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### Data to the Malaysian liverwort flora, III: New Lejeuneaceae records from Sabah and Peninsular Malaysia

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# Data to the Malaysian liverwort flora, III: New Lejeuneaceae records from Sabah and Peninsular Malaysia

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## ABSTRACT

New Malaysian records from the family Lejeuneaceae are presented, including four species new to Malaysia and seven new to Peninsular Malaysia (Kelantan or Terengganu). The new records include *Lejeunea convexiloba* M.L.So & R.L.Zhu, which was only known from China and *Radula grandilobula* Promma & Chantanaorr., which was only known from its type from southern Thailand and Borneo. All species are illustrated, their diagnostic characteristics and morphological comparison between their allies are provided and discussed, habitat and distribution are given.

## RÉSUMÉ

*Données sur la flore d'hépatiques malaisienne, III: Nouveaux enregistrements de Lejeuneaceae de Sabah et de la Malaisie péninsulaire.*

De nouveaux signalements malais de la famille des Lejeuneaceae sont présentés, dont quatre espèces nouvelles pour la Malaisie et sept nouvelles pour la Malaisie péninsulaire (Kelantan ou Terengganu). Les nouveaux enregistrements incluent *Lejeunea convexiloba* M.L.So & R.L.Zhu, qui n'était connu qu'en Chine et *Radula grandilobula* Promma & Chantanaorr., qui n'était connu que par son type dans le sud de la Thaïlande et à Bornéo. Toutes les espèces sont illustrées, leurs caractéristiques diagnostiques et la comparaison morphologique avec les taxons proches sont fournies et discutées, l'habitat et la distribution sont donnés.

## KEY WORDS

Lejeuneaceae,  
liverworts,  
Malaysia,  
new records.

## MOTS CLÉS

Lejeuneaceae,  
hépatiques,  
Malaisie,  
signalements nouveaux.

## INTRODUCTION

Lejeuneaceae is the largest family of the liverworts and widely distributed in the tropical regions. An estimated 30% of the liverwort species in the tropics and up to 50% of the bryophytes in a lowland rain forest are members of this family (e.g., Cornelissen & Ter Steege 1989; Zartman 2003; Gradstein 2006).

Since the publication of the catalogue of Lejeuneaceae of Malaysia (Lee *et al.* 2013), new genera and species of Lejeuneaceae have been added to the Malaysian liverwort flora, e.g., *Colura cristata* Jovet-Ast (Sangrattanaprasert *et al.* 2019), *Leptolejeunea tripuncta* (Mitt.) Steph. (Shu *et al.* 2016), and *Thiersianthus silamensis* R.L.Zhu & L.Shu (Zhu *et al.* 2017), names of species and genera have been reduced to synonymy or transferred to other genera, e.g., *Drepanolejeunea brunnea* Mizut. (*Mohamedia brunnea* (Mizut.) R.L.Zhu & L.Shu), *Lepidolejeunea borneensis* (Steph.) R.M.Schust. (*Mohamedia borneensis* (Steph.) R.L.Zhu & L.Shu (Zhu *et al.* 2019), *Lejeunea tamasposcii* G.E.Lee (synonym of *Lejeunea pulchriflora* G.E.Lee *et al.* (Lee & Gradstein 2013; Lee *et al.* 2016a), *Leptolejeunea serrulata* Herzog (synonym of *Leptolejeunea tripuncta*), *Taxilejeunea compressiuscula* Steph. (*Lejeunea compressiuscula* (Steph.) G.E.Lee & Heinrichs (Lee *et al.* 2016b, 2020), and genus *Mastigolejeunea* (Spruce) Steph. (synonym of *Thysananthus* Lindenb.; Sukkharak & Gradstein 2017), or reinstated (genus *Allorgella* Tixier; Bechteler *et al.* 2016; several *Leptolejeunea* species, Bechteler *et al.* 2017; Shu & Zhu 2019). In the present study, we report four species of Lejeuneaceae new to Malaysia and seven new to Peninsular Malaysia, collected in the state of Sabah and on the East Coast of Peninsular Malaysia (Kelantan, Terengganu). Sabah is the most intensively inventoried state of Malaysia for liverworts (Lee *et al.* 2018) but large parts of Kelantan and Terengganu remain virtually unexplored. Only 12 species (*Frullania intermedia* (Reinw. *et al.*) Dumort., 11 spp. of *Lejeunea* Lib.) have been recorded from Kelantan (Chuah-Petiot 2011; Lee 2013; Lee *et al.* 2013) and two species (*Radula retroflexa* Taylor, *Plagiochila arbuscula* (Brid. ex Lehm. & Lindenb.) Lindenb.) from Terengganu (Lee *et al.* 2019). This paper aims to contribute to the knowledge of liverwort diversity, particularly Lejeuneaceae, in Malaysia.

## MATERIAL AND METHODS

This study is based on the intensive liverwort explorations carried out by the authors during 2018-2020 in Sabah and the East Coast of Peninsular Malaysia (Kelantan, Terengganu). The collections yielded several species new to the country, to Sabah or to Peninsular Malaysia, in spite of the fact that only part of the epiphyllous specimens from Sabah were identified. A first paper on the epiphyllous communities of Sabah has already been published (Pócs *et al.* 2020). The present paper included new floristic records. This is the continuation of a series on new Malaysian records (Pócs *et al.* 2014; Pócs & Lee 2016). The study was largely based

on fresh materials although some older collections made by the last author were also incorporated. Oil bodies were studied within one day (less than 12 hours) after collecting of the material. Names of species new to Malaysia are preceded by an asterisk. Collecting localities are indicated in Figure 1. All specimens are deposited in the Herbarium of Universiti Malaysia Terengganu (UMTP), with selected duplicates in Sandakan Herbarium (SAN).

## RESULTS AND DISCUSSION

Family LEJEUNEACEAE Rostovzev  
Genus *Ceratolejeunea* (Spruce) J.B.Jack & Steph.

*Ceratolejeunea minor* Mizut.  
(Fig. 2)

*Journal of the Hattori Botanical Laboratory* 49: 311 (1981).

SPECIMEN EXAMINED. — **Malaysia.** Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerreh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 100 m alt., on living leaves, 16.IV.2019, G.E. Lee *et al.* 19013, 19014, *ibid.*, E. Pesiu *et al.* 19157, 19182.

### REMARKS

This species is recognized by the weakly keeled perianth without horn-like projections, the small, distant underleaves, and the obovate perianth. Previously known from the type in Sabah, Mt. Templer (Mizutani 1981) and subsequently reported from China (Zhu *et al.* 2005). New to Peninsular Malaysia (Terengganu). The specimens from Terengganu are similar to the Chinese material in the entire margins of underleaf lobes and the absence of weak *Allorgella*-typed denticulations in the margins of leaf lobes; in the type of Sabah the underleaf lobes have 1-2 marginal teeth and the margin denticulation is distinct. This species grows on sandstone, tree trunks or living leaves (this study) in the understorey and canopy of lowland and montane rainforests at an elevation of 100-1000 m (Mizutani 1981; Zhu *et al.* 2005).

*Ceratolejeunea singaporensis* (Lindb.) Schiffl.  
(Fig. 3)

*Conspectus Hepaticarum Archipelagi Indici* 273 (1898).

SPECIMEN EXAMINED. — **Malaysia.** Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerreh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 100 m alt., on living leaves, 16.IV.2019, G.E. Lee *et al.* 19012.

### REMARKS

The distinctive features are the presence of 1-6 basal ocelli, the approximate to distantly arranged and orbicu-





FIG. 1. — **A**, Map of Malaysia showing two separate regions; Peninsular Malaysia and Malaysian Borneo (Sabah, Sarawak); **B**, **C**, the stars indicate the locality where the specimens were collected.

lar underleaves, the entire leaf margin, the absence of utricles, and the oblong leaf lobe with rounded apices. Only known from the type in Singapore and from India

(Mizutani 1981; Udar & Shaheen 1985) and in Sabah, Malaysia (Herzog 1952). New to Peninsular Malaysia (Terengganu).

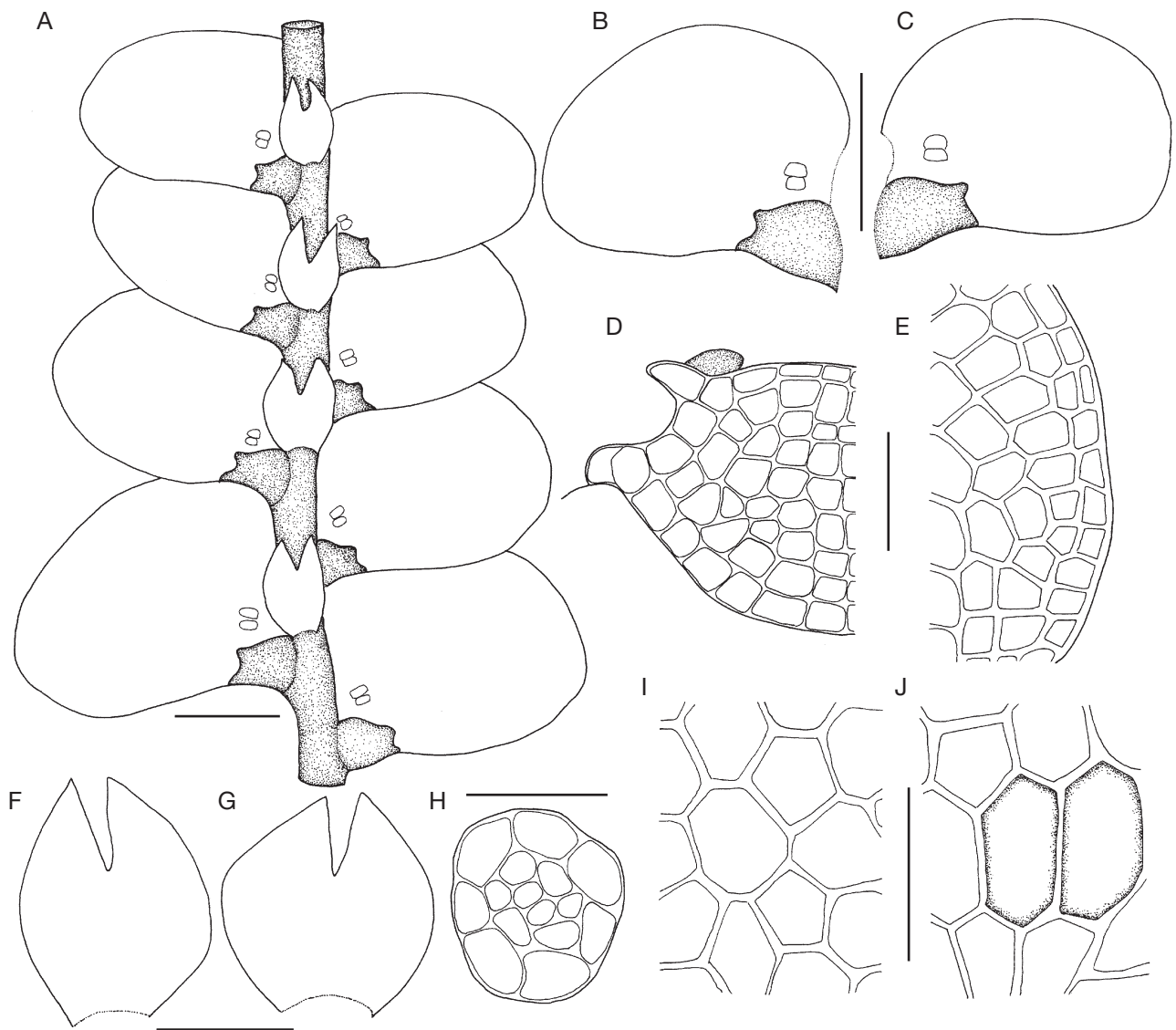


FIG. 2. — *Ceratolejeunea minor* Mizut.: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, upper part of leaf lobule when flattened (hyaline papilla shown in gray); **E**, marginal leaf lobe cells; **F**, **G**, underleaves; **H**, cross-section of stem; **I**, median leaf lobe cells; **J**, basal leaf lobe cells and ocelli. From *E. Pesiu et al.* 19157. Scale bars: A, 0.2 mm; B-C, 0.5 mm; F, G, 0.1 mm; D, E, H-J, 50 µm.

Genus *Cololejeunea* (Spruce) Steph.

*Cololejeunea appressa*  
(A. Evans) Benedix  
(Fig. 4)

*Feddes Repertorium Specierum Novarum Regni Vegetabilis. Beiheft* 134: 31 (1953).

**SPECIMEN EXAMINED.** — **Malaysia.** Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerteh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 100 m alt., on living leaves, 16.IV.2019, *G.E. Lee et al.* 19011.

**REMARKS**

*Cololejeunea appressa* is a member of subg. *Taeniolejeunea* and is distinguished from other members in this subgenus by the single row of 3-4 ocelli, the unicellular first lobule tooth and first and second lobule teeth clearly visible, not overlapping each other. A pantropical species, preferably growing on barks or on living leaves at low elevations, reported in Asia from China, Indonesia (Java, Sumatra), Indonesian New Guinea, Japan, and recently from Laos (Mizutani 1961; Piippo 1990; Pócs & Kovács 2019; Söderström *et al.* 2020). New to Peninsular Malaysia (Terengganu). In Malaysia the species is only known from Mt. Kinabalu, Sabah (Mizutani 1966). In view of its wide world distribution, however, this species is expected to occur in many lowland forest areas in Malaysia.



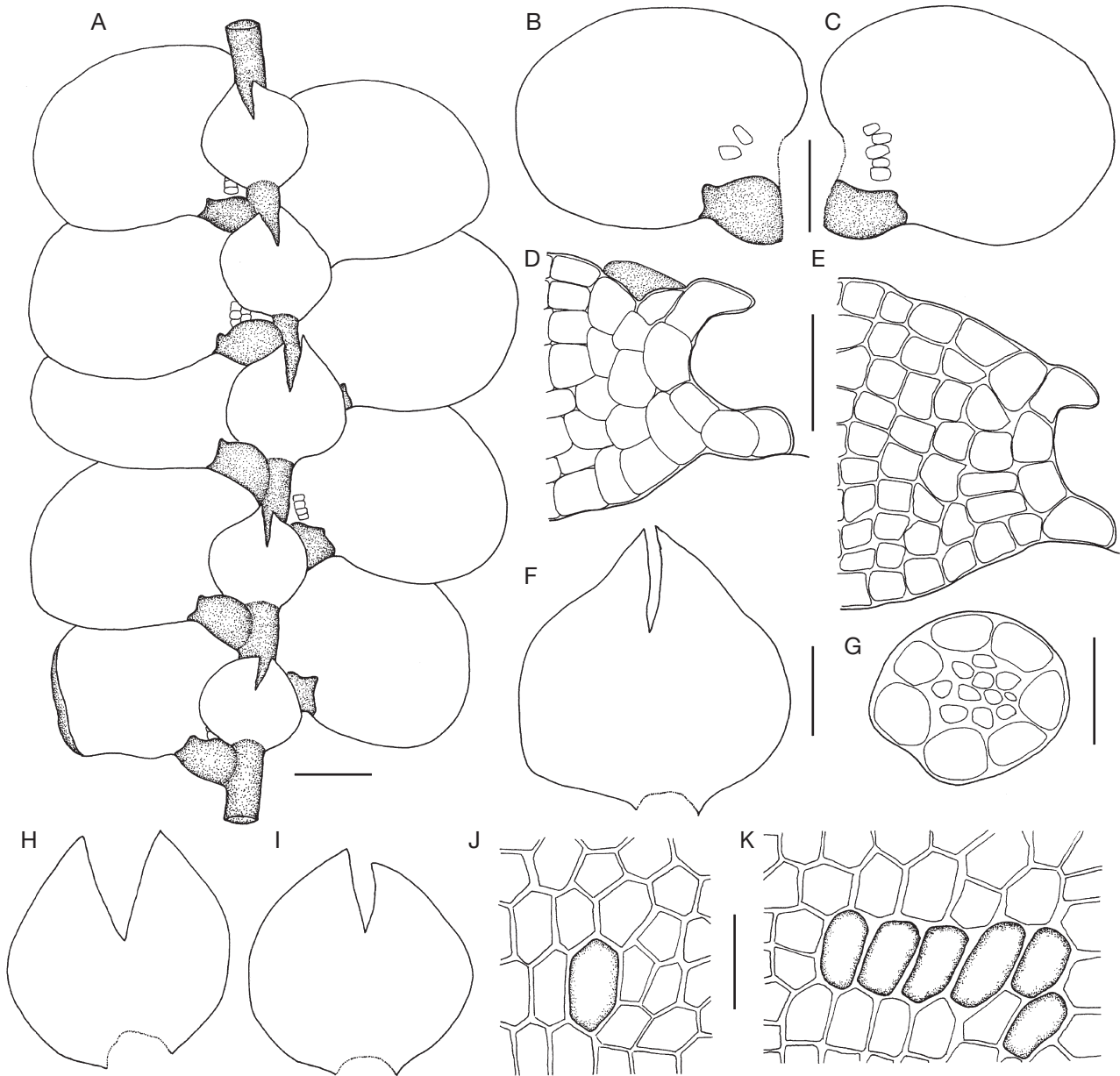


FIG. 3. — *Ceratolejeunea singaporensis* (Lindb.) Schiffn.: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, **E**, upper part of leaf lobule when flattened (hyaline papilla shown in gray); **F**, **H**, **I**, underleaves; **G**, cross-section of stem; **J**, **K**, basal leaf lobe cells and ocelli. From G.E. Lee *et al.* 19012. Scale bars: A-C, 0.2 mm; D, E, G, 50  $\mu$ m; F, H-J, K 100  $\mu$ m.

\**Cololejeunea equialbi* Tixier  
(Figs 5; 6A, B)

*Annales de la Faculté des Sciences, Université de Phnom Penh* 3:  
178 (1970).

SPECIMEN EXAMINED. — **Malaysia**. Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerteh town. Hill dipterocarp forest, area around the summit of Mt. Tebu at 940 m alt., on living leaves, 16.IV.2019, *E. Pesiu et al.* 1929, 1948, 1954, 1955, 1956; Sabah: Mt. Silam, Sapagaya Forest Reserve, 22 km WSW of Lahad Datu town. Summit ridge of

Mt. Silam from the telecommunication towers to the main summit. Lower montane rainforest with *Shorea tenuiramulosa* and *Borneodendron enigmaticum* at elevation of 700-800 m alt., on living leaves, 04°57'12"N, 118°9'39"E, 9.VIII.2018, *J. Havasi & T. Pócs 1811/AX*.

REMARKS

This species is characterized by the small leaf lobule usually with 1-celled first tooth and obsolete second tooth, unicellular stylus, leaf cells with small trigones and indistinct intermediate thickenings, absence of ocelli and vitta, and the widely spreading to retrorsed leaf lobe, 90-160° from the stem. A

widespread Indopacific species (Dey & Singh 2016); new to Malaysia. Because of its wide distribution, its occurrence in Malaysia was predictable. The species grows exclusively on living leaves (Zhu & So 2001; Dey & Singh 2016), therefore can be regarded as an obligate epiphyll.

*\*Cololejeunea ensifera*

Tixier ex L.Söderstr., Pócs, Váňa & A.Hagborg  
(Figs 6C-E; 7)

*Phytotaxa* 220 (2): 199 (2015). — *Cololejeunea ensifera* Tixier, *Revue Bryologique et Lichénologique* 36 (3/4): 562 (1969) *nom. inval.*

SPECIMEN EXAMINED. — **Malaysia.** Sabah: Crocker Range National Park NNW of Tambunan. Gunung Alab Substation at elevation of 1900-1940 m. Mossy cloud (elfin) forest, about 6 m high canopy of *Phyllocladus hypophyllus*, *Rhododendron*, *Dacrydium* and *Nepenthes*, 17.VIII.2018. J. Havasi & T. Pócs 1823D, 1823L, 1823O, 1823AC, 1823AH, 1823AL, 1823AN.

REMARKS

A species hitherto known from Vietnam, Cambodia and Thailand (Tixier 1969; Chantanaorrapint & Pócs 2014). New to Malaysia. Typical features are the acute, sword-like first lobule tooth crossing the triangular second tooth, the pluricellular stylus and the biseriate vitta. On leaves of shrubs and ferns.

*Cololejeunea schmidtii* Steph.

(Fig. 8)

*Botanisk Tidsskrift* 24 (3): 278 (1902).

SPECIMEN EXAMINED. — **Malaysia.** Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerteh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 308 m alt., on living leaves, 16.IV.2019, G.E. Lee *et al.* 19015, 19016, 19017.

REMARKS

*Cololejeunea schmidtii* is unlikely to be confused with other members of Malaysian *Cololejeunea* by its 2-celled first tooth of leaf lobule, large papillose-tuberculate cuticle (1 per cell, usually almost occupying its whole surface), denticulate margin of the dorsal leaf base and the 4-keeled, papillose perianth. A widespread, epiphyllous Indopacific species known from Sri Lanka, Indochina, China, Japan, Philippines, Papua New Guinea and Fiji (Zhu & So 2001; Pócs *et al.* 2011). New to Peninsular Malaysia (Terengganu). In Malaysia, the species was only known from Sabah (Kinabalu area) (Mizutani 1966).

*Cololejeunea gottschei*

(Steph.) Pandé, K.P.Srivast. & Ahmad  
(Fig. 9)

*Journal of the Indian Botanical Society* 36 (3): 345 (1957).

SPECIMEN EXAMINED. — **Malaysia.** Kelantan: Gunung Basor Forest Reserve, halfway between Dabong and Jeli towns near Bkt. Gerongan village at Renyok No. 3 water intake, at 670-680 m alt., on living leaves, submontane rainforest at cataracts. 05°31.171'N, 101°46.940'E, 7.XI.2013, T. Pócs *et al.* 13180/R.

REMARKS

*Cololejeunea gottschei* is close to *C. longifolia* and *C. stellaris* (subg. *Leptocolea* sect. *Salebrosae*) but differs from the latter two species in the apiculate, sometimes denticulate leaf lobes, and furthermore from *C. longifolia* in the obovate perianth and sexangular, multicellular gemmae with four adhesive cells and from *C. stellaris* by its smooth, not papillose cells. A widespread epiphyllous Indomalaysian species, in Malaysia known only from Sabah (Mizutani 1966, under *Cololejeunea paroica* Mizut.). New to Peninsular Malaysia (Kelantan).

Genus *Colura* (Dumort.) Dumort.

*Colura ari* (Steph.) Steph.

(Figs 10; 11C, D)

*Species Hepaticarum* 5: 936 (1916).

SPECIMEN EXAMINED. — **Malaysia.** Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerteh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 100 m alt., on living leaves, 16.IV.2019, G.E. Lee *et al.* 19018, 19019, 19020, 19021.

REMARKS

Distinctive features of *Colura ari* include the strongly serrate leaf margin, the position of lobule and sac more or less parallel to the stem, truncate and apiculate sac (apex usually pointing downward), and leaf cells with large trigones and conspicuous intermediate thickenings (2 per adjacent trigones in basal leaf cells). A common and widespread Indopacific epiphyllous species. New to Peninsular Malaysia (Terengganu). In Malaysia, only known from Sabah (Mizutani 1966, 1970).

*\*Colura inuii* Horik.

(Figs 11A, B; 12)

*Journal of Science of Hiroshima University, Series B, Division 2, Botany* 1: 68 (1931).

SPECIMEN EXAMINED. — **Malaysia.** Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerteh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 80 m alt., on living leaves, 16.IV.2019, G.E. Lee *et al.* 19018, 19019, 19020, 19021, *ibid.*, 13.III.2021, G.E. Lee 21008, 21009, 21010, 21011, 21012.

REMARKS

*Colura inuii* is very similar to the widespread Indopacific *C. conica* (see Zhu & So 2001) but in the latter species, the sac always has a crested, toothed apiculus whereas in *C. inuii*, it



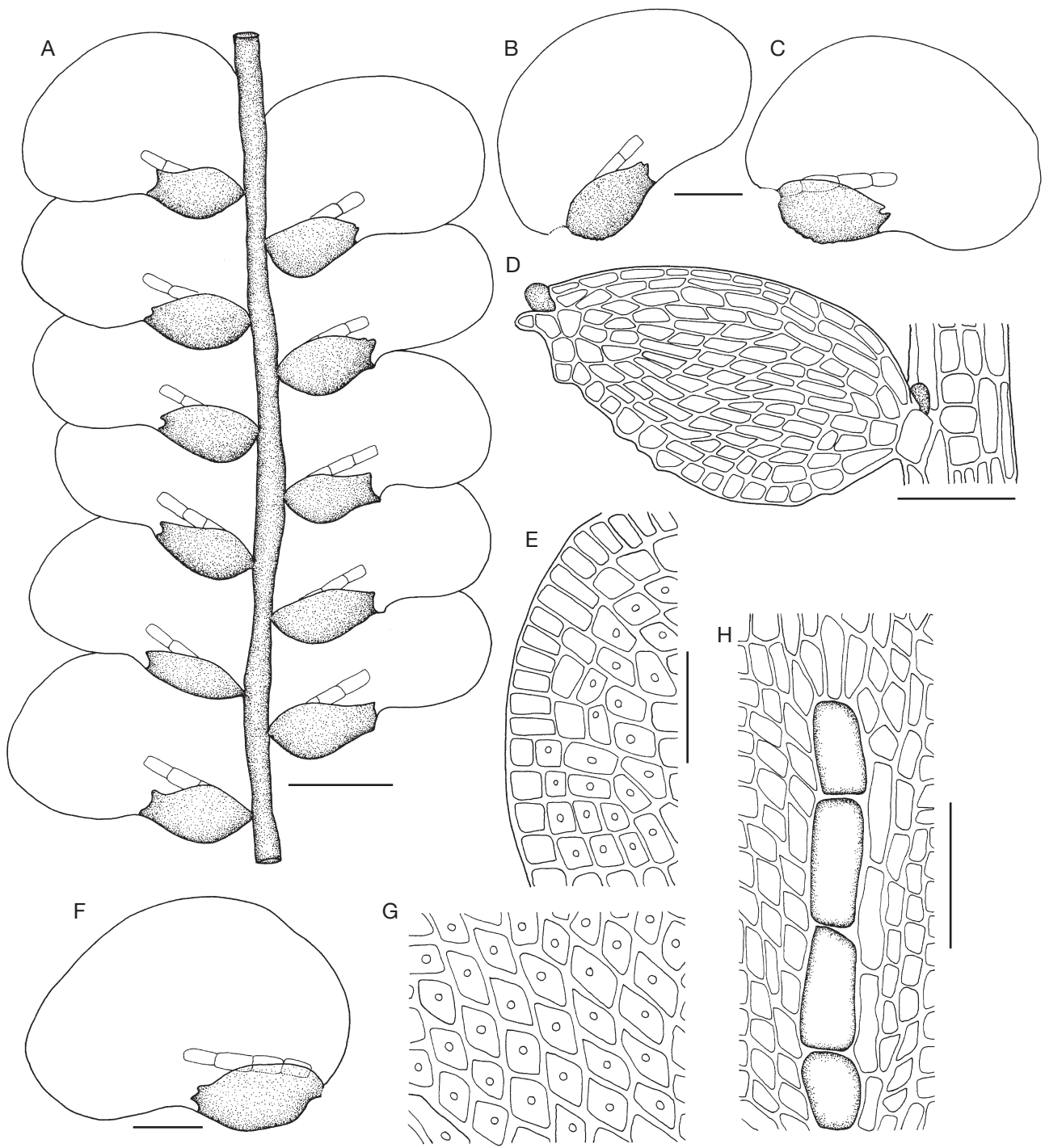


FIG. 4. — *Cololejeunea appressa* (A. Evans) Benedix: **A**, part of plant in ventral view; **B**, **C**, **F**, leaves; **D**, stem portion, leaf lobule and stylus (hyaline papilla shown in gray); **E**, marginal leaf lobe cells; **G**, median leaf lobe cells; **H**, basal leaf lobe cells and ocelli. From G.E. Lee *et al.* 19011. Scale bars: A, 0.2 mm; B, C, F, 0.1 mm; D, H, 50  $\mu$ m; E, G, 25  $\mu$ m.

does not occur. The perianth keels of *C. conica* have 1-3 celled sharp teeth at the end of the wings (Jovet-Ast 1953, fig. 51: 1-3) whereas in *C. inuii*, the perianth keels are often strongly mamillate but teeth are never produced. Moreover, the oil bodies are homogenous (smooth externally, rarely segmented

into indistinct granules) in *C. inuii* while granular (faintly rough externally) in *C. conica* (see Yang *et al.* 2013: figs 2g, 3e). Furthermore, both species can be distinguished by the presence of 18-20 median valve cells and 17-19 surrounding hyaline cells in *C. inuii* while 13-17 and 15-16 in *C. conica*. *Colura*

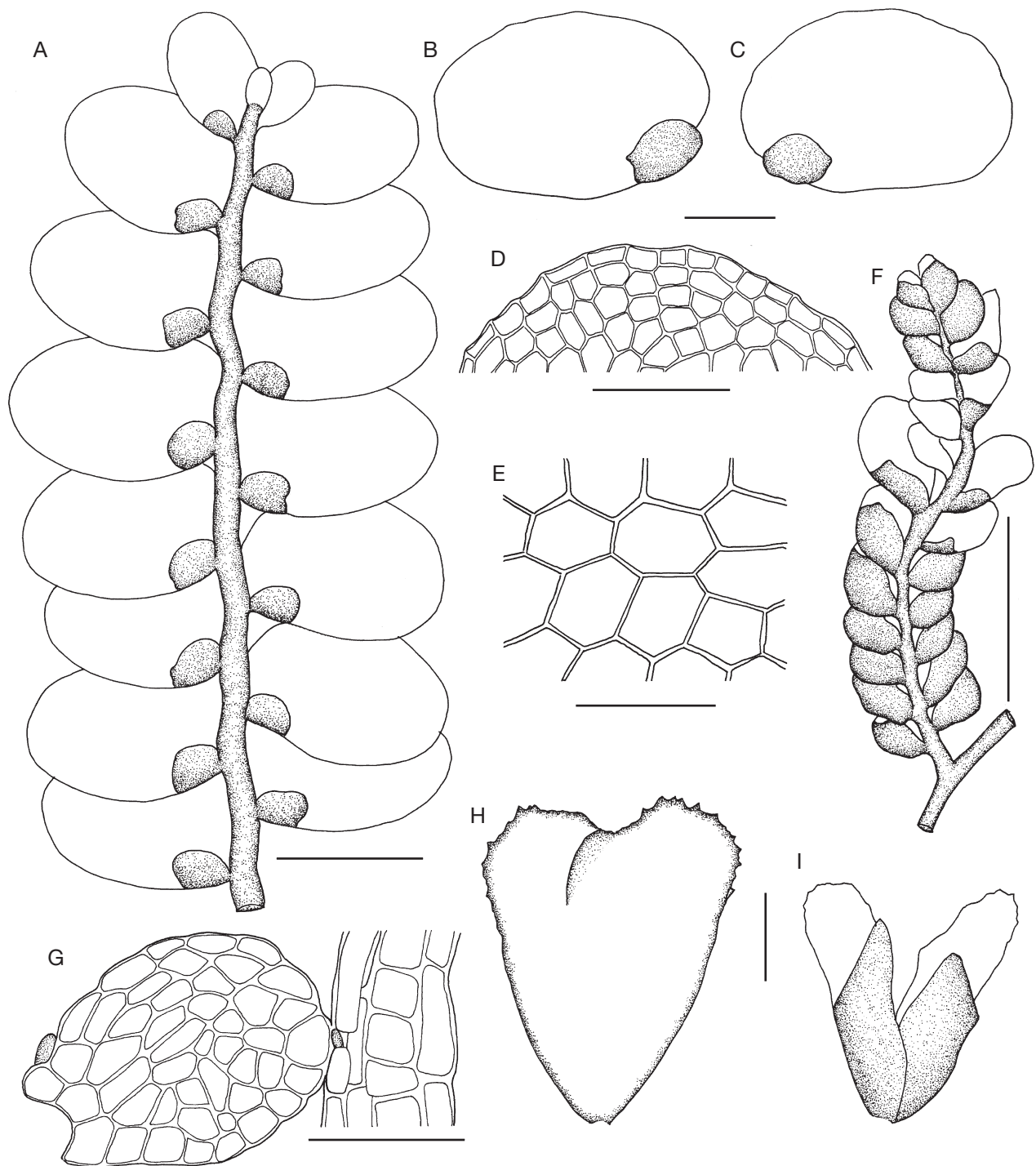


FIG. 5. — *Cololejeunea equialbi* Tixier: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, marginal leaf lobe cells; **E**, median leaf lobe cells; **F**, androgynous shoot; **G**, stem portion, leaf lobule and stylus (hyaline papilla shown in gray); **H**, perianth; **I**, female bracts. From *E. Pesiu et al.* 1955. Scale bars: A, H, I, 0.2 mm; B-D, G, 100 µm; E, 50 µm; F, 0.5 mm.

*inuii* was known from China (Taiwan), Japan and Vietnam (Horikawa 1931; Zhu & So 2001; Shu *et al.* 2017). New to Malaysia, which record in Peninsular Malaysia represents its southernmost locality, extending to the Malesian region. The

species usually grows on living leaves, rarely on bark and can be considered, as typical epiphyll; in Malaysia it was found on living and dry fallen leaves in a lowland dipterocarp forest and also in montane forest, above 750 m alt.



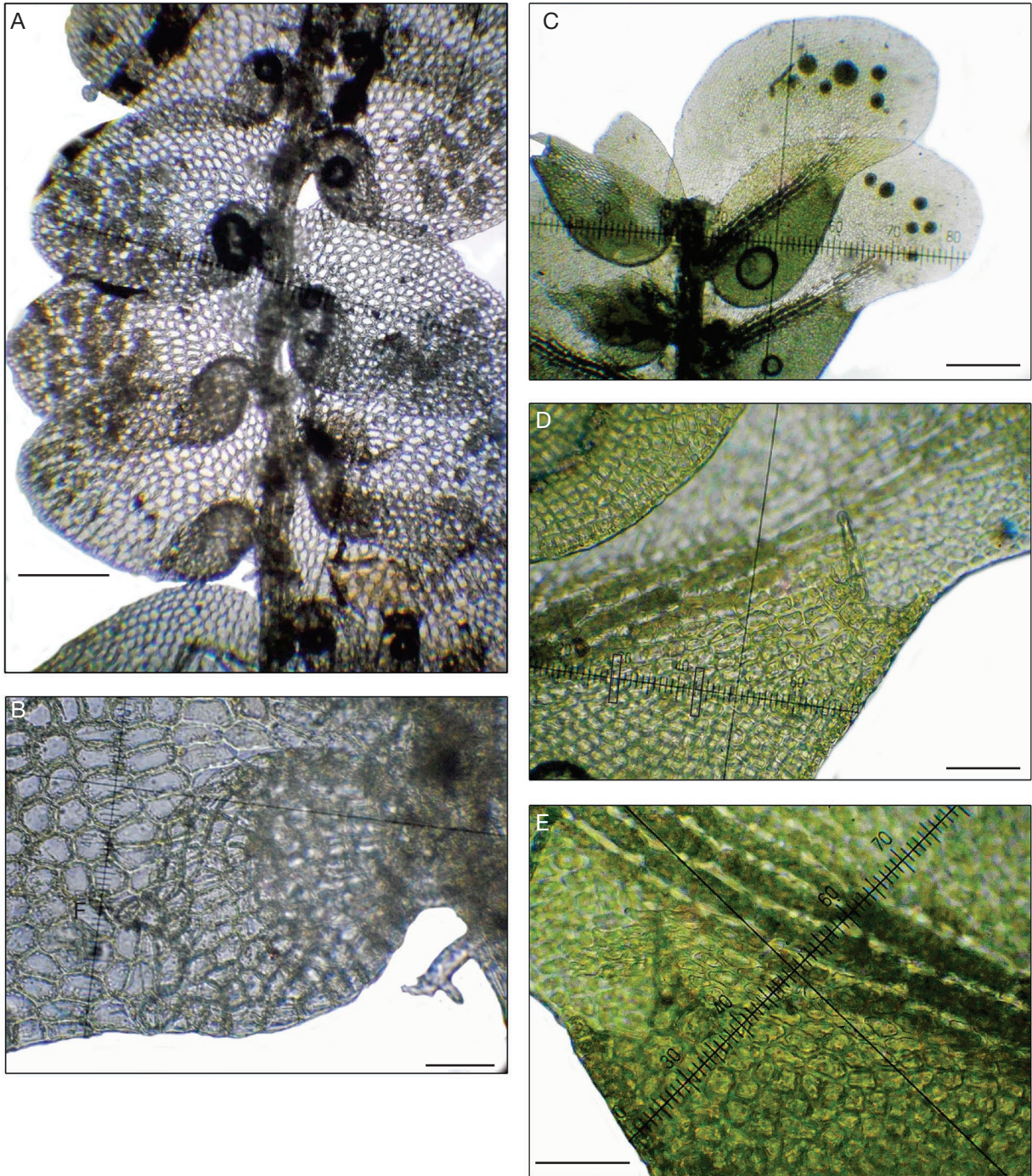


FIG. 6. — *Cololejeunea equialbi* Tixier: **A**, part of plant in ventral view and gemmae; **B**, part of leaf lobe and lobule. From *J.Havasi & T.Pócs 1811/AX*. *Cololejeunea ensifera* Tixier ex L.Söderstr., Pócs, Váňa & A.Hagborg: **C**, part of plant in ventral view; **D**, **E**, part of leaf lobe, lobule and vitta. From *J. Havasi & T. Pócs 1823AL*. Scale bars: 50 µm.

Genus *Lejeunea* Lib.

\**Lejeunea convexiloba* M.L.So & R.L.Zhu  
(Fig. 13)

*The Bryologist* 101 (1): 137 (1998).

SPECIMEN EXAMINED. — **Malaysia**. Sabah: Mt. Kinabalu: Paka Cave, along the trail between Villosa shelter and Laban Rata resthouse, on tree trunk, at 2900 m alt., 13.XI.2010, *G.E. Lee 1940*.

REMARKS

The distinguishing characters of *Lejeunea convexiloba* include 1) the autoicous plant; 2) the relatively large (to ½ the length of leaf lobe) leaf lobules with flat free margin; 3) cross-section of stem with less than 10, usually 5-6 medullary cells; 4) the indistinct trigones and absence of intermediate thickenings; 5) the distantly arranged and orbicular underleaves; 6) the rough cuticle with finely punctate to verrucose-small papillae; and 7) the 5-keeled, obovoid perianth with 2 long ventral

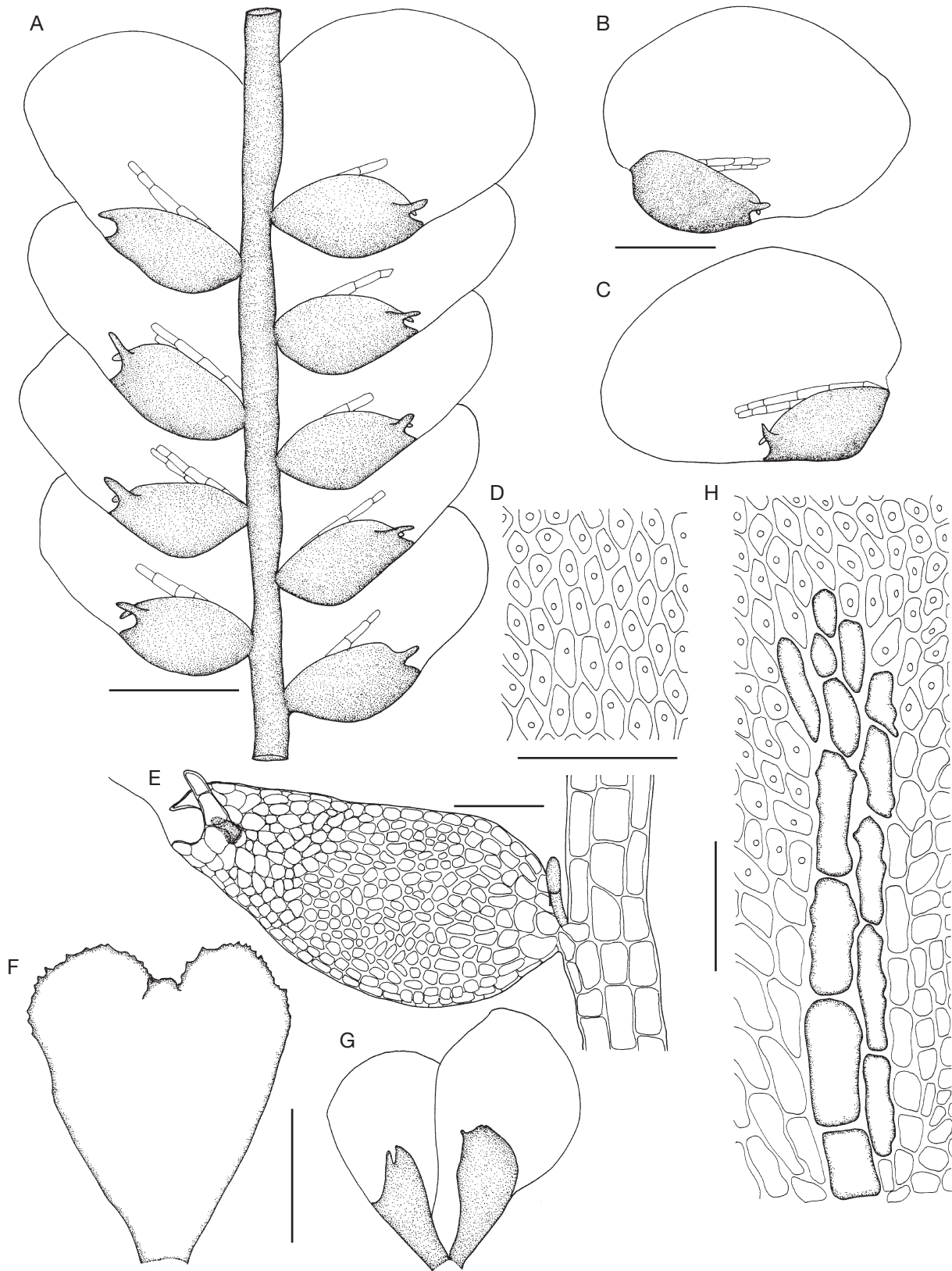


FIG. 7. — *Cololejeunea ensifera* Tixier ex L.Söderstr., Pócs, Váňa & A.Hagborg: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, median leaf lobe cells; **E**, stem portion, leaf lobule and stylus (hyaline papilla shown in gray); **F**, perianth; **G**, female bracts; **H**, basal leaf lobe cells and vitta. From *J. Havasi & T. Pócs 1823AL*. Scale bars: A-C, F, G, 0.2 mm; D, E, H, 50  $\mu$ m.



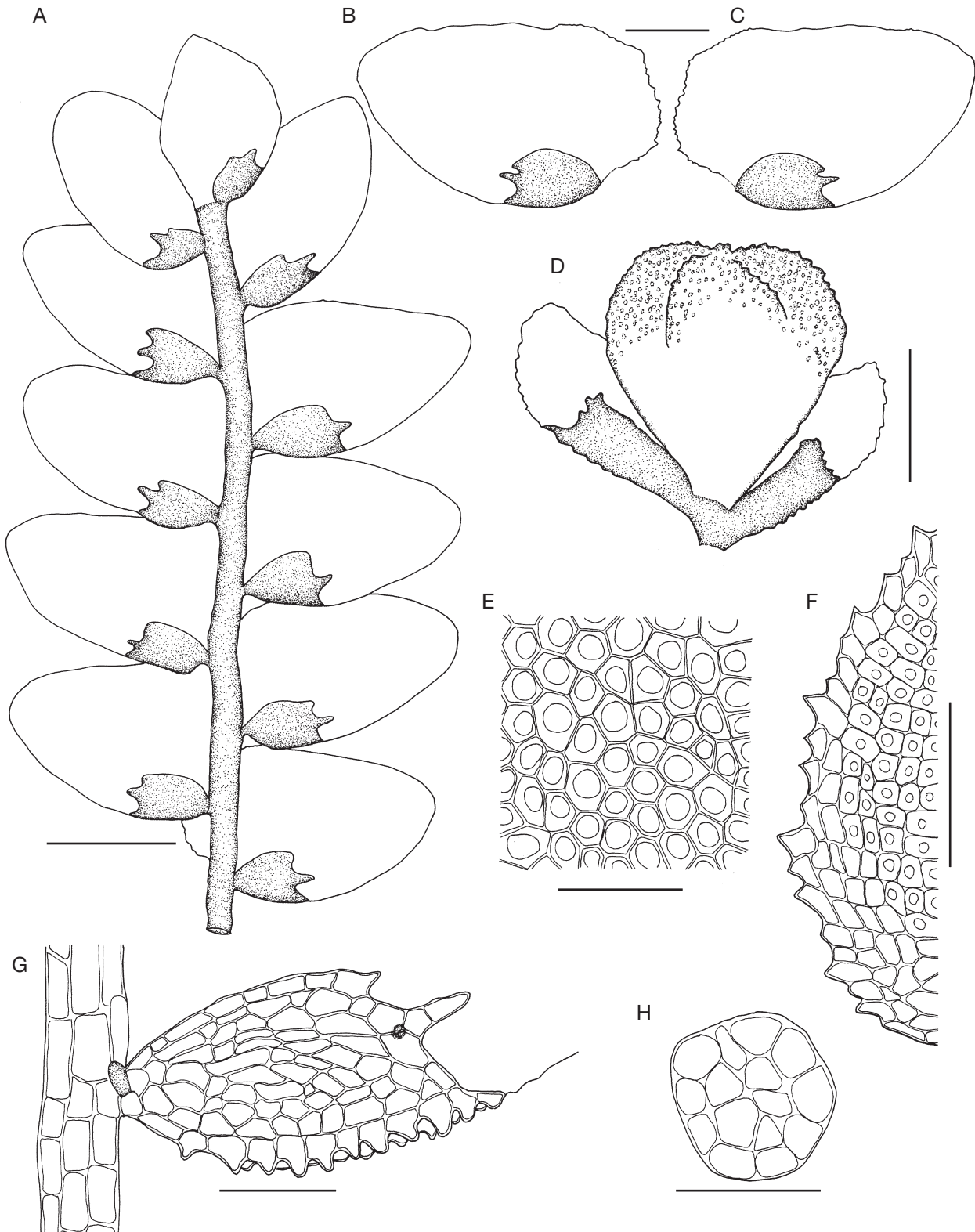


FIG. 8. — *Cololejeunea schmidtii* Steph.: **A**, part of plant in ventral view; **B, C**, leaves; **D**, perianth, female bracts; **E**, median leaf lobe cells; **F**, marginal leaf lobe cells; **G**, stem portion, leaf lobule and stylus (hyaline papilla shown in gray), **H**, gemma. From G.E. Lee *et al.* 19015. Scale bars: A, D, 0.2 mm; B, C, 0.1 mm; E-H, 50  $\mu$ m.

keels (more than  $\frac{2}{3}$  length of perianth) (So & Zhu 1998). By its autoicy, verrucose cuticle, and less than 10 medullary cells in cross-section of stem, *L. convexiloba* most resembles

*L. konosensis* and *L. pallide-virens* but differs by the large leaf lobules with free margin and the long ventral keels of perianth. The species was previously known only from China, new to



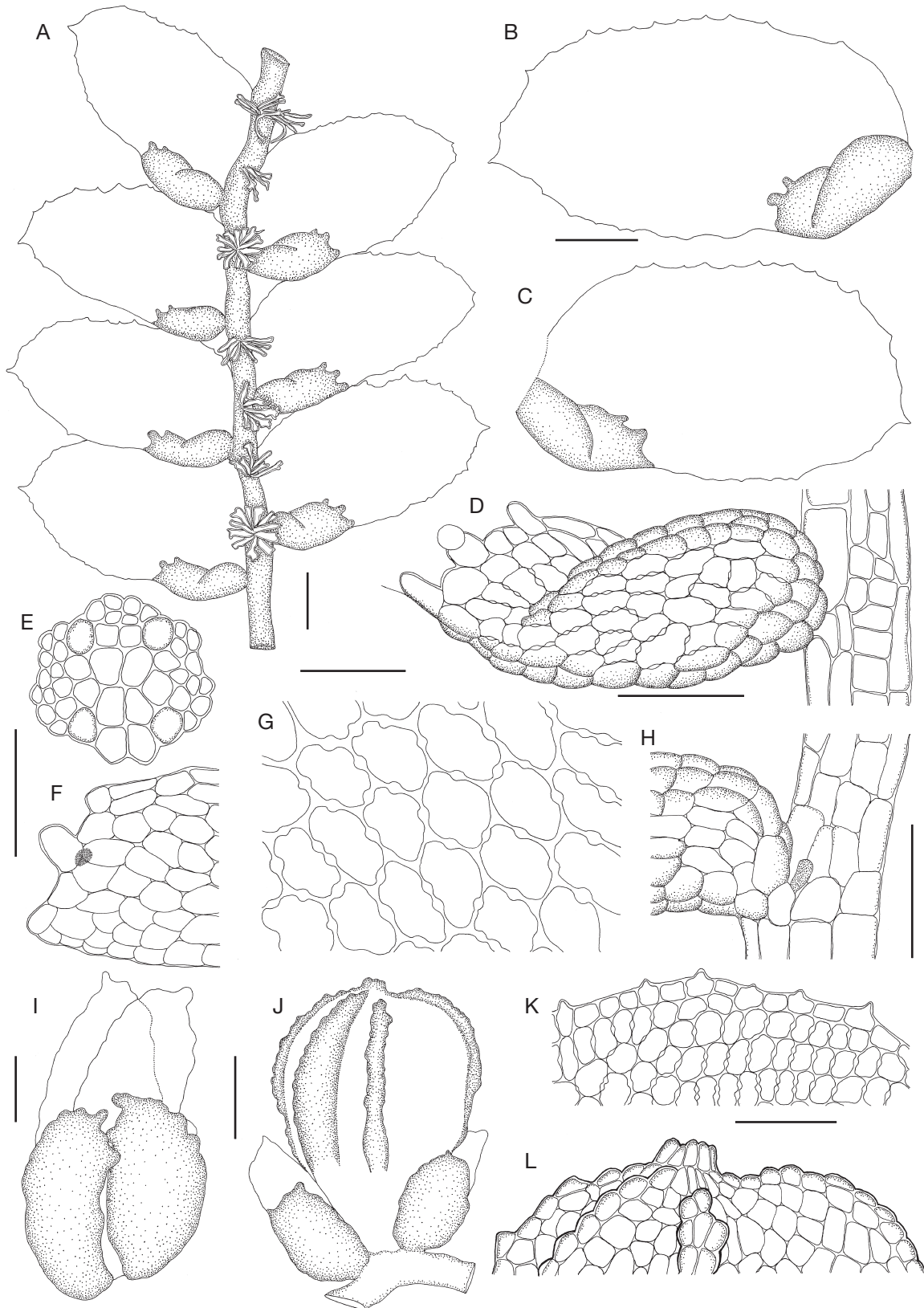


FIG. 9. — *Cololejeunea gottschei* (Steph.) Pandé, K.P.Srivast. & Ahmad: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, stem portion and leaf lobule; **E**, gemma; **F**, leaf lobule when flattened (hyaline papilla shown in gray); **G**, median leaf lobe cells; **H**, stem portion, lower part of leaf lobule and stylus; **I**, female bracts; **J**, perianth and female bracts; **K**, marginal leaf lobe cells; **L**, upper part of perianth. From *T. Pócs et al. 13180/R*. Scale bars: A-C, 0.2 mm; D-F, H-L, 100  $\mu$ m; G, 50  $\mu$ m.

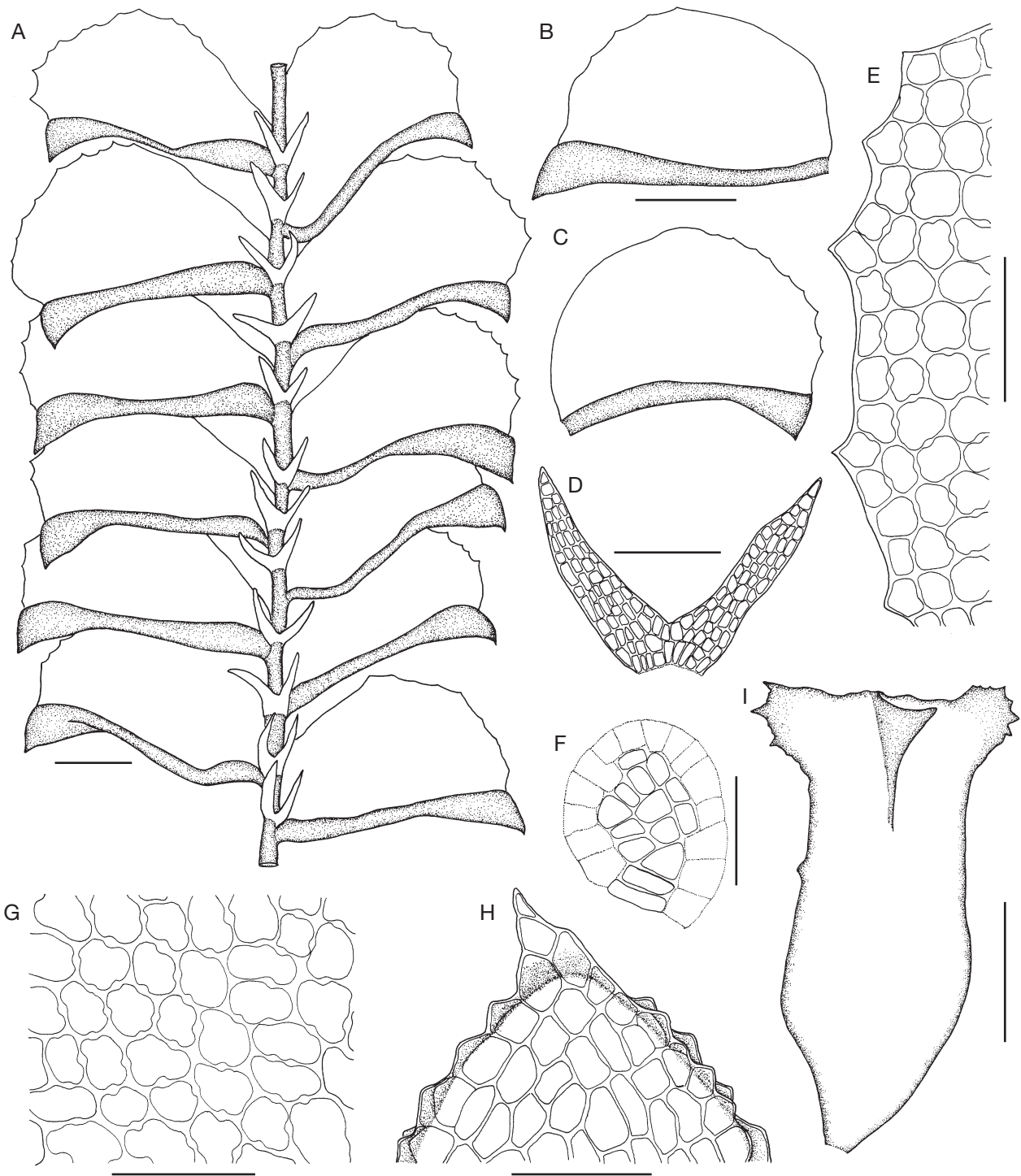


FIG. 10. — *Colura ari* (Steph.) Steph.: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, underleaf; **E**, marginal leaf lobe cells; **F**, valve; **G**, median leaf lobe cells; **H**, apex of lobule sac; **I**, perianth. From G.E. Lee *et al.* 19020. Scale bars: A-C, I, 0.5 mm; D, 0.2 mm; E, G, 100  $\mu$ m; F, H, 50  $\mu$ m.

Malaysia. It occurs on bark at high elevations and was found in China at 1500 m and in Malaysia (Mt. Kinabalu) at 2900 m. Moreover, the holotype in China also found growing on a

tree trunk at 1500 m in a nature reserve. It is expected that *L. convexiloba* may be distributed more widely in montane rainforests of Malesia.



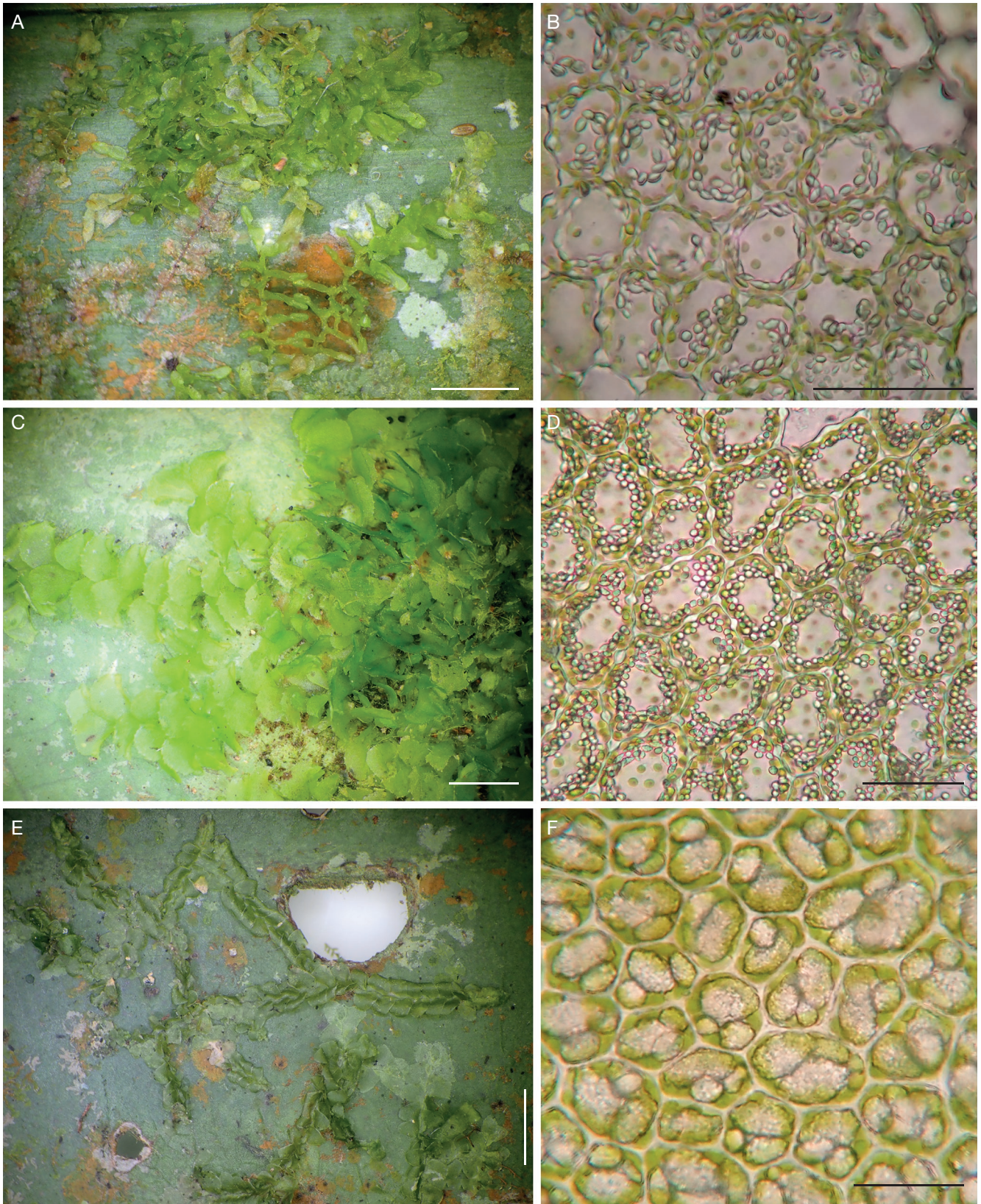


FIG. 11. — *Colura inuii* Horik.: **A**, habit; **B**, oil bodies. From G.E. Lee 21010. *Colura ari* (Steph.) Steph.: **C**, habit; **D**, oil bodies. From G.E. Lee *et al.* 19020. *Radula grandilobula* Promma & Chantanaorr.: **E**, habit; **F**, oil bodies. From G.E. Lee 21003. Scale bars: A, C, E, 2 mm; B, D, 50 µm; F, 25 µm.



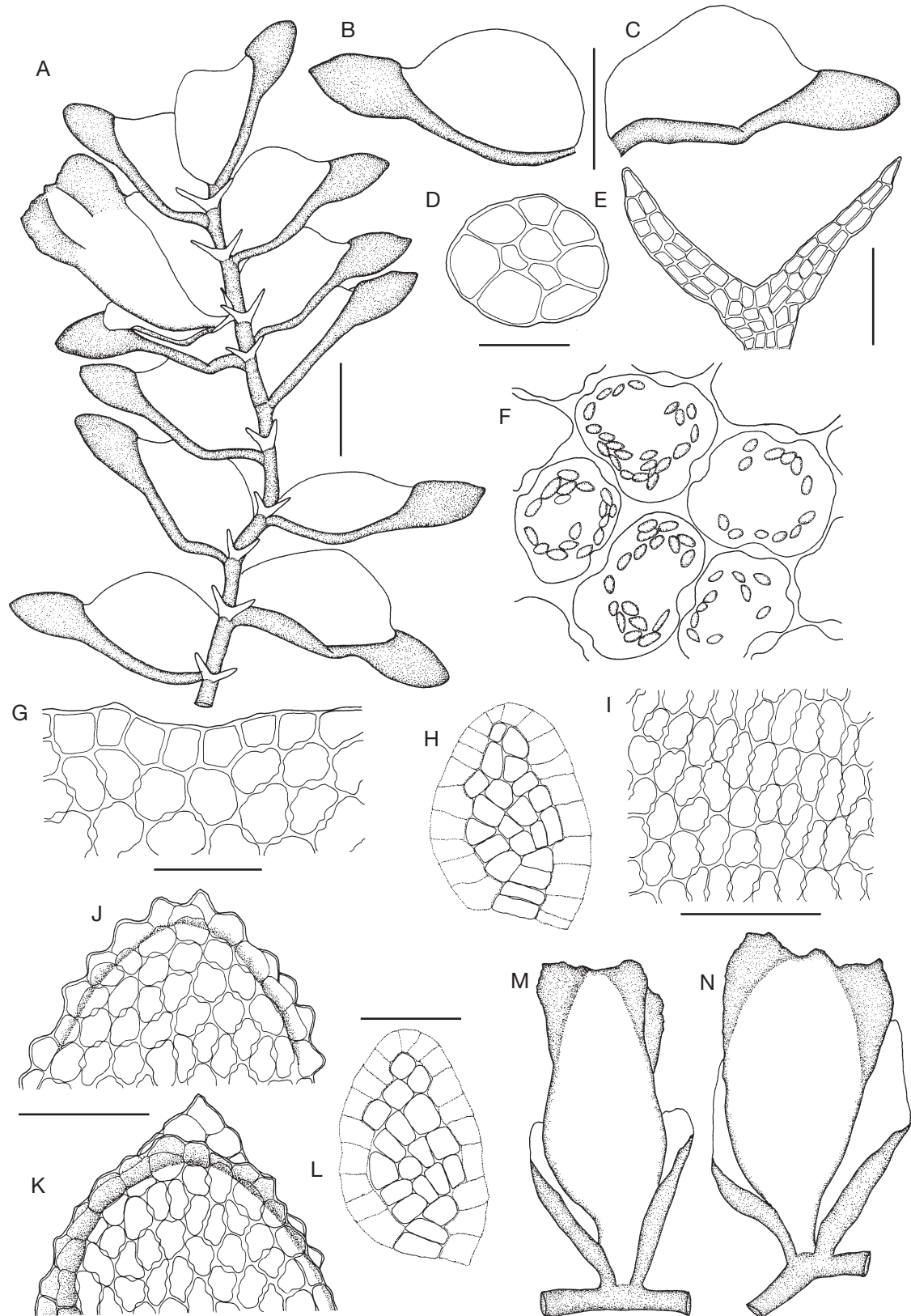


FIG. 12. — *Colura inuii* Horik.: **A**, part of plant and perianth in ventral view; **B**, **C**, leaves; **D**, cross-section of stem; **E**, underleaf; **F**, oil bodies; **G**, marginal leaf lobe cells; **H**, **L**, valves; **I**, median leaf lobe cells; **J**, **K**, apex of lobule sacs; **M**, **N**, perianths and female bracts. **A**, **E**, **G**, **D** from *G.E. Lee et al. 19019*; others from *G.E. Lee 21011*. Scale bars: **A**-**C**, 0.5 mm; **D**, **G**, **H**, **L**, 50  $\mu$ m; **E**, **I**-**K**, 100  $\mu$ m.

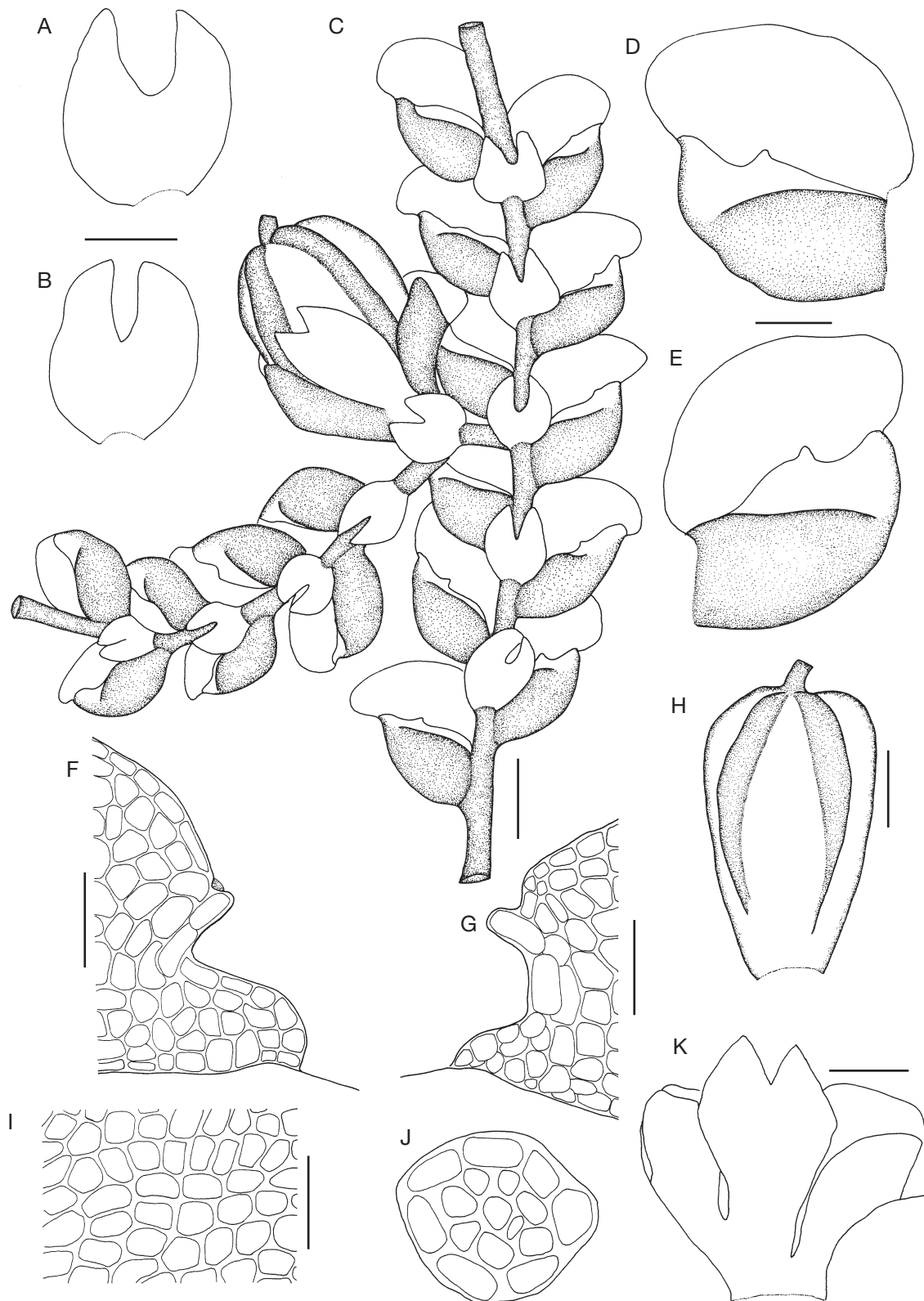


FIG. 13. — *Lejeunea convexiloba* M.L.So & R.L.Zhu: **A, B**, underleaves; **C**, part of plant and perianth in ventral view; **D, E**, leaves; **F, G**, upper part of leaf lobules when flattened (hyaline papilla shown in gray); **H**, perianth; **I**, median leaf lobe cells; **J**, cross-section of stem; **K**, female bracts and bracteole. From *G.E. Lee 1940*. Scale bars: A, B, D, E, 0.1 mm; C, H, K, 0.2 mm; F, G, I, J, 50  $\mu$ m.

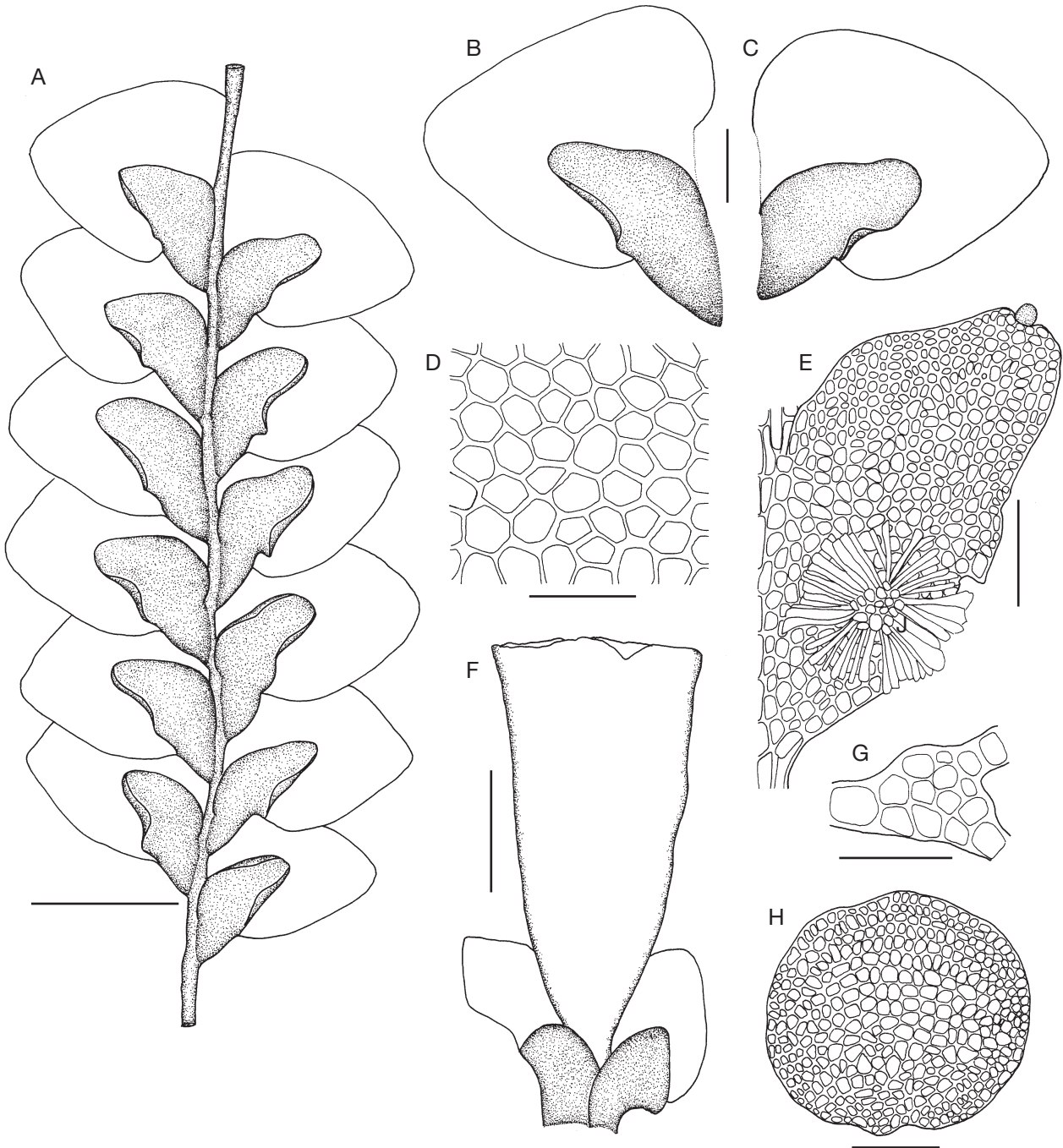


FIG. 14. — *Radula grandilobula* Promma & Chantanaorr.: **A**, part of plant in ventral view; **B**, **C**, leaves; **D**, median leaf lobe cells; **E**, leaf lobule and rhizoids (hyaline papilla shown in gray); **F**, perianth and female bracts; **G**, cross-section of stem; **H**, gemma. From G.E. Lee *et al.* 19022. Scale bars: A, F, 0.5 mm; B, C, 0.2 mm; D, G, 50 µm; E, H, 100 µm.

Genus *Radula* Dumort.

*Radula grandilobula* Promma & Chantanaorr.  
(Figs 11E, F; 14)

*Cryptogamie, Bryologie* 36 (3): 219 (2015).

SPECIMEN EXAMINED. — Malaysia. Terengganu: Mt. Tebu Forest Reserve, 15 km S of Jerteh town. Primary lowland dipterocarp forest with small waterfalls and slow stream. Along the forest trail at

the Lata Belatan Recreational Forest and waterfall, situated at the base of Mt. Tebu at 100 m alt., on living leaves, 16.IV.2019, G.E. Lee *et al.* 19022, 19023, 19024, 19025, *ibid.*, 13.III.2021, G.E. Lee 21001, 21002, 21003, 21004.

REMARKS

*Radula grandilobula* is close to the widespread Indopacific *R. acuminata* (Zhu & So 2001); differs in having triangular-ovate leaf lobes, frequently recurved free margin of leaf lobules,



the leaf lobule apices pointing towards the leaf lobe apices or directed away from the stem, and the finely segmented oil bodies, 2–4 per cell (Promma & Chantanaorrapint 2015). *Radula grandilobula* was first described in Nakhon Si Thammarat, southern Thailand (Promma & Chantanaorrapint 2015), and its occurrence in northern Malaysia was therefore expected. New to Peninsular Malaysia (Terengganu). The species has exclusively been found on living leaves.

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