

Neodolichomitra yunnanensis (Musci) New to Japan

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Abstract *Neodolichomitra yunnanensis* (Besch.) Kop. is reported as new to Japan. The description and illustration based on Japanese plants and the type specimens are given. Some characters, including overlooked or neglected ones, are noted. *Neodolichomitra* is considered monospecific and closely related to *Rhytidiadelphus*.

Key words: *Neodolichomitra yunnanensis*, Musci, Japan, Taxonomy.

In 1996, during the post foray of the 25th Annual Meeting of the Bryological Society of Japan, some of the participants, Mr. Y. Tateishi, Mrs. T. Hiraoka and Mr. Y. Ashida, collected a robust moss in central Honshu, Japan. In appearance it is reminiscent of some species of *Rhytidiadelphus*. However, a microscopic examination confirmed that the plants are not any species of that genus, but rather are *Neodolichomitra yunnanensis* (Besch.) Kop. This species, previously known from Taiwan and southern provinces in mainland China (cf. Redfearn *et al.*, 1996), is new to Japan.

The genus *Neodolichomitra* was described by Noguchi (1937) based on the new species, *Neodolichomitra gigantea* Nog., from Taiwan, and subsequently he (Noguchi 1966) made the new combination, *Neodolichomitra robusta* (Broth.) Nog. based on *Penzigiella robusta* Broth. from Hunan, China. Later Koponen (1971) synonymized *N. robusta* (Broth.) Nog. with *Hylocomium yunnanense* Besch. from Yunnan, China, and he made the new combination, *Neodolichomitra yunnanensis* (Besch.) Kop. We have examined the type specimens of these three species, and agree with Koponen's treatment. We consider the genus *Neodolichomitra* monotypic and closely related to *Rhytidiadelphus*.

Description

Neodolichomitra yunnanensis (Besch.) Kop., Hikobia 6(1–2): 53, 1971.

Hylocomium yunnanense Besch., Ann. Sci. Nat. Bot. Sér. 7, 15: 93, 1892. Type: Yunnan, bois de Koutoui, au-dessus de Mo-so-yu, (1)7 janvier 1890, *Delavay s. no.* (=no. 4636). Lectotype (fid. Koponen, 1971) in BM!; isolectotypes in H-BR!, NY!

PC!, S-PA not seen. – *Rhytidiadelphus yunnanensis* (Besch.) Broth., Nat. Pfl. 1(3): 1057, 1907.

Penzigiella (?) *robusta* Broth., Sitzungsber. Akad. Wiss. Wien, Abt. 1, 131: 216, 1922. Type: China, Hunan, Wukang, Yun-schan, 1200–1300 m, *Handel-Mazzetii* 11178. Holotype in H-BR!, isotype in PC! – *Neodolichomitra robusta* (Broth.) Nog., Bryologist 69: 232, 1966.

Neodolichomitra gigantea Nog., J. Jpn. Bot. 13: 92, 1937. Type: Formosa, Prov. Taihoku, Mt. Taihei, 2200 m, on humus in forest, *Noguchi* 6561. Holotype in NICH!, isotypes in BM!, PC!

The following description is based on the Japanese plants.

Plants robust in loose green mats. Stems reddish-brown, mostly arcuate, irregularly or regularly pinnate-branched, sometimes bipinnate-branched, more or less frondose from a stipitate base, usually stepwise layered because of repeated annual growth from an arched-ascending stoloniform innovation, to 6 cm long (the length is that of the innovation shoot from a single growing season), with a slightly developed central strand; branches tapered, occasionally radiculose at the tips; paraphyllia absent. Pseudoparaphyllia foliose, wide-triangular, a few. Stem leaves spreading when wet and dry, deeply concave, smooth, slightly decurrent, broadly ovate to oblong-lanceolate, cordate at the base, abruptly or gradually narrowed to a short acumen, usually twisted at the apex in upper leaves, 2.4–3.2 mm long, 1.5–2.4 mm wide at median parts of stem; margins plane or erect, usually slightly recurved at the base, sometimes incurved above, serrulate or serrate near the apex, minutely serrulate throughout; costa variable, usually single and branched, long (1/2–3/4 the leaf length), sometimes double and shorter, rarely triple or lacking; median cells smooth, linear; basal cells shorter and wider, incrassate, porose, colored; alar cells scarcely differentiated, porose, colored. Branch leaves similar to stem leaves, smaller, 1.4–2.0 mm long, 0.9–1.3 mm wide at median parts of branch.

Dioicous. Perichaetia on the main stem (unfertilized perichaetia seen).

Sporophytes not seen.

Specimens examined. Japan. Central Honshu, Nagano-ken, Shimoina-gun, Oshika-mura, Shiokawa, 1330–1420 m alt., on humus in deciduous forest at river side, 26 July 1996, coll. *Y. Tateishi* 8700 (HIRU, TNS); *Y. Ashida* 2891 (HIRU); *T. Hiraoka* 10030 (HIRU).

Habitat. The site, “Oshika-mura, Shiokawa”, is one of the famous areas for collecting the calcicolous bryophytes in central Japan. According to the collectors, however, the place where they collected the specimens was somewhat apart from the calcareous area. They found the species separately at or around the same place before reaching the calcareous area. The plants were growing on humus-covered, non-calcareous boulders, in a soft mat like *Rhytidiadelphus japonicus*, in the deciduous forest of *Euptelea polyandra*, *Pterocarya rhoifolia* and *Cercidiphyllum japonicum* along the edge of the Shiokawa River.

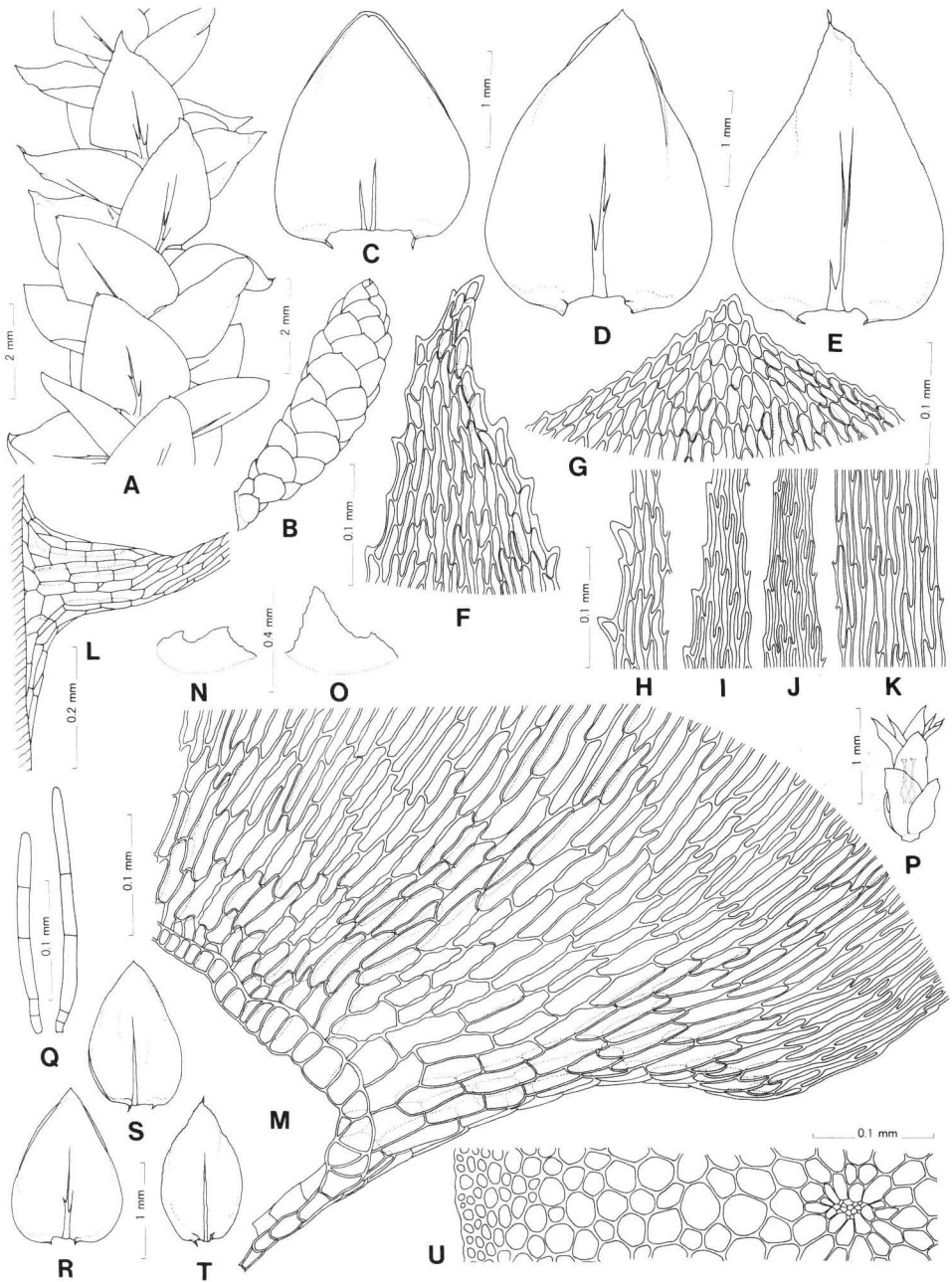


Fig. 1. *Neodolichomitra yunnanensis* (Besch.) Kop. A. A portion of branch. B. Innovation. C–M. Stem leaves. C–E. Whole leaves. F, G. Apical parts. H. Marginal cells at upper portion. I. Marginal cells at median portion. J. Marginal cells at basal portion. K. Median cells. L. Basal part on the stem. M. Basal angle. N, O. Pseudoparaphyllia. P. Unfertilized perichaetium. Q. Axillary hairs. R–T. Branch leaves. U. Portion of a cross section of stem. (A, C–U drawn from *Tateishi 8700*; B from isoelectotype of *Hylocomium yunnanense* in PC.)

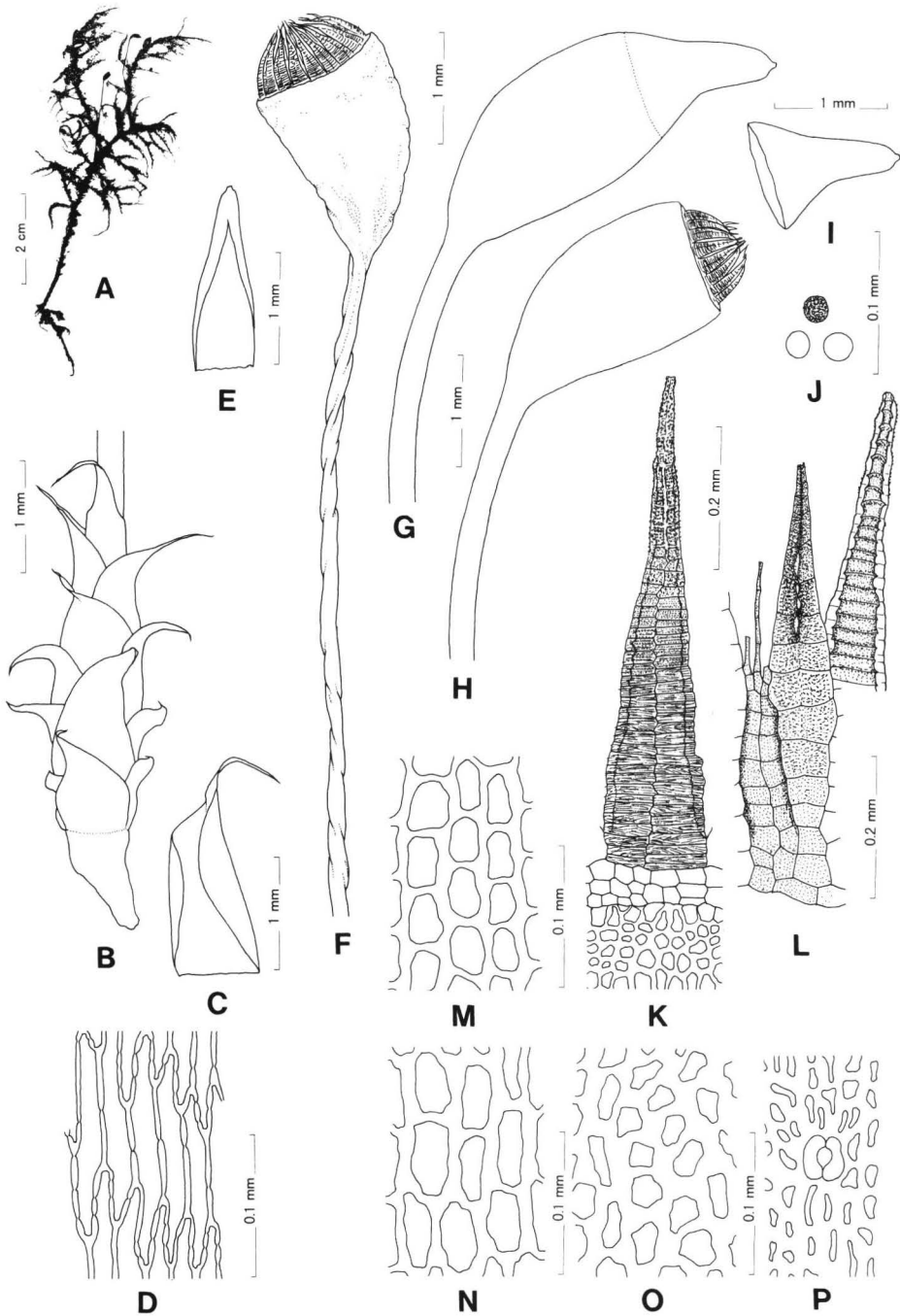


Fig. 2. *Neodolichomitra yunnanensis* (Besch.) Kop. A. A plant. B. Perichaetium. C. Inner perichaetial leaf. D. Median cells of inner perichaetial leaf. E. Calyptra. F–H. Capsules (left: when dry, central & right: when wet). I. Operculum. J. Spores. K. Outside view of peristome with upper exothecial cells. L. Inside view of peristome. M–P. Exothecial cells. M. Upper portion. N. Median portion. O. Lower portion. P. Basal portion with stoma. (All drawn from isolectotype of *Hylacomium yunnanense* in PC.)

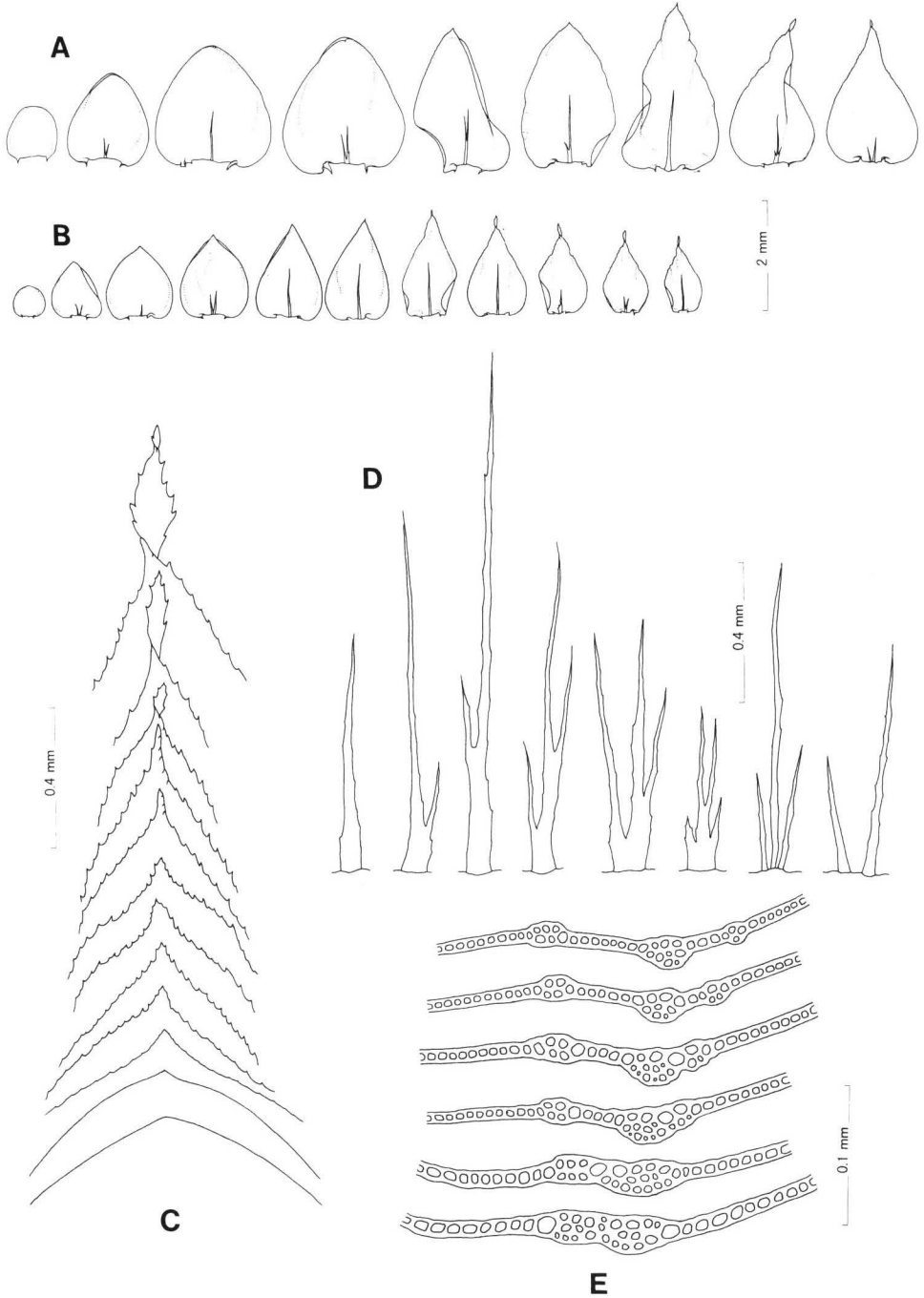


Fig. 3. *Neodolichomitra yunnanensis* (Besch.) Kop. A. Stem leaves (left: lower ones, right: upper ones). B. Branch leaves (left: lower ones, right: upper ones). C. Apical parts of stem leaves (below: lower ones, upper: upper ones). D. Variation of costae of stem leaves. E. Portions of serial cross sections of costa in stem leaves (below: basal portion, upper: upper portion). (All drawn from isolectotype of *Hylocomium yunnanense* in PC.)

Distribution. Taiwan, southern provinces in mainland China. New to Japan.

When Noguchi (1937) established the genus *Neodolichomitra*, the sporophytes were unknown. Subsequently Koponen (1971) and Rohrer (1985b) described the sporophytic characters of *Neodolichomitra yunnanensis*. We examined the sporophytes in the isoelectotype specimen of *Hylocomium yunnanense* Besch. in PC, and found some previously undescribed characters, such as perichaetial leaves, calyptra, seta twisting and detailed surface ornamentation of the peristome.

The following description is based on the isoelectotype of *Hylocomium yunnanense* Besch. in PC.

Inner perichaetial leaves oblong-lanceolate, filiform-acuminate, reflexed and serrulate above; median cells thick-walled, porose. Calyptra cuculate.

Setae 10–16 mm long, reddish-brown, smooth, sinistrorsely twisted in lower half and dextrorsely twisted at upper part when dry. Capsules inclined to horizontal, reddish-brown, ovoid, 1.5–2.2 mm long, 1.1–1.3 mm thick; exothecial cells oblong to elongate-rectangular, unevenly but distinctly thick-walled; stomata few, confined to the neck; annuli present; opercula short-rostrate. Peristome perfect; exostome teeth lance-subulate, yellow, bordered, cross-striolate or irregularly cross-striolate below, pale and papillose above and with a weak zig-zag median line on the external surface, smooth below, roughly papillose above and with projecting trabeculae on the internal surface; endostome pale or hyaline, papillose on the internal surface; segments subulate, keeled, spiculose-papillose, usually narrowly, but sometimes broadly perforated; cilia 2–3, finely papillose; basal membrane about 1/2 as high as exostome teeth, densely papillose. Spores spherical, finely papillose, 15–19 mm in diameter.

Discussion

Japanese plants agree well with the type specimens of the above three names in their essential characters, but differ slightly in having stem leaves with less serration (Fig. 1: H–J). To clarify the relationship between *Neodolichomitra* and its allied genera, some selected characters, including overlooked or neglected ones, are discussed as follows.

Our examination on the peristome by SEM showed that the lower part of the outer exostome is cross-striolate (Fig. 4: E) or irregularly cross-striolate (Fig. 4: F), confirming Rohrer's (1985b) observation that it is cross-striolate. As we examined the sporophytes from only the isoelectotype of *Hylocomium yunnanense* Besch. in PC, we could not judge whether this feature is stable or not. In *Hylocomium* (s. lat) and *Rhytidiadelphus* species the ornamentation on the outer surface of the exostome teeth varies from cross-striolate to irregularly cross-striolate or reticulate (cf. Buck, 1980; Rohrer, 1985b).

Rohrer (1985b) pointed out that the branching pattern of specimens of Taiwan were often monopodial, whereas those of the mainland China were nearly always

sympodial. We also examined the specimens from Taiwan and the mainland of China, but we were unable to observe such a difference. In *Neodolichomitra* the basal parts of plants show the sympodial branching (Fig. 2: A). If the plants lose the older portions from preceding years, then they appear monopodial in their branching.

The pseudoparaphyllia, observed in the Japanese material, are foliose, wide-triangular, few, somewhat apart from the branch primordia (Fig. 1: N, O), and also rarely at the base of young branches. Noguchi (1972) illustrated narrow-lanceolate pseudoparaphyllia which are taller than the branch primordia. However we did not detect such variation from the specimens examined. The cells of the pseudoparaphyllia usually thick-walled. In the type specimen of *Penziella robusta* Broth., they are distinctly thick-walled and porose.

In pleurocarpous mosses axillary hairs are easily observed in the leaf axils of upper portion of young stems. It has been pointed out that the axillary hairs can be of some value in the taxonomy of the hypnaceous mosses (Nishimura, 1985; Higuchi, 1985; Hedenäs, 1989), although the number of taxa examined are limited. In *N. yunnanensis* the axillary hairs consist of two well defined portions. A basal portion consists of two (rarely one), short, yellowish-brown cells, and an upper portion of three (rarely two), long, hyaline cells (Fig. 1: Q). In most of hypnaceous mosses examined by Nishimura (1985), Higuchi (1985) and Hedenäs (1989), a basal portion consists of one colored cell. The structure of axillary hairs in *N. yunnanensis* is similar to that of *Rhytidiadelphus loreus* (cf. Nishimura, 1985), *R. triquetrus*, *R. squarrosus* and *R. loreus* (cf. Hedenäs, 1989).

The size and shape of the stem leaves are clearly differentiated by their position on the stem (Fig. 3: A, C). This feature is one of the unique characters of the genus *Neodolichomitra*. The leaves occurring on the lower 1/3 of the stem are differentiated as stipe leaves. They are widely cochleariform, imbricate, and the smallest in size at the base of the stem, becoming larger in the upper portion. The leaves from the median portion of the stem are the largest, spreading, broadly ovate, and apiculate at apex. The leaves on the upper portion of the stem become smaller again, oblong-lanceolate, and acuminate with apices more distinctly twisted. Among the hypnaceous or hylocomiaceous mosses the differentiation of the lower stem leaves as stipe leaves is also found in *Pleurozium schreberi* (Brid.) Mitt., but they are not so clearly differentiated as those of *Neodolichomitra yunnanensis*. The differentiation of leaves noted above is also seen in the branch leaves (Fig. 3: B).

The development of the costa is one of the important features circumscribing genera or families in the Hypnobryales (Fleischer, 1923; Brotherus, 1925). As pointed out by the preceding authors examining the *Neodolichomitra*, the costa is one of the most notable characters of the genus. Noguchi (1937, 1966) suggested that *Neodolichomitra* is near *Rhytidiadelphus*, but differs in uncostate leaves. Later, however, Noguchi (1972) stated that the singleness or doubleness of costa may not be an extremely reliable character for separating genera. In *N. yunnanensis* the costa is

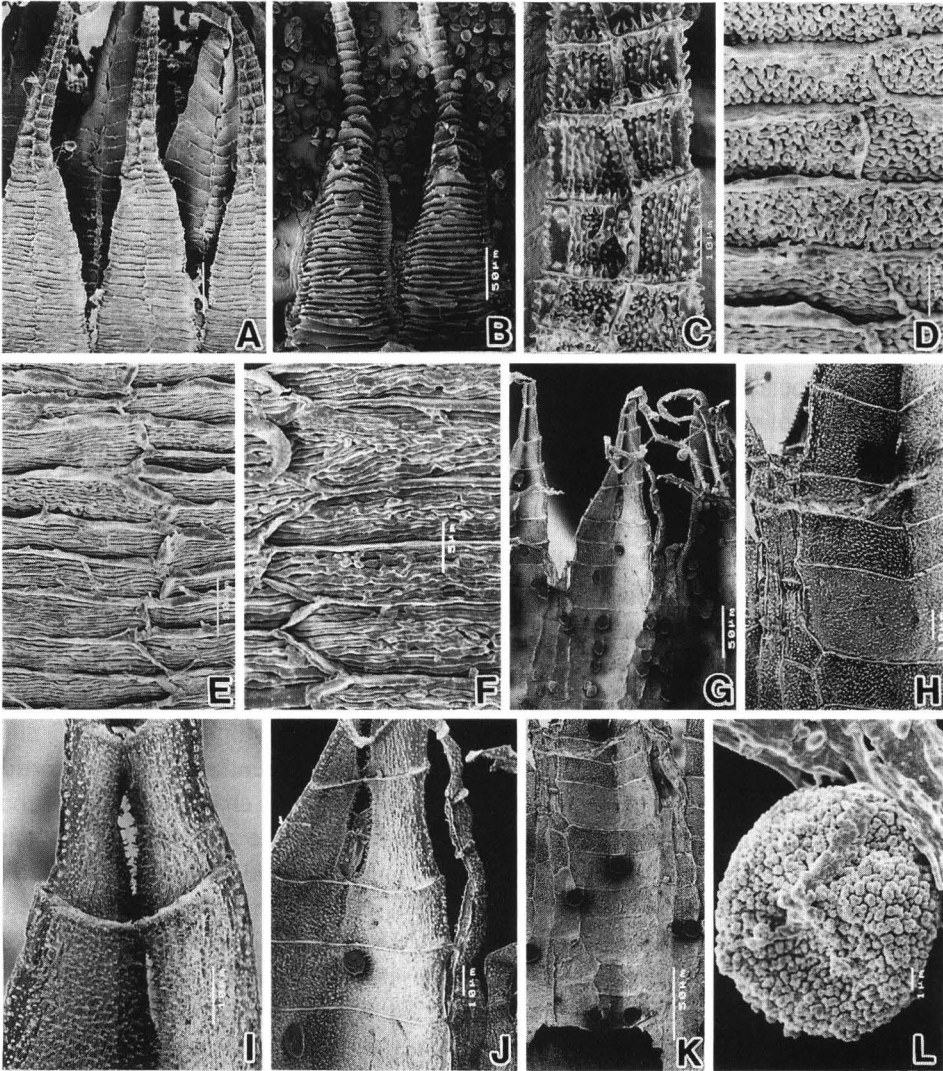


Fig. 4. SEM micrographs of peristome of *Neodolichomitra yunnanensis* (Besch.) Kop. A. Outside view of peristome. B. Inside view of exostome teeth. C–F. Outer surface of exostome teeth (C: apical part. D: middle part. E, F: lower parts). G. Inside view of endostome. H. Lower parts of segment and cilium. I. Middle part of segment. J. Cilia. K. Basal membrane. L. Spore. (all from isoelectotype of *Hylocomium yunnanense* in PC.)

very variable even in the leaves of the same stem or branch (Fig. 3: D, E), but is basically single. The size and shape of the leaf are differentiated as stated above, which is independent from the variation of the costa. A similar variable condition of the costa is also observed in *Hylocomiastrum umbratum* (Hedw.) Fleisch. ex Broth. (cf.

Rohrer, 1985b). However, our examination indicated that the costa of *H. umbratum* is different from that of *N. yunnanensis* by being unbranching (at least in stem leaves), having spines or protuberances on dorsal sides (smooth in *N. yunnanensis*), and flat on ventral sides in cross section (convex in *N. yunnanensis*, Fig. 3: E). Ochyra (1990) pointed out that *Streimannia turgida* Ochyra (= *Bryostreimannia turgida* Ochyra) has a similar costa, and *Neodolichomitra* shared many essential characters with the Brachytheciaceae. Although we did not examine this species because we did not have access to specimens, some of characters to which he referred are not restricted only to the Brachytheciaceae. For example, leaves with twisted apices are observed in some species of *Ctenidium* as well as in *Hypnum heseleri* Ando & Higuchi.

Neodolichomitra has been placed in the Rhytidiaceae (Noguchi, 1937; Redfearn *et al.*, 1996), Hypnaceae (Noguchi 1966, 1972), Hylocomiaceae (Rohrer, 1985a, b; Buck & Vitt, 1986) or Brachytheciaceae (Ochyra, 1990). However, it is significant that they consider *Neodolichomitra* to be near *Rhytidiadelphus* or *Macrothamnium*, except Ochyra (1990). The familial position of the genus depends on which family *Rhytidiadelphus* belongs to. *Neodolichomitra* is characterized by (1) growth pattern with sympodial branching, (2) differentiated leaves into stipe, median stem and upper stem, (3) variably branched costa, (4) scarcely differentiated alar cells with porose thick-walls, (5) ovoid capsules, and (6) unevenly distinctly thick-walled exothelial cells. We do not intend to discuss the familial position of *Neodolichomitra* here, but we believe that the genus is allied to *Rhytidiadelphus*.

Acknowledgments

We wish to appreciate Mr. Y. Tateishi, Mrs. T. Hiraoka, and Mr. Y. Ashida for their kind offer of the specimens. Thanks are also due to the curators of the herbaria (BM, H, NICH, NY, PC) for loan of specimens, and Dr. W. R. Buck for reading the manuscript and giving valuable comments. The first author is grateful to Prof. Dr. A. Couté for his kindness in providing research facilities during his stay in 1998 at the Laboratory of Cryptogamy, the National Museum of Natural History, Paris, with help of a Grant-in-Aid for Overseas Research Fellows (no. 9-293) from the Ministry of Education, Science, Sports and Culture, Japan. The second author is grateful to the National Science Museum, Tokyo, for inviting him as an inviting researcher of 1998 and providing him research facilities.

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