

FURTHER STUDIES ON TAIWAN HEPATICAE THE GENUS THYSANANTHUS

by

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The genus *Thysananthus* of the Lejeuneaceae was first established by Lindenberg in 1844⁽⁶⁾. Three species of *Thysananthus* were found and described by Y. Horikawa in 1934⁽⁷⁾, namely: *T. formosanus*, *T. fuscobrunneus* and *T. liukiensis*. As it was understood by Horikawa these species were characterized as follows: *T. formosanus* had underleaves broader than long, and a curved seta borne at the apex of each lobule; *T. fuscobrunneus* had underleaves longer than broad and the apex of the lobule was denticulate; while *T. liukiensis* had stem leaves entire throughout. Because of these characters Horikawa proposed that they were not only new records for Taiwan but also new to science.

Hattori, however, 1951⁽⁵⁾ having noticed the close resemblance between *T. formosanus* Horik. and *T. aculeatus* Herz. in respect to its lobule-tooth, suggested that these two species were very close. Then in 1961, M. Mizutani⁽⁹⁾ formally proposed the new combination that *T. formosanus* Horik. and *T. aculeatus* Herz. which had been reported from Japan as well as Taiwan, are synonyms. He stated further that *T. formosanus* Horik. is not distinct in any respect from *T. richardsonianus*, a species reported as endemic to Borneo, and which resembles, *T. aculeatus* Herz. These three species are now considered as one species. Therefore, *T. formosanus* Horik. and *T. richardsonianus* have been reduced to be synonyms of *T. aculeatus* Herz.

In this paper, two additional species of *Thysananthus*, recently found in Taiwan are described. They are distinct in several respects from the other species previously described, so they are here proposed as new.

The main characteristics of the genus *Thysananthus* may be summarized as follows⁽⁴⁾: (1) the female inflorescence terminal on main or principal branches, subfloral innovations arising from one or both sides below, (2) the perianth 3-angled in transverse section, with ventral keel sharp and distinct, (3) secondary folds or ridges none, (4) carinal and surface wings developed in some species, (5) the female bracts and bracteoles and keels toothed to a greater or lesser degree, (6) leaves and underleaves usually with some indications of teeth along the apical margins.

The vegetative features of the genus: Plants large, dark olive green, often with dark brown pigments, growing in depressed mats on trunks of trees and occasionally on logs or rocks; the primary stem prostrate, appressed to the substratum, the secondary stems ascending or upright; the transverse section of the secondary stems showing uniform orange-brown pigmentation, with the cells in cortex region

similar but smaller than those of the medulla (2); the branching being the Radula type (3); the lobule small, inflated, usually with a toothed apical margin.

All the Taiwan species reported by Horikawa and the two additional ones described here possess, in general, the above generic characters. There are some additional features recently found which will be discussed under the separate species.

KEY TO THE SPECIES

1. Underleaves obovate, the apex entire and rounded; stem leaves serrate at apex 1. *T. obovatus*
1. Underleaves subquadrate-cuneate, from retuse to bifid at apex.....2
2. Stem leaves serrate on upper half; lobule more or less rectangular, margins smooth; leaf cells with trabeculate walls; underleaves bifid, and toothed on both lobes.....3. *T. fuscobrunneus*
2. Stem leaves entire or with only one-tooth3
3. Lobule with two or more marginal teeth..... 2. *T. setacea*
3. Lobule with a minute or longer pointed tooth.....4
4. Lobule with apical seta of several cells long..... 4. *T. aculeatus*
4. Lobule minutely apiculate..... 5. *T. liukiensis*

DESCRIPTION OF THE SPECIES

1. *Thysananthus obovatus* Yang sp. nov.

Planta robusta, olivacea, pinnate ramosca, feminina dichotomia; folia imbricata, divaricata, asymmetrica, ovata, ad 2 mm. longa, 1 mm. lata, superne serrate; mediae cellulis $16\mu \times 61\mu$ to $19\mu \times 32\mu$. trigonis magnis; lobulo parvo, papillae hyaline obscure; amphigastria obovata, imbricata, integerrima, rotunda, 1-1.2 mm. longa, 1 mm. lata, vitta distincta; perianthia elongata-obconica, pluri-plicata carinata, bracteae femininis foliosae, lobulis magnis, crasse dentata serrata, bracteola magna ovata, carinata, crasse dentata. Dioici.

Plants (Figs. 1, 2.) dark brown to blackish green, pendent on the trunks of trees; the primary stem creeping, appressed to substratum, the secondary stems robust, tufted, 4.5-8 cm. long and 3-4.5 mm. broad with leaves, irregularly branching; the female inflorescence terminal on the main stem or principal branches with innovations arising from one or both sides below; dichotomous toward the top of the plant; leaves (Figs. 3, 4) incubous, imbricate, and obliquely spreading, slightly deflexed when dry, about 2 mm. long, 1 mm. broad, unsymmetrically ovate, serrate above the middle, the middle or the largest tooth of the apex often being 2-3 cells long (Figs 7, 8.), the base of the leaf shallowly cordate, the upper margin straight; the cells (Figs. 9, 10.) in the basal portion of the leaf $19\mu \times 49\mu$ to $22\mu \times 55\mu$, in the median portion $16\mu \times 61\mu$ to $19\mu \times 32\mu$, and on the margins $13\mu \times 19\mu$ to $13\mu \times 23\mu$, and cells of

the apical region $19\mu \times 26\mu$, trigones large, intermediate thickenings frequent, the cell lumen angular-oblong in outline, the cortical smooth to verruculose; the lobule (Figs. 3, 4) small and inflated, appressed, faintly toothed with 2 hyaline papillae; the underleaves (Fig. 5.) obovate 1 mm. broad, 1–1.2 mm. high, obovate, appressed to the stem, imbricate in a straight line, the upper margin entire, rounded, vitta differentiated, marginal cells uniform $9.7\mu \times 12.5\mu$; transverse section of stems showing an elliptical outline (Fig. 6.) about 0.4–0.5 mm. (or $288\mu \times 360\mu$) in diam., with about 30 peripheral cells in the cortical zone, 3–4 layers thick, each about 13μ – 19μ in diam., the bounding wall as much as 3μ – 4μ thick with pronounced dark yellowish pigmentation, cell lumen 2.5μ in diam., the medulla consisting of distinct, larger, thinner walled cells of about 10–12 cells across, each about $23\mu \times 36\mu$ (Fig. 6.).

Perianth (Figs. 11–13.) 3 mm. long, the dorsal surface slightly flattened, rudimentary ridges obscure, extending upward toward the mouth, the ventral surface convex, 2 lateral keels spreading, one on each side, a transverse section of the perianth showing an outline of several angles above (Figs. 11–12) and being triangular below; the bracts (Figs. 14–17) leaf-like in outline, much larger than ordinary leaves, 3 mm. long, 1.5 mm. broad, coarsely serrate above the middle, bracteoles (Fig. 18.) 2.5 mm. long, 1.6 mm. broad, bifid, strongly serrate on upper margins of both lobes, vitta distinct. Male branches and sporophytes not seen.

Habitat: On the trunks of trees.

Distribution: Hualien Hsien, Mt. Tsing-shui, Dec. 1961, T. Shimizu and M. T. Kao 317.

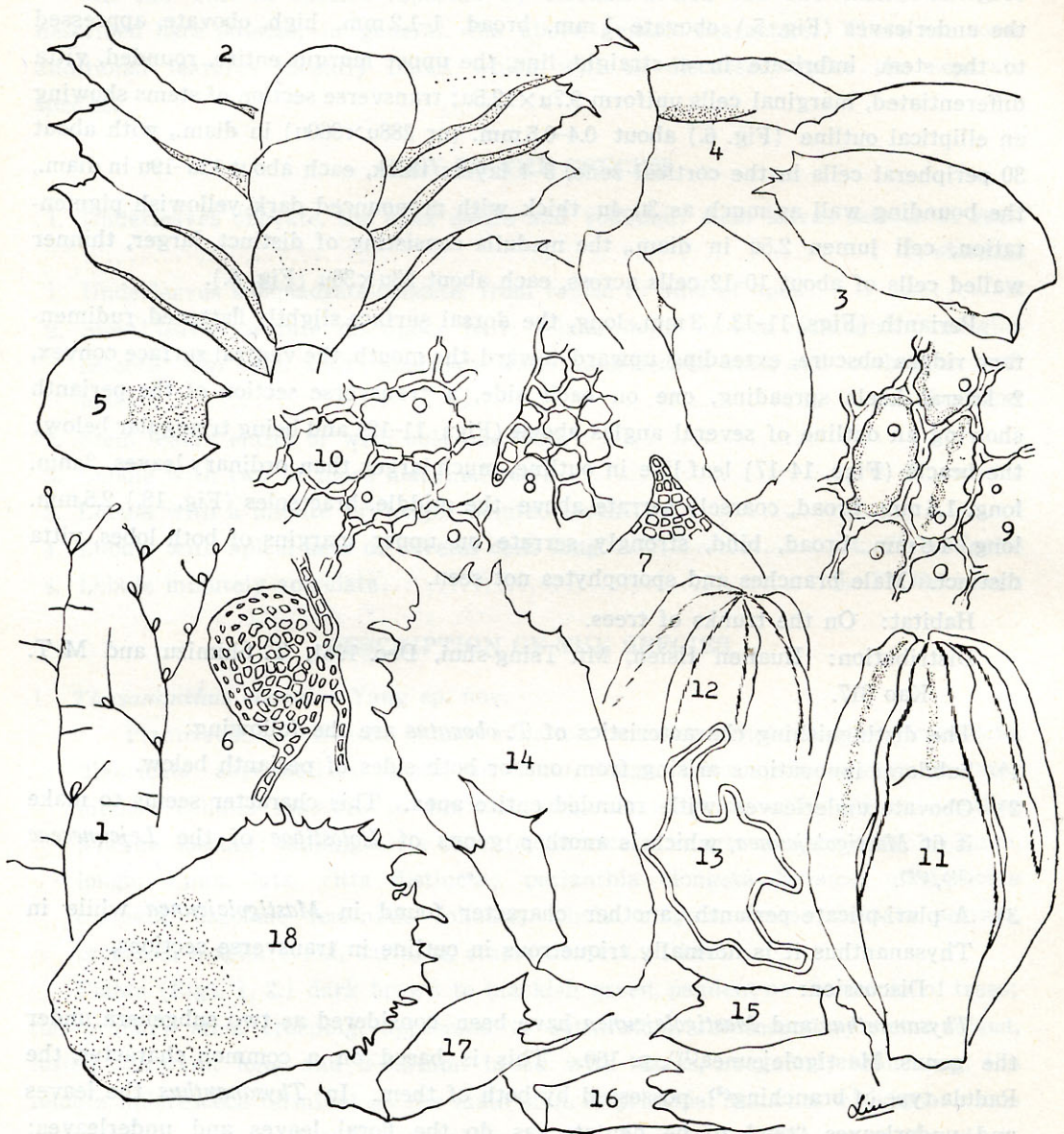
The distinguishing characteristics of *T. obovatus* are the following:

- 1) Subfloral innovations arising from one or both sides of perianth below.
- 2) Obovate underleaves with rounded entire apex. This character seems to make it fit *Mastigolejeunea*, which is another genus of *Holostipae* of the *Lejeuneaceae* ^{(11), (12)}.
- 3) A pluri-plicate perianth, another character found in *Mastigolejeunea* while in *Thysananthus* it is normally triquetrous in outline in transverse sections.

Discussion:

Thysananthus and *Mastigolejeunea* have been considered as two subgenera under the genus *Mastigolejeunea*⁽¹⁰⁾, p. 160. This is based on a common character, the *Radula*-type of branching⁽³⁾ possessed by both of them. In *Thysananthus* the leaves and underleaves "tend to be dentate, as do the floral leaves and underleaves; similarly, the perianth keels" tend to be toothed. These features are entire in *Mastigolejeunea*. The entire, round underleaves in *T. obovatus* may indicate an overlapping of characters among these closely related genera which is commonly met with in other cases. The pluri-plicate perianth in *T. obovatus* might represent a step in modification from a 3 angled perianth of *Thysananthus* type as exemplified in *T. aculeatus*, *T. liukiensis* and *T. fuscobrunneus*. In other words, they may be

Plate I



Figs. 1-18. *T. obovatus* Yang. 1. Diagram of ♀ plant × 20. 2. Portion of a branch, v. v. × 20. 3. Branch leaves × 20. 4. Ditto × 50. 5. Underleaf × 20. 6. Stem t. s. × 50. 7. Apical tooth × 100. 8. Marginal tooth × 220. 9. Cells from branch leaf × 450. 10. Cells from underleaf × 450. 11. Perianth, d. v. × 20. 12. Ditto, v. v. × 20. 13. Ditto t. s. × 20. 14-17. Bracts × 20. 18. Bracteoles × 20.

considered as a secondary condition arising from primitively trigonous to pluri-plicate which can occur within a single genus.

The keels of *T. cosmos* Lindenb. and *T. amazonicus* (Spruce) Steph.⁽⁴⁾ are lacinate and serrate. Such characters are not found in *T. obovatus*.

2. *Thysananthus setacea* Yang sp. nov.

Planta parva, fusca olivacea, caulis 3 cm. longa, 0.5 m. lata, cum folis, irregulariter ramosa; folia imbricata, divaricata ad 1.2–1.5 mm. longa, 0.7–0.8 mm. lata, margine plana, saepe apice seta 4–7 cellulis; foliae cellulae cum magnis trigonon, mediae cellulae 16u×13u to 22.6u×16.5u; vitta distincta; lobulus parus valde inflatus cum duabus rudimentariis dentibus vel pluribus; amphigastria subquadrata, emarginata, 0.5 mm. lata, 0.6 mm. longa; perianthia triplicata; bracteis femininis foliosis, lobulis magnis, plains, ovatis; bracteola magna, ovata carinata crasse dentata. Dioici.

Plants (Figs. 1–2) small, dark olive green to almost black, secondary stems up to 3 cm. long, 0.5 mm. broad with leaves; irregularly branching below and dichotomously above; leaves imbricate (Figs. 3, 4), deflexed, about 1.2–1.5 mm. long, 0.7–0.8 mm. broad, margins flat and entire, occasionally with folds on the margin of the lobule side; usually with a tooth of 4–7 cells high borne at the apex (Fig. 5); leaf cells (Figs. 7, 8, 9) with marked trigones and intermediate thickenings, basal cells 19u×22u to 16u to 36u, apical cells 11u×13u to 13u×19u, marginal 9.5 to 9u×10u, and median cells 16u×13u to 22.6u×16.5u, vitta broad, occupying almost half the width of the leaf and extending from the base to the upper half, near the lobule side, cells other than vitta covered with a coat of yellowish brown pigmentation; lobule small, cylindrical, appressed, usually with 2 or more rudimentary teeth near the apex of the free margin (Figs. 3, 4); underleaves subquadrate-cuneate (Fig. 6), imbricate, attached in a straight line, slightly recurved at the depressed notch, each about 0.5 mm. broad, and 0.6 mm. long, cells (Fig. 7) in the median basal vitta 16u×32u, apical region 8.8u×11u to 9.8u×9.1u. Stem section (Fig. 10) showing 1 layer of large cortical cells with brown pigmentation with about 15 cells in the peripheral zone and cells in medulla are similar in size to those of the cortex, both are thick-walled and variable in size.

Female perianth trigonous, terminal, subfloral innovations arising from both sides below (Fig. 11.).

Habitat: On rocks, Alt. 600 m.

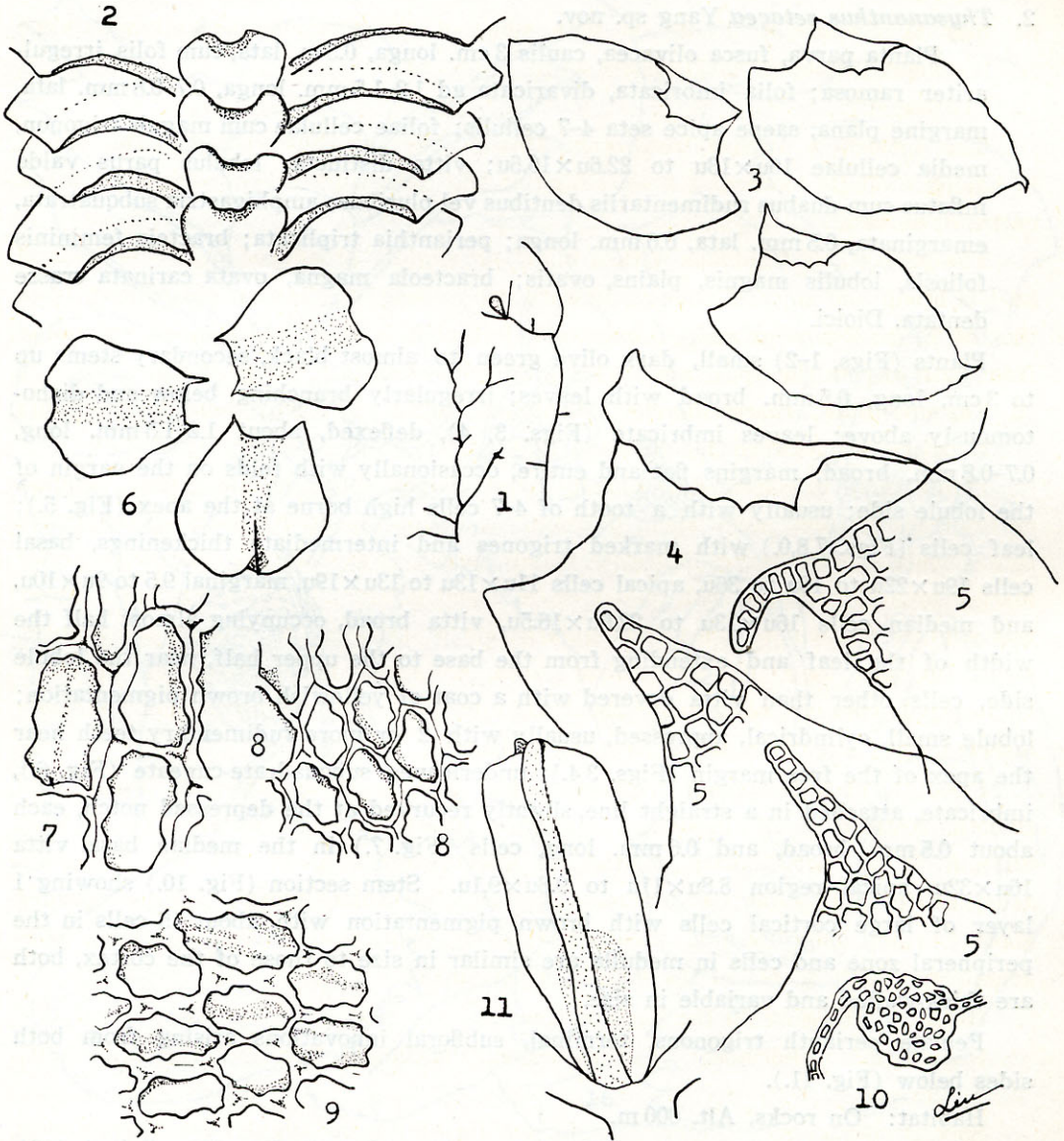
Distribution: Hualien Hsien, Tien-tsiang, Dec. 27, 1960, Kao 316; Feb. 4, 1964,

Yang 1882.

Special characters of this species:

- 1) Underleaves recurved at apex somewhat emarginate, very closely imbricate.
- 2) Leaves characterized by a single tooth of 4–7 cells high at the apex, which accounts for the name of this species

Plate II



Figs. 1-11. *T. setacea* Yang. 1. Diagram of branching $\times 1$. 2. Portion of a branch, v. v. $\times 20$. 3. Branch leaves $\times 20$. 4. Ditto $\times 50$. 5. Apical tooth of branch leaves $\times 220$. 6. Underleaves $\times 20$. 7. Cells of vitta $\times 450$. 8. Cells of underleaf other than vitta $\times 450$. 9. Cells of branch leaf $\times 450$. 10. Stem t. s. $\times 50$. 11. Perianth, v. v. $\times 20$.

- 3) Vitta well differentiated from the base to the upper part of the leaf along the lobule side.
- 4) Lobule with 2 or more obtuse, rudimentary teeth toward the apex on the free margin.
- 5) Female innovations arising on both sides of the terminal perianth which are trigonous instead of pluri-plicate as in *T. obovatus*.

Discussion:

This species is distinct from other Taiwan *Thysananthus* treated in this paper, in having a single tooth of 4-7 cells high at leaf apex while other species are either entire or serrate.

The perianth is trigonous with a blunt or slightly broadened top. The ventral keel is broad and smooth, running upward from base to the top; this differs from that of *T. fuscobrunneus* and *T. formosanus* in that it is short and slender, extending from half way to the apex, not covering the whole length of the perianth.

3. *Thysananthus fuscobrunneus* Horikawa Journ. of Sci. Rep. Monographia Hepaticurum Australi Japonicarum 1934.

Plants small to robust, dark-bluish, about 16 mm. long, 1.6 mm. broad, pendent on branches of trees, stem about 0.12 mm. in diam., repeatedly forking, frequently subfasciculate. Stem leaves imbricate, widely spreading exceedingly concave, posterior margin broadly incurved, flat, oblong-ovate, about 0.95 mm. long, 0.5 mm. broad, upper leaf slightly denticulate, apex, triangularly acute; Lobules flat, broadly rectangular, about 0.33 mm. long, 0.15 mm. broad, apex truncate; 1/3 as long as the leaf. Underleaves concave, emarginate about 0.66 mm. long, 0.48 mm. broad, subtransversely inserted, apex slightly notched irregularly dentate.

Perianth obovate-oblong, triplicate about 1.7 mm. long, 0.66 mm. broad, keel smooth, rostrum small, indistinct, innermost bracts mostly similar, 2.1 mm. long, 0.93 mm. broad, acuminate, denticulate above; lobule about 1/3 free, lanceolate acuminate, slightly dentate; bracteole innermost spatulate, margin slightly recurved about 1.45 mm. long, 0.56 mm. broad, irregularly denticulate above, apex bifid, lobes acuminate. Male plants in the middle or terminal.

Habitat: Hanging on the bark of trees.

Distributions: Formosa: Taitung Hsien, Mt. Chipen, Dec. 1932, Horikawa 10505.

Typus.

Special characters: Underleaf bifid, serrate on top but slightly dentate to almost entire on the recurved sides. Lobule rectangular.

4. *Thysananthus aculeatus* Herz. Ann. Bryol. 4: 89, f. 3, a-i (1931); Mizutani, A Revision of Jap. Lejeuneaceae, Journ. Hat. Bot. Lab. No. 24, 152-161, 1961.

Thysananthus formosanus Horik. Jour. Sci. Hiroshima Univ. ser. B, div. 2, 2: 252, pl. 20, 1-10 (1934). syn. nov. (Exsicc.) Hattori, Hepat. Jap. 4: 197 (1951); 7: 349 (1956).

Dioica. Plants median size to robust, olive or dark bluish, about 5 cm. long, 1.7 mm. broad, with leaves, prostrate or pendent, stem about 0.1 mm. in diam., branches numerous, about 8 mm. long irregularly branched, subfloral branch terminal, dichotomous; stem leaves densely imbricate, very concave, posterior margins slightly ovate, subsymmetrical about 0.88 mm. long, 0.61 mm. broad, apex broadly triangular, acute or truncate, anterior margins acutely curved, base frequently small, short serrate above, posteriorly undulate, where there is a faint tooth; apical leaf cells 11u, median 12u×23u and basal 12u×37u, walls winding, nodulose; lobule narrowly oblong about 0.33 mm. long, 0.16 mm. broad, apical seta long and extending; underleaves loosely imbricate, cuneate, about 0.41 mm. long, 0.56 mm. broad, apex broadly truncate, broader than long, minutely denticulate above and concave below; perianth elongate to conic, apex truncate about 2 mm. long, 0.77 mm. broad, 5 keeled, irregularly serrate, rostrum, not strong, innermost bracts oblong, bracteoles short, about 1.16 mm. long, 0.56 mm. broad, acute, irregularly and strongly dentate, naked below; lobules short, free toward middle, tapering at both ends, irregularly dentate, innermost bracteole spatulate about 0.75 mm. long, 0.58 mm. broad, apex broad, truncate, margins serrate.

Habitat: On the bark of trees.

Distribution: Taitung Hsien, between Tsing-shui-ying and Tawu, Aug, 1932, Y Horikawa.

5. *Thysananthus liukiensis* Horik. Journ. of Sci. Rep. Hiroshima Univ. Ser. B. Div. 2, Vol. 2, 252, (1934).

Dioica. Plants medium to robust, dark-bluish gray, about 20 mm. long, 2 mm. broad with leaves, stems closely matted in dense tufts, 0.18 mm. in diam; stem leaves imbricate, perpendicularly extending, slightly falcate, posterior margin deeply bending, flat, ovate-oblong about 1.11 mm. long, 0.58 mm. broad, asymmetrical apex obtuse; upper half cells 11u×15u, median 15u×26u, base 18u×37u, trigones with winding nodulose; lobules large, short fold, narrowly oblong, inflated, sub-rectangular, nearly twice as long as broad, about 0.4 mm. long, 0.23 mm. broad, apex obliquely truncate, apiculate; underleaves somewhat broader than stem, cuneate, about 3.6 mm. long, 0.41 mm. broad, subtransversely inserted, apex slightly notched; perianth obovate-oblong, tri-plicate about 1.55 mm. long, 0.66 mm. broad, rostrum distinct and small, the innermost floral leaves oblong, bracteoles about 1.5 mm. long, 0.66 mm. broad, apex acuminate; lobule 1/3 smaller, about 0.95 mm. long, 0.33 mm. broad at free side, slightly and irregularly denticulate, innermost bracteoles oblong, ligulate, about 1.11 mm. long, 0.55 mm. broad, apex truncate, margin deeply recurved.

Habitat: On the bark of trees.

Distribution: Taiwan, Nantou Hsien; Okanawa, Aug. 1932, Y. Horikawa.

LITERATURE CITED

- (1) ENGLER & PRANTL.: *Thysananthus* in *Die Natürlichen Pflanzenfamilien I Teil, Ableitung 3*, P. 129-130. (1909)
- (2) EVANS, A. W.: Branching in the leafy Hepaticae. *Ann. Bot.* 26: 1-37. (1912)
- (3) _____: The Anatomy of the stem in the Lejeuneae. *Bull. Torrey Club*, 62(4) 187-214. (1935)
- (4) FULFORD, M.: Studies on American Hepaticae—Revision of the genera *Thysananthus*. *Bull. Torrey Bot. Club*, 68(1) 32-42. (1941)
- (5) HATTORI, S.: *Contributio ad Floram Hepaticarum Yakusimensis V. Family Lejeuneaceae.* *Jour. Hattori Bot. Lab. No. 5*, P. 60-61. (1951)
- (6) _____: *Contributio ad Floram Hepaticarum Yakusimensis VI. Family Lejeuneaceae.* *Jour. Hattori Bot. Lab. No. 6*, P. 23. (1951)
- (7) HORIKAWA, Y.: *Monographia Hepaticarum Australi-Japonicarum*, *Jour. Sci. Hiroshima University, Japan. B2*, 2. 250-252, pls. 20, 1-10; 19, 17-25. (1934)
- (8) LINDENBERG: *Syh Hepaticarum.* p. 286. (1845)
- (9) MIZUTANI, M.: A Revision of Japanese Lejeuneaceae. *Jour. Hattori Bot. Lab. No. 24*, pp. 116-119. (1961)
- (10) SCHUSTER, R. M.: The genera *Thysananthus*, *Ptychocholeus*, *Tuzibeanthus*, *Phragmilejeunea* and *Bracheolejeunea* (Lejeuneaceae Holostipae) *The Bryologist* 64: 243 166-167 166 (1961)
- (11) STEPHANI, F.: *Die Gattung Lejeunea in Herbarium Lindenberg.* *Hedwigia* Januar u. Februar. 1890. Heft 1. pp. 4, 11, 19, 134, 142. (1890)
- (12) ARNELL, S.: Hepaticae of South Africa. *Stockholm Thysananthus, Mastigolejeunea and etc.* pp. 229, 235. (1963)