

## STUDIES ON TAIWAN HEPATICAE. II. RADULA SPECIES COLLECTED IN TAIWAN

by

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Radula is a genus of minute leafy hepaticae. It is likely to be overlooked or confused with other closely resemble genera such as Frullania, Porella and Lejeunea. But a close study under the microscope will readily reveal the fact that it differs from all these genera in its lack of underleaves. Its incubous leaves consist of two lobes, the broadly rounded dorsal lobe and the smaller ventral lobe which is usually less than half the size of the dorsal one. The rhizoids are often born on the ventral lobe and not directly upon the stem. Radula usually grows in patches, mainly on wet rock surfaces or tree trunks of some shade.

This paper is intended to summerize the seven species of Radula known to Taiwan. Radula borneensis Steph. and Radula guatemalensis Steph. have not been previously reported from Taiwan. Radula pinnulata is of special interest because of the unusual configuration of its microphyllous branches in definite plumose habit and its papillose branch-leaves. For this reason the species is proposed new to description.

The following key includes the seven species of Radula encountered in the study.

- A. Microphyllous branches present; each arising from the base of every ventral lobe exhibiting plumose habit on the ventral side of the plant, microphyllis boat-shaped and papillose; stem 1-1.2 cm.×1 mm.; dorsal lobe broadly ovate, ventral lobe slightly arched; rhizoids entirely lacking.....(5) **Radula pinnulata**
- AA. Microphyllous branches absent or sparse
  - B. Plant without perianth
  - C. Rhizoids lacking
    - D. Plant pale olive, stem 3 cm.×0.16 mm. or 2.3 mm. with leaves; pinnately or bipinnately branched, upper dorsal slightly imbricate and strongly concave, ventral lobe large, erect and inflatus, apex crescent-shaped.....(4) **Radula lunulatilobula**
    - DD. Plant dark green, stem 4 cm.×0.5 mm., irregularly, pinnately branched; dorsal lobe ovate, apex broadly rounded, ventral lobe heartshaped, somewhat vertical in position; trigones large and conspicuous.....(6) **Radula valida**
    - DDD. Plant born on rocks, occasionally on bark of trees; ventral lobe vertically rhomboid, small, less than 1/3 length of the dorsal lobe; epidermis of leaves slightly papillose to smooth, trigones comparatively small .....(7) **Radula variabilis**

CC. Rhizoids born on the base of lobules; plant olive green to dark green, stem 1-3 cm×0.3 mm., pinnately branched, leaves imbricate; dorsal lobe ovate, concave, the apex well rounded, the apex of the ventral lobe bluntly angled .....(1) **Radula borneensis**

BB. Plant with perianth

C. Perianth triangular toward the free end, the mouth two-lipped, lips coarsely lobed; vegetative propagation lacking..(3) **Radula guatemlensis**

CC. Perianth present in all seasons, mouth conspicuously flattened; rhizoids born on the lobule, multicellular gemmae occur on the margin of leaves .....(2) **Radula complanata**

(1) **Radula borneensis** Stephani, Sp. Hep. 4; 209. 1910. Annales Bryol. Vol. IX, 50-51, 1936. On rocks, Kan-kou, on the way to Wulai, Taipei, Taiwan, C. C. Hsu, April 9, 1960 (222).

(2) **Radula complanata** (Linneus) Dumortier, Comm. Bot., 112 (1822). Horikawa, Journ. Sci. Hiroshima Univ. B. 2, 2, 226 (1934) sine descr. The locality recorded from Taiwan and Okinawa is questionable, Journ. Hattori Bot. Lab., No. 4, 65, 1950.

(3) **Radula guatemlensis** Stephani, Sp. Hep. 4: 198. 1910. Annales Bryol. Vol. IX, 49-50, 1936.<sup>1</sup> Ta-hsueh Shan, alt. 2000 mm., T. C. Huang, Oct. 13-20, 1960 (219).

This species agrees with the description given by Castle in its pinnately branched upper part and its sparsely branched lower part and the general structure of its lobules, except that the plant is larger, 2-6 cm. long and 1 mm. wide, including the leaves.

(4) **Radula lunulatilobula** Horikawa, Journ. Sci. Hiroshima University. Ser. B., div. 2, 2: 226, 1934. Known from Taiwan, Mt. Taiheizan, Index Speciminum Typiminum in Herbariis Japonensibus, Pars Bryophyta, 49, 1960.

(5) **Radula pinnulata**, sp. nov.<sup>2</sup>

Plant brownish green in dried condition, 10-12 mm. in length, 1 mm. in width; vegetative branches usually terminate in dichotomous habit,<sup>3</sup> secondary branching usually close to the top, one or at most two; leaves subimbricate, incubous, the ventral lobe slightly arched in the center, somewhat kidney-shaped, the dorsal lobe broadly ovate or orbicular, the base free one-third to one half its length, the free basal portion rounded and extended one-third to the entire distance across the

1. Castle, H.; A Revision of the Genus *Radula*, Annales of Bryologica, Vol. IX, 49-50, 1936.

2. Plantae fusco-viridis, 10-12 mm. longae, 1 mm. amplae, cum terminis dichotomis; rami secundarii absentes vel infrequentes; folia sub-imbricata, incubata; lobus ovatus, paululum convexus, lobulus in forma renum; radicululae nullae; cellulae loborum cum trigonibus vel incrassatae, magna ex parte hexagonales,  $15\mu \times 13\mu$  ad partem mediam,  $7\mu \times 6\mu$  in margine autem; androecium et gynoecium incognitum; rami cum foliis-minutis in forma plumarum, procedentes regulariter ab unoquoque lobulo; cellulae rami-foliarum irregulariter quadratae vel rectangulares, papilliae prominentes.

3. Castle, H.; A Revision of the Genus *Radula* Part II. Sec. 3 Dichotomae, Journ. Hat. Bot. Lab., No. 21, 1959.

axis, occasionally beyond; rhizoids entirely lacking; cells of dorsal lobe throughout with conspicuous trigones or evenly incrassate, mostly hexagonal (Plate I, Fig. 5), cells in median portion  $15\mu \times 13\mu$ , those of marginal layer  $7\mu \times 6\mu$ ; male and female inflorescence not found; microphyllous branches, each bearing 6-8 pairs of minute, boat-shaped leaves, arising regularly and pinnately from the base of each ventral lobe, exhibiting a definite plumose habit on the ventral side of the plant, each branch extending across the length of dorsal lobe, rarely beyond; the size and the shape of branch-leaf cells irregularly quadrate to rectangular, somewhat similar to that of the stem-leaf cells, but prominently papillose, especially the abaxial surface (Plate I, Fig. 4). These microphyllous branches obviously, serve as a means of vegetative propagation since fertile branches do not exit.

On tree trunk or rocks, wet ground, Taipei vicinity, Tatiao-tze, Ping-ling Shian (臺北縣, 坪林鄉, 倒吊子), M. T. Kao, Sept. 5, 1956 (27b).

**Radula pinnulata** is closely resemble to **Radula polyclada** Evans<sup>4</sup> described in Castle's extensive study on *Radula* in having "...branches arising almost invariably behind every leaf..." but the size of the two species does not quite agree, *Radula polyclada* Evans being 2-3 cm. in length while **Radula pinnulata** only 0.8-1.2 cm., besides, in the former, a fertile branch often terminating the dichotomous branch and in the latter, no fertile branch existing at all. The distinct papillose branch-leaves in **Radula pinnulata** is another characteristic distinguishing it from **Radula polyclada** Evans.

Comparing **Radula pinnulata** with **Radula brunnea** Stephani ex Yoshinaga, Journ. Hat. Bot. Lab. No. 3, 46, 1948, the former differs from the latter in lacking rhizoids at the base of ventral lobe and its leaf-cells are more or less quadrate or rectangular so trigones are not as large and regular as that of *Radula brunnea* as shown in Fig. 38, I and H, however, the marginal cells are very much alike between the two species.

It is interesting to note that the plumose habit of branching in **Frullani pinnulata**<sup>5</sup> resemble very much to that of **Radula pinnulata**. For this reason, the word 'pinnulata' is selected to name the present species which is not described previously.

(6) **Radula valida** Stepnani, Ashina, Horikawa and others, 日本隠花植物圖鑑 849, 1939.

This is the only species described from Taiwan in that book.

(7) **Radula variabilis** S. Hattori, I. c. 86, f. 54. Newly recorded Taiwan, Wulai, Journ. Bot. Lab., No. 4, 70, 1950.

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- (10) LACOSTE, SANDE. 1856. *Synopsis Hepaticarum Javanicarum.* 86, Tab. XVI.
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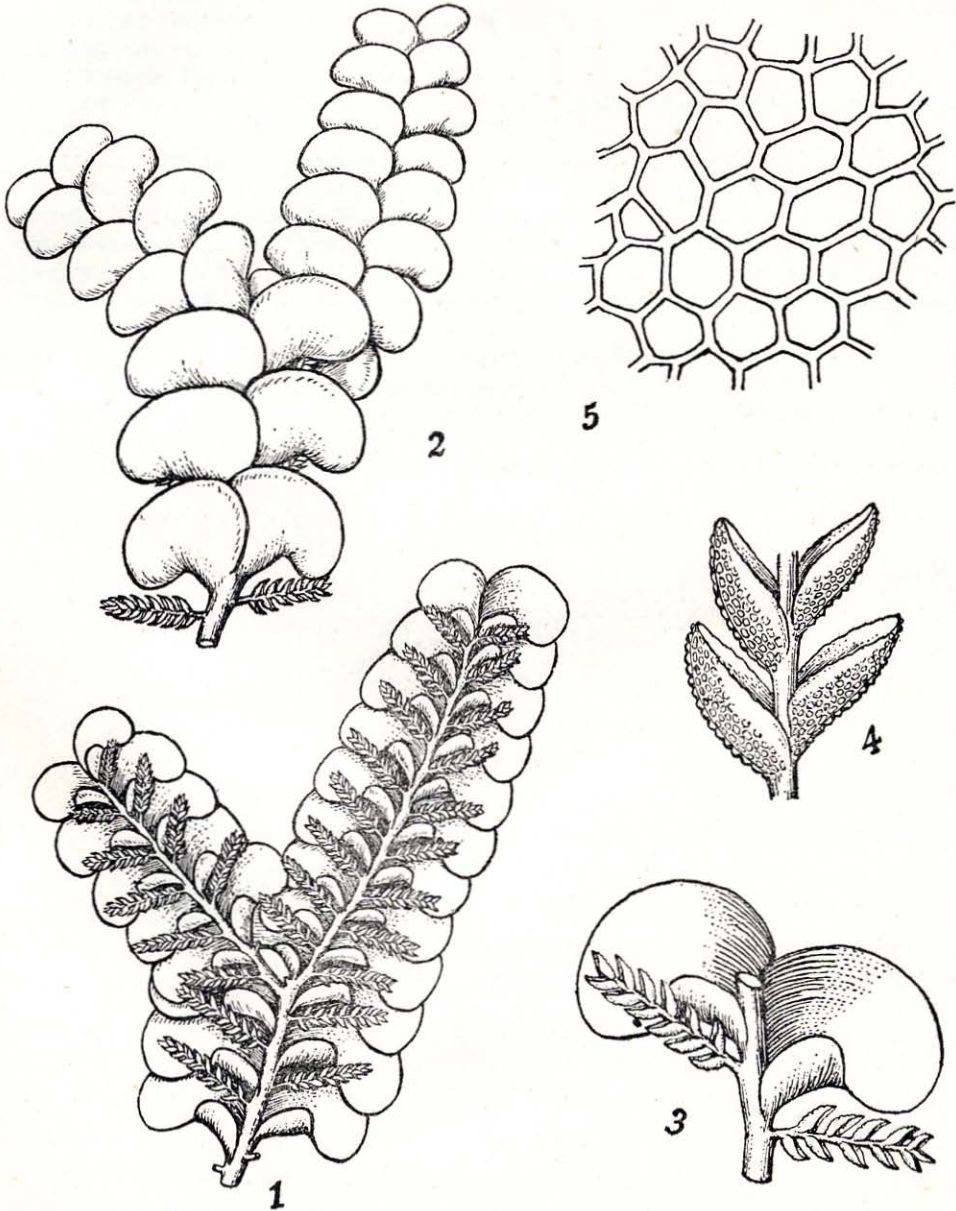


Plate I. *Radula pinnulata* Sp. Nov.

Figs. 1. Portion of plant, ventral view  $\times 24$ . 2. The same, dorsal view. 3. Stem leaves  $\times 42$ . 4. Portion of branch showing leaves and papillose cells  $\times 200$ . 5. Cells from stem-leaf, median portion  $\times 440$ .