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THE GENUS *LEPTOLEJEUNEA* (SPRUCE) STEPH. IN INDIA[1]

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ABSTRACT

Two species of the genus *Leptolejeunea* (Spruce) Steph., *L. balansae* Steph. from Andaman Island and *L. subacuta* Steph. from eastern India (Arunachal Pradesh, Jorpokhari, Khasi Jaintia Hills and Rimbic) and south India (Agumbe and Kodaikanal) have been described. Of the five species of the genus known in India *L. balansae, L. foliicola, L. schiffneri* and *L. subacuta* are foliicolous and *L. sikkimensis* is corticolous.

INTRODUCTION

The genus *Leptolejeunea* (Spruce) Steph. includes both epiphytic as well as epiphyllous species which either grow in pure populations or are usually associated with the members of its own family. The plants are closely appressed to the substratum but female branches tend to grow erect or suberect partially lifting the sporophyte from the substratum presumably to facilitate spore dispersal. The stem is irregularly branched by the *Lejeunea*-type of branching and consists of 7 rows of cortical and 3 rows of comparatively smaller medullary cells. The ventral cortical cells are smaller in comparison to lateral and dorsal ones. The leaves are compactly and or distanlty arranged and are elliptical, ovate, obovate, lanceolate or rhombic. Their apices are acute, subacute, apiculate, obtuse or rounded and margins are entire or dentate. The leaf cells are with distinct trigones and intermediate nodular thickenings. In dried herbarium specimens the cells are shrunken and often do not stretch easily even after soaking in warm water, but the hyaline trigones and intermediate nodular thickenings still remain distinctive. The oil-bodies are small, homogeneous or granular. The ocelli are usually present. The underleaves are deeply bilobed. The lobes are 2-4 cells long and may be uniseriate or biseriate or biseriate at base and uniseriate above. They are widely spreading, sometimes forming an angle of 180 from each other thus resulting in horizontal sinus, otherwise the same is acute ('V'shaped),'U' shaped or lunulate. The basal portion of the underleaf is trapezoidal or more or less rectnagular and consists of 6 marginal cells encircling (except at base) numerous small rhizoid

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initial cells. The rhizoid initial cells are distinctive in young leaves as they later form numerous rhizoids which are simple, usually hyaline, branched or unbranched and often cover the entire basal portion of the underleaf. The inflorescence is monoecious or dioecious. The male inflorescence is terminal on short lateral branch or on a leading branch with the bracts more of less equally bilobed, having entire or dentate margin. The bracteoles are usually 1-3 in number and restricted at base of the inflorescence. Cells of the male bracts are thin walled. The female inflorescence is terminal on short lateral branch and lacks subfloral innovations. Evans (1902), however stated that it innovates to one side in some species. The bracts and bracteoles are mostly smaller than the perianth and are entire or dentate at their margin. The perianth in most cases is obovate-obconical and has 5 distinct keels prolonged into horns. The ocelli are usually present on male bracts, female bracts, bracteole and perianth. Asexual reproduction occurs by means of brood-branches. The brood-branches are specialized lateral branches produced on the normal stem, like other branches, but differ from them in having first few leaves and underleaves different from the normal. The lobe usually has 2-3 teeth in first and second pairs of leaves. The lobule of the first formed leaf is reduced to a single row of cells or sometime absent while in other modified leaves it is usually small. The modified first two underleaves often develop an adhesive rhizoid-disc or paramphigastrium. The brood-branches remain attached to the stem by means of few cells only and hence get detached easily leaving behind a bell-shaped collar of cells.

Stephani (1913) described *L. balansae* Steph. from Andaman and *L. erecta* Steph. from Sikkim. Later Pande & Misra (1943) described a new species of *Leptolejeunea* : *L. himalayensis* Pande et Misra. Subsequently Pande *et al* (1957) listed 2 more species of *Leptolejeunea* from India viz.; *L. dapitana* Steph. from Udipi (South India), *L. spathulifolia* Steph. from Rimbic (Eastern India) and described *L. schiffneri* Steph. from Gersoppa fall, Agumbe (South India) and Rimbic (Eastern India). of these, *L. erecta* has recently been transferred to the genus *Drepanolejeunea* (Mizutani 1976, See also Grolle 1979, Udar & Awasthi 1982) and *L. dapitana* has been reduced as a synonym of *L. subacuta* Steph. (Mizutani, 1961). The plants described by Pande *et al.* as *L. schiffneri* were found to be *L. subacuta* Steph. *L. spathulifolia* is a doubtful record as neither description and illustrations have been provided nor the plants are available in LWU. Judging from the description and illustrations *Leptolejunea himalayensis* seems to be more closer to *Lejeunea* rather than to *Leptolejeunea*. As the Type specimen of this taxon is not available for study its status remains yet to be decided. *L. schiffneri* (Schiffn.) Steph. has recently been listed by Mizutani (1975) from Andaman.

In the present state of our knowledge there are thus five species of *Leptolejeunea* occur in India including *L. sikkimensis* which occurs on bark surface the other four taxa grow on the surface of leaf.

The present communication provides the details of the Indian plants of *L. balansae* and *L. subacuta* as the other two species have already been described earlier by Udar & Awasthi (1979, 1982a). The description of *L. schiffneri* remains yet to be given as its plants are not available for study.

KEY TO THE INDIAN SPECIES OF *LEPTOLEJEUNEA*

1. Leaves with two ocelli, one basal and the other superbasal ..... *L. balansae*
1. Leaves with several ocelli, one basal and other

scattered 2
2. Leaf-lobe with denticulate or dentate margin 3
2. Leaf lobe with entire margin 4
3. Leaf-lobe obovate with apiculate apex and denticulate margin, underleaf-lobe biseriate .....*L. foliicola*
3. Leaf-lobe ovate-oblong with rounded-obtuse apex and dentate margin, underleaf-lobe uniseriate .....*L. schiffneri*
4. Lobule 1/2 the length of the lobe, underleaf with trapezoid base and usually biseriate lobes .....*L. sikkimensis*
4. Lobule 1/3 the length of the lobe, underleaf with rectangular base and usually uniseriate lobes .....*L. subacuta*

1. *Leptolejeunea balansae* Steph. (Figs. : 1-14).

Spec. Hepat. 5 : 377-(1913).

Description : Plants 5-10 mm long brown in colour (in Herbarium), growing closely appressed to the substratum. Cross section of the stem 0.06-0.07 mm in diameter with 7 cortical and 3 medullary cells, cells with distinct trigones. Leaves mostly distantly arranged, usually obliquely spreading, lobe 0.48-0.64 mm long, 0.17-0.32 mm wide, oblong or obovate with dorsal and ventral margin often involuted, entire or with few dentitions towards apex, apex acute, cells with distinct hyaline trigones and intermediate nodular thickenings, basal cells 42-52 × 22-29 μm, median cells 29-42 × 17-25 μm, marginal cells 12-16 × 16-20 μm, 0celli 2, basal large 63-71 × 34-42 μm, superbasal 50-55 × 29-33 μm sometimes absent, lobule ca 1/4 of the lobe length, 0.13-0.17 mm long, 0.06-0.08 mm wide, ovate, first tooth single celled with proximal hyaline papilla, second tooth reduced. Underleaves deeply bilobed, lobes distant, widely spreading, 3-4 cells or 0.09-0.11 mm long, biseriate at base and uniseriate above sinus broad lunulate, basal portion rectangular, ca 0.04 mm long and 0.16 mm wide, with 6 marginal cells encircling numerous small rhizoid initial cells except at base, in older underleaves, central area with a tuft of hyaline rhizoids. Dioecious. Male infloresece terminal on short lateral branch, bracts in 3-9 pairs, lobe 0.21-0.24 mm long, 0.14-0.16 mm wide, ovate with dorsal margin cranulate due to hyaline projecting cells, ventral margin entire, apex subacute, cells thin-walled, lobule 0.17-0.19 mm long, 0.13-0.14 mm wide, with entire margin, free margin slightly involuted, oceli rarely present; bracteole one, at the base of the inflorescence similar to underleaf except the basal portion which is almost trapezoid with a tuft of rhizoids.

Specimens examined : G 751/17, 751/18, Loc. : Andaman Is, (12°N, 92°42'E, alt. at sea level), Leg.: Man, Dt.: 1895,

Det. : Stephani.

Habitat : Epiphillous.

Range : Tonkin, Siam, Perak, Andaman Is.

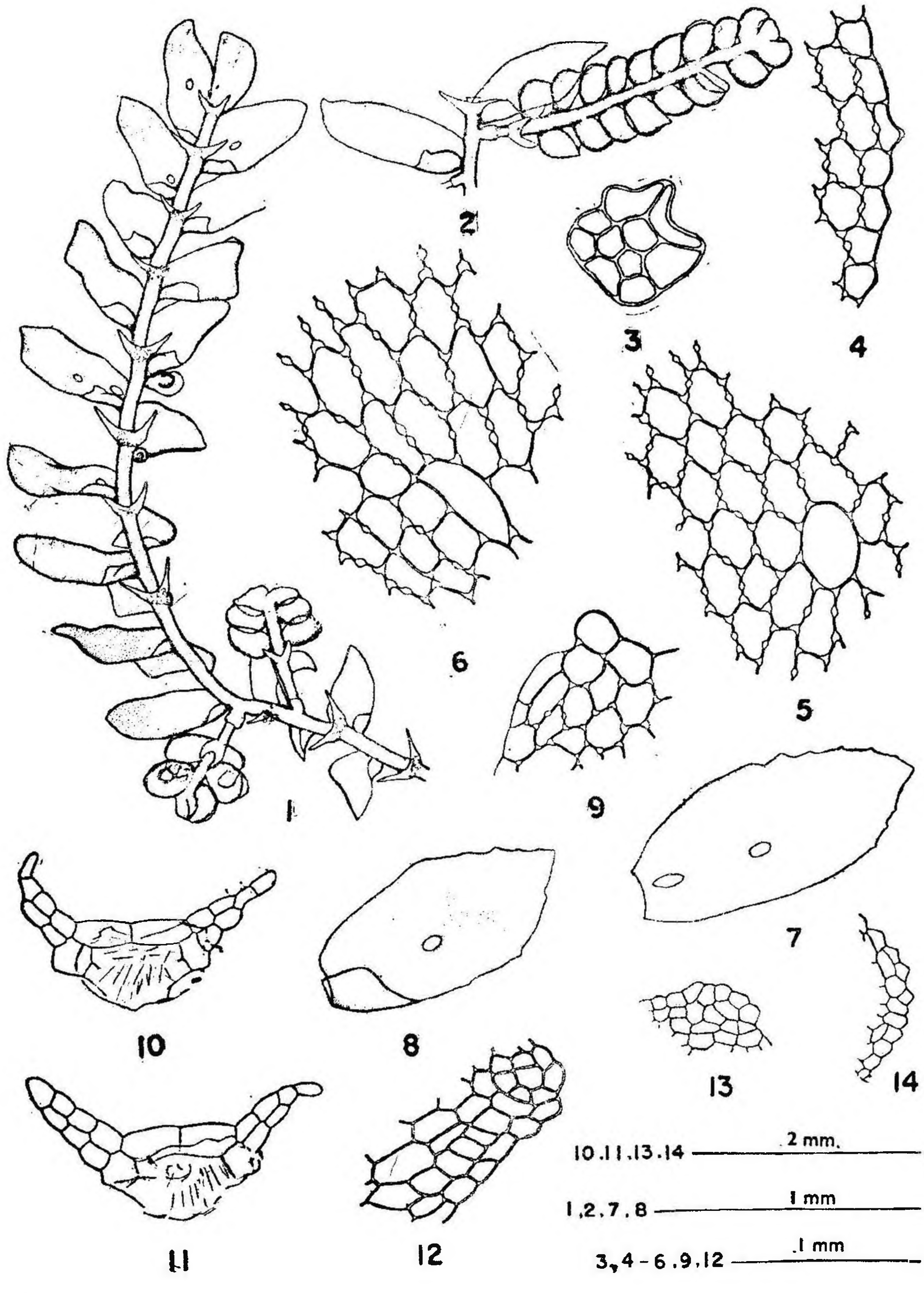
The present species approaches *L. foliicola* to some extent in the obovate shape of leaf (Figs. 7,8) and its denticulate margin (Fig. 4) but differs in having only (1-)2 ocelli (Fig. 7) which are several in *L. foliicola*. In having 2 ocelii per leaf it differs from other Indian species as well which have several ocelli per leaf.

2. *Leptolejeunea foliicola* Steph.

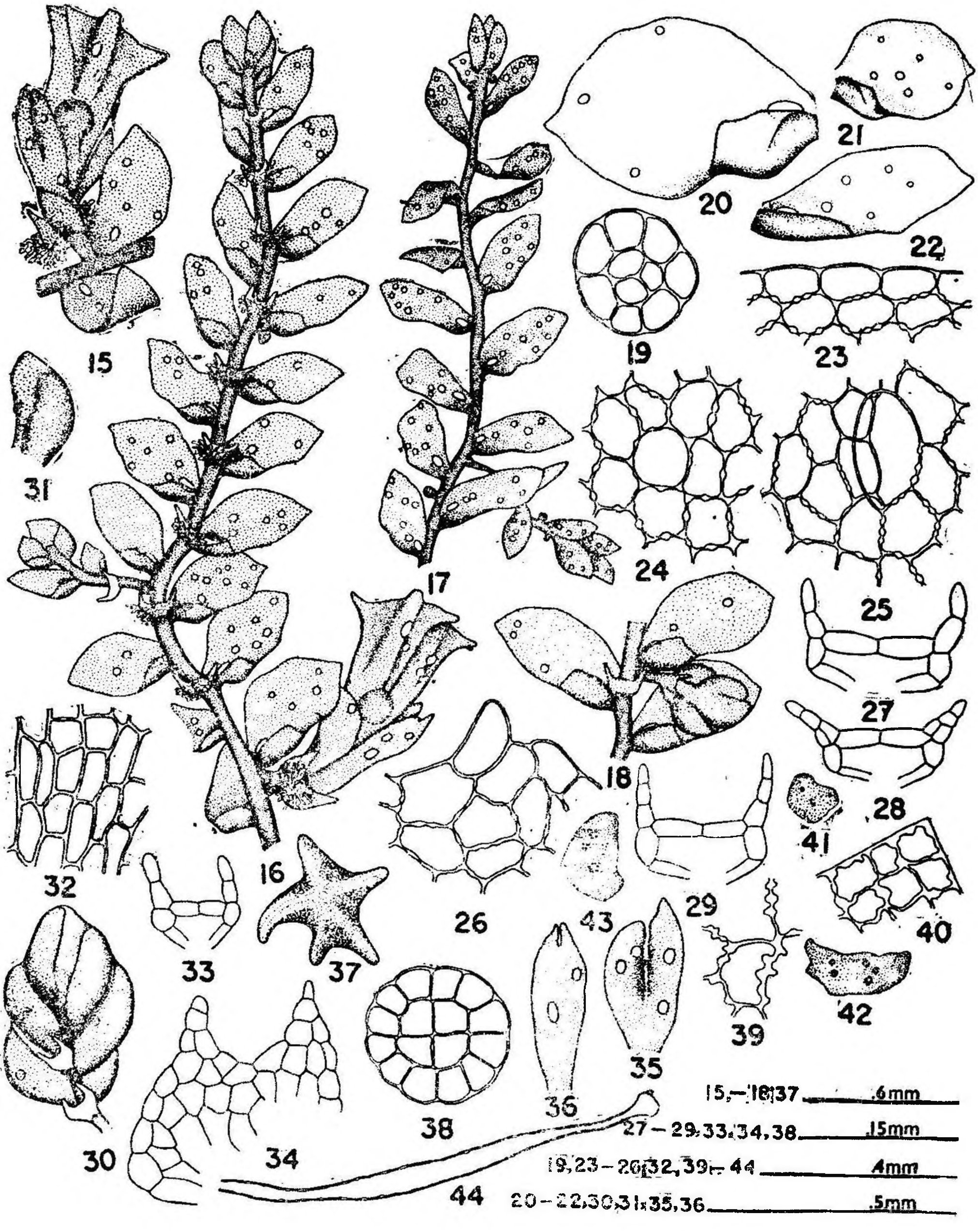
Hedwigia 35 : 106 (1896).

Drepanolejeunea apiculata Horik. Journ. Sci. Hiroshima Univ. 2:46 f. 54 (1934); Amakawa, Journ Jap. Bot. 35 : 163, f. 19, A-M (1960) ; Udar & Awasthi, J. Indian bot. Soc. (Suppl.) 50 : 32 (1979).

Range : Formosa, Indo-China, Java, Malay Pen., Moluccas, Philippines, Ryukyu, Sumatra and India (Meghalaya).



Figs. 1-14. *Leptolejeunea balansae* Steph. Figs. 1,2. Portions of the plant showing male inflorescence. Fig.3. Cross-section of the stem. Fig. 4. Marginal cells of the leaf-lobe. Figs. 5, 6. Basal cells and ocellus of the leaf-lobe. Fig. 7. Leaf in dorsal view showing basal and super basal ocelli. Fig. 8. Leaf in ventral view. Fig. 9. Portion of the leaf-lobule. Figs. 10, 11. Underleaves. Fig. 12. Portion of cells of the male bract. Figs. 13, 14. Cells of the keel of male bracts.



Figs. 15-44 *Leptolejeunea subacuta* Steph. Figs. 15, 16. Portions of the plant showing female inflorescences. Fig. 17. Portion of the plant showing variously folded leaves. Fig. 18. Portion of the plant showing male inflorescence. Fig. 19. Cross-section of the stem. Figs. 20-22. Leaves. Fig. 23. Marginal cells of the leaf. Fig. 24. Median cells and ocellus. Fig. 25. Basal cells and ocellus. Fig. 26. Lobule of the leaf-lobe. Figs. 27-29. Underleaves. Fig. 30. Male inflorescence. Fig. 31. Male bract. Fig. 32. Cells of the male bract. Fig. 33. Male bracteole. Fig. 34. Portion of the underleaf of female branch. Fig. 35. Female bract. Fig. 36. Female bracteole. Fig. 37. Top of the perianth. Fig. 38. Cross-section of the seta. Fig. 39. Inner layer of the capsule wall. Fig. 40. Outer layer of the capsule wall. Figs. 41. 43. Spores. Fig. 44. Elater.

3. *L. schiffneri* (Schiffn.) Steph. Hedwigia 35 : 107 (1896).

Range : Andaman Is., Malay Pen. Sumatra, Java, Borneo, Moluccas, Philippines, New Caledonia, Samoa.

4. *Leptolejeunea sikkimensis* Udar et Awasthi Misc. Bryol. Lichenol. 8(6) : 115-117 (1979).

Range : Endemic to India (Sikkim).

4. *Leptolejeunea subacuta* Steph. (Figs. 15-44).

Spec. Hepat. 5 : 379 (1913).

Leptolejeunea schiffneri Steph. (Pande *et al.* 1957) non *L. schiffneri* Steph. Spec. Hepat. 5 : 386 (1913).
L. dapitana Steph. Bull. Herb. Boiss. 5 : 79 (1897).

Description : Plants 5-10 mm long, green brown (in Herbarium), growing closely appressed to the substratum except for the female branches which are suberect. Cross-section of the stem 0.06-0.07 mm in diameter, with 7 cortical and 3 comparatively smaller medullary cells, cells with distinct trigones. Leaves usually distantly arranged and obliquely spreading, lobe 0.40-0.52 mm long, 0.16-0.32 mm wide, elliptical or elliptical-obovate, margin entire, often variously folded, dorsal margin arched, ventral margin almost straight with a slight notch at about middle, apex acute or apiculate, cells with distinct hyaline trigones and intermediate nodular thickenings, basal cells 24-41×24-28 (—33) μm, median cells 24-33 μm long and wide, marginal cells 20-31×14-24μm, ocelli several, basal ocellus elliptical, 57-65×33-35 μm, overlapping the adjacent cell of one side in ventral view, other ocelli smaller, scattered, rounded (28-33 μm in diameter), lobule about 1/3 of the lobe length, 0.16-0.22 mm long, 0.06-0.08 mm wide, first tooth single celled with proximal hyaline papilla, second tooth reduced, free margin slightly involuted. Underleaves deeply bilobed, lobes distant, straight or widely spreading, 2-3 cells or 0.02-0.03 mm long, uniseriate, sometimes biseriate at base and uniseriate above, sinus broad 'U' shaped or lunulate, basal portion almost rectangular, with 6 marginal cells encircling except at base, numerous small rhizoid initial cells, in older underleaves central area with a tuft of hyaline rhizoids. Dioecious. Male inflorescence terminal on short lateral branch, bracts in 2-5 pairs, lobe 0.22-0.25 mm long, 0.11-0.13 mm wide, ovate, margin entire, apex obtuse, cells thin-walled lobule 0.20-0.22 mm long, 0.07-0.09 mm wide, free margin involuted, entire, apex acute; bracteoles 1-2, restricted at base of the infloresence, similar to underleaves but smaller in size. Female inflorescence terminal on short lateral branch, underleaf on the female branch very different from those present on vegetative axis, deeply bilobed, lobes 3-4 cells long, 3-4 cells wide at base, uniseriate above, basal portion 0.16-0.19 mm long, 0.13-0.16 mm wide with numerous hyaline rhizoids, marginal cells several, the leaf on the female branch single, dorsolateral, 0.14-0.15 mm long, 0.09-0.10 mm wide, ovate, lobule reduced; bracts and bracteole ca 1/2 of the perianth length, bract-lobe 0.32-0.40 mm long, 0.06-0.09 mm wide, more or less obovate, apex acute, lobule 0.27-0.28 mm long, 0.06-0.08 mm wide, apex acute, bracteole 0.35-0.45 mm long, 0.13-0.16 mm wide, with entire margin, bifid for about 1/6 of the length; perianth obconical-obovate, 5 keeled, keels smooth, prolonged into horns, ocelli on bracts, baracteole and perianth several, scattered, elliptical-oval (24-60×20-37 μm) or rounded (24-41 μm in diameter), cross section of the seta with 12

peripheral and 4 central cells; capsule wall bistratose, cells of the outer layer with better developed sinuate-nodular thickenings on radial walls, spores 20-53×16-29 μm, variously shaped, with minute papillae and isolated groups of spines, elaters few, with sinuately thickened walls, often with faint interrupted spiral thickening band.

Specimens examined : LWU No. 2563/40, 2856/40, Loc.: Rimbic, Assam (26°N, 93°E, alt. 2561 m), eastern India, Leg.: S. K. Pande, Dt.: October 1940, Det.: R. Udar and U. S. Awasthi. LWU No. 2583/40, Loc.: Jorpokhari; Assam (26°N, 93°E, alt. 2, 134 m), eastern India, Leg.: S. K. Pande, Dt.: October 1940, Det.: R. Udar and U. S. Awasthi. LWU Nos. 2855/41, 3561/41, 3592/41, Loc.: Rimbic, Assam (26°N, 93°E, alt. 2561 m), eastern India, Leg.: S. K. Pande, Dt.: October 1941, Det: R. Udar and U. S. Awasthi. LWU No. 73/52, Loc.: Khasi-Jaintia Hills (25°30′N, 91°30′E alt. 1000-1500 m) Meghalaya, eastern India, Leg.: S. K. Pande, Dt.: October 1952, Det.: R. Udar and U. S. Awasthi. LWU No. 6803/80, Loc.: Tirup, Arunachal Pradesh (28°N, 95°E, alt. ca 1500 m) Leg.: D. K. Singh, Dt.: 1980, Det: R. Udar and U. S. Awasthi. LWU No. 323/71, Loc.: Kodaikanal (10°13′N, 77°32′E, alt. 2,090 m), Tamil Nadu, South India, Leg.: K. P. Singh, Dt.: December 17, 1971, Det.: R. Udar and U. S. Awasthi. LWU No. 6304F/82, Loc.: Agumbe, Shimoga (13° 56′N, 75°38′E, alt. 2000 m), Karanataka, South India, Leg.: R. Udar and party, Dt.: September 28, 1982, Det.: R. Udar and U. S. Awasthi.

Habitat : Epiphyllous, associates- *Leptolejunea foliicola* Steph., *Rhaphidolejunea foliicola* (Horik.) Chen.

Range : Bonin, Borneo, Formosa, Japan, Java, Molucca, Philippines, Ryukyu, Sumatra, India (Assam, Meghalaya, Arunachal Pradesh, Tamil Nadu, Karnataka).

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UDAR, R. AND U. S. AWASTHI 1982. The genus *Drepanolejeunea* St. in India. *J. Hattori bot. Lab.* **53 :** 419-437.

UDAR, R. AND U. S. AWASTHI 1982a. *Leptolejeunea foliicola* St. new to Indian bryoflora. *J. Indian bot. Soc.* **61 :** 299-301.