, E; 2 mm for F; 500 μm for H, I.

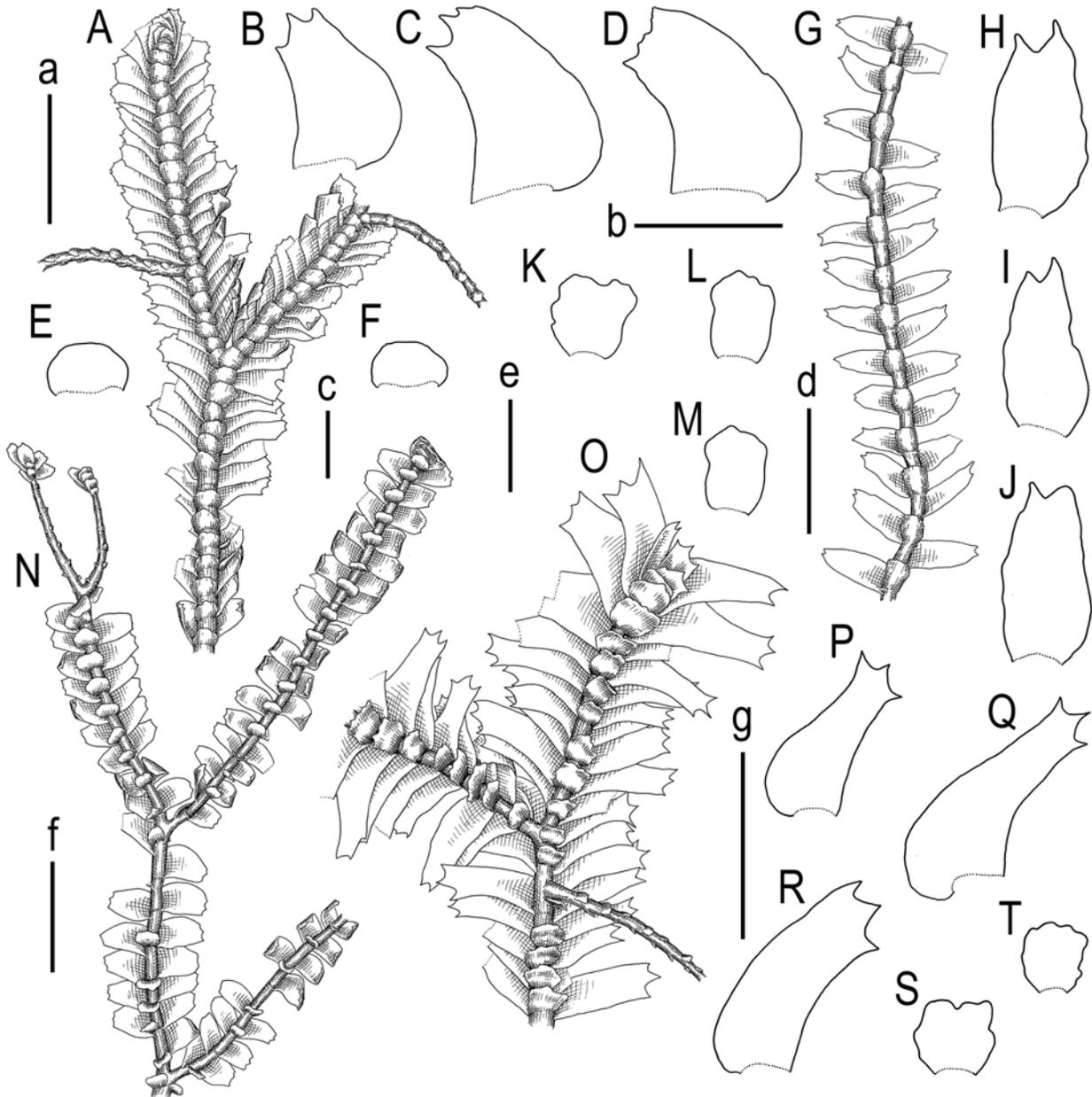


Fig. 6. *Bazzania assamica* (Steph.) S. Hatt. (from G00069769/5283): A: plant habit, fragment, ventral view; B, C, D: leaves; E, F: underleaves; *Bazzania debilis* N.Kitag. (from G00113551): G: plant habit, fragment, ventral view; H, I, J: leaves; K, L, M: underleaves; *Bazzania denudata* (Lindenb. et Gottsche) Trevis. (from STR, s.n.): N: plant habit, fragment, ventral view; *Bazzania faurieana* (Steph.) S.Hatt. (from G00067623): O: plant habit, fragment, ventral view; P, Q, R: leaves; S, T: underleaves. Scales: a – 2 mm, for A; b – 1 mm, for B, C, D; c – 500  $\mu$ m, for E, F, P-T; d – 1 mm, for G; e – 300  $\mu$ m, for H–M; f – 2 mm, for N; g – 2 mm, for O.

gia 24 (5): 216, 1885 (Stephani, 1885). Lectotype (selected here): “Assam. (Herb. Sande-Lacoste)” G00069769/5283! Fig. 6: A–F, Fig. 7.

Description. Plants (a few material is in the specimens) greenish brownish, more or less rigid, 1.2–2.2 mm wide; rhizoids common at the ends of ventral flagellae; stem 250–350  $\mu$ m wide, freely dichotomously branched, ventral flagellae common. Leaves obliquely inserted, very obliquely oriented, slightly convex, slightly turned to ventral side, 1000–1200 $\times$ 670–800  $\mu$ m, obliquely ovate-narrowly trapezoidal, falcate, apex divided by U-shaped sinus into three acute triangular lobes, rarely with addi-

tional 1–2 subapical teeth. Midleaf cells thin-walled, with large and convex trigones, 30–50 $\times$ 25–30  $\mu$ m, cuticle smooth, cells along margin with very thickened outer wall, 17–30  $\mu$ m, unequally thickened, with large, mostly slightly concave trigones, cell walls become thinner inward and trigones become more convex, cuticle virtually smooth along margin in the middle and basal part of leaves, but may be unclearly papillose in apical part of the leaf. Underleaves appressed to the stem to narrow obliquely spreading, with shallowly recurved apex, 1.1–1.6 as wide as stem (when on the stem, not in the slide), connate (adjacent or truly connate) with leaf in one or

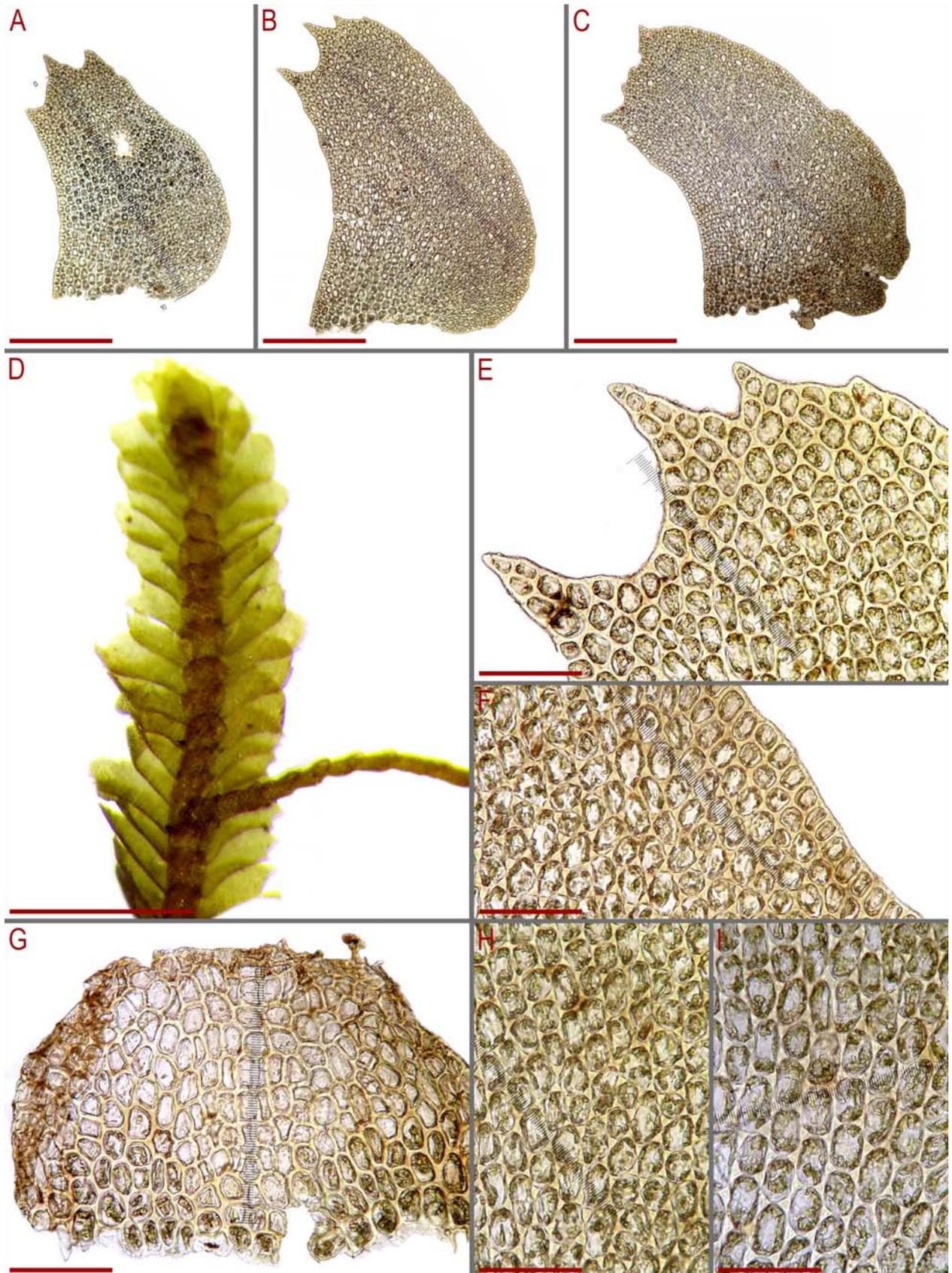


Fig. 7. *Bazzania assamica* (Steph.) S. Hatt. (from G00069769/5283): A, B, C: leaves; D: plant habit, fragment, ventral view; E: leaf apex cells; F: leaf margin cells; G: underleaf; H, I: leaf middle cells. Scales: 1 mm for A, B, C; 2 mm for D; 100 µm for E, F, G, H, I.

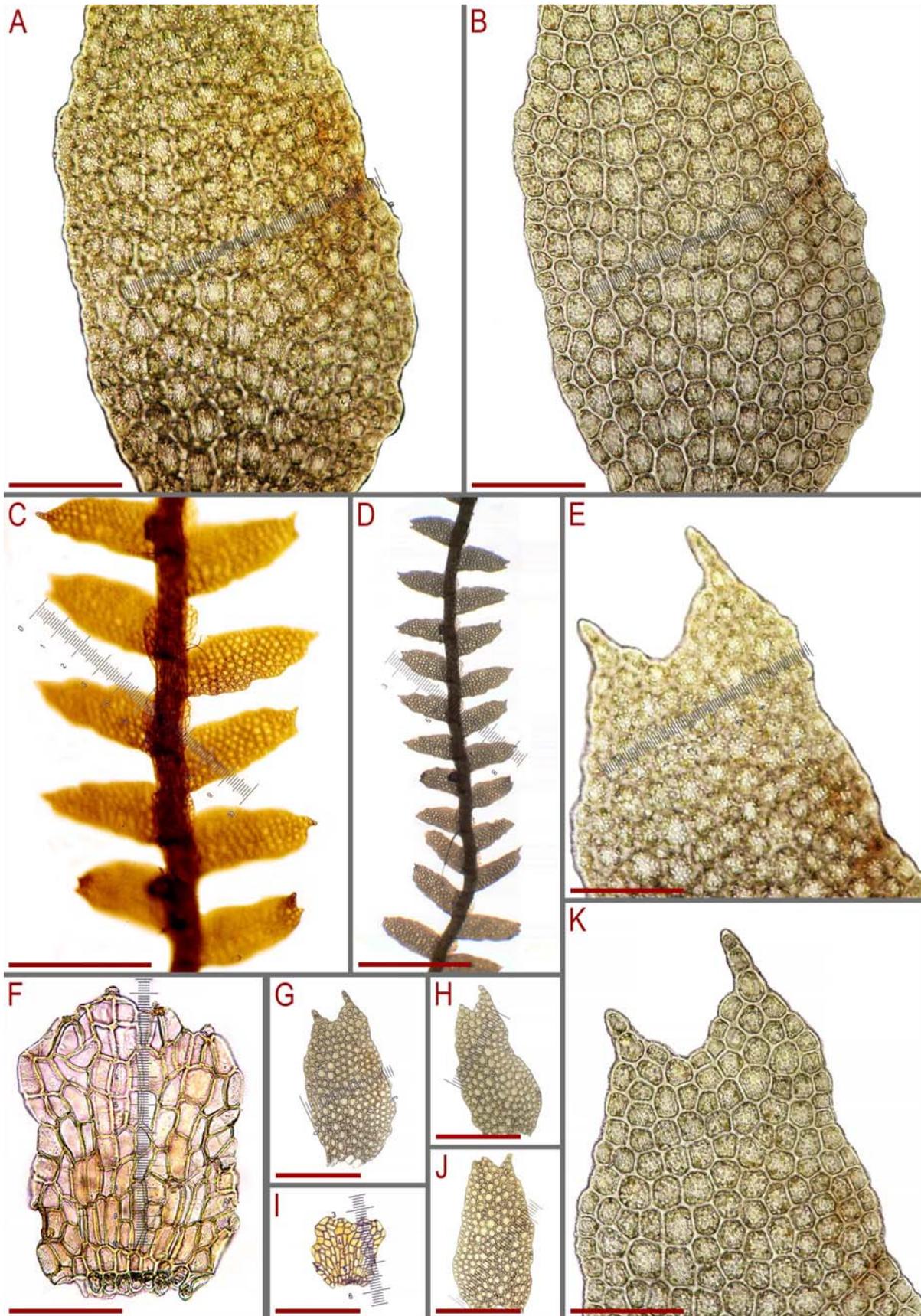


Fig. 8. *Bazzania debilis* N.Kitag. (from G00113551): A: papilla of the leaf; B: leaf cells; C, D: plant habit, fragment, ventral view; E: papilla of the leaf apex; F, I: underleaves; G, H, J: leaves; K: leaf apex cells. Scales: 100  $\mu\text{m}$  for A, B, E, F, K; 500  $\mu\text{m}$  for C; 1 mm for D; 300  $\mu\text{m}$  for G, H, I, J.

both sides, chlorophyllose in the basal part, above hyaline, but with normal cells (not very thin-walled), with moderate to small trigones), the only 3–5 rows of cells along underleaf margin are thin-walled although still contain small trigones, this marginal band is commonly erose (destroyed) or sometimes narrowly revolute, underleaves reniform, wider than long.

Comments. 1) Treated as variety under *B. tridens* in the World liverwort checklist (Söderström et al., 2016), but accepted in species status by Shu et al. 2017.

2) There are two specimens in the herbarium, but only one of them is from herbarium Sande Lacoste (the cited) and it is selected as lectotype here. Another specimen (G00282310) is somewhat similar to the lectotype, with the exception of more appressed underleaves to the stem. That specimen is from herbarium Jack (acquired in 1900, although the species was described in 1886) and cannot be regarded as the type.

3) The species is different from *B. tridens* by the wider and shorter leaves and distinct differences in underleaves that are although also discolored, but not trigones-free and narrowly spreading with loosely recurved margin.

*Bazzania debilis* N.Kitag., J. Hattori Bot. Lab. 30: 256, 1967 (Kitagawa, 1967). Thailand. Loey: Mt. Phu Kradung, 1100–1200 m a.s.l., on moist rock by a stream, M. Tagawa & N. Kitagawa, no. T727, 28 November, 1965. Isotypes: G00113551!, NICH27975! Fig. 6: G–M, Fig. 8.

Description. Plants greenish, 0.88–1.2 mm wide, relatively soft, rhizoids sparse, in unclear fascicles. Leaves very obliquely inserted and subhorizontally oriented, distant, narrowly ovate to lanceolate, divided by V- to U-shaped sinus into two narrow and acute lobes, 500–600×250–300 µm. Midleaf cells thin-walled, with moderate in size, triangle to slightly convex trigones, 27.5–37.5×20–32.5 µm, cells along margin with thin to slightly thickened walls (outer wall always thickened), 15–25 µm, cuticle distinctly papillose throughout. Underleaves 1.5–2.0 as wide as stem, subquadrate to rectangular, as wide as long or slightly longer than wide, hyaline, composed by thin-walled cells with vestigial to wanting trigones.

Comment. The small size, distant leaves, hyaline underleaves and papillose cuticle are illustrative. The relationships with *Bazzania mayebarae* described from Japan are unclear due to commonly occurring transitional(?) morphological modification in North Vietnam. The molecular-genetic studies should clarify the connections of the two taxa.

*Bazzania denudata* (Lindenb. et Gottsche) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4 (13): 414, 1877 (Trevisan, 1877). Bas.: *Mastigobryum denudatum* Lindenb. et Gottsche, Syn. Hepat. 2: 216, 1845 (Gottsche et al., 1845). Fig. 6: N, Fig. 9: A. “America septentrionali prope Novum Eboracum (Torrey in Hb. Kunz.), prope Plainfields in Massachusetts” Syntype (the

second of the specimens cited above): STR (s.n.)!

Comment 1. *Bazzania denudata* was many times described in the literature. The one of the most exhaustive description is in Schuster (1969). The plants in the scarce type specimen are corresponding to the cited description and seems no more description (especially taking into account this specimen is syntype) is necessary.

Comment 2. *Bazzania ovifolia* (Steph.) S. Hatt. is commonly treated as the synonym of *Bazzania denudata* (e.g. Söderström et al., 2016; Bakalin, 2016). Here we follow that concept and provide the morphological description based on the lectotype of *Mastigobryum ovifolium* “Japan. Faurie” Lectotype (nov.) G00282561/14780! Fig. 10: A–J, Fig. 11.

Description. Plants greenish brownish, forming loose patches, prostrate, 1300–2300 µm wide and 20–50 mm long, ventral flagellae commonly occurs; rhizoids virtually absent, rarely present in ventral flagella, colorless, in unclear obliquely spreading fascicles. Leaves incubously oblique, dorsally insertion line arcuate, contiguous to imbricate, erect spreading, subhorizontally oriented, slightly convex, evidently, but not strongly, incurved to ventral side of the stem, obliquely ovate, with merely straight ventral side, 800–1300×500–950 µm, apex obliquely truncate, shortly incised by U- to V-shaped sinus into 3 (rarely 2, in weak leaves) short and acute nearly triangular lobes. Midleaf cells 26–40×24–40 µm, subsodiametric to shortly oblong, thin-walled, trigones moderate to large in size, nearly triangular, cuticle smooth; cells in lobe apices nearly thin-walled to walls slightly thickened, external wall strongly thickened, 20–30 µm in diameter, trigones large, convex, cuticle smooth. Underleaves obliquely (sometimes very narrowly) to suberect spreading, plane or larger concave with recurved upper half, connate in one or both sides with leaves, 300–500×450–700 µm, transversely elliptic, crispate or irregularly lobed, for 4–7 obtuse to rounded lobes.

*Bazzania faurieana* (Steph.) S.Hatt., Bot. Mag. (Tokyo) 59 (693/694): 27, 1946 (Hattori, 1946). Bas.: *Mastigobryum faurieanum* (as ‘*faurianum*’) Steph., Bull. Herb. Boissier (sér. 2) 8 (11): 843 (467), 1908 (Stephani, 1908b). Japan (Faurie) “Ichifusa [Kumamoto Prefecture]. Faurie 721, June 1900”. Lectotype (selected here): G00067623! Fig. 6: O–T, Fig. 9: B–I.

Description. Plants greenish brownish, 2.0–3.2 mm wide, 3–5 cm long, more or less rigid; rhizoids at the end of ventral flagellae; stem 200–220 µm wide, freely dichotomously branched, ventral flagellae frequent. Leaves obliquely inserted and subhorizontally oriented, nearly plane or very loosely convex, 1.3–1.6×0.6–0.8 mm, obliquely narrowly trapezoidal, falcate, apex divided by U-shaped sinus into distinctly diverging acute lobes. Midleaf cells vary in size, 15–40×17–30 µm, thin-walled, trigones moderate to large in size, convex, cuticle smooth, cells along margin 7.5–15.0 µm, with outer wall thickened, other walls thin, trigones moderate

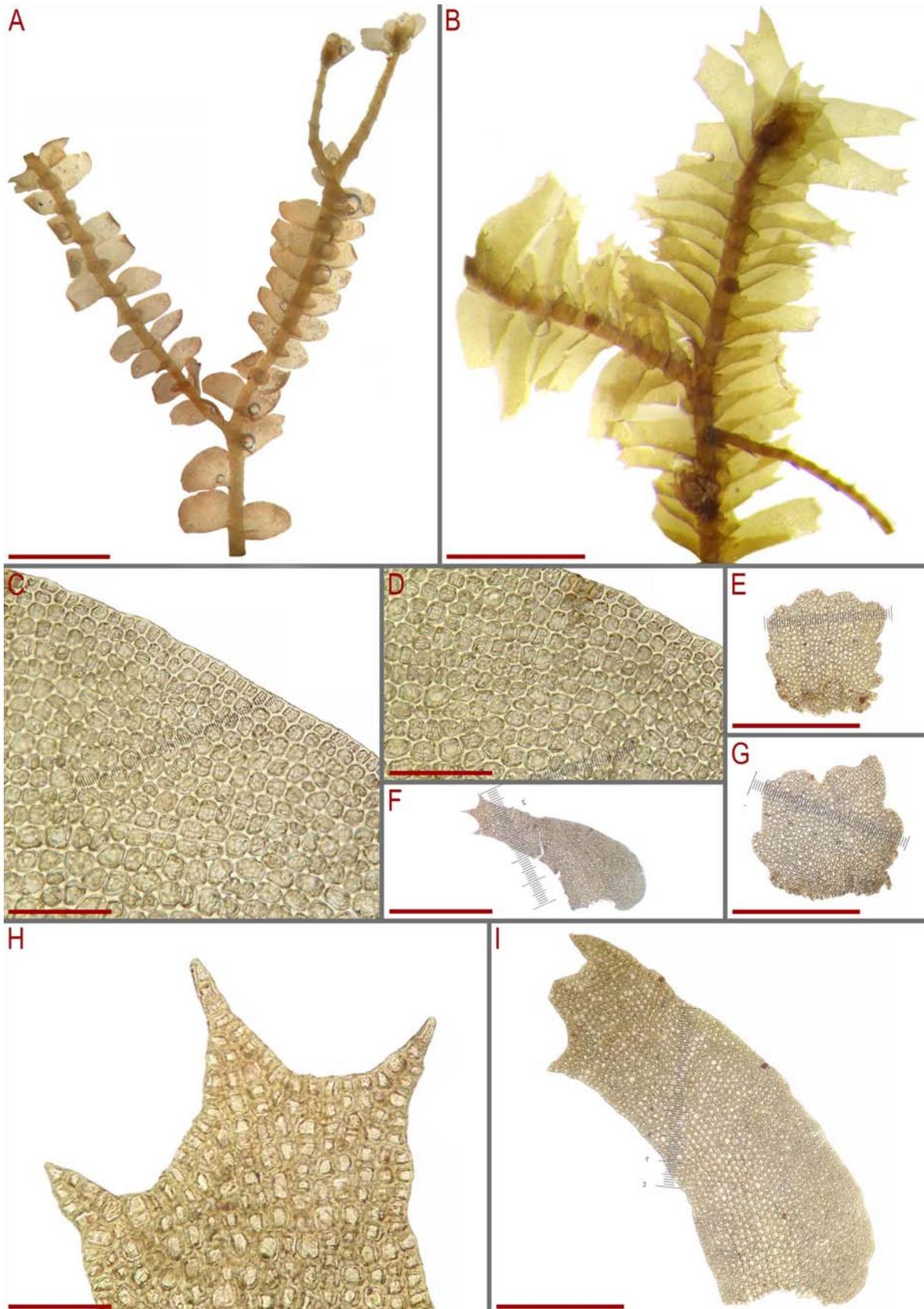


Fig. 9. *Bazzania denudata* (Lindenb. et Gottsche) Trevis. (from STR, s.n.): A: plant habit, fragment, ventral view; *Bazzania faurieana* (Steph.) S.Hatt. (from G00067623): B: plant habit, fragment, ventral view; C, D: leaf margin cells; E, G: underleaves; F, I: leaves; H: leaf apex cells. Scales: 2 mm for A, B; 100  $\mu$ m for C, D, H; 500  $\mu$ m for E, G, I; 1 mm for F.

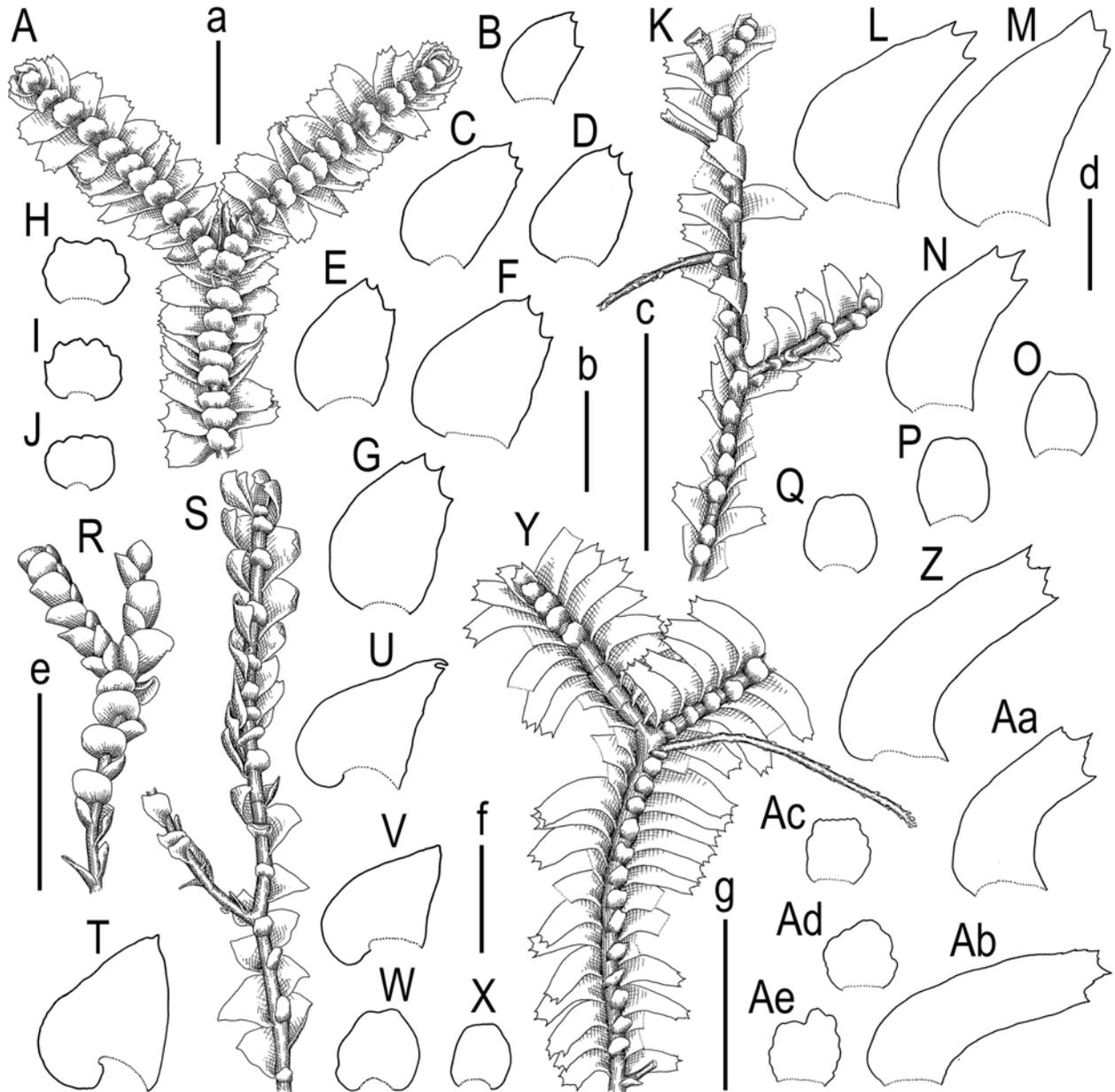


Fig. 10. *Bazzania ovifolia* (Steph.) S. Hatt. (from G00282561/14780): A: plant habit, fragment, ventral view; B–G: leaves; H, I, J: underleaves; *Bazzania ovistipula* (Steph.) Abeyw. (from G00067020/11184): K: plant habit, fragment, ventral view; L, M, N: leaves; O, P, Q: underleaves; *Bazzania pearsonii* Steph. (from G00061249/13890): R: plant habit, fragment, ventral view; S: plant habit, fragment, dorsal view; T, U, V: leaves; W, X: underleaves. *Bazzania manillana* (Gottsche ex Steph.) S.Hatt. (from the lectotype of *Mastigobryum philippinense* G00067096/12907): Y: plant habit, fragment, ventral view; Z, Aa, Ab: leaves; Ac, Ad, Ae: underleaves. Scales: a – 2 mm, for A; b – 1 mm, for B–J, Z, Aa–Ae; c – 5 mm, for K; d – 500  $\mu$ m, for L–Q; e – 5 mm, for R, S; f – 500  $\mu$ m, for T–X; g – 3 mm, for Y.

to large in size, slightly convex to slightly concave (trigones adjacent to external wall always large and convex). Underleaves obliquely spreading with recurved upper third, connate (or adjacent) in one or rarely two sides with the leaves, 1.5–2.5 as wide as stem (when on the stem, not in the slide), in the slide subquadrate, as wide as long or nearly so, roughly crispate along margin.

Comment. 1) The specimen contains aside *Bazzania faurieana* also admixture of *B. tridens*.

2) The description in Hattori and Mizutani (1958) is

somewhat discrepant with the type of *B. faurieana* that is characterized by plants with leaves sublinear almost from the base, underleaves 3–4-lobed with lobe apices rounded, not dentate as in l.c.

3) The species closely related to *B. japonica* (Sande Lac.) Lindb., from which it however differs in more linear leaves, underleaves connate with leaves in one side only and crispate, but not dentate underleaf apex.

*Bazzania himalayana* (Mitt.) Schiffn., Österr. Bot. Z. 49 (4): 132, 1899 (Schiffner, 1899). Bas.: *Mastigo-*

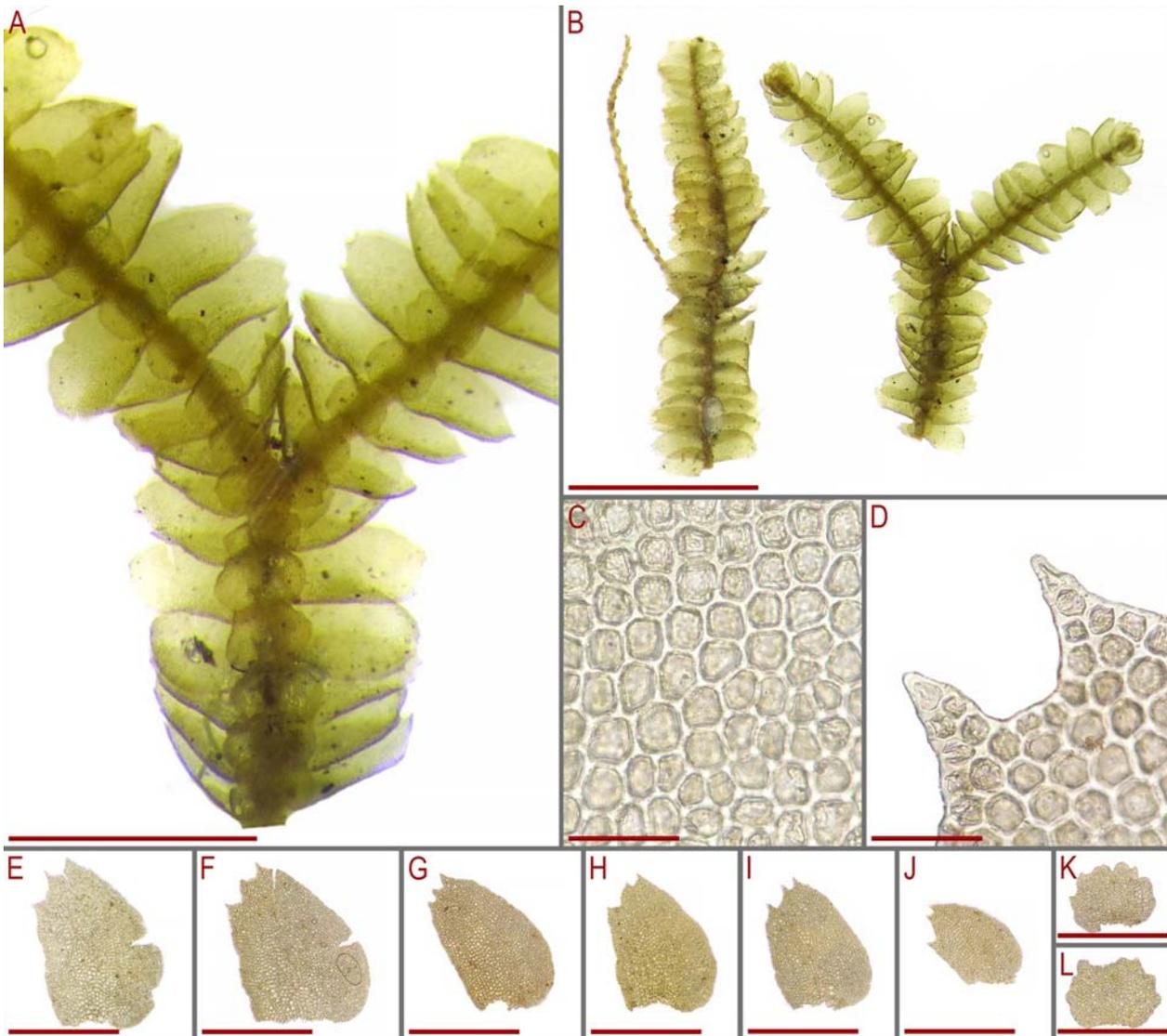


Fig. 11. *Bazzania ovifolia* (Steph.) S. Hatt. (from G00282561/14780): A: plant habit, fragment, ventral view; B: plant habit, fragment, dorsal view and ventral view; C: leaf middle cells; D: leaf apex cells; E–J: leaves; K, L: underleaves. Scales: 2 mm for A; 5 mm for B; 100  $\mu\text{m}$  for C, D; 1 mm for E–L.

*bryum himalayanum* Mitt., J. Proc. Linn. Soc., Bot. 5 (18): 105, 1860 [1861] (Mitten, 1860). “Himalayae orient. reg. temp., Sikkim, 8–10000 ped., J.D.H. (No. 1426, 1432, 1424, 1429)”. Syntype: G00113567! (there are no numbers on the envelope and it is unknown whether the present specimen is authentic. Fig. 12: A–E, Fig. 13.

Description. Plant (only one plant is in the specimen) yellowish brownish, rigid, 3–4 mm wide; rhizoids at the ends of ventral flagellae only; stem 350–450  $\mu\text{m}$  wide, freely dichotomously branched, ventral flagellae common. Leaves contiguous to subimbricate, obliquely inserted, subhorizontally oriented, overlapping 1/3–2/5 of leaf in the base (free above middle), slightly ob-canaliculate, in the slide ovate-narrowly trapezoidal, falcate, 2.0–2.25 $\times$ 1.15–1.6 mm, divided by U- to widely V-shaped sinus into slightly diverging acute triangular lobes. Midleaf cells 25–40 $\times$ 25–30  $\mu\text{m}$ , thin-walled, with moderate to

large in size, nodulose trigones, cells along leaf margin 12.5–25.0  $\mu\text{m}$ , external wall thickened, other walls thin, trigones large to moderate in size, convex to concave, cuticle smooth. Underleaves appressed to the stem to very narrowly spreading and with shallowly recurved apex, 1.4–1.8 as wide as stem, connate (adjacent) to the leaf in one side, transversely elliptic, roughly crispate along margin, margin more intensively (brownish to brown) colored, chlorophyllose area in the middle of basal half of the underleaf, aside cells become gradually larger to the margin, thin-walled, with small trigones and noticeable thickened external wall of the underleaf.

Comment. The species is distinguishable due to underleaf features.

*Bazzania indica* (Gottsche et Lindenb.) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4 (13): 415, 1877 (Trevisan, 1877). Bas.: *Mastigobryum indi-*

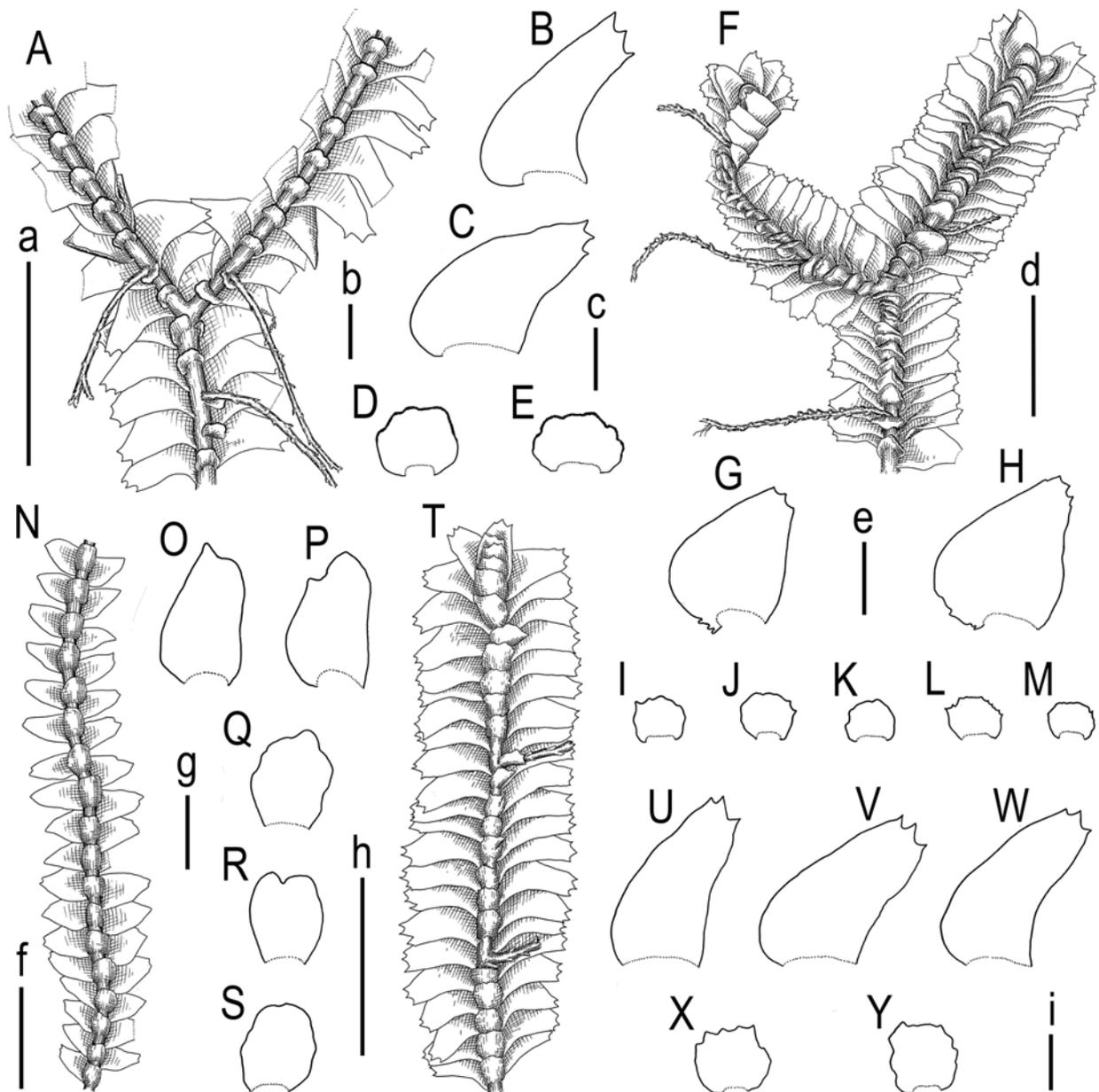


Fig. 12. *Bazzania himalayana* (Mitt.) Schiffn. (from G00113567): A: plant habit, fragment, ventral view; B, C: leaves; D, E: underleaves; *Bazzania indica* (Gottsche et Lindenb.) Trevis. (from G00282451/12692): F: plant habit, fragment, ventral view; G, H: leaves; I–M: underleaves; *Bazzania mayebarae* S.Hatt. (from NICH-20445): N: plant habit, fragment, ventral view; O, P: leaves; Q, R, S: underleaves; *Bazzania oshimensis* (Steph.) Horik. (from G00067019): T: plant habit, fragment, ventral view; U, V, W: leaves; X, Y: underleaves. Scales: a – 5 mm, for A; b – 1 mm, for B, C; c – 500  $\mu$ m, for D, E; d – 3 mm, for F; e – 1 mm, for G–M; f – 1 mm, for N; g – 300  $\mu$ m, for O–S; h – 5 mm, for T; i – 1 mm, for U–Y.

cum Gottsche et Lindenb., Syn. Hepat. 2: 230, 1845 (Gottsche et al., 1845). Singapore “in *Dacallia parvula* cum *M. concavula*”. Isotype: G00282451/12692! Fig. 12: F–M, Fig. 14.

Description. Plant (the only one plant is in the specimen) yellowish brownish, merely rigid; rhizoids only at the ends of ventral flagellae; stem 250–300  $\mu$ m wide, dichotomously branched, with several ventral flagellae, flagellae sometimes branched again. Leaves obliquely inserted, ob-canaliculate-convex, loosely turned to ventral side, very densely inserted, imbricate, covering 2/3–

3/4 of the leaf situated above, obliquely triangular-ovate, 1.5–1.75 $\times$ 1.25–1.5 mm, with sometimes roughly but bluntly toothed dorsal base, apex narrow, 1/4–1/6 of the widest place of the leaf, divided by U- to crescentic sinus into three acute lobes, sometimes with additional short teeth and denticulations near lobe apices (rarely below), leaf margin sometimes crenulate due to protrudent marginal cells. Midleaf cells thin-walled, with large and convex trigones, with visible median lamina, cuticle smooth, 25–35 $\times$ 15–25  $\mu$ m; cells along leaf margin with thickened external wall, other walls slightly thickened, trigo-

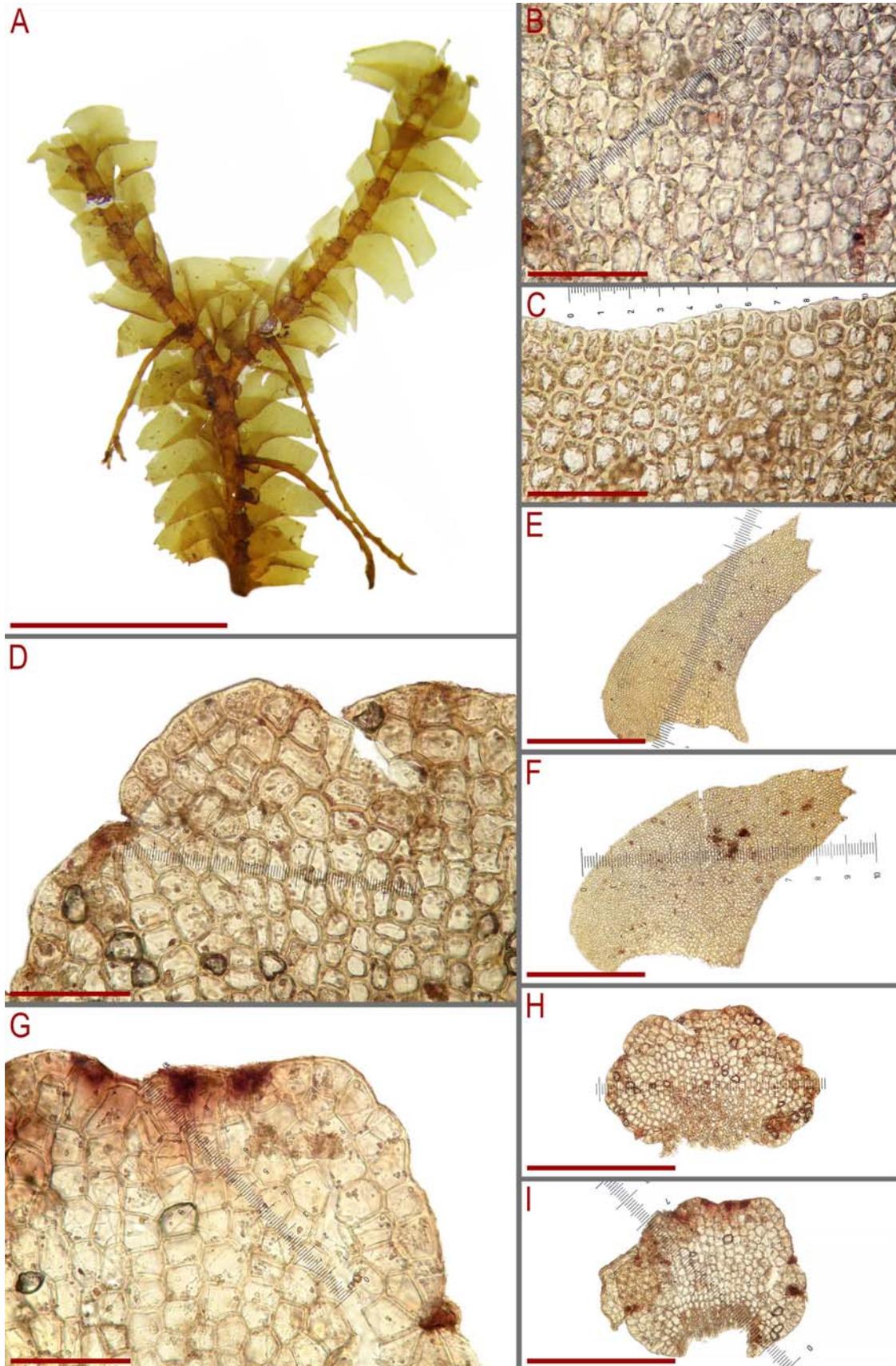


Fig. 13. *Bazzania himalayana* (Mitt.) Schiffn. (from G00113567): A: plant habit, fragment, ventral view; B: leaf middle cells; C: leaf margin cells; D: underleaf apex cells; E, F: leaves; G: underleaf margin cells; H, I: underleaves. Scales: 5 mm for A; 100  $\mu$ m for B, C, D, G; 1 mm for E, F; 500  $\mu$ m for H, I.

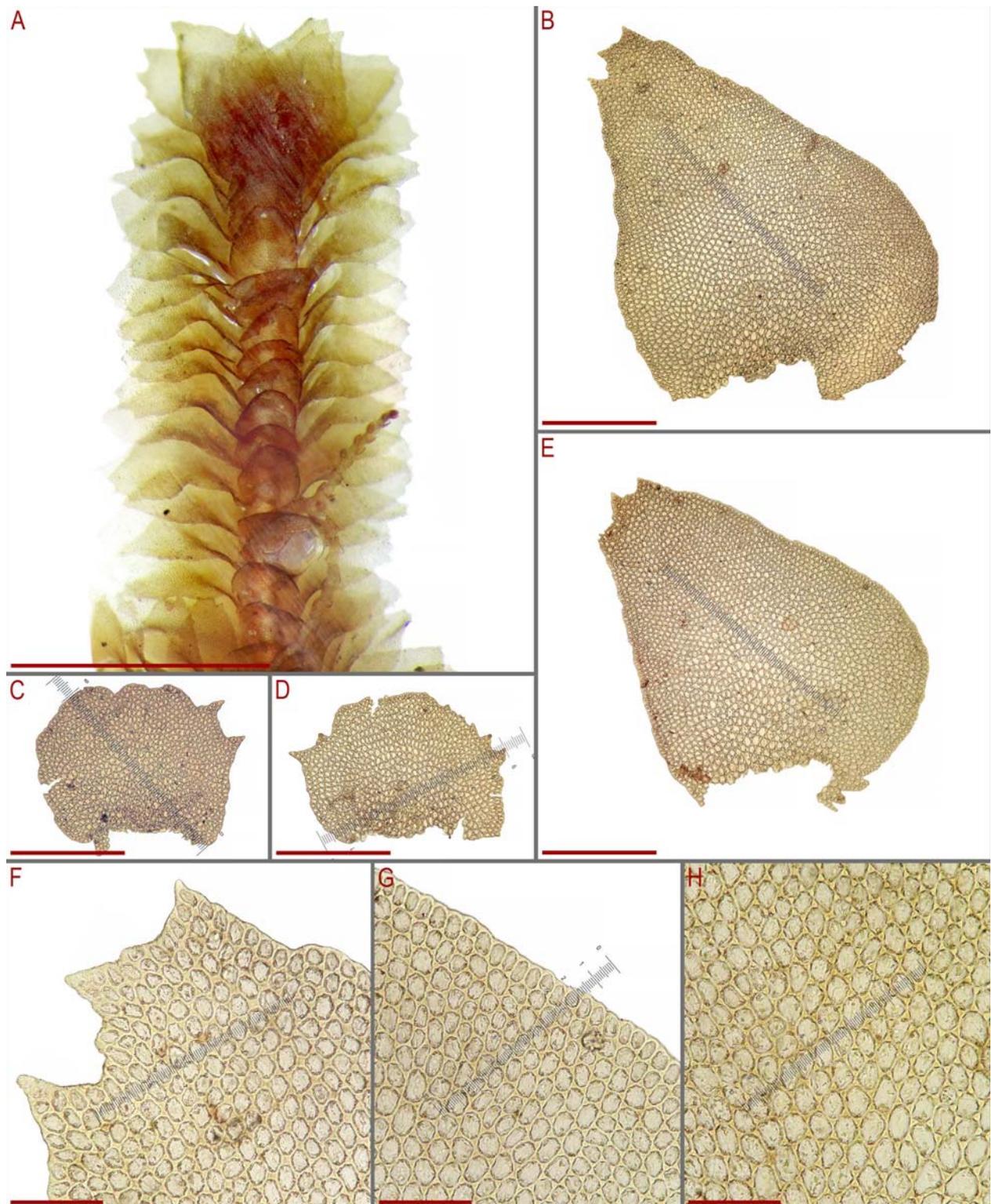


Fig. 14. *Bazzania indica* (Gottsche et Lindenb.) Trevis. (from G00282451/12692): A: plant habit, fragment, ventral view; B, E: leaves; C, D: underleaves; F: leaf apex cells; G: leaf margin cells; H: leaf middle cells. Scales: 3 mm for A; 500  $\mu$ m for B–E; 100  $\mu$ m for F, G, H.

nes large, convex, cells tangentially oblong, 15–20  $\mu$ m along margin. Underleaves obliquely spreading, recurved in upper halves and loosely and widely recurved below, 2.0–2.5 as wide as stem when on the stem (not in the slide), connate in the both sides with leaves, reniform to

transversely elliptic, wider than long, coarsely crispate, sometimes with 1–5 teeth instead crispae, with auriculate base.

Comment. The species is distinguishable due to narrow apex, large trigones, acute shortly lobed apical part

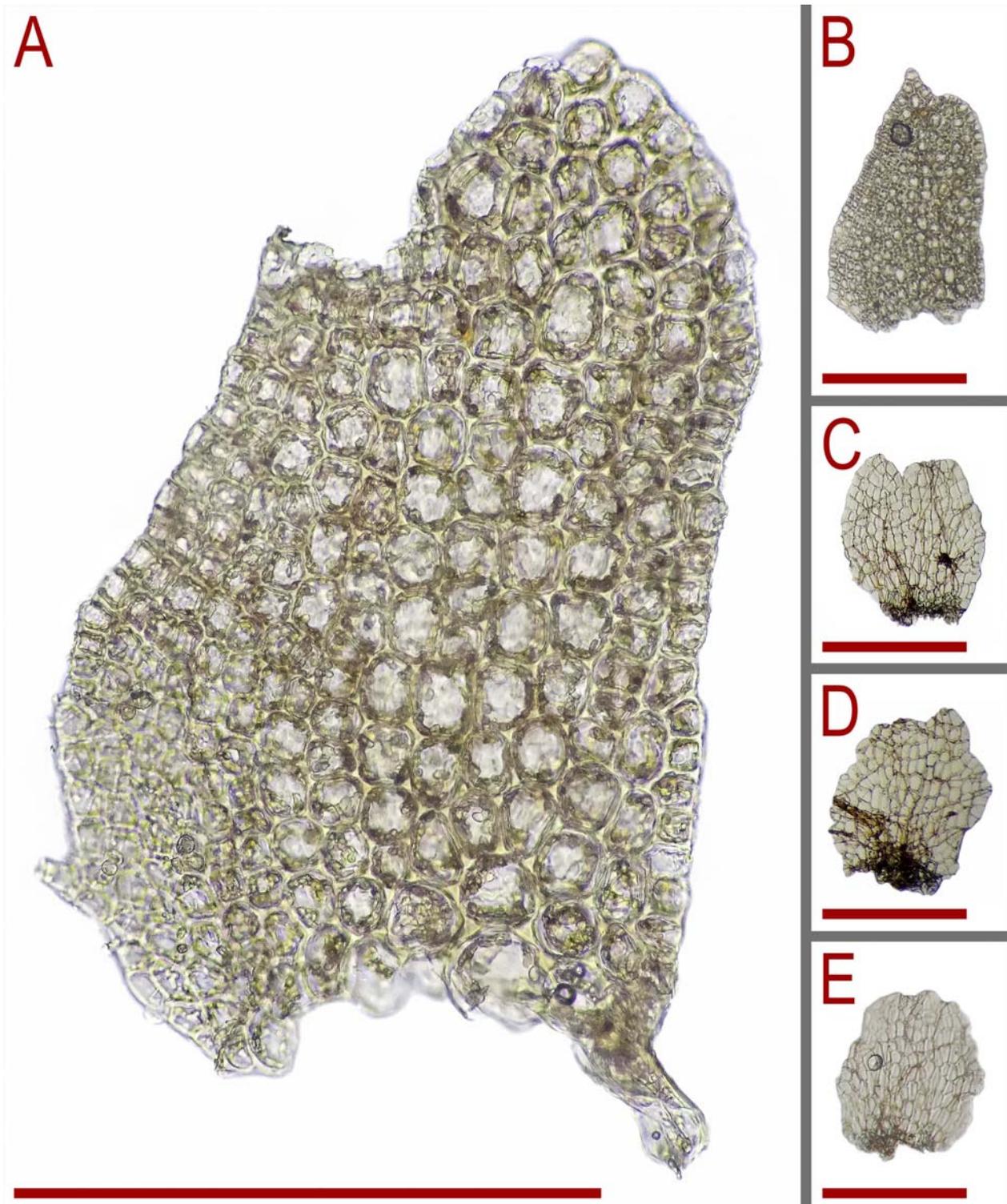


Fig. 15. *Bazzania mayebarae* S. Hatt. (from holotype NICH-20445): A, B: leaves; C, D, E: underleaves. Scales: 300  $\mu$ m for A–E.

of the leaf, recurved, crispate, with some teeth underleaves and closely situated, imbricate leaves with obtuse teeth near dorsal leaf base.

*Bazzania mayebarae* S.Hatt., J. Hattori Bot. Lab. 19: 91, 1958 (Hattori & Mizutani, 1958).

Japan. Kumamoto Prefecture ['Higo'], Koonose, 60 m., K. Mayebara 2827, 28 January 1951. Holotype:

NICH-20445! Fig. 12: N–S, Fig. 15.

Comment. The species description is provided by Hattori and Mizutani (1958) and seems no more description is necessary. The problem in delimitation with *B. debilis* is discussed under the latter.

*Bazzania oshimensis* (Steph.) Horik. J. Sci. Hiroshima Univ., Ser. B, Div. 2, Bot. 2: 197 1934 *Mastigobryum*

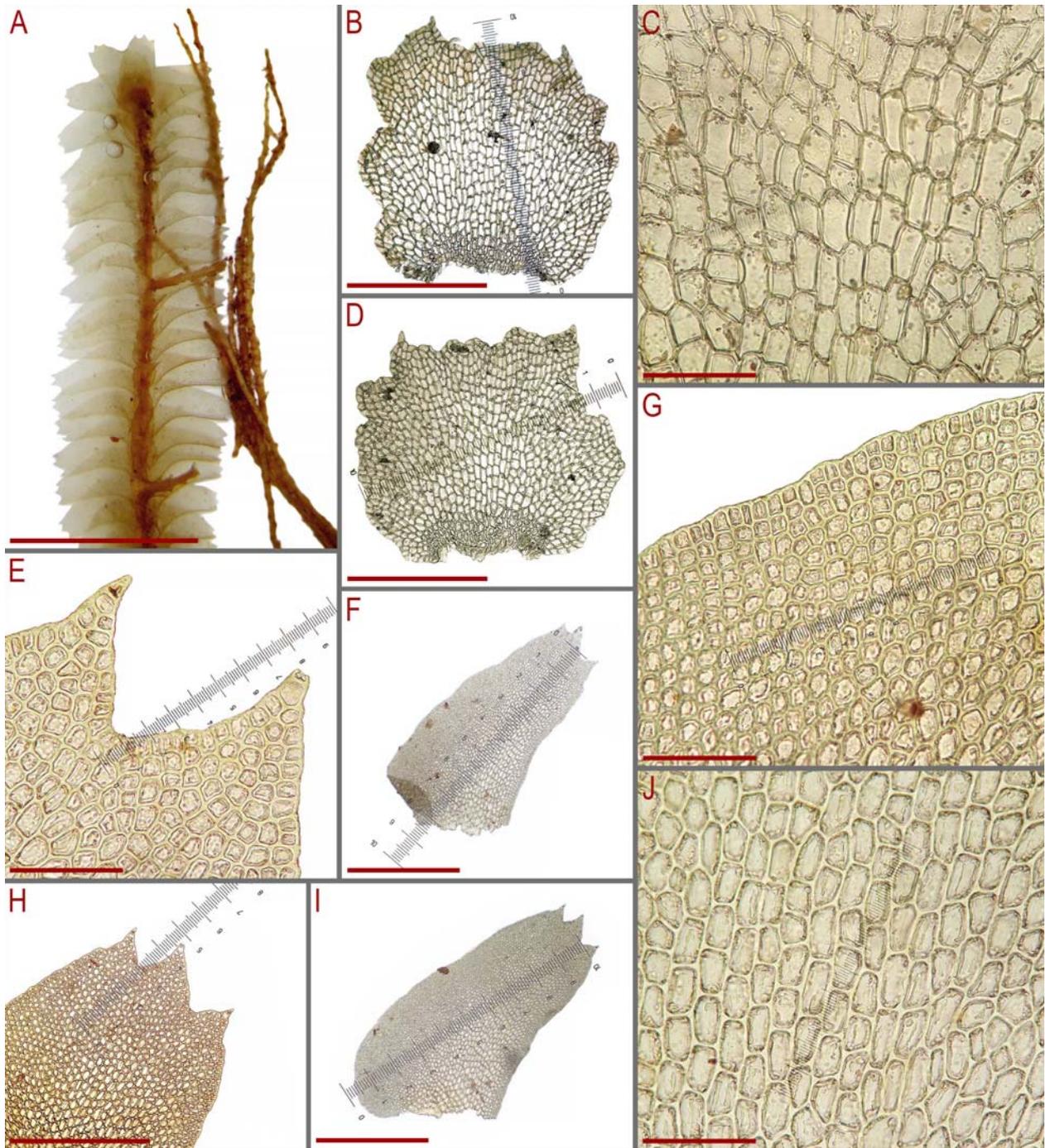


Fig. 16. *Bazzania oshimensis* (Steph.) Horik. (from G00067019): A: plant habit, fragment, ventral view; B, D: underleaves; C: underleaf middle cells; E: leaf apex cells; F, I: leaves; G: leaf margin cells; H: leaf apex; J: leaf middle cells. Scales: 5 mm for A; 500 µm for B, D, H; 100 µm for C, E, G, J; 1 mm for F, I.

*oshimensis* Steph. Species Hepaticarum 3: 466. 1908. Japan. Oshima. Faurie 639, July 1900. Lectotype (selected here): G00067019! Fig. 12: T–Y, Fig. 16.

Description. Plants (only two plants are in the type) yellowish brownish, more or less rigid, 3.5–4.3 mm wide, 4–6 cm long; stem 380–420 µm wide, dichotomously branched, ventral flagellae numerous; rhizoids seen only at the ends of ventral flagellae, where obliquely upward spreading in unclear fascicles, grayish. Leaves obliquely

inserted, ob-canaliculate, slightly turned to ventral side or not, obliquely narrowly lingulate-ovate, 2.0–2.3×1.1–1.4 mm, divided by V-shaped sinus into three triangular acute lobes. Midleaf cells much larger in the midline and then to leaf base than in the margins, oblong, 35–60×20–32 µm, thin-walled, with large and convex trigones, cells along leaf margin 7.5–15.0 µm, commonly tangentially elongate, unequally thickened, become gradually thinner inward of the leaf (thin-walled after 5–7 rows of cells

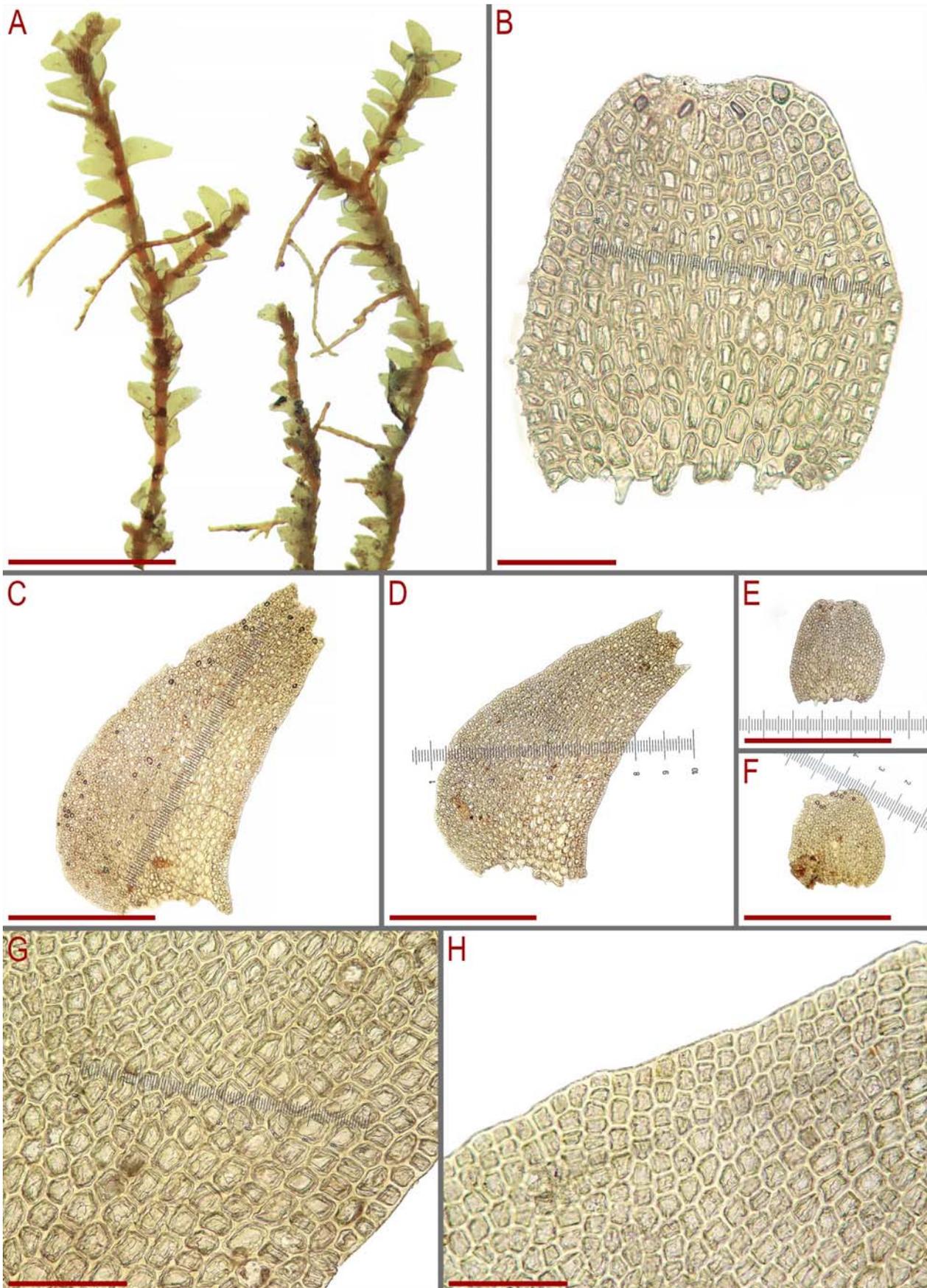


Fig. 17. *Bazzania ovistipula* (Steph.) Abeyw. (from G00067020/11184): A: plant habit, fragments; B, E, F: underleaves; C, D: leaves; G: leaf middle and margin cells; H: leaf margin cells. Scales: 5 mm for A; 100 µm for B, G, H; 500 µm for C–F.

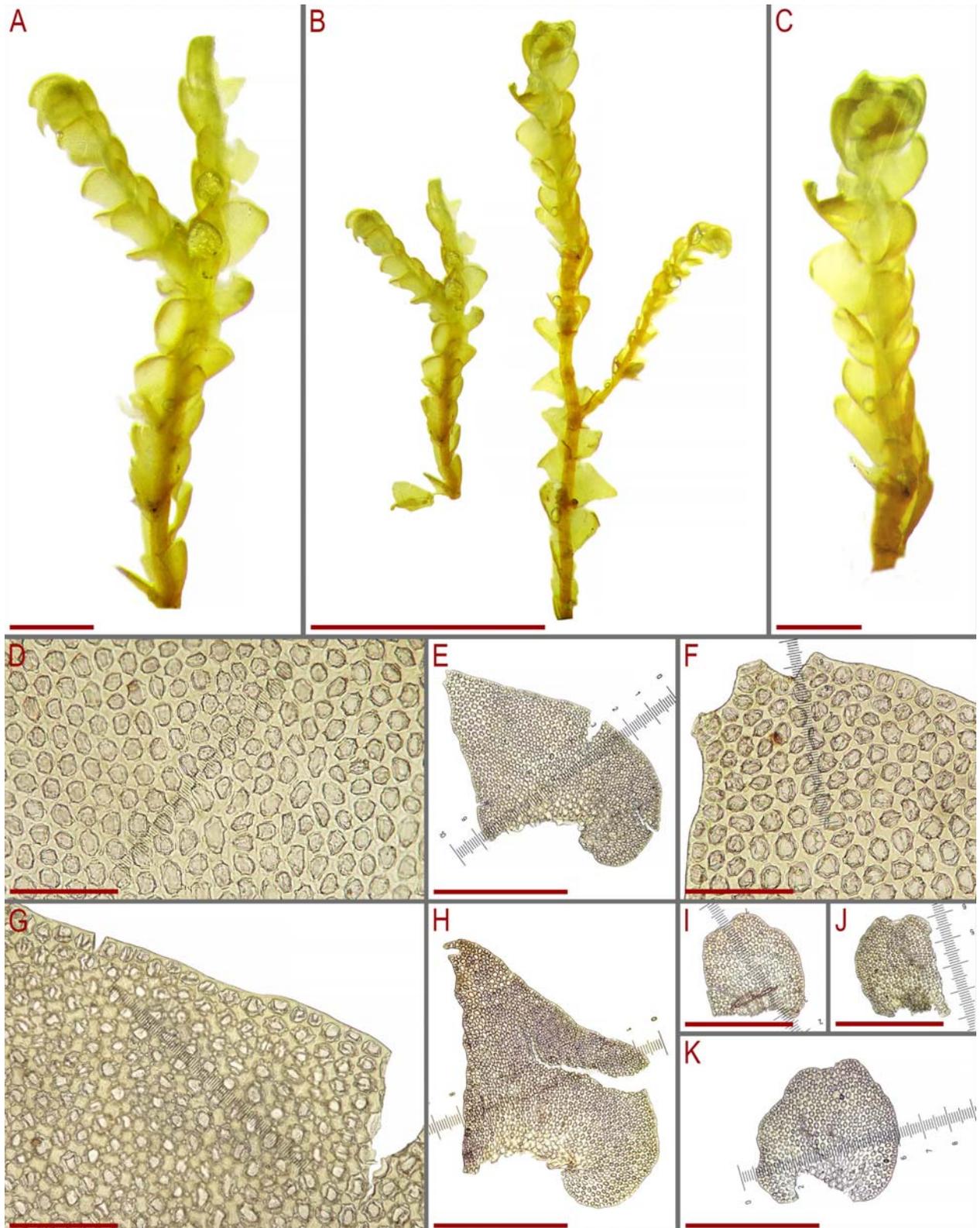


Fig. 18. *Bazzania pearsonii* Steph. (from G00061249/13890): A, B, C: plant habit, fragments; D: leaf middle cells; E, H: leaves; F: leaf apex cells; G: leaf margin cells; I, J, K: underleaves. Scales: 1 mm for A, C, I, J; 5 mm for B; 100  $\mu$ m for D, F, G; 500  $\mu$ m for E, H, K.

inward), cuticle smooth throughout, with the exception of apical part of lobes, where it may be loosely verrucose. Underleaves appressed to the stem or narrowly spreading, 1.5–1.8 as wide as stem, not or loosely undulate along

margin, connate with leaf in one side, as wide as long or wider than long, subquadrate, roughly crispate along margin, with 2-several teeth in the apex (the main teeth are at the corners where lateral side meets apical one),

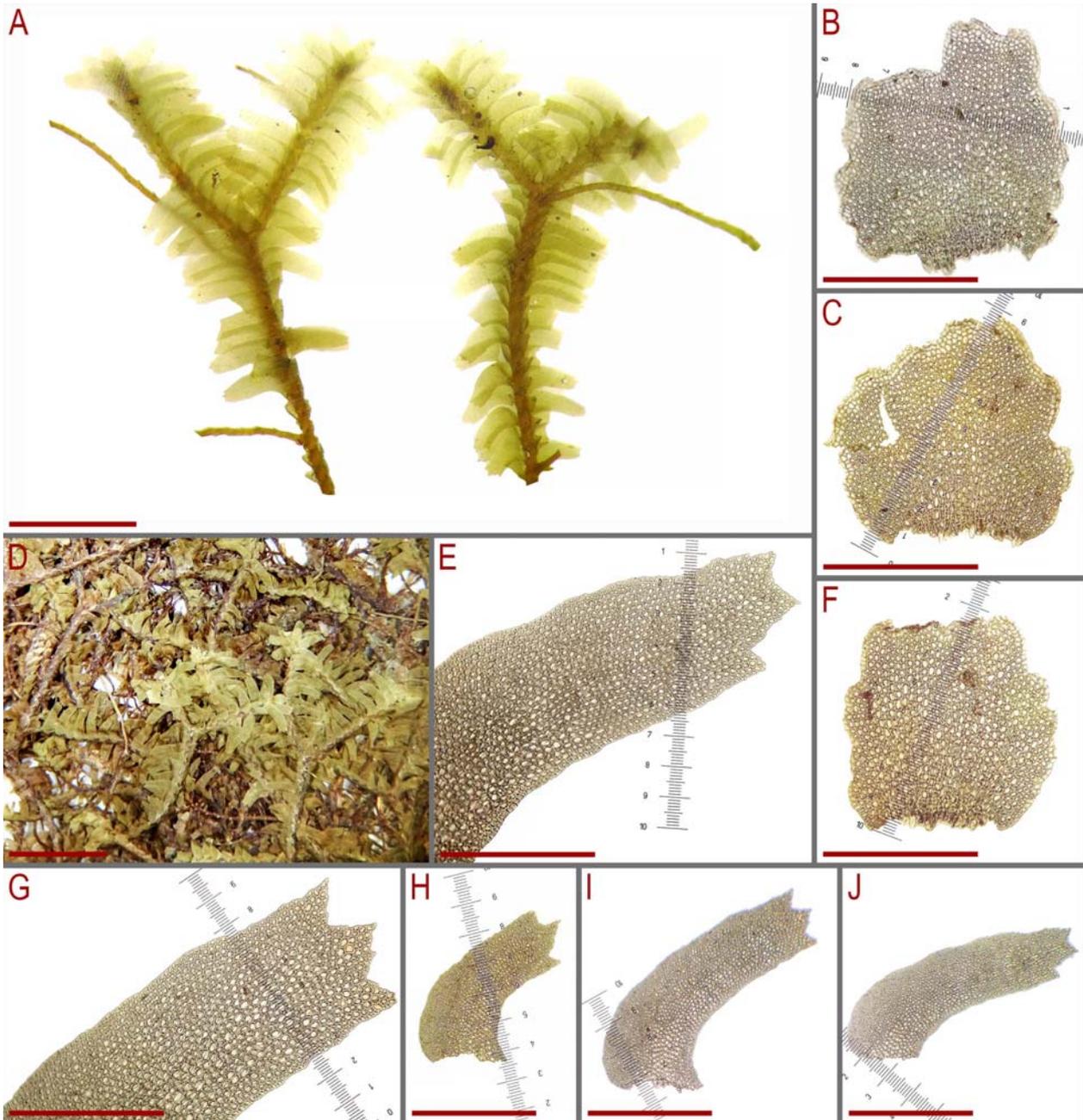


Fig. 19. *Bazzania manillana* (Gottsche ex Steph.) S.Hatt. (from G00067096/12907): A: plant habit, fragments; B, C, F: underleaves; D: mat; E, G: leaf middle and apex cells; H, I, J: leaves. Scales: 3 mm for A; 500 µm for B, C, E, F, G; 5 mm for D; 1 mm for H, I, J.

hyaline with no content in the cells, thin-walled, with wanting to vestigial trigones (the exception is only in narrow zone in the underleaf base, where the ‘normal’ cells are developed).

Comment. Zhou et al. (2012b) have published the photograph of the “type of *Bazzania oshimensis*” (fig. 22 in l.c.) that illustrate possibly another species, different from the plants present here (Fig. 12: T–Y, Fig. 16), although the field number is the same with the field number of the specimen in G00067019 (Faurie 639). Plants differs noticeable in the more oblong leaves and underleaves. Meantime we think that the specimen in G selected here as the lectotype contain plants on those

Stephani’s description was based, because the envelope contains Stephani’s handwritten measurements of the cells as well as the name of the taxon: <https://www.ville-ge.ch/musinfo/bd/cjb/chg/adetail.php?id=113139&base=img&lang=en>. Taking into account Zhou et al. (2012b) did not make any lectotypification procedures we guess the specimen from G should be selected as the lectotype.

*Bazzania ovistipula* (Steph.) Abeyw., Ceylon J. Sci., Biol. Sci. 2 (1): 45, 1959 (Abeywickrama, 1959). Bas.: *Mastigobryum ovistipulum* Steph., Bull. Herb. Boissier (sér. 2) 8 (10): 760 (444), 1908 (Stephani, 1908a). Sri Lanka [Ceylon]. “Ins. Ceylon prov. centr. in montosis

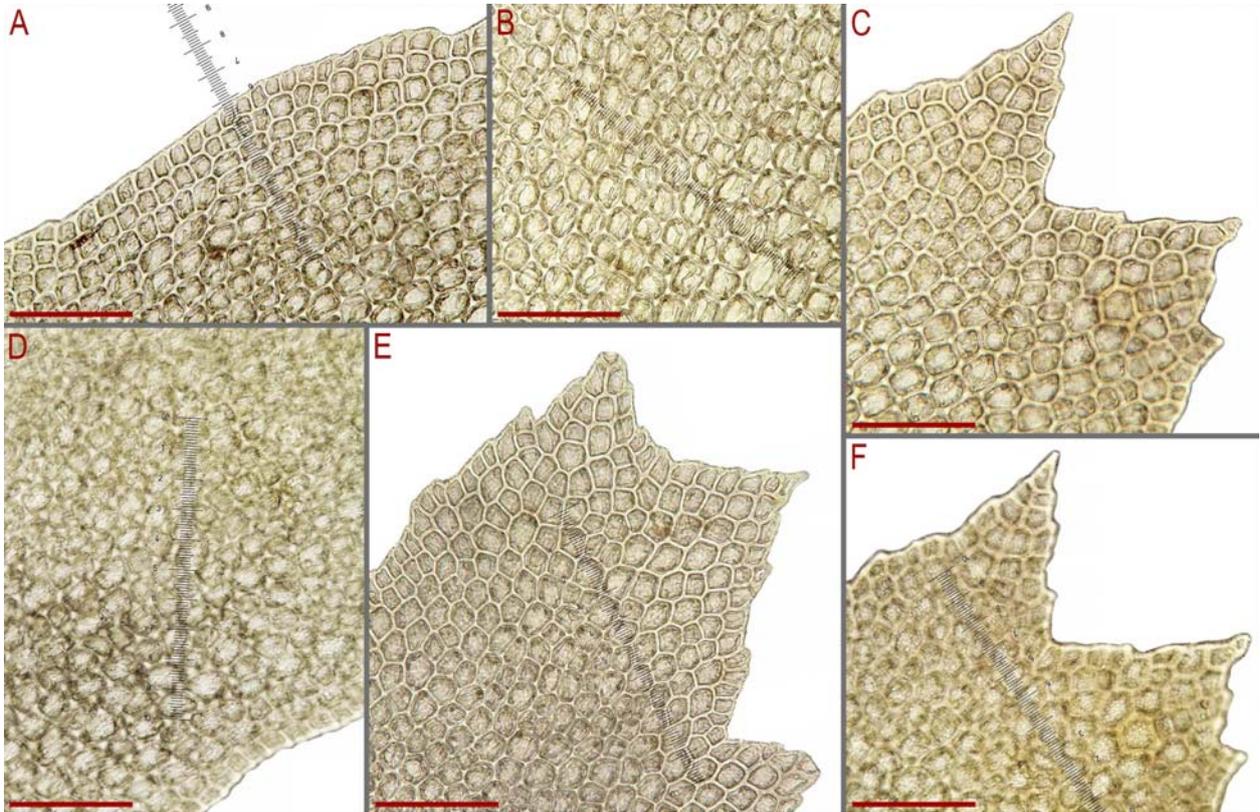


Fig. 20. *Bazzania manillana* (Gottsche ex Steph.) S.Hatt. (from G00067096/12907): A: leaf margin cells; B: leaf middle cells; C, E: leaf apex cells; D: papilla of the leaf; F: papilla of the leaf apex. Scales: for A–F—100 µm.

prope Nuwara Eliya”. M. Fleischer 10 February 1898. Lectotype (selected here): G00067020/11184! Fig. 10: K–Q, Fig. 17.

Description. Plants yellowish brownish, merely rigid, 1.5–2.2 mm wide, 2–4 cm long; rhizoids not seen; stem 230–270 µm wide, freely dichotomously branched, with numerous ventral flagellae. Leaves contiguous to slightly overlapping in the base, ob-canaliculate-convex, slightly to evidently turned to ventral side, 850–1200×400–600 µm, obliquely ovate-narrowly trapezoidal, somewhat falcate, divided by U-shaped sinus into three narrow triangular, acute, not diverging lobes. Middle leaf cells 25–35×20–30 µm, thin-walled, trigones large (rarely moderate in size), convex, cuticle smooth, cells along margin 15–24 µm, with mostly unequally thickened walls, trigones adjacent to outer wall large and convex, trigones inward – moderate and concave, cuticle smooth. Underleaves free or slightly connate with leaf in one side, 0.8–1.2 as wide as the stem, as wide as long or longer than wide, margin entire, apex emarginate.

Comment. Distinguishable due to acute and more or less large to moderate in size trigones in leaf cells, commonly longer than wide, entire, with emarginate apex underleaves and leaves slightly turned to ventral side. Some modification from shady habitats (or otherwise suppressed stations) of *Bazzania praerupta* may be hardly distinguishable from the present species and their relationships need to be studied by genetic methods.

*Bazzania pearsonii* Steph., Hedwigia 32 (4): 212, 1893 (Stephani, 1893). Ireland. Killarney. Eagles Nest. Stewart et Holt. Lectotype (selected here): G00061249/13890! Fig. 10: R–X, Fig. 18.

Description. Plants brownish to yellowish brownish, merely soft, 0.8–1.2 mm wide and 2–6 cm long; rhizoids rare, in short erect spreading grayish to colorless fascicles; stem 160–250 µm wide (in well developed plants) sparsely dichotomously branched, ventral flagellae sparse, isophyllous (actually with not so dramatically reduced leaves as commonly in other taxa of *Bazzania*). Leaves distant to contiguous, obliquely inserted and oriented, convex, strongly turned to ventral side (sometimes as to enroll the stem and touch and overlap the opposite leaf of the pair), with large auriculate appendage in dorsal base, ovate-triangular with very narrow, shortly (1–)2(–3)-dentate apex 700–900×700–800 µm. Middle leaf cells 15–37×15–20 µm, thin-walled, trigones coarsely nodulose, very large, with visible median lamina, cells along margin 15–25 µm, external wall thickened, other walls thin, trigones coarsely nodulose, large, sometimes confluent, cuticle smooth throughout. Underleaves 1.0–1.8 as wide as stem, erect to obliquely spreading, sometimes with recurved apex, commonly adjacent to the leaf base in one side, lingulate to lingulate-ovate, shallowly crispate along margin, with commonly emarginate apex.

Comment. The present species, as it is written by Stephani in original description (1893), is similar to

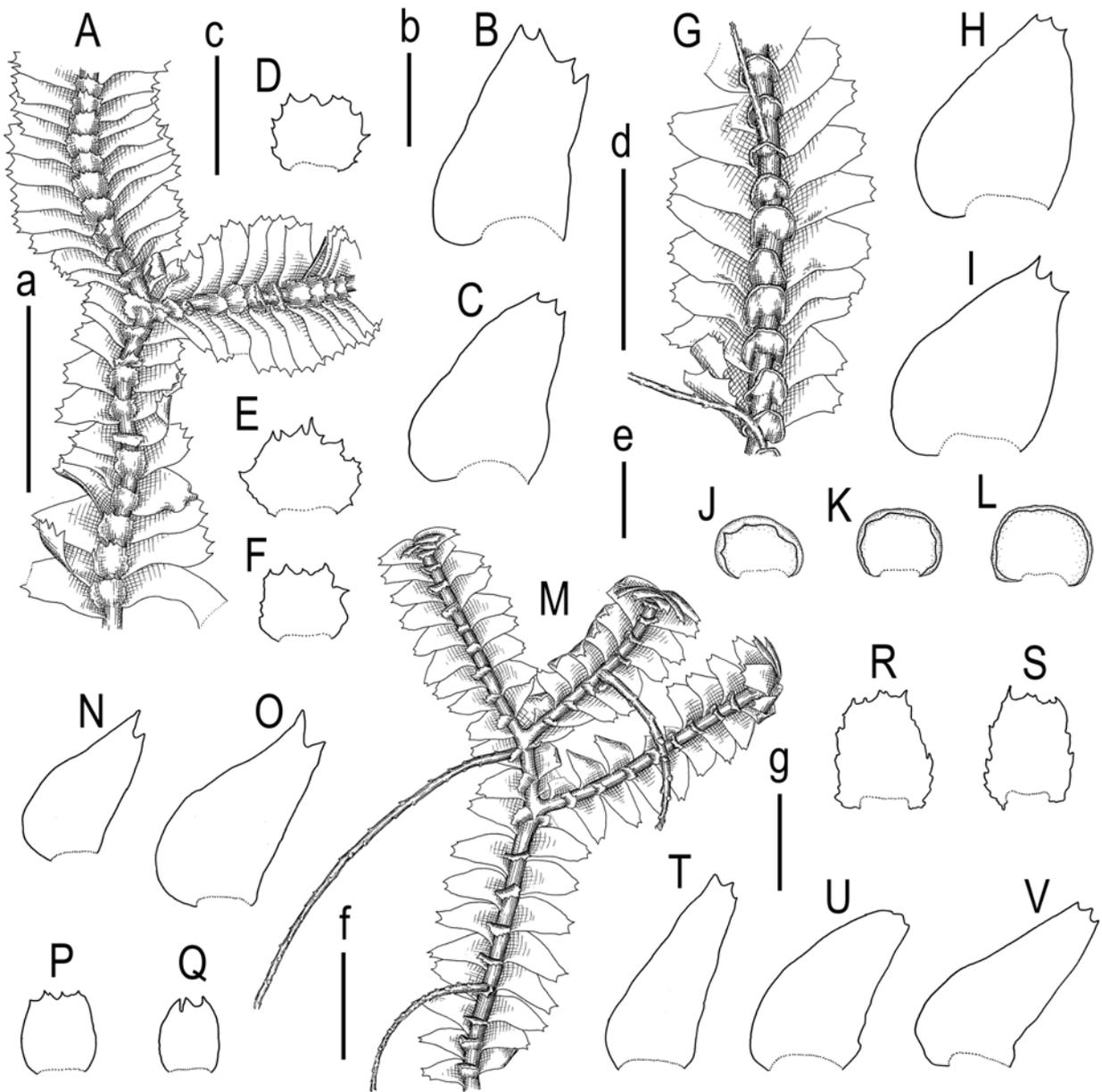


Fig. 21. *Bazzania pompeana* (Sande Lac.) Mitt. (from G00282483): A: plant habit, fragment, ventral view; B, C: leaves; D, E, F: underleaves; *Bazzania revoluta* (Steph.) N.Kitag. (from G00112684): G: plant habit, fragment, ventral view; H, I: leaves; J, K, L: underleaves; *Bazzania sikkimensis* (Steph.) Herzog (from G00067029/12557): M: plant habit, fragment, ventral view; N, O: leaves; P, Q: underleaves; *Bazzania sumatrana* (Sande Lac. ex Steph.) Steph. (from G00282523): R, S: underleaves; T, U, V: leaves. Scales: a – 5 mm, for A; b – 1 mm, for B, C; c – 1 mm, for D, E, F; d – 3 mm, for G; e – 1 mm, for H–L, N–Q, T, U, V; f – 2 mm, for M; g – 500  $\mu$ m, for R, S.

*Bazzania deflexa* (Mart.) Carruth. (that is now treated as the synonym of *B. tricrenata* (Wahlenb.) Lindb.), indeed both taxa similar in general appearance (narrow triangular leaves, dorsal leaf base auriculate appendage, strongly turned to dorsal side leaves and even the coloration). Besides, the species is resembling in the similar ways poorly known Sino-Himalayan *Bazzania imbricata* (Mitt.) S. Hatt. However, the species is different from both in prominently large trigones. The identity of the plants coming from West Europe with the East Asian accessions should be questioned.

*Bazzania manillana* (Gottsche ex Steph.) S.Hatt., Bot. Mag. (Tokyo) 64 (755/756): 113, 1951 (Hattori, 1951). Bas.: *Mastigobryum manillanum* Gottsche ex Steph., Hedwigia 25 (5): 204, 1886 (Stephani, 1886b). The study is based on *Mastigobryum philippinense* J.B. Jack ex Steph. Hedwigia 25(5): 206 1886, regarded as the synonymous with *Bazzania manillana* in Söderström et al. (2016). Philippines. Luzon. G. Wallis 1870. Lectotype of *Mastigobryum philippinense* (selected here): G00067096/12907! Note: another specimen marked as *Mastigobryum philippinense* (G00282489!) does not con-

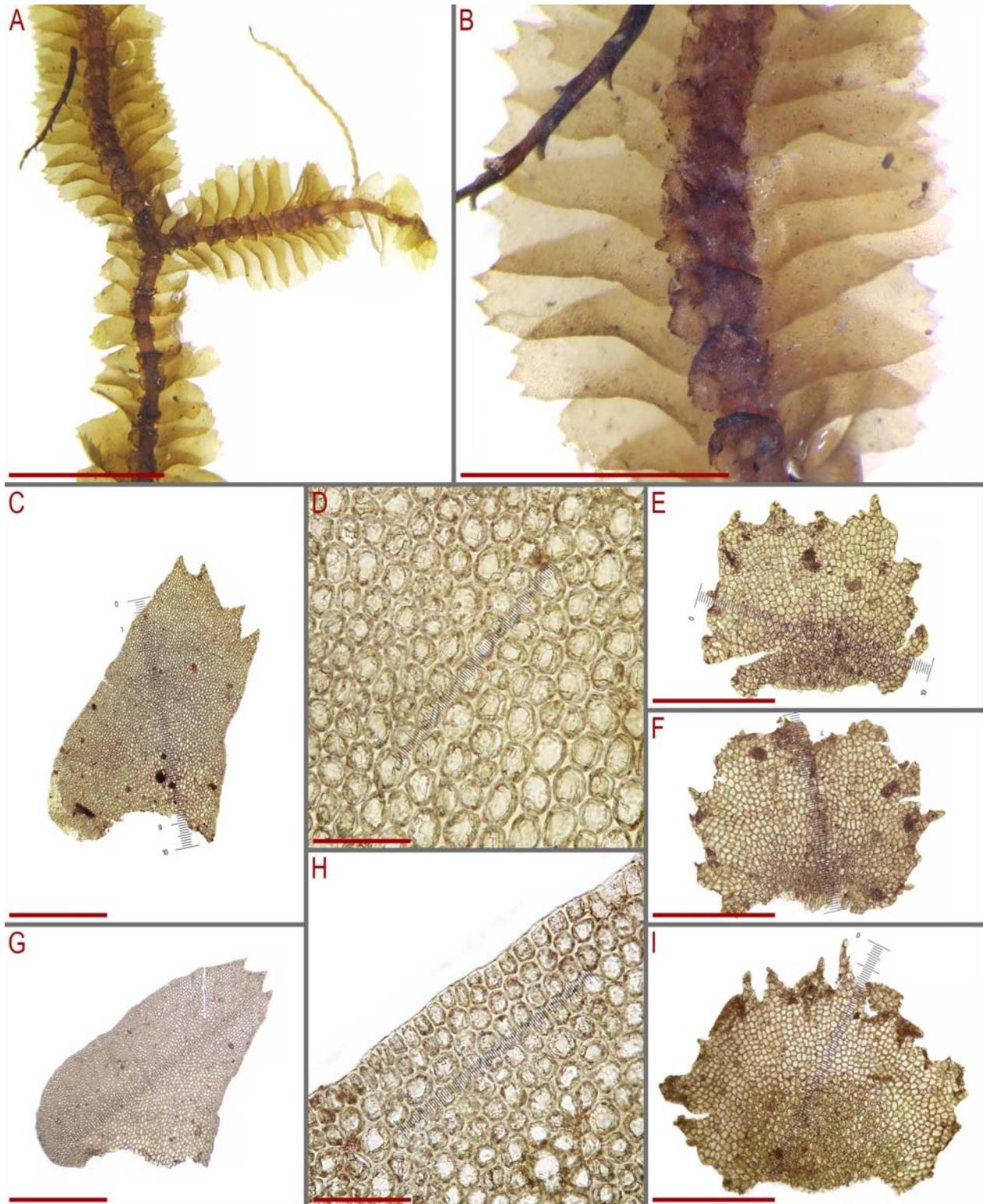


Fig. 22. *Bazzania pompeana* (Sande Lac.) Mitt. (from G00282483): A, B: plant habit, fragment, ventral view; C, G: leaves; D: leaf middle cells; E, F, I: underleaves; H: leaf margin cells. Scales: 5 mm for A; 3 mm for B; 1 mm for C, G; 500  $\mu\text{m}$  for E, F, I; 100  $\mu\text{m}$  for D, H.

tain *Bazzania* (only some branches of *Lejeunea* Lib. are present inside). Fig. 10: Y–Ae, Fig. 19, Fig. 20.

Description. Plants greenish brownish, merely soft, dorsiventrally flattened, 3–4 mm wide, 3–5 cm long; rhizoids not seen; stem 320–430  $\mu\text{m}$  wide, freely dichotomously branched, ventral flagellae common. Leaves con-

tiguous to slightly overlapping, not turned to ventral side, sublinear, distinctly falcate, 1250–2000 $\times$ 620–730  $\mu\text{m}$ , apex trilobate, divided by V-shaped sinus, lobes triangular, acute, sometimes (well developed as usual) shortly but sharply dentate to denticulate or crenulate, leaves sometimes slightly crispate in upper third. Midleaf cells

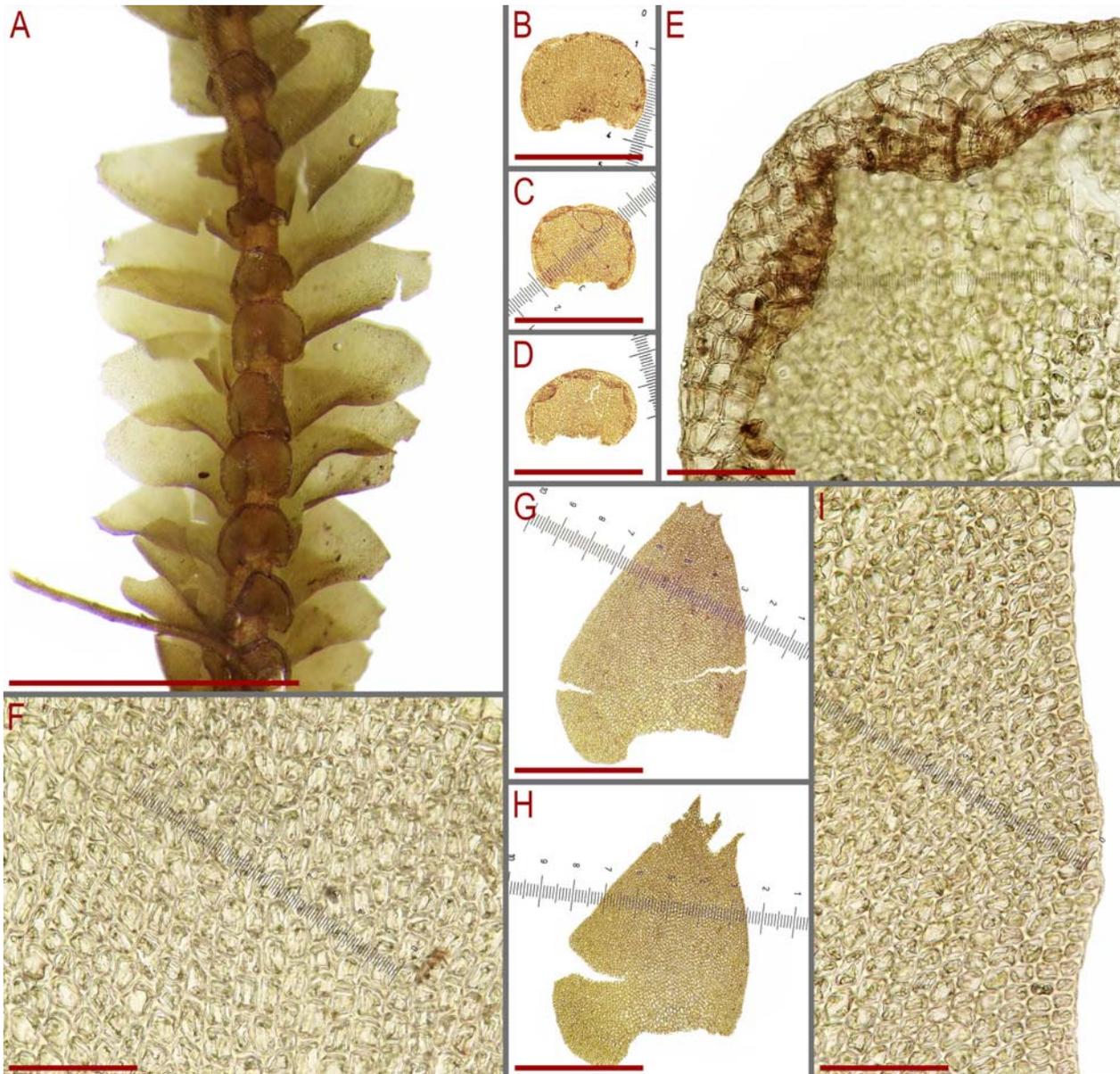


Fig. 23. *Bazzania revoluta* (Steph.) N.Kitag. (from G00112684): A: plant habit, fragment, ventral view; B, C, D: underleaves; E: underleaf margin cells; F: leaf middle cells; G, H: leaves; I: leaf margin cells. Scales: 3 mm for A; 1 mm for B, C, D, G, H; 100  $\mu$ m for E, F, I.

20–32 $\times$ 20–30  $\mu$ m, thin-walled, with moderate in size, convex trigones, cuticle distinctly papillose, cells along leaf margin 10–18  $\mu$ m, thick-walled, with small trigones, becoming inward more thin-walled and with larger trigones, cuticle finely papillose, in the leaf apex with distinct papillose-verrucose cuticle. Underleaves 1.2–1.4 times wider than stem (when on the stem, not in the slide), connate or (mostly) adjacent with leaf in one or both sides, narrowly obliquely spreading, chlorophyllose with the exception of marginal 1–4 rows of cells, where discolored, thin-walled and mostly with vestigial trigones, margin crispate, as wide as long or slightly wider than long.

Comment. The species is distinguishable due to papillose cuticle, somewhat dentate lobes, sublinear leaves

and narrow band of discolored cells along underleaf margin.

*Bazzania pompeana* (Sande Lac.) Mitt., Trans. Linn. Soc. London, Bot. 3 (3): 200, 1891 (Mitten, 1891). Bas.: *Mastigobryum pompeanum* Sande Lac., Ann. Mus. Bot. Lugduno-Batavi 1: 304, 1864 (Sande Lacoste, 1864). Japan. Siebold, Pompe van Meerdervoort. Syntype: Coll. Pompe van Meerdervoort. G00282483! Note: three specimens are present in G. Two other G00282484! and G00282485! are collected by Siebold. Plants in them are identical to G00282483!, but lesser in amount. Fig. 21: A–F, Fig. 22.

Description. Plants brownish to yellowish brownish, more or less rigid, 4–5 mm wide and 3–6 cm long; rhizoids not seen; stem freely dichotomously branched, ven-

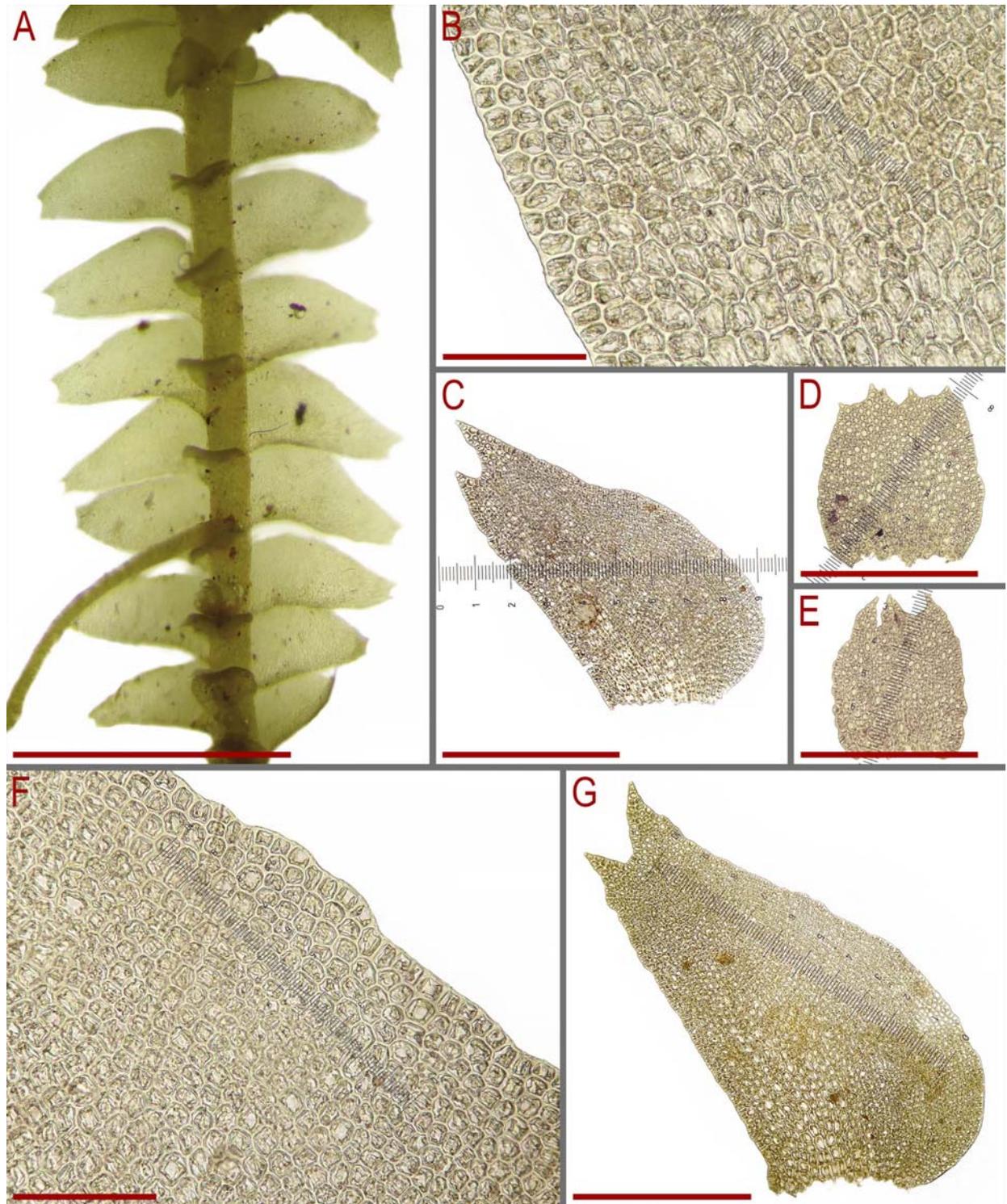


Fig. 24. *Bazzania sikkimensis* (Steph.) Herzog (from G00067029/12557): A: plant habit, fragment, ventral view; B, F: leaf middle and margin cells; C, G: leaves; D, E: underleaves. Scales: 2 mm for A; 100  $\mu$ m for B, F; 500  $\mu$ m for C, D, E, G.

tral flagellae common, 450–575  $\mu$ m wide. Leaves sub-imbricate, overlapping 1/3–2/3 of next leaf in the leaf base, obliquely inserted, ob-canaliculate-concave, not or very loosely turned to ventral side, obliquely narrowly lingulate-ovate, apex divided by V- to U-shaped sinuses into 3–4 triangular acute lobes. Midleaf cells 25–45 $\times$ 25–37  $\mu$ m, thin-walled, trigones moderate to large in size,

slightly convex, cuticle smooth, cells along leaf margin 12.5–25.0  $\mu$ m, outer wall thickened, tangential walls unequally thickened (due to trigones confluence) or thin, inner wall thin, trigones moderate in size to (adjacent to external wall) large, cuticle smooth throughout. Underleaves 1.6–2.2 as wide as stem (when attached to the stem), appressed to the stem, nearly plane or loosely un-

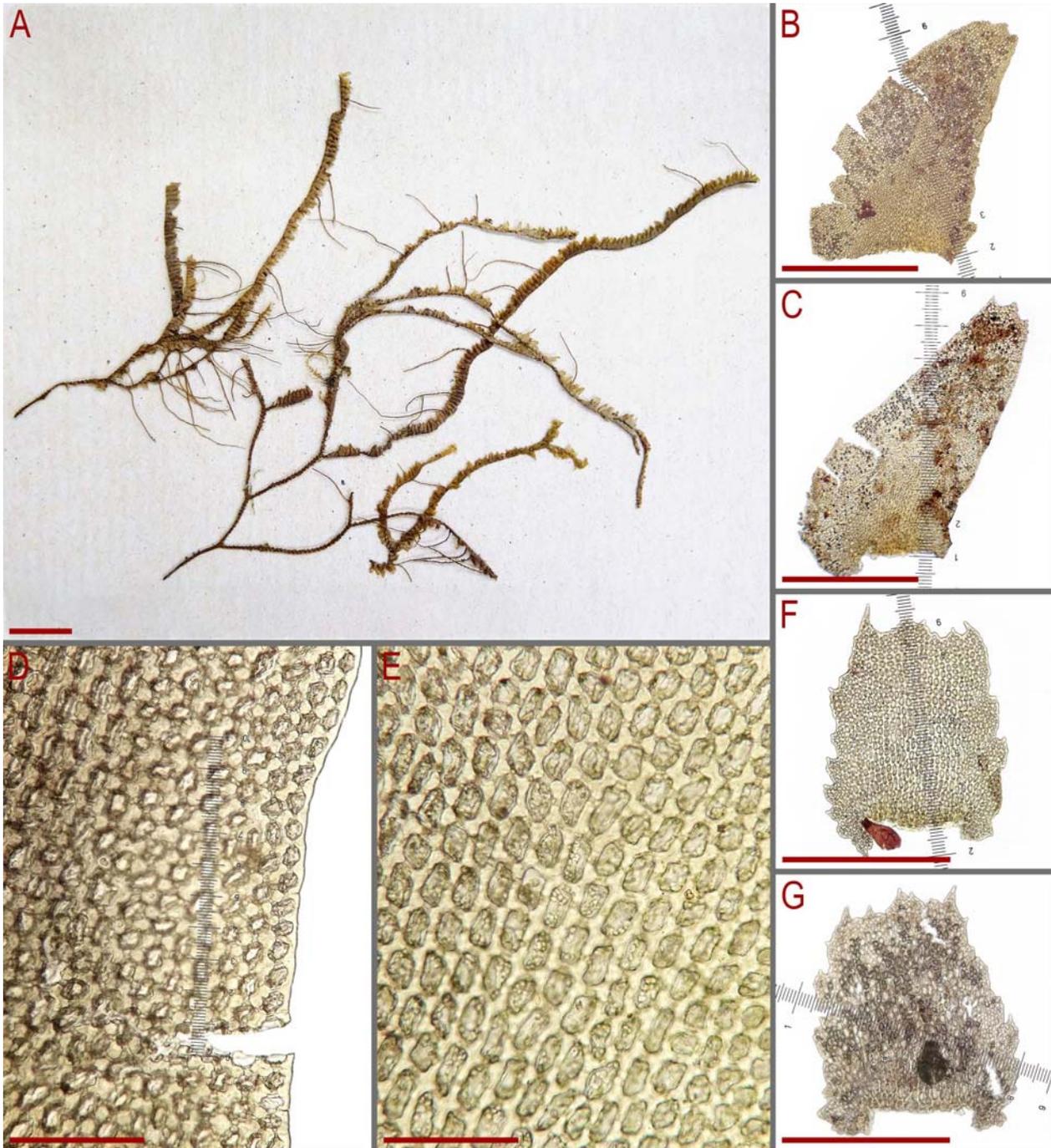


Fig. 25. *Bazzania sumatrana* (Sande Lac. ex Steph.) Steph. (from G00282523): A: plant habits; B, C: leaves; D: leaf margin cells; E: leaf middle cells; F, G: underleaves. Scales: 10 mm for A; 1 mm for B, C; 500 $\mu$ m for F, G.

dulate along margin or narrowly recurved along margin, commonly connate (or adjacent) in one side with leaf, transversely rectangular to transversely elliptic, roughly dentate along margin, lower 1/3–1/2 composed by chlorophyllose cells, above cells are ‘content-free’, thin-walled, with small to vestigial trigones.

Comment. The species is distinguishable due to large size, relatively wide apical part of leaves, hyaline and coarsely dentate underleaf margin.

*Bazzania revoluta* (Steph.) N.Kitag., J. Hattori Bot. Lab. 36: 450, 1972 [1973] (Kitagawa, 1972). Bas.: *Mas-*

*tigobryum revolutum* Steph., Bull. Herb. Boissier (sér. 2) 8 (12): 961 (511), 1908 (Stephani, 1908c). Myanmar [‘Upper Burma’]. Fraser. Lectotype (selected here): G00112684! Fig. 21: G–L, Fig. 23.

Description. Plant (only one plant is present in the specimen) greenish brownish, merely rigid, 2.5–3.5 mm wide, 6 cm long, lying on lateral side because leaves strongly turned to dorsal side; stem 425–450  $\mu$ m wide, ventral flagellae numerous; rhizoids not seen. Leaves obliquely inserted, turned to dorsal side, convex-ob-canaliculate, when flattened obliquely triangular-ovate, ca.

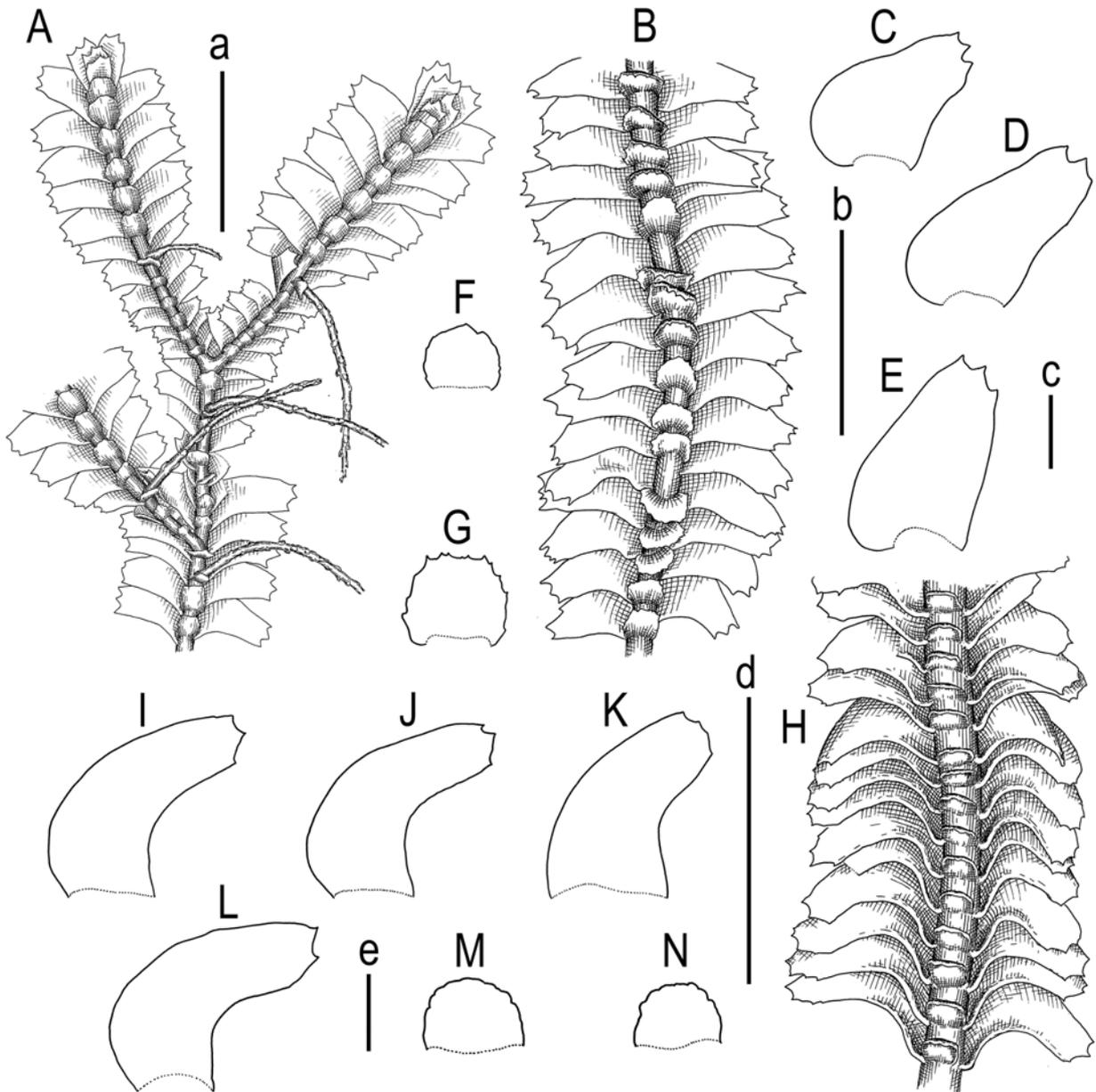


Fig. 26. *Bazzania tridens* (Reinw., Blume et Nees) Trevis. (from STR, s.n.): A: plant habit, fragment, ventral view; *Bazzania yoshinagana* (Steph.) Yasuda (from G00120730): B: plant habit, fragment, ventral view; C, D, E: leaves; F, G: underleaves; *Bazzania zollingeri* (Lindenb.) Trevis. (from G00282506): H: plant habit, fragment, ventral view; I–L: leaves; M, N: underleaves. Scales: a – 3 mm, for A; b – 3 mm, for B; c – 1 mm, for C–G; d – 3 mm, for H; e – 500  $\mu$ m, for I–N.

2000x1500  $\mu$ m, apex trilobed, by the U-shaped to crescentic sinus, lobes not or loosely diverging. Midleaf cells thin-walled 15–37x12–25  $\mu$ m, trigones moderate in size, convex, cells along margin 10–18  $\mu$ m, trigones moderate (large when adjacent to external wall) in size, convex, cuticle smooth throughout. Underleaves adjacent to one of the leaf pair (never observed as truly connate), obliquely spreading, with narrowly recurved margin, 1.4–1.9 as wide as stem (when on the stem, not in the slide), somewhat auriculate near base, chlorophyllose with the exception of underleaf margin (its revolute part), where cells are ‘content-free’, thin-walled, and virtually without trigones.

Comment. Noticeable in the species is narrowly revolute and discolored, composed by thin-walled cells without trigones underleaf margin, relatively small leaf cells and large leaves turned to ventral side of the shoot.

*Bazzania sikkimensis* (Steph.) Herzog, Ann. Bryol. 12: 78, 1939 (Herzog, 1939). Bas.: *Mastigobryum sikkimense* Steph., Hedwigia 44 (2): 73, 1905 (Stephani, 1905). 114 India [West Bengal], Sikkim Himalaya, Kurseong, Alt. ca 1000 m, inter *Leucobryum* Hampe sp., 1895, Rev. Bretandeu. Lectotype (selected by Mizutani, 1967): G00067029/12557! Note: originally described from “Sikkim (Stevens)” (Stephani, 1905). Later re-described (invalidly) by the same author in Bulletin de



Fig. 27. *Bazzania tridens* (Reinw., Blume et Nees) Trevis. (from G00120730): A: plant habit, fragment, ventral view; B: label; *Bazzania yoshinagana* (Steph.) Yasuda (from G00120730): C, F, H: leaves; D: plant habit, fragment, ventral view; E: leaf middle cells; G, I: leaf margin cells; J, K, L: underleaves. Scales: 3 mm for A, D; 1 mm for C, F, H, K, L; 100 $\mu$ m for E, G, I; 500  $\mu$ m for J.

l'Herbier Boissier, sér. 2, 8(10): 750. 1908 (Stephani, 1908a) from "Himalaya (Bretandeu, Stevens, Hartless)". The specimen collected by Bretandeu was selected by Mizutani (1967) as the lectotype, while other available specimens were regarded as paratypes. The same specimen was incorrectly treated as holotype by Sharma & Srivastava (1993). Fig. 21: M–Q, Fig. 24.

Description. Plants greenish to yellowish greenish, relatively rigid. 1.8–2.5 mm wide 2–4 cm long; rhizoids

not seen; stem 230–260  $\mu$ m wide, freely dichotomously branched, ventral flagellae common. Leaves contiguous to slightly overlapping, obliquely inserted, slightly obcanaliculate, slightly turned to ventral side (commonly very loosely so), 1000–1250 $\times$ 550–700  $\mu$ m, obliquely and narrowly ovate-triangular, more or less deeply incised at apex by U-shaped sinus into two triangular and acute lobes without additional teeth, leaf margin entire. Midleaf cells 20.0–37.5 $\times$ 15.0–25.0  $\mu$ m, thin-walled, trigones

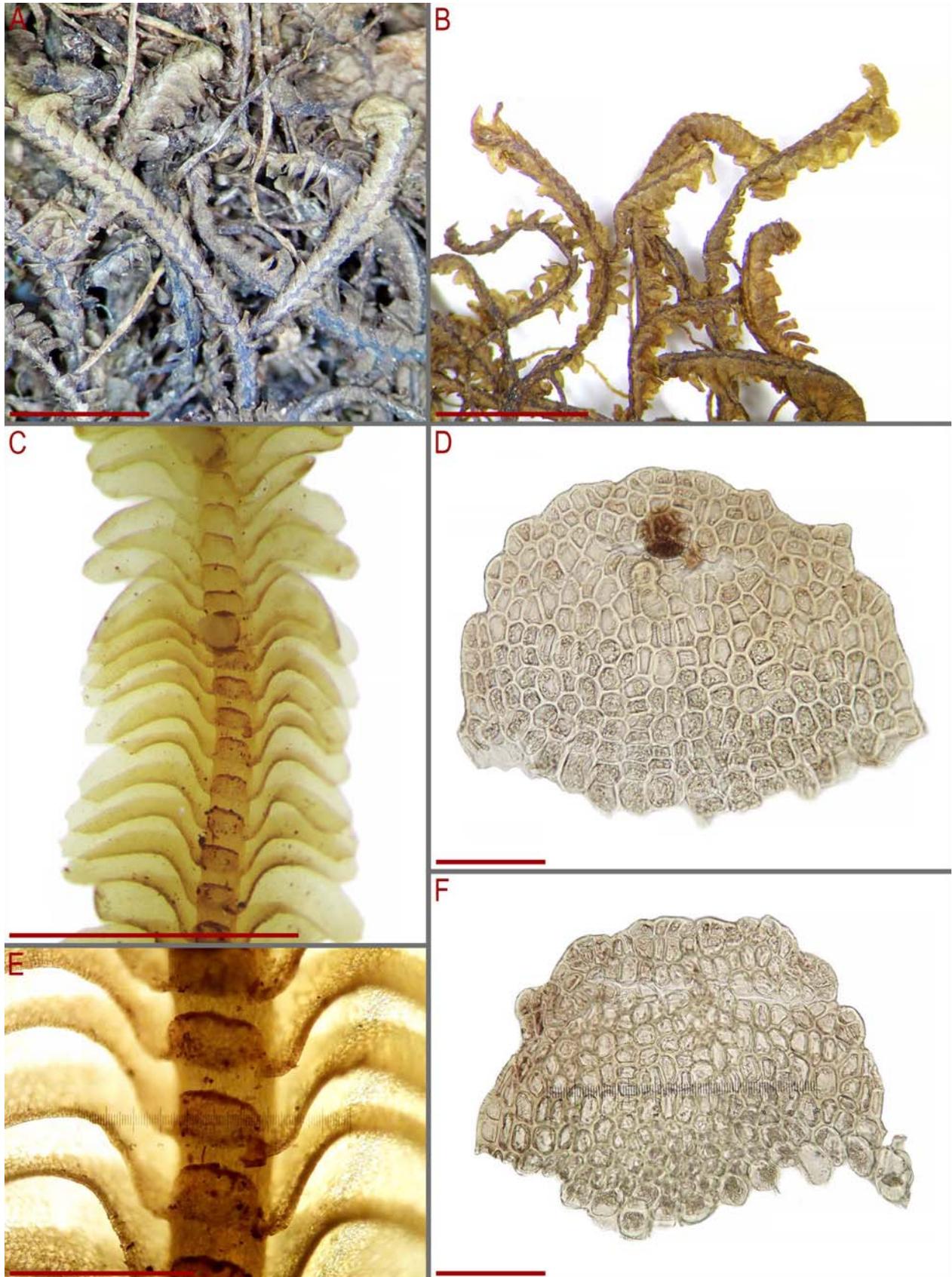


Fig. 28. *Bazzania zollingerii* (Lindenb.) Trevis. (from G00282506): A: mat; B: plant habits; C, E: plant habit, fragment, ventral view; D, F: underleaves. Scales: 5 mm for A, B; 3 mm for C; 100 $\mu$ m for D, F; 1 mm for E.

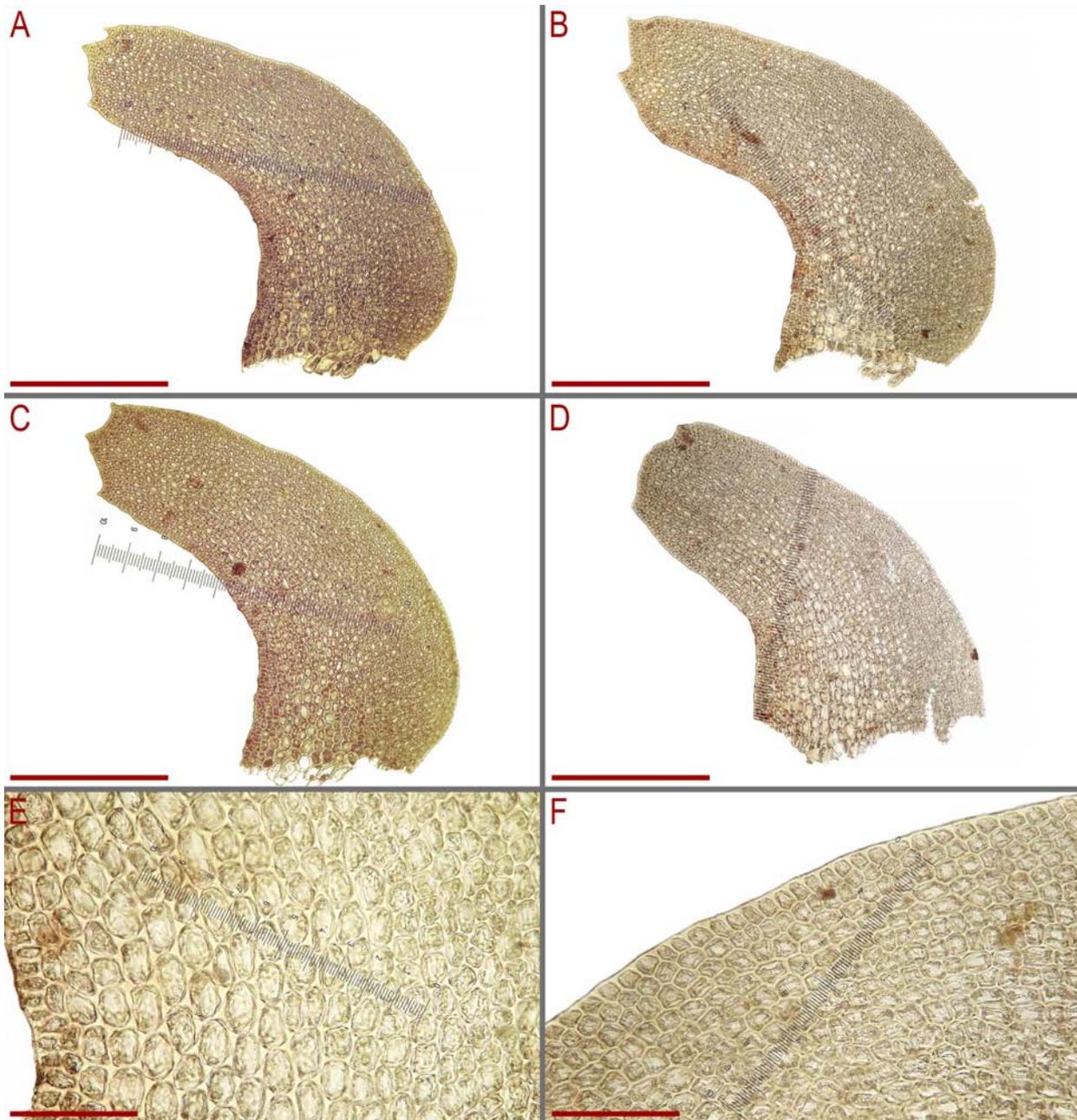


Fig. 29. *Bazzania zollingerii* (Lindenb.) Trevis. (from G00282506): A, B, C, D: leaves; E: leaf middle and margin cells; F: leaf margin cells. Scales: 500µm for A–D; 100µm for E, F.

moderate in size, triangular to slightly convex, cuticle smooth, vitta absent, although in base cells become distinctly longer, cells along margin 12–15 µm, with unequally thickened walls, become thin-walled inward, with small and later moderate trigones. Underleaves obliquely to erect spreading with apex recurved, 1.2–1.6 as wide as stem (when attached to the stem, not in the slide), very narrowly connate (mostly adjacent, but not truly connate) with leaf in one side (never with two sides), as long as wide or slightly longer than wide, subquadrate to shortly rectangular, with 4–5 sharp, short (1–2 cells long) or more long teeth, lateral margins more or less entire to crispate, chlorophyllose throughout.

Comments. 1) Small admixture of *Bazzania tridens* (also mentioned by Mizutani, 1967) is observed.

2) The species is distinguishable by relatively deeply bilobed leaves, that slightly turned to ventral side, small trigones (moderate in the leaf midline only), subquadrate to shortly rectangular underleaves with sharp teeth.

***Bazzania sumatrana*** (Sande Lac. ex Steph.) Steph., Hedwigia 32 (4): 209, 1893 (Stephani, 1893). Bas.: *Mastigobryum sumatranum* Sande Lac. ex Steph., Hedwigia 25 (6): 234, 1886 (Stephani, 1886a). Indonesia. Sumatra, “De Vriese in espeditione sua anno 1878”. Lectotype (selected here): G00282523! Another available specimen (G00282524!) looks as lectotype duplicate (plants there

are fully identical to lectotype), but more scarce. Fig. 21: R–V, Fig. 25.

Description. Plants greenish brownish, more or less rigid, 3–4 mm wide (if flattened, because commonly leaves turned to ventral side and plants lie on the lateral side), 5–10 cm long; rhizoids not seen; stem ca. 300  $\mu\text{m}$  wide, sparsely dichotomously branched, ventral flagellae common. Leaves subimbricate, obliquely inserted, obcanaliculate, turned to ventral side when wet and when dry, obliquely narrowly trapezoidal to loosely falcate, apex shallowly (2–)3-lobed, lobes divided by U-shaped to crescentic sinus, 2000–2300 $\times$ 1000–1250  $\mu\text{m}$ , entire at margins, but in ventral side base sometimes with angulations. Midleaf cells 27.5–40.0 $\times$ 20.0–30.0  $\mu\text{m}$ , thin-walled, with very large, coarsely bulging and sometimes confluent trigones with visible median lamina, cuticle smooth, cells along leaf margin 15.0–22.5  $\mu\text{m}$ , thin-walled (although outer wall strongly thickened), trigones large, coarsely bulging, with visible median lamina. Underleaves appressed to the stem, but in upper half of underleaf recurved (commonly loosely or more distinctly recurved also along lateral margins), 1.2–1.5 as wide as stem (when attached to the stem, not in the slide), spatulate, distinctly longer than wide, variously toothed, with teeth longer in curve area from lateral to apical part and near base (where sometimes looks as dentate appendages), chlorophyllose throughout.

Comment. The distinction features include longer than wide variously toothed underleaves, with teeth larger in the area near base, coarsely bulging trigones in the leaf (also including leaf margin, where cell walls nevertheless are thin), angulations near leaf ventral base and turned to ventral side leaves (not their apices only, but leaves by itself).

*Bazzania tridens* (Reinw., Blume et Nees) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4 (13): 415, 1877 (Trevisan, 1877). Bas.: *Jungermannia tridens* Reinw., Blume et Nees, Nova Acta Phys.-Med. Acad. Caes. Leop.-Carol. Nat. Cur. 12 (1): 228, 1824 [1825] (Reinwardt et al., 1824). Indonesia. Java Island. “Habitat in terra nuda et inter muscos”. Lectotype (selected here): “á foliis latioribus” [Nees handwriting]. There are a lot of material of this species in STR, with one specimen only signed as *Jungermannia tridens* (not *Mastigobryum* (Nees) Nees or *Herpetium* Nees), it fit well with the common well developed modifications of the species in East Asia. It is selected as lectotype here. Fig. 26: A, Fig. 27: A, B.

Comment. The morphology of the species was several times described in the literature; the description in Mizutani (1967) is corresponding to the type material in STR.

*Bazzania yoshinagana* (Steph.) Yasuda, Shokubut-sugaku Kakuron: 711, 1911 (Yasuda, 1911). Bas.: *Mastigobryum yoshinaganum* Steph., Bull. Herb. Boissier (sér. 2) 8 (11): 866 (490), 1908 (Stephani, 1908b). Ja-

pan. Komagadake Mt. Lectotype (selected here): G00120730! Note: the original description cites collector as Yoshinaga. The same is indicated in the outer label of the type envelope, with the collection number 98. However, inside of the envelope the small draft label is present that clearly indicates “No. 38. Mt. Komagadake, Kai. Aug. 1903, Coll. K. Tamura”. We suggest Yoshinaga was only the sender of this specimen to Stephani, and it is the reason of the noted discrepancy, while the real collector is Tamura. Another specimen of the same species present in G is G00120754! Both specimens were collected very near one to another or even represent the duplicates of the same specimen. The latter was also collected by Tamura and has the next field number: 39. The plants in the both specimens are virtually identical, but material in G00120730 is more copious and this was the reason it was selected as lectotype. Fig. 26: B–G, Fig. 27: C–L.

Description. Plants greenish brownish, more or less rigid, 3.5–4.2 mm wide; rhizoids not seen; stem 450–550  $\mu\text{m}$  wide, freely dichotomously branched, ventral flagellae common. Leaves contiguous to imbricate and overlapping to 1/3 of above situated leaf near leaf base, obcanaliculate, not of slightly turned to ventral side, distinctly to loosely falcate (on the same branch leaves are varying), obliquely ovate to narrowly trapezoidal, 1620–2050 $\times$ 1250–1400  $\mu\text{m}$ , basically trilobed with sinus U-shaped, but commonly bears various teeth and angulations between. Midleaf cells 25.0–37.5 $\times$ 17.5–32.5  $\mu\text{m}$ , thin-walled, trigones large to (rarer) moderate in size, slightly convex to triangle, cuticle smooth, cells along margin 12.5–22.5  $\mu\text{m}$ , virtually thin-walled (sometimes tangential walls unequally thickened due to trigones confluence), with large and convex trigones adjacent to external wall, external wall noticeable thickened, inward trigones become moderate in size. Underleaves 1.4–1.9 as wide as stem (when in living plant), narrowly and sometimes not clearly connate with one leaf of the pair, very rarely connate with both leaves, obliquely to erect spreading, in the slide as long as wide or slightly longer than wide, recurved along margin, reniform to trapezoidal, crispate to irregularly dentate along margin (more prominently near apex), chlorophyllose throughout.

Comment: The species seems to be very similar to *B. japonica* (the type is described and discussed in Bakalin, 2016), however, unlike to *B. japonica*, *B. yoshinagana* has underleaves connate with the leaves in one side only, and more ovate (never with sublinear upper half) leaves. The status of the taxon needs clarification by molecular methods.

*Bazzania zollingeri* (Lindenb.) Trevis., Mem. Reale Ist. Lombardo Sci. (Ser. 3), C. Sci. Mat. 4 (13): 414, 1877 (Trevisan, 1877). Bas.: *Mastigobryum zollingeri* Lindenb., Bot. Zeitung (Berlin) 6 (25): 462, 1848 (Meissner, 1848). Indonesia. Java. Zollinger. Syntype: G00282506! Note: there are several specimens in G that most probably repre-

sent the type duplicates (identical one to another) with different quantity of the material. The larger amount is in the described specimen and G00282510 and G00282511. Fig. 26: H–N, Fig. 28, Fig. 29.

Description. Plants greenish brownish, more or less rigid, 2.5–3.0 mm wide (or slightly wider), 5–10 cm long; rhizoids virtually absent; stem 300–400 µm wide, freely dichotomously branched, ventral flagella numerous. Leaves imbricate, overlapping ca 1/4–1/2 of above situated leaf, obliquely inserted, ob-canaliculate, slightly or evidently turned to ventral side (not leaf apex, but leaf by itself!), distinctly falcate, sublinear (curved narrowly trapezoidal), not vittate, although cells are much bigger near leaf base until leaf middle, 1100–1400×620–800 µm, apex very shortly tridentate (rarely bidentate or with additional small fourth tooth between main teeth), lobes divided by very shallow (rarely U-shaped) sinus. Midleaf cells 22.5–42.5×17.5–25.0 µm, thin-walled, trigones moderate to large, convex; cells along margin 15–20 µm, with large trigones adjacent to the outer wall, and small inward, cells inward of the leaf lamina become somewhat thick-walled, with small concave trigones, and later cell walls become thinner while trigones become larger, cuticle nearly smooth. Underleaves connate with leaves at the both sides, reniform, distinctly wider than long, 0.8–1.0 as wide as stem, crenulate (to slightly so) in the apex), chlorophyllose throughout, with outer wall noticeable thickened.

Comment. The strongly falcate leaves with only short lobation in the apex, crenulate to shortly dentate along margin small underleaves are distinctive.

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