
It is thus clear that a large number of Japanese mosses have become better understood during the past fifty years. However, many species still remain to be discovered, particularly in montane areas of northern Japan, and a considerable number are known only from the type collections.

No manual describing the Japanese moss flora has yet been published, and such a work is urgently required. I have been working towards the preparation of Japanese moss flora since 1930, examining some 50,000 specimens. The present work is inevitably incomplete for the reasons outlined above, but I hope it will prove useful to research workers and others who are interested in Japanese mosses.

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A. Noguchi
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INTRODUCTION

This book provides descriptions and drains some 900 species that have hitherto been recorded from Japan. The delimitation of some genera and species was difficult and my treatment may not always be satisfactory. I have attempted to give a complete account of all the taxa recorded from Japan, but owing to lack of the authentic material, many remain for future studies, and some previously described infraspecific taxa are not considered as I do not adequately understand them. The system of classification is based on Dixon (1932) and Brotherus (1924, 1925), though many minor modifications are inevitable. Nomenclature follows Index Muscorum (van der Wijk et al., 1959-1969) and synonyms cite there are omitted. The descriptions and drawings are, where possible, based on Japanese specimens. Japanese material, particularly of sporophytes, was not always available and foreign collections were then consulted. The specimens examined are all deposited in the herbarium of the Hattori Botanical Laboratory and of Kumamoto University. The drawings were originally prepared by me for this book, but some are reproduced from my previous publications. The Exsiccati listed under each species are restricted to those published by the Hattori Botanical Laboratory: Musci Japonici Exsiccati ser. 1-34 (nos. 1-1700), Bryophyta Exsiccata fasc. 1-4 (nos. 1-200) and Fissidentaceae Asiaticae Exsiccatae fasc. 1-2 (nos. 1-20).

This book covers the whole of Japan, from Yaeyama Islands, the southernmost islands of Ryukyu Archipelago, through Kyushu, Shikoku, and Honshu, to Hokkaido, the northernmost main island of Japan, and also Bonin Islands located far south of Tokyo. The geographical distributions are based on herbarium specimens and reliable published data.
Protonema thallose. Plants small, reddish- to blackish-brown. Stems simple or forked; central strand lacking. Leaves ovate-lanceolate, oblong-ovate or almost panduriform, costate or not, costa extending to the leaf apex; margin entire or nearly so. Laminal cells irregular, walls incrassate, collenchymatous, often porose, often with large, round papillae on the dorsal surface; cells larger towards the leaf base. Perichaetal leaves with a large, sheathing base. Capsule erect on the swollen apex of a pseudopodium, without air spaces, ovoid to ellipsoid, splitting longitudinally into 4 valves, the intervening slits extending from near the base to near the apex of the capsule which is closed when moist and open when dry; columella derived from the inner layer of endothecium.

In Japan mosses of this genus grow on rocks in the alpine or subalpine regions. Most prefer andesite or basalt rocks in dry, sunny places, but A. nivalis is found in damp environments.

Key to the Species

1. Leaves ovate-lanceolate to ovate, ecostate, apex obtuse . . . . .
   1. A. rupestris var. fauriei
1. Leaves oblong-lanceolate, costate, apex attenuate . . 2. A. nivalis

1. ANDREAEA RUPESTRIS VAR. FAURIEI (BESCH.) TAKAKI (Fig. 1, `A)


Dioicous, rarely autoicous. Leaves ovate-lanceolate, constricted at middle, showing a panduriform outline.


Distribution: Endemic to Japan (Hokkaido, Honshu, Shikoku, Kyushu).

A. rupestris var. fauriei occurs almost throughout Japan on volcanic rocks in the alpine and subalpine zones. It is frequent in northern Honshu and Hokkaido, but rare southwards. On Mt. Kirishima, southern Kyushu, it grows in small quantity on dry andesite at an elevation of ca. 1000 m. The southernmost limit of distribution is Yakushima Island where it is found on granite at an elevation of ca. 1800 m. A. rupestris var. rupestris is almost cosmopolitan but is not yet recorded from Japan. It differs from var. fauriei in having leaves
Figure 1.
A. *Andreaea rupestris* var. *fauriei* (Besch.) Tak.  
a. Plants, x1.  
b. Moist plant, x8.  
c. Dry branch, x20.  
d. Leaves (*d*1, dorsal view), x34.  
e. Median cells of leaf (dorsal view), x385.  
f. Cells at leaf base, x385.  
g. Inner perichaetial leaf, x34.  
h. Spores, x250.  
i. Inner perigonial leaf, x34.  
[Musci Japonici 12: 552]

B. *A. nivalis* Hook.  
j. Plants, x1.  
k. Moist plant, x8.  
l. Dry branch, x15.  
m. Leaves, x20.  
n. Cells at leaf apex (dorsal view), x250.  
o. Median cells of leaf, x385.  
p. Cells at leaf base, x250.  
q. Branch with capsule, x15.  
r. Inner perichaetial leaf, x20.  
[Musci Japonici 14: 653]
ovate to ovate-lanceolate, only weakly constricted in the middle, and in being autoicous.

2. **ANDREAEEA NIVALIS** HOOK. (Fig. 1, B)

Trans. Linn. Soc. 10: 395, pl. 31 (1811).

Plants reddish-brown, in dense tufts. Stems flexuose, with several branches, to 30 mm long. Leaves homomallous and falcate, especially in upper leaves, hooked at apices of stem and branches, oblong-lanceolate, attenuate, to 2.0 x 0.5 mm, canalicate above, apex narrowly acute or acuminate; margin remotely toothed in the upper half; costa stout, extending to the leaf apex, scarcely narrowed upwards, reddish-brown. Cells in upper 2/3 with a single large papilla on the dorsal surface over each cell lumen. Median cells of lamina subquadrate or rectangular, 8.5-10.0 µm, uniformly thick-walled; lower cells subquadrate or rectangular, 7-12 µm, inflated, uniformly thick-walled, smooth. Autoicous. Inner perichaetial leaves similar to vegetative leaves, to 2.5 mm long. Pseudopodia to 1.2 mm long, pale. Capsule ca. 1 mm long. Spores 20-25. µm.


Distribution: Japan (Hokkaido, Honshu), Kamtschatka, Europe, Greenland, western N.America.

In Japan *A. nivalis* grows on damp ground or rocks, sometimes it is submerged in the thawing water of small streams in the alpine regions.

**TETRAPHIDACEAE**

Key to the Genera

1. Protonemal leaves deciduous. Stems long, with numerous of leaves; costa stout. Capsule cylindric. Calyptra cylindric, sulcate, covering most of capsule. Gemma cups present

   1. **TETRAPHIS** HEDW.

   Protonemata filamentous, bearing deciduous protonemal leaves. Plants small. Stems erect, triangular in cross-section, central strand present. Leaves distant, almost in 3 rows, lower leaves ovate and acute, upper leaves oblong-lanceolate and acuminate; margin entire; costa stout, extending nearly to leaf apex. Median cells of lamina
Figure 2.
rounded-hexagonal, thick-walled, collenchymatous, towards leaf base longer. Autoicous. Perichaetium terminal; inner leaves longer but proportionally narrower than the upper, vegetative leaves, linear-lanceolate. Seta elongate. Capsule erect or nearly so, narrowly cylindric, symmetric, straight or slightly curved; apophysis absent. Peristome consisting of 4 segments cleft from the whole tissue, teeth narrowly long-triangular, deeply inserted below the thickened rim, yellowish-brown. Calyptra narrowly mitrate, sulcate. Perigonia terminal.

Key to the Species

1. Seta geniculate at middle, scabrous in the upper half .......... 2. T. geniculata
1. Seta not geniculate, smooth throughout .......... 1. T. pellucida

1. TETRAPHIS PELLUCIDA HEDW. (Fig. 2, A)

Spec. Musc.: 45, t. 7, f. 1a-f (1801).

Plants small and slender, gregarious. Stems simple, naked below, leaves distant above. Lower leaves appressed when dry, remote, oblong, larger upwards, oblong-lanceolate, acute or acuminate, to 2.00 x 0.55 mm; margin entire, plane or ± recurved; costa stout, extending to leaf apex or percurrent, prominent at back. Median laminal cells thin-walled, collenchymatous, rounded-hexagonal, 12-16 µm, longer towards leaf base. Seta straight, smooth, 7-15 mm. Capsule narrowly cylindric, 2.5-3.5 x 0.4-0.5 mm, ± curved, thickened at the mouth. Operculum conic, ca. 1 mm long. Annulus absent. Peristome teeth 0.6-0.8 mm, brown. Spores 10-12 µm, smooth. Calyptra 2.0-2.5 mm long, brown and scabrous in the upper half, smooth below, sulcate, lobate at base. Gemmiparous plants present; gemmae platelike, in a gemma cup at the apex of sterile plant.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the N. Hemisphere.

This circumboreal species is more frequent than T. geniculata and extends southwards to Kyushu where it is, however, rare. It usually grows on moist decayed log, accompanied by many small mosses and liverworts. Gemma-bearing shoots are more frequently produced in artificial culture than in the field.

2. TETRAPHIS GENICULATA GIRG. EX MILD. (Fig. 2, B)


This species is very similar to T. pellucida and is distinguished by the characters shown in the key. Spores 12-16 µm, larger than those of T. pellucida, verrucose.
BUXBAUMIACEAE


Distribution: Japan (Hokkaido, Honshu), China, Soviet Far East, N. America.

This species grows on rotten logs in the subalpine zone, and is more northern than T. pellucida in its distribution in Japan.

2. TETRONDONIUM SCHWAEGR.

TETRONDONIUM BROWNIANUM VAR. REPANDUM (FUNCK) LIMPR. (Fig. 3, A)


Protonemata filamentous, bearing persistent protonemal leaves. Plants dark-green, bud-like. Stems with several brownish, slender, minute, ± curved leaves at base. Perichaetial leaves oblong-lanceolate; margin entire or prominently crenate; costa weak, ending far below the leaf apex, or absent. Median cells of lamina and inner perichaetial leaves rectangular to rhomboid-hexagonal, 20–30 x 6.5–9.0 µm. Autoicous. Seta straight, elongate, smooth. Capsule oblong-ovoid, 0.6–0.8 x 0.3–0.4 mm, dark-brown, sometimes with stomata. Operculum conic, to 0.45 mm. Peristome teeth to 0.35 mm. Calyptra deeply split, ca. 1.5 mm long, yellowish, brown at apex. Spores 10–15 µm. Protonemal leaves gregarious around the sporophyte, linear-clavate, acute or obtuse, more or less irregular in outline.


Distribution: Japan (Hokkaido, Honshu), Asia, Europe, N. America.

The plants are minute and occur scattered in crevices of shaded, vertical rocks, small cave of volcanic origin, or on the lower surface of overhanging rocks in the alpine to subalpine regions. The gametophytes are reduced to a short stem bearing a few small leaves. The protonema and protonemal leaves are well-developed and persistent.

BUXBAUMIACEAE

BUXBAUMIA HEDW.

Plants annual, scattered on persistent filamentous protonemata. Stems very short. Leaves few, very small, ovate, with ciliate margins,
ecostate. Dioecious. Perichaetial leaves not differentiated. Capsule widely ovoid or oblong-ovoid, obliquely inserted on a short or elongate, stout, papillose seta, often flattened on one side, rounded at base, asymmetric, with an apophysis and stomata, very narrow at mouth, annulus absent. Operculum conic, blunt at apex. Peristome double; exostome consisting of a series of rudimentary, irregularly shaped, pale brown teeth, becoming longer inwards; endostome membranous, whitish, a truncate tubular cone, folded like a fan with 32 longitudinal plicae. Calyptra thimble-shaped, small, covering the upper part of operculum. Male gametophytes reduced to a single leaf arising from the protonema, its lamina concave or folded like a shell and enclosing one stalked, globose antheridium resembling those of liverworts.

Key to the Species

1. Seta much longer than the capsule. Capsule ridged between the upper and lower surfaces, the upper side flattened ...........

1. B. aphylla

1. Seta almost as long as the capsule. Capsule not ridged, cylindric

2. B. minakatae

1. BUXBAUMIA APHYLLA HEDW. (Fig. 3, B)

Spec. Musc.: 166 (1801).

Seta variable in length, usually 5-10 mm, straight, or ± curved, brown. Capsule inclined to horizontal, broadly ovoid, 3-4 x 2.0-2.5 mm, ridged between the upper and lower surfaces, the upper surface flattened, reddish-brown, glossy particularly on the border, stomata immersed; endostome to 0.7 mm long. Operculum 0.6-0.8 mm. Spores. globose, 7-10 µm, minutely papillose.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the N.Hemisphere.

In Japan B. aphylla is of rare occurrence on the floor of coniferous forests in the subalpine zone.

2. BUXBAUMIA MINAKATAE OKAM. (Fig. 3, C)


Seta 2.5-3.5 mm long, straight or ± curved. Capsule inclined, 3.5-5.0 x 1.5-2.0 mm, ovoid-cylindric, not ridged, brown. Operculum ca. 1 mm long. Endostome ca. 0.5 mm long. Spores 10-15 µm. Calyptra ca. 0.8 mm long.

Distribution: Japan (Hokkaido, Honshu, Kyushu), Korea, China, Taiwan, Soviet Far East, eastern N.America.
Figure 3.
A. *Tetrodontium brownianum* var. *repandum* (Funck) Limpr.  
B. *Buxbaumia aphylla* Hedw.  
  f. Sporophyte, x7. [Noguchi s.n.]
C. *B. minakatae* Okam.  
  g. Sporophyte, x11.
Diphysciaceae

Key to the Genera

1. Leaves linear to ovate-oblong, lamina bistratose, without bands of chlorophylllose cells in cross-section. Costa distinct, excurrent as a long awn
   1. Diphysciaceae

1. Laminal cells papillose or mammillose, obscure. Awn of perichaetial leaves scabrous

1. Laminal cells neither papillose nor mammillose, ± pellucid. Awn of perichaetial leaves smooth

2. Laminal cells mammillose

2. Laminal cells papillose

3. Leaves apiculate, costa reaching leaf apex. Inner perichaetial leaves

Due to their unique features, especially the ventricose capsules surrounded by the long-setaceous perichaetial leaves, mosses of the genus *Diphysciaceae* cannot be mistaken for any others.
1. **Diphysciaceae**

**D. fulvifolium** Mitt. (Fig. 4)


Plants greenish-brown. Leaves numerous, crowded, constricted when dry; lower leaves widely spreading, linear; upper leaves acute at apex, undulate above; costa aristate, to 5 mm long. Laminal cells inflated, obscure, each with several papillae; median cells, rounded-quadrate or transversely rectangular, thin-walled; upper cells similar to the medians; marginal cells bi- or uni-stratose, similar to the medians; lower cells elongate-rectangular or -hexagonal, lax. Perichaetial leaves numerous, with an elongate, straight, scabrous awn; inner leaves ovate-oblong, acute or shallowly bifurcate with many ciliate appendages, awn straight, scabrous. Capsule ovoid, to 5.0 x 0.5 mm; stomata present. Operculum to 2 mm long, papillose. Endostome ca. 1 mm long. Spores 9-12 µm, minutely papillose. Calyptra to 1.5 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Ryukyu), Korea, Taiwan, Philippines.

This species resembles *D. foliosum* in general aspect. Beside the characters shown in the key it has larger, more crowded leaves, and costa of perichaetial leaves proportionally longer than in *D. foliosum*. *D. fulvifolium* is common on dry sunny slopes or cliffs throughout the main islands of Japan, on sandy soils stabilized by the roots of shrubs. Kitagawa (1975, 1976) has discussed its ecology and spores in detail.

2. **Diphysciaceae**

**D. foliosum** (Hedw.) Mohr (Fig. 5, A)


*Buxbaumia foliosa* L. ex Hedw., Spec. Musc.: 166 (1801).

Plants dark-green, becoming brownish with age. Leaves rather few, crowded; lower leaves erect-spreading, linear, apex obtuse; costa ending below leaf apex; upper leaves larger, ovate-lanceolate, apex acute; leaf costa excurrent as an elongate, papillose awn; leaf margin...
Figure 4. *Diphyscium fulvifolium* Mitt.  

- b, c. Leaves, x8.  
- d. Median cells of leaf, x240.  
- e. Cells at leaf base, x240.  
- f. Cross-section of upper lamina, x270.  
- g. Outer perichaetial leaf, x8.  
- h. Inner perichaetial leaf, x8.  
- i. Part of awn, x216.  
- j. Capsule, x7.  
- k. Operculum and calyptra, x15.  
- l. Spore, x420.
Figure 5.

A. *Diphyrium foliosum* (Hedw.) Mohr.  
a. Leaves, x10.  
b. Median cells of leaf, x245.  
c. Inner perichaetial leaves, x10.  
d. Upper part of lamina of inner perichaetial leaf, x36.  

B. *D. satoi* Tuzibe.  
e. Plant, x10.  
f. Leaves x20.  
g. Upper part of lamina of outer perichaetial leaf, x180.  
h. Inner perichaetial leaves, x20.  

C. *D. perminutum* Tak.  
i. Plant, x10.  
j. Leaves, x20.  
k. Cross-sections of leaf (*k1*, upper, *k2*, lower parts), x250.  
l. Inner perichaetial leaves, x20.  
m. Upper part of inner perichaetial leaf, x125.  
n. Capsule, x10.  

[Takaki 6703]  
[Noguchi 27025]  
[Noguchi 60703]
plane. Laminal cells inflated, each with several papillae, obscure; median cells rounded–quadratet or transversely rectangular, 8–10 µm, thin-walled; upper similar to the medians; lower cells elongate-rectangular or -hexagonal, lax. Inner perichaetial leaves ovate– or oblong–lanceolate, apex bifurcate and fringed or dissected, to 8 mm long; awn straight or ± flexuose, papillose. Capsule to 3.5 x 2.0 mm, ovoid, stomata present. Operculum to 2 mm long. Spores 9–12 µm.

Distribution: Japan (Hokkaido, Honshu), Europe, N. and C. America, Africa.

3. DIPHYSCIUM SATOI Tuzibe (Fig. 5, B)


Plants small, to 5 mm, brownish. Leaves few; lower leaves erect-spreading, linear; upper leaves longer, incurved when dry, ovate, wider below, acute at apex, less than 1.5 mm long; margin serrulate above; costa ending below apex. Laminal cells plane, almost pellucid; median cells unistratose, upper cells bistratose, smaller; lower cells elongate-rectangular or -hexagonal. Perichaetial leaves oblong to elliptic; awn elongate, smooth; outer leaves elliptic or ovate-oblong, acute at apex, to 3 mm long; inner leaves oblong, obtuse or emarginate and dentate, to 2 mm long. Capsule ovoid, brownish, to 3.0 x 1.2 mm, stomata present. Operculum 1.2–1.4 mm long, smooth. Endostome ca. 0.6 mm long. Calyptra 0.7 mm long. Spores 8–13 µm.

Distribution: Endemic to Japan (Hokkaido, Honshu).

This species has only been collected few times. The plants occur scattered on bare exposed volcanic rocks. As the leaves are highly reduced, the capsules appear to be directly attached to rocks.

4. DIPHYSCIUM PERMINUTUM Tak. (Fig. 5, C)


Plants small, to 3.5 mm, dark-green. Leaves few; lower leaves linear, obtuse, ca. 1 mm long; upper leaves linear, wider at the base, apex acute; costa stout, ending below leaf apex. Laminal cells inflated, ± obscure; median cells rounded to rounded-hexagonal, 8–12 µm, mammillose, walls ± incrassate at the corners, upper cells similar to the medians; lower cells rectangular, with thin walls. Perichaetial leaves numerous; outer leaves oblong, acute at apex; awn scabrous, ca. 3.5 mm long; inner leaves acute with many long cilia on the upper half of leaf margins, awn ± flexuose, crenulate, to 2.5 mm long. Capsule ca. 2 x 1 mm, ovoid, stomata present. Endostome ca. 0.5 mm long.


Distribution: Endemic to Japan (Honshu, Kyushu).
Figure 6. *Diphysciaceae*

*Diphysciaceae involutum* Mitt.  

a. Plant, x8.  
b. Leaves, x12.  
c. Median cells of leaf, x270.  
d. Cells at leaf base, x270.  
e. Cross-section of upper lamina, x216.  
f. Outer perichaetial leaf, x8.  
g. Inner perichaetial leaf, x8.  
h. Part of awn, x216.  
i. Capsule, x8. [Holotype of *D. ryukyuense* Nog.]
DIPHYSCIACEAE

5. **DIPHYSCIUM INVOLUTUM** MITT. (Fig. 6)


Plants to 15 mm, dark-green. Leaves crowded, incurved when dry, erect-spreading when moist; lower leaves narrowly-spathulate, acute; upper leaves spathulate, acute, ca. 5 x 1 mm; costa shortly excurrent. Laminal cells almost plane, smooth, rather pellucid; median cells quadrate to rounded-quadrate, 9-12 µm, upper cells similar to the median; margin bistratose, not bordered; lower cells elongate-rectangular or hexagonal. Perichaetial leaves ovate- or oblong-lanceolate; awn straight, rarely flexuose, to 9 mm long; inner leaves with acute apex and dissected. Capsule ovoid, 2.5-3.0 x 1.0-1.2 mm, stomata not seen. Endostome ca. 0.6 mm long. Spores 9-12 µm.


Distribution: Japan (Honshu, Kyushu, Ryukyu), Taiwan, Philippines, India, Sri Lanka.

This species grows on moist rocks covered with thin soil. It is distributed throughout Ryukyu and extends northward along the Pacific coast of Honshu.

6. **DIPHYSCIUM SUZUKII** IWATS.


Small plants. Stems very short. Rhizoids minutely papillose. Stem leaves elongate-lingulate, 3-5 mm long, ca. 0.5 mm wide at middle, mucronate to apiculate at apex; costa strong but indistinctly delimited at upper part, sometimes shortly excurrent, occupying 1/3 to 1/2 of width of leaf base; margin almost entire; cells at upper part of lamina round to irregularly elliptical with thickened corners, often transversely elongated, lumen 8-13 µm long, 10-13 µm wide, smooth; in cross-section laminal part composed of 2-cell layers; cells at basal part of leaves elongated, hyaline, thin-walled, in cross-section composed of 1-cell layer, smooth. Outer perichaetial leaves much longer than stem leaves, 6-8 mm long; costa long excurrent in setaceous, smooth point from elongate triangular laminal portion; margin entire; inner perichaetial leaves with long excurrent costa from oblong laminal portion; margin at upper part of lamina fimbriate; marginal fimbriate area often down to near the middle of the leaf; laminal cells elongated, thin-walled, hyaline. Dioicous. Capsule ca. 4 mm long, ovate, asymmetric, immersed in perichaetial leaves. Operculum long-conic. Spores 6-14 µm, finely papillose. Male plants much smaller than female plants; stem leaves similar to those of female plants, but smaller, 1.3-1.9 mm long.

Distribution: Endemic to Japan (Honshu).
Figure 7. *Theriotia lorifolia* Card. a. Plant, x8. b. Leaves, x9. c. Cross-sections of leaf (c1, basal, c2, middle, c3, upper parts), x180. d. Median cells of leaf, x225. e. Cells at leaf base, x225. f. Inner perichaetial leaf, x14. g. Part of peristome teeth, x115. h. Spore, x420. [Noguchi 2005]
Plants small, dark-green. Stems very short. Leaves crowded, erect-spreading when moist, slightly altered when dry, straight, linear, with a short-ovate sheathing base, terete above, to 12 mm long; costa occupying the greater part of the sheathing base and the entire width of the leaf above; cross-section of linear part of leaf flat (or adaxial surface ± convex), multistratose; outer and inner layer and a single central layer of cells chlorophyllose, the other layers pellucid, colorless and with thin walls. Perichaetial leaves filmy, oblong, densely ciliate on the upper margins, much shorter than the stem leaves; costa occupying ca. 1/3 the width of lamina at base, excurrent as an awn as long as the lamina. Capsule sessile, obliquely cylindric-ovoid, very narrow at mouth, rounded at base, ventricose, greenish-brown, to 5.0 x 2.5 mm. Operculum conic, ca. 1.7 mm long. Exostome almost absent; endostome membranous, tubular, truncate, whitish, folded like a fan with 16 longitudinal plicae, ca. 0.6 mm long, densely papillose. Spores, minutely papillose, 6-9 µm.


Distribution: Japan (Honshu, Kyushu), Korea, China, India.

*T. lorifolia* is a moss forming a mat on rock faces lapped by running water.

**POLYTRICHACEAE**

Key to the Genera (mainly based on Osada, 1965)

1. Peristome absent; leaves with long cilia on the upper margin of sheath .................................................. 3. *Bartramopsis*
2. Peristome present; leaves without cilia on the margin ........... 2
   2. Calyptra nearly naked or with a few hairs ..................... 3
   3. Calyptra covered with a thick felt of long hairs ............. 4
3. Leaves distinctly bordered by narrow thick-walled cells, marginal teeth of leaf mostly paired; capsules without stomata ................. 1. *Atrichum*
4. Leaves never bordered, marginal teeth of leaf single; capsules with stomata ............................................. 2. *Oligotrichum*
5. Seta densely papillose ........................................ 4. *Rhacelopodopsis*
6. Seta smooth ...................................................... 5
5. Capsules not angled, with usually 32 peristome teeth ............. 5. *Pogonatum*
POLYTRICHACEAE

5. Capsules angled with distinct ridges, with 64 peristome teeth ....

.................................................................................. 6. Polytrichum

1. ATRICHUM P.BEAUV.

Plants usually large, mostly growing on earth, with subterranean radiculose rhizomes. Stems simple or sparingly branched at the base. Lower leaves appressed, small, scale-like; upper leaves larger, crisped and contorted when dry, widely spreading when moist, lingulate to oblong-lanceolate, with a poorly differentiated sheathing base, acute to obtuse, usually sharply toothed at back of costa and lamina; margin bearing spinous teeth double above but single below; bordered by linear, incrassate cells in 1 or frequently 2 (rarely 3) rows; costa wide, ± prominent on the dorsal surface, ending near the leaf apex or percurrent; lamellae green, few (less than 7), running parallel on the ventral surface of costa, in cross-section the marginal cells of lamellae scarcely differentiated from the inner cells. Upper and median cells of lamina mostly hexagonal, often transversely elongate, with thin walls; lower cells pellucid, short-rectangular. Dioicus, or monoicous. Perichaetial leaves slightly differentiated, narrower than stem leaves. Capsule large on a long, smooth seta, suberect, cylindric, usually ± arcuate, without annulus or stomata. Columella expanded at apex to form the epiphragm which is united to the apices of the 32 short, lingulate peristome teeth; each tooth incurved, obtuse, with yellow or brownish vertical lines; basal membrane narrow. Operculum convex, with a very long beak. Calyptra narrow, long-cucullate, spinosely toothed at apex. Perigonia terminal, discoid; antheridia and paraphyses abundant.

The genus Atrichum is unique in the Polytrichaceae in having bordered leaf margins, few lamellae restricted on the costa, a long-beaked operculum and an elongate, non-hairy calyptra. The marginal cells of lamellae are uniform and of little taxonomic value, whereas the number and size of lamellae are regarded as diagnostic characters in distinguishing species.

Key to the Species

1. Stems short, to 10 mm long; leaves distant, lingulate to narrowly spatulate; lamellae indistinct (1 or 2 cells high) or absent .........

.................................................................................. 4. A. yakushimense

1. Stems longer, leaves crowded, lanceolate to lingulate; lamellae well-developed, more than 2 cells high ................. 2

2. Plants large; stems to 80 mm long; leaves strongly contracted and crisped when dry, lingulate, widest at middle; lamellae 2-3 cells high ......................... 3. A. crispulum

2. Plants small to large; stems usually shorter than 40 mm; leaves crisped and incurved when dry, lanceolate to lingulate, widest at or above middle; lamellae 3-4 cells high ..................... 3

3. Leaves scarcely undulate, without teeth on dorsal surface; lamellae few (1-3), 1-2 cells high .................. 5. A. crispum

..................................................................................
3. Leaves distinctly undulate, with numerous teeth on the dorsal surface; lamellae more numerous (4-6) well-developed, 3-6 cells high. 

4. Dioicous. Plants small; median laminal cells 12-18 µm. 

4. Monoicous, rarely dioicous. Plants large; stems usually to 40 mm long; median laminal cells 17-25 µm.

1. ATRICHUM UNDULATUM (HEDW.) P.BEAUV.

Prodr.: 42 (1805).


Stems usually to 40 mm long, mostly simple. Lower leaves distant; upper leaves crowded, much larger, strongly crisped and incurved when dry, widely spreading, strongly and regularly undulate above, keeled, lanceolate to lingulate, acute, to 8.0 x 0.8 mm, with single or aggregated teeth in irregular rows on the undulation at back, without undulations or teeth below; lamellae 4-6, 3-4 cells high; leaf margin usually bordered with 2 rows of linear cells, toothed in the upper 2/3; costa percurrent, toothed at back above. Median cells of lamina hexagonal to subquadrate, transversely elongate, 17-25 µm; basal cells 30-50 x 15-20 µm. Monoicous, rarely dioicous. Seta solitary, sometimes to 3, reddish-brown, 25-45 mm long, 0.20-0.25 mm thick. Capsule inclined, gradually narrowed towards base, cylindric, slightly arcuate, reddish-brown, 3.0-4.5 x 0.5-0.8 mm. Peristome teeth to 0.45 mm high. Spores, finely papillose, 13-18 µm. Operculum to 2.5 mm long, long-rostrate from a hemispherical base. Calyptra to 6 mm long, pale, apex brown, with long spines. Male plants ca. 15 mm long, with small leaves and discoid perigonia.

Distribution: Widely distributed in the N.Hemisphere.

Sexuality is variable in this species: var. undulatum is autoicous; var. gracilisetum is paraicous or synoicous and this seems to be correlated with the polysety, shorter setae and smaller gametophytes.

1a. VAR. UNDULATUM (Fig. 8, A)

Stems usually simple. Leaves lanceolate to lingulate, to 8.0 x 0.8 mm. Median laminal cells 17-25 µm. Seta usually solitary. Capsule inclined, 3.0-4.5 x 0.5-0.8 mm.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Europe, N.America.

This taxon is not rare on humus in mountain forests. The capsule is variable in size, and larger than that of var.
Figure 8.


B. *A. undulatum* var. *gracilisetum* Besch. h. Leaves (*h₂*, dorsal view), x10. i. Teeth on back of lamina, x250. j. Median cells of leaf, x250. k. Cross-section of leaf, x34. l. Cross-section of costa, x135. m. Perichaetial leaves, x10. n. Inner perichaetial leaf, x10. o. Capsule, x10.

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gracilisetum.

1b. VAR. GRACILISETUM BECH. (Fig. 8, B)

Plants usually smaller than those of var. undulatum, often forming a new innovation and sporophyte annually. Stem leaves wider than those of the type, to 8.0 x 1.3 mm, lingulate, rarely triangular- or ovate-oblong; undulation and dorsal teeth of lamina less marked than in var. undulatum; lamellae and size of laminal cells similar to those of var. undulatum. Paroicous or synoicous. Setae lateral in appearance, 1-3 in each perichaetium, yellowish-brown. Capsule usually suberect, slightly arcuate, 3.0-4.5 x 0.7-1.0 mm. Spores 10-17 µm.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the N. Hemisphere.

This taxon is uncommon in northern Japan (including Hokkaido), and rare towards the south.

Setae are often 2 or 3 in a single perichaetium, somewhat flexuose; innovations are often developed below the perichaetia, so that sporophyte of several annual cycles may occur in succession along a shoot.

Noguchi and Osada (1960) treated var. gracilisetum as identical with the European var. haussknechtii. Later examination suggests that the two taxa different, more karyological investigations are needed to indicate their relationship.

2. ATRICHUM RHYSTOPHYLLUM (C.MUELL.) PAR. (Fig. 8, C)
Ind. Bryol. suppl.: 17 (1900).


Plants smaller and more slender than in the preceding species. Stems to 20 mm long. Leaves lanceolate, stiff, to 5.0 x 0.8 mm, with a sheathing base, undulate in the upper half with teeth at back in irregular rows; lamellae 4-6, to 7 cells high. Median cells of lamina 12-18 µm; basal cells 20-35 x 15-20 µm. Dioicous. Seta solitary, rarely double, yellowish, to 20 mm long. Capsule brown, narrowly cylindric, slightly curved, to 2.50 x 0.65 mm. Peristome teeth 0.27 mm high. Operculum to 2.5 mm long. Spores 12-20 µm, finely papillose. Calyptra to 4.5 mm long. Male plants ca. 10 mm high; leaves small, to 3 mm long, lamellae sparse. Perigonium of a conspicuous discoid; outer leaves of perigonia widely ovate or suborbicular, acuminate, 2.5 x 2.0 mm; inner leaves to 0.7 x 0.6 mm, obcordate.
POLYTRICHACEAE


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Europe, C.America.

This species is common on shaded ground near human habitation. This species is distinguished from A. undulatum var. undulatum by the smaller plants bearing narrower leaves with smaller laminal cells, and higher lamellae.

3. ATRICHUM CRISPULUM SCHIMP. EX BESCH. (Fig. 9, A)


Plants large. Stems usually simple, to 80 mm, leaves distant. Upper leaves broadly and ± complanately spreading when moist, strongly contracted and crisped when dry, lingulate, widest at middle, acute, with a sheathing base, to 10.0 x 1.8 mm, irregularly undulate in the upper half, toothed at back on the undulations; margin bordered with 1-2 rows of linear cells, densely and sharply serrate in the upper 2/3, teeth spinose, in pairs; costa with several teeth on the upper dorsal surface. Lamellae 5-6, 2-3 cells high. Laminal cells ± irregularly hexagonal, subquadrate or ovate, transversely elongate, 20-32 µm; basal cells 30-55 x 15-18 µm. Dioicous. Seta solitary, rarely double, yellowish, with age yellowish-brown, 15-30 mm long. Capsule suberect, brown, 4-5 x 0.8-1.0 mm. Peristome to 0.4 mm high. Spores smooth, 12-15 µm. Operculum to 3 mm long. Calyptra 4.5-6.0 mm long. Male plants to 40 mm long; leaves to 6 mm long, with discoid perigonia.

Exsiccati: Musci Japonici 16: 753 (1960), as A. spinulosum; 23: 1104 (1968), as A. spinulosum.

Distribution: Japan (Honshu, Shikoku, Kyushu), Korea.

The large plants and leaves strongly crisped when dry characterise this species. The marginal teeth of leaves are larger than those of allied species. The lamellae are rather low, being only 2 or 3 cells high. Fertile plants are rare.

4. ATRICHUM YAKUSHIMENSE (HOR.) MIZ. (Fig. 9, B)


Plants small, pale to yellowish-green, scattered on rocks. Stems usually to 10 mm long. Leaves distant, crispate when dry, obliquely spreading when moist, lingulate or narrowly spatulate, without sheathing base, acute, widest above the middle, to 8.0 x 1.2 mm, slightly undulate, the dorsal surface with blunt teeth; leaf margin bordered with 1-2 rows of linear cells, serrate in the upper 2/3; costa sometimes bearing several sharp teeth. Lamellae intermittent, one cell high or entirely lacking. Laminal cells hexagonal or rounded-quadrate, ± collenchymatous, 20-28 x 17-22 µm. Dioicus. Seta solitary, rarely double, yellowish-brown, 2.5-3.0 mm long. Capsule suberect, straight or slightly arcuate, cylindric, brown, to 6.0 x 0.9 mm. Peristome to 0.4 mm high. Spores smooth, 10-15 µm. Operculum ca. 3 mm long. Calyptra ca. 4.5 mm long. Male plants ca. 10 mm long, with few, small leaves; perigonia terminal, discoid.


Distribution: Endemic to Japan (Hokkaido, Honshu, Shikoku, Kyushu).

This species grows on bare rock-faces or in crevices, usually volcanic rock except on Yakushima Island.

The stems are short, with few, lingulate, or narrowly spatulate leaves, and the lamellae are absent or only slightly developed, being only one cell high. These characters will easily distinguish _A. yakushimense_ from allied species.

5. _ATRICHUM CRISPUM_ (JAM.) SULL. & LESQ. (Fig. 9, C)

Musci Bor. Am.: 44 (1856).


Stems usually to 20 mm long. Leaves distant, crispate when dry, narrowly oblong-lanceolate, widest at or below middle, lacking sheathing base, slightly keeled above, apex acuminate; upper leaves to 5 x 1 mm, somewhat recurved, scarcely undulate, lacking teeth at back or occasionally with several indistinct teeth; margin sharply serrate in the upper half, teeth spinose, border 1-2 cells wide and 2 cells thick; costa usually with 2-3 teeth at back above. Median cells of lamina lax, mostly quadratile-hexagonal, somewhat inflated, thin-walled, scarcely collenchymatous, 18-25 x 15-35 µm, towards margin and leaf apex smaller, 14-18 x 16-20 µm; lower cells hyaline, shortly rectangular or quadratile, 20-30 x 5-20 µm. Lamellae few (1-3), 1-2 cells high. Sporophyte solitary. Seta straight, brown, ca. 13 mm long and 0.25 mm thick. Capsule inclined, slightly curved, brown, 3-5 x 1 mm. Spores ca. 20 µm, finely papillose.
Figure 9.
A. Atrichum crispulum Schimp. ex Besch. a. Leaves (a2, dorsal view), x8. b. Teeth on back of lamina, x250. c. Median cells of leaf, x250. d. Cross-section of leaf, x34. e. Cross-section of costa, x135. f. Inner perichaetial leaf, x8. g. Capsule, x8.
B. A. yakushimense (Hor.) Miz. h. Leaves (h2, dorsal view), x10. i. Teeth on back of lamina, x250. j. Median cells of leaf, x250. k. Cross-sections of costa, x135. l. Inner perichaetial leaf, x10. m. Capsule, x8.
Distribution: Japan (Honshu), Europe, N.America.

This species is characterised by the lax areolation and the presence of few and indistinct lamellae of leaves.

2. **OLIGOTRICHUM** LAM. & CAND.

Plants usually small. Stems erect from subterranean radiculose rhizomes. Lower leaves small, scale-like, distant; upper leaves much larger, crowded, incurved, contorted or crisped when dry, with an oblong, lingulate or lanceolate limb arising from a well-defined sheathing base, concave, not bordered; costa with several lamellae on both sides; ventral lamellae straight or wavy, variable in height, notched and crested or crenate in profile, the marginal cells scarcely different from the rest; dorsal lamellae long but low, ridged or toothed. Dorsal surface of lamina often bearing many, short and serrate lamellae or a few teeth. Leaf margin involute, not bordered, serrate in the upper half or almost entire; costa stout. Limb with unistratose lamina, the cells hexagonal to quadrate, thin-walled, somewhat longer towards leaf base. Dioicus. Capsule inclined on a long, smooth seta, cylindric, without apophysis and ridges, ± rugose, greenish-brown, becoming black with age, old capsule often geniculate at neck, with large stomata at base. Operculum convex, with short ± oblique beak. Annulus absent. Peristome teeth 32 or more, irregular in shape and size, pale-yellow, a white epiphragm attached to the apices of the incurved teeth. Calyptra cucullate, brownish, with a few, erect hairs. Male plants smaller and with shorter leaves than the females, each with a discoid perigonium. Perigonial leaves reniform, apiculate, lamellae occupying 1/3-1/2 the width of leaf in the upper part, upper margins variously notched and crested.

From the nearest genus *Atrichum* this is easily distinguished by the non-bordered leaf margins and shortly rostrate opercula. The presence of lamellae on both surfaces of costa and laminae is also a remarkable character. Sometimes teeth or short lamellae are developed on the dorsal surface of the lamina towards the apex.

**Key to the Species**

1. Leaf margin entire; dorsal lamellae absent or scanty, ventral lamellae strongly wavy .......... 2. *O. hercynicum*

1. Leaf margin serrate or crenulate; dorsal lamellae many, ventral lamellae straight or slightly wavy .......... 2

2. Dorsal lamellae long, ventral lamellae 6-10, margins notched and crested in profile .......... 1. *O. aligerum*

2. Dorsal lamellae short, ventral lamellae 4-5, margins serrate in profile .......... 3. *O. parallellum*
1. **OLIGOTRICHUM ALIGERUM** MITT. (Fig. 10, A)

J. Linn. Soc. Bot. 8: 48, f. 8 (1864).


Plants greenish-brown. Stems 10-15 mm. Lower leaves ovate, acute, without lamellae; upper leaves lanceolate from a short, ovate, sheathing bases, contracted above the sheath, acute to acuminate, 2.5-3.5 x 0.3-0.5 mm, concave; margin incurved, crenate in the upper half, entire below; ventral lamellae 6-10, straight or slightly wavy, 6-10 cells high, the margin notched and crested in profile; dorsal lamellae covering the entire lamina and costa in the limb, lower than the ventral lamellae, margins remotely toothed in profile; median cells of limb hexagonal or subquadrate, 10-15 µm; lower cells rectangular, 25-40 x 10-15 µm. Perichaetial leaves lanceolate from a long wide-sheathing base (1/2 or more the leaf-length), canaliculate. Seta 20-25 mm long (rarely longer), ca. 0.25 mm thick, reddish-brown. Capsule erect when young, inclined when mature, cylindrical, brown, 2.0-2.5 mm long, 1.0-1.3 mm thick. Peristome teeth 35-36, 0.2-0.3 mm high, obtuse; basal membrane low. Spores, 10-13 µm. Operculum ca. 0.8 mm long, short-rostrate. Calyptra cucullate, 3.0-3.5 mm long, yellowish below, black above. Male plants 5-12 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Taiwan, Philippines, N. and C. America.

This species is found at high elevations (1000-3000 m), becoming rare southwards in Japan. The ventral lamellae are often wavy as in *O. hercynicum*, but *O. aligerum* may be distinguished by its larger dorsal lamellae and other characters noted under *O. hercynicum*.

2. **OLIGOTRICHUM HERCYNICUM** (HEDW.) LAM. & CAND. (Fig. 11, A)

Fl. Franc. ed. 2, 2: 492 (1805).


Plants greenish-brown. Stems to 20 mm, usually less than 15 mm. Lower leaves ca. 0.8 mm long, ovate, obtuse, cymbiform; upper leaves loosely appressed when dry, to 2 mm long, ovate, oblong-lanceolate, obtuse with a small apiculus, cucullate, deeply concave, the sheathing base indistinct; margin involute, almost entire (sometimes with small, remote teeth); costa stout, ventrally bearing numerous, strongly wavy lamellae in the upper 2/3, the ventral lamellae 5-7 cells high, the margins notched and crested in profile; dorsally bearing few, low,
fragmentary lamellae at back above. Median cells of lamina hexagonal or subquadrate, transversely elongate, 8–13 µm, thin-walled, lower cells short-rectangular or subquadrate, 8–20 µm, thin walled. Perichaetal leaves shortly narrowed from an elongate sheathing base. Seta ca. 2 cm long. Capsule cylindric, ca. 3.2 x 1.0 mm. Peristome teeth oblong, obtuse, with the basal membrane 1/5 the length of teeth. Spores smooth, ca. 10 µm. Male plants similar to the females; perigonal leaves obovate to reniform. [The descriptions of sporophytes and male plants follow those of Osada (1966)].


Distribution: Japan (Hokkaido, Honshu), Kamchatka, Siberia, Europe, Greenland, N.America.

This species is found in alpine regions, but is confined to sandy soil. Takaki (1953) gives 2400–2900 m alt. as the altitudinal range in central Japan.

This species is similar to O. aligerum in appearance, but differs in the fewer, smaller dorsal lamellae in the more consistently and strongly wavy lamellae on the ventral surface, and in the leaves being usually ovate- to oblong-lanceolate and lacking a well-defined sheathing base (except for the lower leaves). The sporophytes are rare in Japan.

3. **OLIGOTRICHUM PARALLELUM** (MITT.) KINDB. (Fig. 10, B)


Plants soft, dark-green, becoming blackish with age. Stems more than 50 mm, denuded below. Leaves soft, median leaves oblong-lanceolate, blackish-green, with small teeth; upper leaves long-lingulate, with a short, indistinct sheathing base, to 6.5 x 1.2 mm, recurved, undulate above, bearing short dorsal lamellae on the upper half of the lamina; costa stout, with 2–4 lamellae both on the ventral and dorsal sides in the upper half; ventral lamellae in 4–5 rows, slightly wavy, 4–8 cells (to 0.12 mm) high, the margins strongly serrate in profile. Median cells of lamina hexagonal, transversely elongate, thin-walled, 25–30 µm; marginal cells smaller, lower cells elongate-rectangular, thin-walled, pellucid, 40–65 x 16–24 µm. Leaf margin undulate above, sharply toothed in the upper half, the teeth multicellular. Seta 30–40 mm long, ca. 0.35 mm thick, reddish-brown. Capsule inclined, cylindric, 3.5–4.0 x 1.5–1.7 mm. Operculum 1.2–1.5 mm long, obtuse, yellowish. Peristome teeth 32, each tooth obtuse, with a complicate median sinus, basal membrane high. Spores 8–13 µm. Male plants smaller than the females, the leaves oblong, to 3.5 x 1.2 mm, sheathing base indistinct, the marginal teeth small, the lamellae poorly developed.

Figure 10.
A. Oligotrichum aligerum Mitt.  
a. Female plant, x1.  
b. Male plant, x1.  
c. Leaves, x14.  
d. Median cells of leaf, x290.  
e. Cross-section of leaf, x95.  
f. Profile of lamella, x250.  
g. Peristome teeth, x100.  
[Noguchi 11885]

B. O. parallellum (Mitt.) Kindb.  
h. Female plant, x1.  
i. Male plant, x1.  
j. Leaves (j3, dorsal view), x10.  
k. Cross-section of leaf, x48.  
l. Cross-section of costa, x180.  
m. Profile of lamella, x180.  
n. Perigonial leaves, x10.  
[Noguchi 28385]
Distribution: Japan (Hokkaido, Honshu, Shikoku), Kamchatka, Soviet Far East, N. America.

This species is restricted to northern regions where it is not rare on humus or rocks at high elevations. Mt. Tsurugi in Shikoku is an isolated southern location for this species.

This species is similar to *Atrichum* spp. in appearance, but is easily distinguished by its non-bordered leaves. The large plants and the blackish-green leaves, crisped leaves when dry, distinguish it from *O. aligerum* and *O. hercynicum*. This species is also distinctive in that the leaves are oblong-lanceolate with an indistinct sheathing base, and thus the leaves are lingulate in outline, and are undulate above. Dorsal lamellae occur in only 4-5 rows on the costa but occupy the full width of lamina, which is slightly wider than costa. The margins of lamellae are serrate, whereas they are notched and crested in *O. aligerum* and *O. hercynicum*.

3. **BARTRAMIOPSIS** KINDB.

**BARTRAMIOPSIS LESCURII** (JAM.) KINDB. (Fig. 11, B)

Rev. Bryol. 21: 35 (1894).


Plants slender, forming dense tufts. Stems simple, to 50 mm, rarely 150 mm, filiform, ca. 0.17 mm thick, leaves on the lower 1/2-2/3 of stem distant, small, appressed, scale-like, on the upper 1/2-1/3 crowded. Rhizoids papillose. Leaves strongly incurved, contorted when dry, widely spreading when moist, lanceolate from an oblong, clasping, sheathing base, narrowly acuminate, reflexed above the sheath, to 5.0 x 0.5 mm; margin 1-2-stratose, strongly serrate in the upper 2/3, the teeth large, multicellular; costa extending to near the leaf apex, smooth at back; ventral lamellae in 6-7 rows at middle, 2-6 cells (40-50 µm) high, the margin of each lamella remotely crenate in profile, marginal cells scarcely differentiated; median leaves bearing several cilia on the shoulder of the sheathing base; lower leaves distant, appressed, small, scale-like, brown, toothed above. Limb almost entirely bistratose; median limb cells hexagonal, thin-walled, 6-8 µm, longer towards leaf base; lower cells linear, thin-walled, 50-65 x 4.0-4.5 µm. Perichaetial leaves scarcely differentiated. Seta terminal, solitary, ca. 10 mm long, 0.2 mm thick, smooth. Capsule erect, cylindric or obconic, wide-mouthed especially when empty; apophysis long, 2.2-2.8 x 0.8-1.0 mm, smooth, with large stomata. Operculum 1.0-1.3 mm long, with a long, curved beak. Peristome none, but an epiphragm present. Spores 15-20 µm, densely papillose. Calyptra cucullate, 1.7-2.2 mm long, smooth. Male plants similar to the females, with small heads.

Exsiccati: Musci Japonici 2: 99 (1948); 20: 957 (1964); 25: 1206
Figure 11.
A. Oligotrichum herculinum (Hedw.) Lam. & Cand.  
   a. Dry male plant, x8.  
   b. Leaves (b2, dorsal view), x20. [Noguchi 37068]  
B. Bartramia lescurii (Jam.) Kindb.  
   c. Dry plants, x1.  
   d. Moist female plant, x1.  
   e. Leaves (e3, dorsal view), x15.  
   f. Cells at leaf margin, x290.  
   g. Cilium at leaf margin, x225.  
   h. Cross-section of leaf, x48.  
   i. Cross-section of leaf, x250.  
   j. Profile of lamella, x250.  
   k. Capsule, x9. [Musci Japonici 20: 957]  
C. Pogonatum capillare (Michx.) Brid.  
   l. Dry plant, x1.  
   m. Leaves (m3, dorsal view), x10.  
   n. Cross-section of leaf, x48.  
   o. Lamellae in section, x250.  
   p. Profile of lamella, x250.  
   q. Peristome teeth, x135. [Noguchi 23561]  
D. P. urnigerum (Hedw.) P.Beauv.  
   s. Dry plant, x1.  
   t. Leaves (t2, dorsal view), x10.  
   u. Cross-section of leaf, x63.  
   v. Cross-section of leaf, x250. [Noguchi 69704]
Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Soviet Far East, N.America.

This species extends from Hokkaido to the summit of Yakushima Island, south of the main island of Kyushu, where it is at the southernmost limit of its known distribution. It grows on humus, on cliffs, and in rock crevices in the subalpine coniferous forests and in deciduous forests. Volcanic rocks are the preferred substrata.

4. RHACELOPODOPSIS THÉR.

RHACELOPODOPSIS CAMUSII THÉR. (Fig. 12, A)

Monde Pl. sér. 2, 9: 22 (1907).

Protonema persistent. Stems very short with few leaves. Lower leaves minute, ovate, acuminate, almost ecostate, margins with large teeth; upper leaves larger, oblong-ovate, without lamellae, acuminate, with large teeth on the upper margin, costa very poorly developed. Cells in the upper part of the limb hexagonal to subquadrate, 30–65 µm, thin-walled; in lower part of limb cells rectangular or sublinear, 100–150 x 12–16 µm, with very thin walls. Perichaetial leaves lanceolate with a narrow acumen, lacking lamellae, with long, spinulose or ± ciliate teeth on the upper margin; costa very poorly developed, percurrent or ending far below the apex. Inner perichaetial leaves to 4 mm long, oblong-ovate, long-aristate. Seta 15–18 mm long, ca. 0.25 mm thick, flexuose, densely papillose, brown. Capsule shortly cylindric, inclined, without apophysis, 2.2–2.6 x 1.0–1.2 mm, rarely ca. 1.5 x 0.6 mm, 5-angled with distinct ridges in cross-section, scarcely verrucose, greenish-brown; annulus and stomata not seen. Operculum ca. 0.8 mm long, convex with a short, erect beak. Peristome teeth 34–36, ca. 0.2 mm long, obtuse, teeth occasionally bearing two central, brown areas. Spores 8–10 µm, smooth. Calyptra 4.0–4.5 mm long, similar to that of Pogonatum. Male plants unknown.

Distribution: Japan (Ryukyu), Taiwan.

This species resembles Pogonatum spinulosum in the persistent protonemata and reduced gametophytes. The papillose setae clearly distinguish it from P. spinulosum.

5. POGONATUM P.BEAUV.

Plants usually large, growing on earth. Stems simple or sparingly branched, arising from subterranean, curved, tomentose rhizomes. Lower leaves small, scale-like; upper leaves much larger, mostly crisped and contorted when dry, mostly with a lingulate to oblong-lanceolate limb and
Figure 12.
B. *Pogonatum spinulosum* Mitt.  g. Plants, x1.  h. Leaves, x8.  i. Upper marginal cells of leaf, x135.  j, k. Inner perichaetial leaves, x8.  l. Peristome teeth, x95.
C. *P. otaruense* Besch.  m. Plants, x1.  n. Dry Plant, x8.  o. Leaves (o2, dorsal view), x10.  p. Marginal cells of leaf, x250.  q. Cross-section of leaf, x34.  r. Lamellae in section, x250.  s, t. Capsules x8. [Noguchi 20659]
a well-defined, enlarged, membranous sheathing base, apex acute to obtuse, often with a spinous tooth at tip; margin of limb bearing large and sharp teeth, not bordered; costa stout, expanded, percurrent, usually toothed above at back; lamellae green, abundant, occupying almost the entire width of the ventral surface of limb, 1 - several cells high, the marginal cells usually differentiated. Laminal cells of limb mostly hexagonal, often transversely elongate; areolation of sheathing base lax, pale, the cells mostly elongate, rectangular to sublinear, mostly thin-walled, often brownish. Dioicous or monoicous. Perichaetial leaves slightly differentiated, narrow, the sheathing bases longer than in stem leaves. Capsule on a long, smooth seta, suberect (old capsule inclined), large, ovoid or cylindric, nearly globose, mostly not angled but often with indistinct striae, without apophysis, annulus or stoma, the surface scabrous with a mammilla over each exothecial cell lumen; epiphragm attached to the apices of the peristome teeth. Peristome teeth 32, lingulate, obtuse, incurved above. Operculum rostrate from convex base. Spores small, smooth. Calyptra cucullate, with numerous long hairs. Perigonia terminal, discoid; antheridia and paraphyses numerous. New perigonal shoots formed successively above the preceding years' perigonia in a series on the same stem.

Leaf characters are useful in distinguishing the infrageneric taxa. The marginal cells of lamellae are usually less variable in form and size within a species and have been regarded as important in distinguishing the species.

As in *Polytrichum* and *Atrichum* (Wigglesworth, 1947; Longton and Miles, 1982) the leafy plants of *Pogonatum* innovate from underground rhizoid wicks.

*Pogonatum aloides* has been reported as occurring in Japan (e.g. van der Sande Lacoste, 1866; Brotherus, 1899; Salmon, 1900). According to Paris (1905) van der Sande Lacoste's plant is *P. inflexum*, and judging from his notes, Salmon's plant seems to be *P. akitense*. The plant recorded by Brotherus probably belong to *P. akitense*.

**Key to the Species (mainly based on Osada, 1965)**

1. Plants with all leaves as yellowish-brown scales in clusters, scattered over a persistent protonemata; leaves without lamellae ....
   1. *P. spinulosum*
1. Plants with ordinary green leaves; leaves with lamellae ....
   2. Leaf margins entire, involute covering the lamellae; capsules nearly globose to ovoid, inclined to cernuous with a short seta ....
   2. *P. sphaerothecium*
   2. Leaf margins serrate, flat or erect; capsules cylindric to narrowly ovoid, erect to somewhat inclined with a long seta ....
   3. Marginal cells of lamellae distinctly papillose ....
   3. Marginal cells of lamellae nearly smooth ....
   4. Upper wall of the marginal cells of lamellae with elliptical papillae in surface view, as thick as the cell lumen in lateral view; capsule wall smooth ....
   3. *P. alpinum*
   4. Upper wall of the marginal cells of lamellae with roundish papillae

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**POLYTRICHACEAE**
in surface view, far thinner than the cell lumen in lateral view; capsule wall mammillose ........................................ 5
5. Leaves scarcely crispate when dry; lamellae 35-50, usually 4-7(-8) cells high, marginal cells never geminate ....................... 6
5. Leaves contorted when dry; lamellae 60-85, usually 2-3(-4) cells high, marginal cells partly to mostly geminate ................. 9. *P. japonicum*
6. Marginal cells of lamellae longer than wide in surface view, ovate to elliptical in cross-section; peristome teeth nearly oblong, dark, with high basal membrane ......................... 12. *P. urnigerum*
6. Marginal cells of lamellae wider than long in surface view, quad-rate to transversely rectangular in cross-section; peristome teeth lanceolate, pale, with low basal membrane .................. 11. *P. capillare*
7. Leaf margins bistratose to the width of (1-)2-3 cells; lamellae (1-)2-3(-4) cells high, margins entire or nearly so ...................... 8
7. Leaf margins unistratose; lamellae (3-)4-6 cells high, margins crenate to sinuate due to protruding marginal cells .................... 9
8. Margins of leaf sheath dentate with a few patent teeth on the upper half; hyaline marginal portion of leaves 5-12 cells wide; capsule wall distinctly mammillose ...................... 7. *P. contortum*
8. Margins of leaf sheath entire; hyaline marginal portion of leaves 3-5 cells wide; capsule wall smooth .................................. 8. *P. spurio-cirratum*
9. Marginal cells of lamellae partly to mostly geminate, very irregularly arranged and often overlapping each other in lateral view, obtuse to rounded at apex in cross-section (in fresh material) ......................... 4. *P. otaruense*
9. Marginal cells of lamellae not or very rarely geminate, rather regularly arranged in lateral view, neither obtuse nor rounded at apex in cross-section .................................................. 10
10. Marginal cells of lamellae in surface view transversely elliptical, twice as wide as long, in cross-section variable in shape, but mostly rhombate, wider than long, with apices somewhat convex to truncate (rarely shallowly convex) .................. 5. *P. inflexum*
10. Marginal cells of lamellae in surface view orbicular and isodia-metric, in cross-section oblong to obovate, usually a little longer than wide, with apices retuse to emarginate ......................... 11
11. Leaves homomallous when dry, with constriction between limb and sheath; limb broadest in the upper half, obtuse to subacute at apex; lamellae 50-60 ................................................. 10. *P. nipponicum*
11. Leaves not homomallous when dry, without constriction between limb and sheath; limb broadest in the lower half, acute to acuminate at apex; lamellae 30-50 .................................................. 6. *P. akitense*

1. **POGONATUM SPINUOSUM** MITT. (Fig. 12, B)

J. Linn. Soc. Bot. 8: 156 (1864).

Plants scattered over green mats of persistent protonemata, brown-ish. Stems very short. Lower leaves reddish-brown, minute, cordate to widely ovate, acuminate or with long aristae; median leaves oblong; margin sparingly dentate above, entire below; costa broad, prominent on
the dorsal side, excurrent, lacking lamellae; upper leaves and perichaetial leaves much larger, to 8 mm long, lanceolate, acuminate, involute, thin; margin entire; costa brownish, percurrent, smooth, lacking lamellae. Limb cells hyaline, linear or long-hexagonal, 80-140 x 8.5-15.0 µm, thin-walled. Seta ca. 30 mm long, ca. 0.35 mm thick, ± flexuose. Capsule erect, cylindric, 3-5 x 1.2-1.5 mm, mamilllose. Operculum 0.8-1.0 mm long. Peristome ca. 0.35 mm high, teeth obtuse, basal membrane high. Spores 10-12 µm.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East, Philippines.

This species is usually growing on semi-shaded, rather moist ground in forests.

As the leaves are extremely reduced photosynthesis is performed principally by green, persistent protonemata.

2. **POGONATUM SPHAEROTHECIUM** BESCH. (Fig. 15, B)


Plants small, castaneous-brown, slightly lustrous when dry. Stems simple, usually to 20 mm long. Lower leaves small, imbricate, scale-like; upper leaves much larger, to 5.0 x 1.0 mm, incurved to appressed when dry, erect-spread when moist, canaliculate, lanceolate from a large oblong, sheathing base, limb often shorter than the sheath, minute-apiculate; margin entire, widely involute covering several rows of lamellae; costa percurrent, smooth at back. Lamellae ca. 30, with margins entire in profile, 7-10 cells high at middle of limb, marginal cells yellowish, mamilllose, high-conic in cross-section, similar to other cells in size, the apical walls thick. Median and marginal limb cells hexagonal to quadrate or irregular, transversely elongate, 12-15 µm, uniformly thick-walled; basal cells of the sheath long-rectangular, 40-65 x 10-20 µm, thin-walled, yellowish; sheathing base with a border of pale, elongate-rectangular, thin-walled cells. Dioicous. Perichaetial leaves to 8 mm long, lanceolate from an oblong sheath, limb shorter than the sheath, with 4-5 lamellae. Seta terminal, solitary, 5-7 mm long, 0.30-0.35 mm thick, geniculate or curved. Capsule inclined to cernuous, 2.0-2.5 x 1.7-2.5 mm, nearly globose or ovoid, not angled, narrowed at mouth, apophysis indistinct, somewhat rugose when dry; exothecial cells without pits. Operculum ca. 0.6 mm high. Peristome teeth unequal in shape and size but mostly triangular, ca. 32, to 0.15 mm high, yellowish, basal membrane high. Spores 12-17 µm. Male plants similar to the females.

POLYTRICHACEAE

Distribution: Japan (Hokkaido, Honshu), Korea, China.

This species forms dense tufts on bare rock faces and in crevices, especially of volcanic rocks in the alpine zone.

Schofield (1966) suggested that *Pogonatum sphaerothecium* is conspecific with *Polytrichum norvegicum* var. *vulcanicum* (C. Jens.) Podp. from Iceland. Differences between the two species are, however, found in the sporophytes. The setae of *P. sphaerothecium* are shorter, being usually 5–7 mm, than those of *P. norvegicum*. The capsules of *P. sphaerothecium* are globose or widely ovoid and not angled. Those of *P. norvegicum* are normally angled and ovoid, although occasionally globose. In addition, the peristome teeth are usually triangular and 32 in number in *P. sphaerothecium* but lanceolate and 64 in number in *P. norvegicum*. At present, I think that it is better to consider *P. sphaerothecium* as a distinct species.

3. **POGONATUM ALPINUM** (HEDW.) ROEHL


Stems simple or sparingly branched, usually ca. 50 mm long. Upper leaves appressed when dry, widely spreading or lightly recurved when moist, almost linear–lanceolate from a much wider obovate base, acuminate, to 10 mm long, limb to 0.6 mm wide; margin of limb plane; coarsely toothed above, margin of sheath involute, entire; costa ending in a short, dentate awn. Lamellae ca. 40, margins entire in profile, 5–8 cells high in mid-leaf, marginal cells papillose above, ovate-conic in cross-section, slightly larger than other cells, apical walls strongly thickened. Limb cells 10–15 µm, isodiametric, hexagonal to subquadrate, sometimes transversely elongate, walls uniformly thick, cells of sheath sublinear. Dioicous. Inner perichaetial leaves similar to stem leaves. Seta 20–50 mm, brown. Capsule suberect to inclined, cylindric, rarely ovoid, 3–5 x 1.5 mm, dark-brown, becoming blackish and rugulose with age, apophysis indistinct, exothecial cells without pits. Operculum convex, with a long, curved, subulate beak, ca. 2 mm long. Peristome teeth 40–55, ca. 0.25 mm high, obtuse, unequal in width. Spores 12–18 µm, minutely papillose. Calyptra 6–8 mm long. Male plants similar to the females.

It is not clear whether *P. alpinum*, and also *P. sphaerothecium*, should be placed in *Polytrichum* or *Pogonatum*. They resemble species of *Pogonatum* in the non-angular capsules, and of *Polytrichum* in other characters.

3a. **VAR. ALPINUM** (Fig. 16, A)

Stems elongate. Leaf margins coarsely serrate throughout. Capsule cylindric.

Distribution: Japan (Hokkaido, Honshu, Shikoku), Asia, Europe, N. and S.America, Africa.
This taxon is not rare in the alpine and subalpine zone, growing on somewhat moist soil in forests or among boulders. Saito (1956) reported *Polytrichum alpinum* var. *macounii* (Kindb.) Saito from Hokkaido but the material on which his record is based appears to be identical with *Pogonatum alpinum* var. *alpinum*.

3b. VAR. *SEPTENTRIONALE* (SW.) BRID.


Stems to 20 mm long. Leaf margin poorly serrate. Capsule ovoid to subcylindric.

Distribution: Japan (Hokkaido, Honshu), northern Asia, Europe, northern N. America.

4. **POGONATUM OTARUENSE** BESCH. (Fig. 12, C)


Plants small, dark-green, becoming brownish with age. Stems ca. 10 mm. Lower leaves distant, oblong-lanceolate; upper leaves much larger, strongly incurved to contorted when dry, obliquely spreading when moist, oblong-lanceolate from broad sheathing base, to 5.00 x 0.65 mm, acute, the sheathing base much wider than the limb, reaching ca. 1.2 mm in width; margin unistratose, toothed downwards to the shoulders of sheathing base, the upper teeth larger, somewhat brownish; costa broad, with a few, small teeth at back above. Lamellae ca. 50, 5-8 cells high, adjacent marginal cells projecting in different directions so that the cells appear to be geminate in cross-section. Marginal laminal cells rounded-hexagonal or -quadrate, 7-8 µm, somewhat collenchymatous; lower cells elongate-hexagonal to rectangular, 35-55 x 15-20 µm. Seta solitary, variable in length, commonly 10-20 mm long, brown. Capsule suberect or inclined, ovoid or somewhat cylindrical, 3.0-3.5 x 1.2-1.5 mm. Operculum 1.0-1.3 mm long. Peristome teeth ca. 0.3 mm long, obtuse. Spores 8.5-10 µm, smooth. Male plants smaller than the females; perigonal leaves widely ovate.

Distribution: Endemic to Japan (Hokkaido, Honshu, Kyushu).

The irregularly arranged marginal cells of lamellae, and the turgid, ovate capsules are diagnostic. The leaves are wider in proportion of their length than in allied species.

5. **POGONATUM INFLEXUM** (LINDB.) LAC. (Fig. 13, A)


*Polytrichum inflexum* Lindb., *Nat. Saellsk. F. Fl. Fenn. Foerh.* 9:
Plants medium-sized, pale green, becoming brownish with age. Stems simple, usually ca. 30 mm, rarely longer. Lower leaves distant, triangular or ovate-lanceolate; upper leaves crowded, incurved, circinate or crisped when dry, widely spreading when moist, lanceolate from an ovate sheathing base, strongly contracted and slightly reflexed above the sheathing base, the apex acute and incurved, to 6.0 x 0.7 mm (rarely larger), glaucous on the ventral surface; margin slightly incurved, unistratose, strongly serrate in the upper half, each tooth a row of 2-4 cells, the terminal cells large and brown; costa reddish, densely and sharply toothed at back in the upper 2/3; lamellae ea. 40, 4-6 cells high with marginal cells transversely elliptical or rounded-quadrat in cross-section, somewhat wider than long, not retuse, slightly thicker-walled than the others. Marginal cells of lamina quadrate or rounded, walls thick and collenchymatous, 8-13 µm, lower cells rectangular, 20-35 x 12-16 µm, uniformly thin-walled. Dioicus. Seta usually solitary, 25-35 mm long, 0.20-0.25 mm thick, reddish-brown. Capsule erect or suberect, cylindric, widest at middle, 3.5-4.5 x 1-2 mm. Peristome teeth ca. 0.2 mm high, obtuse, basal membrane high. Spores 8-10 µm, smooth. Operculum ca. 1.2 mm long. Perigonial leaves widely ovate, apiculate. Male and female plants often established separate tufts even in the same place.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Taiwan.

This species is common in exposed, sunny situations, especially on new siliceous cuts along road.

This species is often confused with *P. akitense*. In addition to the characters given in the key, *P. inflexum* is distinguished from *P. akitense* by the leaves being thinner, with a reddish costa and more crisped when dry, and by its presence for more sunny habitats or siliceous soil.

6. **Pogonatum akitense** Besch. (Fig. 13, B)


PLANTS similar to those of the preceding species in size. Upper leaves incurved when dry, widely reflexed when moist, lanceolate from a less distinct sheathing base than in *P. inflexum*, scarcely incurved, limb ca. 5.0 x 0.7 mm or larger; margin plane, unistratose, sharply toothed, each tooth a row of 1-3 cells, terminal cell brownish; costa greenish, densely toothed at back in the upper 1/3. Lamellae ca. 45, 3-4 cells high, marginal cells scarcely differentiated, round or rounded-quadrate, slightly retuse or rounded-obtuse. Seta solitary, 15-25 mm long, 0.25-0.30 mm thick, dark-brown. Capsule shortly cylindric, mamillose, 3-5 x 1.5-1.8 mm. Basal membrane of peristome low; peristome teeth ca. 0.18 mm long. Spores ca. 13 µm, smooth. Operculum ca. 1 mm long. Calyptra ca. 4 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Ryukyu), Korea.

This species occurs in similar habitats to that of *P. inflexum*, but prefers more shaded conditions.

*P. akitense, P. junguhnianum* (Dozy & Molk.) Dozy & Molk. and *P. neesii* (C.Muell.) Dozy are closely related and possibly conspecific.

7. **POGONATUM CONTORTUM** (BRID.) LESQ. (Fig. 13, C)


Plants large, dark-green, slightly brownish with age. Stems to 100 mm. Leaves strongly contorted when dry, widely spreading when moist, lanceolate from a poorly defined ovate sheathing base, slightly contracted above the sheath, limb acuminate, to 9 x 1 mm, the sheathing base ca. 1.4 mm wide; margin uni- or bistratose, remotely toothed throughout, the teeth brownish, of several cells, costa broad, with several small teeth at back above. Lamellae ca. 40, absent in somewhat wide areas along the leaf margins, 2-3 cells high, marginal cells slightly differentiated, round. Marginal cells of lamina transversely hexagonal to subquadrat, 15-20 µm, thin-walled, ± collenchymatous, lower cells short-rectangular or subquadrat, 13-25 x 12-15 mm. Seta solitary, 20-30 mm long, ca. 0.27 mm thick, dark-brown. Capsule erect, narrowly ovoid, ca. 2.5 x 1.2 mm, mammillose. Peristome teeth ca. 0.25 mm high, obtuse, basal membrane low. Spores 8-12 µm. Male plants with shorter, less crowded leaves than the females.

Exsiccati: Musci Japonici 13: 636 (1958); 18: 888 (1962); 27: 1337
Figure 13.
A. *Pogonatum inflexum* (Lindb.) Lac.  
- a. Dry plant, x1.  
- b. Leaves (*b4*, dorsal view), x15.  
- c. Median cells of leaf, x250.  
- d. Cross-section of leaf, x48.  
- e. Lamellae in section, x250.  
- f. Capsule, x8.  
- g. Peristome teeth, x135.  
- h, i. Calyptrae, x8.

B. *P. akitense* Besch.  
- j. Dry plant, x1.  
- k. Leaves (*k1, k2, k4*, dorsal view), x15.  
- l. Marginal cells of leaf, x250.  
- m. Cross-section of leaf, x34.  
- n. Cross-section of leaf, x250.  
- o. Capsule, x8.

C. *P. contortum* (Brid.) Lesq.  
- p. Dry plant, x1.  
- q. Leaves (*q2*, dorsal view), x8.  
- r. Marginal cells of leaf, 250.  
- s. Cross-section of leaf, x34.  
- t. Lamellae in section, x250.
Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East, western N. America.

This species is rather common on the ground at the edge of forests, rarely on the shaded forest floor in montane regions. This species is more southern in distribution than *P. japonicum*.

The dark-green leaves, loosely incurved when dry, are a distinct feature which this species is distinguished even by the naked eye from most related taxa.

**8. POGONATUM SPURIO-CIRRATUM** BROTH. (Fig. 14, A)


Plants large and rigid, brownish-green, becoming brown with age. Stems usually 50 mm or rarely longer, reddish, the lower part with small, distant, scale-like leaves. Upper leaves ± crowded, contorted when dry, erect-spreading when moist, linear-lanceolate from a widely ovate sheathing base, contracted above the sheathing base, acuminated with awn, to 10 mm long, the sheathing base much wider than the limb; margin plane, bistratose, coarsely serrate in the upper half, entire in the lower half; costa sparsely toothed at back in the upper half. Lamellae more than 50, only 1-2 cells high, marginal cells not differentiated, rounded-obtuse. Marginal cells of lamina rounded, strongly thick-walled, 45-65 x 8.5-12.0 µm. Seta solitary, 20-25 mm long, ca. 0.3 mm thick, brown. Capsule erect, ovoid, ca. 3 x 1.5 mm, surface smooth. Peristome teeth ca. 0.2 mm long, obtuse, basal membrane low. Spores 8-10 µm. Male plants similar to the female; perigonal leaves ovate.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu), China, Taiwan, Philippines, Malaya, Celebes.

In leaf arrangement this species resembles *P. contortum*, from which it is distinguished by the brownish color, the stout, less contorted, slender leaves with margins entire in the lower half, and the turgid, ovoid, scarcely cylindric capsules. The sporophytes are rare compared with related species.

**9. POGONATUM JAPONICUM** SULL. & LESQ. (Fig. 14, B)


Figure 14.

A. Pogonatum spurio-cirratum Broth. a. Dry plant, x1. b. Leaves, x8. c. Marginal cells of leaf, x250. d. Cross-section of leaf, x34. e. Lamellae in section, x250. [Noguchi 40394]

B. P. japonicum Sull. & Lesq. f. Dry plant, x1. g. Leaf (dorsal view), x8. h. Marginal cells of leaf, x250. i. Cross-section of leaf, x34. j, k. Cross-sections of lamellae, x250. [Noguchi s.n.]

C. P. nipponicum Nog. & Osada. l. Dry plants, x1. m. Leaves (m2, dorsal view), x10. n. Marginal cells of leaf, x250. o. Cross-section of leaf, x48. p. Lamellae in section, x250. q. Capsule, x10. [Noguchi 32304]
Plants robust, dark-green, brownish with age. Stems usually to 150 mm (rarely longer), simple or with 2–3 branches above, the basal small-leaved portion short. Leaves strongly circinate or contorted when dry, widely spreading when moist, lanceolate from a distinct, oblong, sheathing base, contracted above the sheath, concave, limb to 0.8 mm; margin bistratose, coarsely toothed in the upper half, the teeth composed of several cells uniseriate, the terminal cell much larger and brown; costa broad, percurrent, with a short awn and several sharp teeth at back above. Lamellae 60 or more, 3–5 cells high, marginal cells round, frequently geminate, bearing papillae on the upper surface. Marginal cells of limb rounded-hexagonal, 8.5–12.0 μm, thick-walled; cells of sheath elongate-rectangular, 65–120 x 9–13 μm. Seta 15–25 mm long, ca. 0.35 mm thick. Capsule ovoid, 4–5 x 1.8–2.2 mm, mammillose. Operculum ca. 1.2 mm long. Peristome teeth ca. 0.35 mm long, obtuse, brown. Spores 8–13 μm.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East.

This species is found from the lowlands to the alpine zone, most frequently at the edge of subalpine forests in northern and central Japan. Southwards it becomes rare, and restricted to the summit areas of high mountains.

The plants are large and can scarcely be confused with other Japanese species of the genus. The low lamellae often with geminate, verrucose marginal cells, as well as the bistratose leaf margins, are among the characteristic features.

10. **POGONATUM NIPPONICUM** NOG. & OSADA (Fig. 14, C)


Plants dark-green, becoming blackish or brownish with age. Stems 10–20 mm, curved, denuded and flexuose below the middle. Leaves crowded on and near stem apex, distant downward, strongly incurved when dry, widely spreading when moist, narrowly lingulate from an indistinct, ovate sheathing base, slightly contracted above the sheath, obtuse, to 4.0 x 0.6 mm; margin plane, unistratose, toothed in the upper half, teeth rather small, brownish; upper half of costa broad, densely toothed at back. Lamellae ca. 50, 4–5 cells high, marginal cells truncate or slightly retuse at apex, otherwise scarcely differentiated. Marginal cells of lamina rounded-hexagonal to quadrate, 6.0–8.5 μm, uniformly thick-walled, lower cells rectangular, 16–20 x 8.5–13.0 μm, ± thick-walled. Seta solitary, stout, 10–20 mm long, ca. 0.25 mm thick, brown. Capsule erect, ovoid, ca. 2.0 x 1.2 mm, mammillose. Operculum ca. 0.9 mm long.
Figure 15.
A. *Polytrichum norvegicum* Hedw.  
a. Leaves, x8.  
b. Cross-sections of leaf, x34.  
c. Lamellae in section, x250.  
d. Profile of lamella, x250.  
e. Capsule, x8.

B. *Pogonatum sphaerothecium* Besch.  
f. Dry plant, x8.  
g. Cross-section of stem, x250.  
h. Leaves (*h2*, dorsal view), x10.  
i. Cross-sections of leaf, x34.  
j. Lamellae in section, x250.  
k. Capsule, x8.  
l. Peristome teeth, x180.  
m. Calyptra, x8. [Noguchi 34406].
Peristome teeth to 0.2 mm high, obtuse; basal membrane low. Spores 6.5–8.5 µm, smooth. Calyptra 3–4 mm long. Male plants similar to the females.


Distribution: Japan (Honshu, Shikoku, Kyushu), Korea.

This species occurs on rocks covered by thin soil in forests. The short and obtuse leaves, constricted between limb and sheathing lamina, are characteristic. *P. otaruense* somewhat resembles the present species, but is distinguished by the remarkable marginal cells of its lamellae.

**11. POGONATUM CAPILLARE** (MICHX.) BRID. (Fig. 11, C)

Bryol. Univ. 2: 127 (1827).


Plants medium-sized, glaucous green. Stems 15–20 mm long with 2–3 branches above. Leaves crowded toward stem apex, crisped when dry, erect-spread when moist, lanceolate from a rounded, concave sheathing base, strongly contracted above the shoulder of the sheath, apex narrowly acute and apiculate, limb to 4.5 x 0.7 mm, sheathing base ca. 1.2 mm wide; margin of limb incurved, remotely serrate, teeth large, bistratose, consisting of 6–8 large cells; costa broad, with several small teeth at back. Lamellae ca. 30, 3–6 cells high, each cell taller than broad in cross-section; marginal cells subquadrate or rectangular and shorter than broad, wider than the remaining cells, thick-walled, with papillae on the upper surface. Marginal cells of lamina rounded-quadrate, 12–16 µm, thick-walled, lower cells elongate-hexagonal to rectangular, 30–45 x 8.5–12.0 µm. Seta solitary, 10–15 mm long, ca. 0.17 mm thick, yellowish-red, often flexuose when dry. Capsule suberect, shortly ovoid-cylindric, 2.0–2.5 x 0.8–1.2 mm, mammillose. Peristome teeth 0.25 mm long, acute, pellucid, the central and basal parts of basal membrane brownish. Spores 13–20 µm.

Distribution: Japan (Hokkaido, Honshu), Korea, Soviet Far East, Europe, N.America.

This species is most common on sunny, sandy soil among boulders at higher elevations in northern Japan.

This species is easily distinguished from related taxa such as *P. akitense* and *P. inflexum* by the marginal cells of the lamella which are large, and range from almost square to transversely rectangular in cross-section.
12. *POGONATUM URNIGERUM* (HEDW.) P.BEAUV. (Fig. 11, D)

Prodr.: 84 (1805).

*Polytrichum urnigerum* Hedw., Spec. Musc.: 100, t. 22, f. 5–7 (1801).

Plants medium-sized, brown below, glaucous green above. Stems to 30 mm, with 2–3 fasciculate branches above. Lower leaves ovate-lanceolate, apiculate; upper leaves much larger, appressed or ± homomalous when dry, widely spreading, ± recurved when moist, lanceolate from a widely ovate sheathing base, contracted above the sheath, the apex with an awn, to 6.0 x 0.7 mm, sheathing base ca. 1.2 mm wide, concave; margin of limb ± incurved, coarsely serrate in the upper half, unistratose; costa with several large teeth at back above. Lamellae ca. 50, 4–6 cells high, marginal cells brownish, rounded to ovate, papillose, walls thick. Marginal cells of lamina rounded–quadrate, thick-walled, 8.5–12.0 µm, lower cells rectangular, 35–50 x 9–15 µm. Seta 25–30 mm long, ca. 0.25 mm thick, brown to reddish–brown. Capsule suberect, cylindric, 2.5–3.5 x 1.0–1.5 mm, mamillose. Peristome teeth ca. 0.22 mm long, obtuse, brown. Spores 10–15 µm. Male plants similar to the females.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the N.Hemisphere.

This species is not rare at higher elevations, where it occurs on dry, sunny ground or in rock crevices.

This species is unique in its forked branching and leaves strongly appressed when dry. The leaves are stout and scarcely crisped or incurved when dry, and the sterile plants are similar in appearance to those of *Polytrichum*. The dome-shaped, papillose marginal cells of lamellae are the best distinguishing character.

6. *POLYTRICHUM* HEDW.

Plants mostly robust and growing on earth. Stems simple or sparingly branched, arising from subterranean curved, tomentose rhizomes. Lower leaves small, strongly appressed; upper leaves much larger, mostly appressed when dry and long-lanceolate from a well-defined, membranous, sheathing base, apex acuminate; margin erect or plane, unistratose, coarsely toothed in the limb, rarely entire; costa stout, expanded, often ending in a long, usually coarsely toothed awn, toothed at back above; lamellae green, occupying almost the entire width of the ventral surface of leaves, several cells high, the marginal cells usually differentiated from other cells in cross-section. Laminal cells of limb hexagonal to subquadrate, areolation of sheathing base lax, unistratose, yellowish–brown, the cells elongate, rectangular to sub-linear, thin-walled. Dioicous or autoicous. Perichaetial leaves slightly
differentiated, the sheathing base longer than in stem leaves. Capsule on a long, smooth seta, large, mostly inclined and 4-6-angled, with conspicuous ridges, cubic, usually with a thick apophysis; exothecial cells slightly convex, with or without a central pit over each lumen, stomata abundant on the apophysis; annulus scarcely developed; epiphragm white, united with apices of the incurved peristome teeth. Peristome teeth usually 64, mostly lingulate and obtuse. Spores small to medium-sized, smooth. Calyptra cucullate, felted with numerous long hairs, covering the entire capsule. Perigonia terminal, discoid.

As in *Pogonatum*, the form and size of the marginal cells of lamellae are important in the taxonomy of this genus. The angular capsules are characteristic. When the plants are sterile it is not always easy for beginners to distinguish *Polytrichum* from *Pogonatum*. The closely appressed leaves, not crisped and scarcely incurved, provide a useful distinguishing character.

**Key to the Species (mainly based on Osada, 1966)**

1. Leaf margins entire; margins of limb broad and involute, covering the lamellae
2. Leaf margins serrate (at least in part); margins of limb usually narrow, never covering lamellae

2. Leaf apex cucullate; costa percurrent to shortly excurrent; marginal cells of limb quadrate to rectangular, 1-2 times as wide as long; margins of lamellae nearly entire

1. *P. norvegicum*

2. Leaf apex not cucullate; costa excurrent as a distinct arista; marginal cells of limb narrowly rectangular to vermicular, more than 4 times as wide as long; margins of lamellae crenate

3. Arista of leaf hyaline, rather abruptly narrowed and elongated from an obtuse to subacute leaf apex, usually 1/3-1/2 as long as the limb; median cells of leaf sheath rectangular, (2-)3-5(-6) times as long as wide

5. *P. piliferum*

3. Arista of leaf reddish-brown, gradually narrowed and elongated from an acute to acuminate leaf apex, very short; median cells of leaf sheath narrowly rectangular to linear, 6-20 times as long as wide

6. *P. juniperinum*

4. Capsule with a hypophysis separated from the urn by a distinct constriction; exothecial cells convex on surface, with a pit over each cell lumen

3. *P. commune*

4. Capsule with a hypophysis separated from the urn by a weak constriction; exothecial cells flat, without a pit over the lumen

5. Marginal cells of lamellae in cross-section wider than long, mostly flabellate in outline, larger than other cells, with apices usually truncate to subconvex, rarely shallowly concave; upper walls of marginal cells distinctly thicker than side walls

4. *P. ohioense*

5. Marginal cells of lamellae in cross-section slightly longer than wide, ovate, as large as other cells, with rounded apices; upper walls of marginal cells as thick as side walls
6. Leaf margin 2–4(–5) cells wide in the middle of limb; median cells of leaf sheath (5–)6–12 times as long as wide; urn distinctly longer than wide; peristome teeth with high basal membrane...

6. Leaf margin 5–8 or more cells wide in the middle of limb; median cells of leaf sheath 3–5(–7) times as long as wide; urn slightly longer than wide; peristome teeth with low basal membrane, barely projecting from the mouth.

2. *P. formosum*

1. **POLYTRICHUM NORVEGICUM** HEDW. (Fig. 15, A)


Plants slender, to 50 mm. Leaves appressed when dry, upper leaves lanceolate from an ovate base, apiculate at apex, to 4 x 1.2 mm, limb much longer than the sheathing base, concave, cucullate at apex; margin strongly involute, entire; costa smooth at back. Lamellae 6–8 cells (to 0.17 mm) high, 30–35 at mid-leaf. Lower cells of sheathing lamina elongate-rectangular, 40–50 x 10–15 μm. Border of linear, pellucid cells weakly developed on the shoulder of the sheathing base. Seta 10–20 mm long, straight. Capsule erect to slightly inclined, 4–6-angled, occasionally nearly globose, to 3 x 2 mm, wide-mouthed. Peristome teeth usually 64, lanceolate, scarcely compound, to 0.3 mm long, yellowish. Spore, operculum and calyptra unknown in Japan.

Distribution: Japan (Hokkaido, Honshu), Soviet Far East, Europe, N.America.

This species is very rare in Japan; being known only at or near the summit of Mt. Daisetsu (Hokkaido) and Mt. Tateyama (central Honshu).

2. **POLYTRICHUM FORMOSUM** HEDW.


Plants large. Stems usually 50–100 mm. Lower leaves small, distant, erect-spreading, limb very narrow. Upper leaves crowded, appressed when dry, wide- or erect-spreading and ± recurved, sometimes homomallous when moist, to 15 mm long, limb 0.6 mm wide, linear-lanceolate from a wider oblong sheathing base, aciculate; margin erect, limb coarsely dentate almost throughout, teeth unicellular, much larger than marginal cells; costa distantly dentate at back above, excurrent as a long, coarsely toothed awn. Lamellae 55–60 at middle of limb, 4–6 cells (to 0.08 mm) high, marginal cells rounded, scarcely differentiated from other cells but ± yellowish. Median limb cells rounded-hexagonal, rather thin-walled, 8.5–10.0 μm; cells of sheath sublinear, thin-walled, 65–85 x 7–9 μm. Dioicous or autoicous. Seta 20–50 mm long, 0.3–0.4 mm thick, reddish-brown. Capsule inclined, 4–5 x 2.0–2.5 mm, 4-angled, with a
thick apophysis, exothecal cells without pits. Operculum with a long beak. Peristome teeth ca. 0.2 mm long, rounded-obtuse, yellowish, basal membrane low, brownish. Spores 10-13 \( \mu m \). Calyptra ca. 8 mm long. Male plants similar to the females.

2a. VAR. FORMOSUM (Fig. 16, B)


Lamellae 35-65 \( \mu m \) high with entire margins. Cells of exothecium 20-50 \( \mu m \) long. Dioicus. Chromosome number \( n = 7 \).


**Distribution:** Japan (Hokkaido, Honshu, Shikoku, Kyushu), China, Taiwan, Europe, N.America, Australia, Africa.

This taxon occurs on ground in forests.

Osada (1966) suggested that Japanese plants of *P. formosum* are conspecific with *P. intersedens* Card., but it seems better to treat these plants as a typical variety of *P. formosum*. According to Osada (1966) this variety is more abundant than var. densifolium.

2b. VAR. DENSIFOLIUM (MITT.) OSADA


Lamellae 50-85 \( \mu m \) high with crenulate margins. Cells of exothecium 50-90 \( \mu m \) long. Autoicous. Chromosome number \( n = 14 \).

**Distribution:** Japan (Hokkaido, Honshu, Kyushu), Taiwan, Himalaya.

3. POLYTRICHUM COMMUNE L. EX HEDW. (Fig. 16, C)

Spec. Musc.: 88 (1801).


Plants large. Stems usually 50-100 mm. Upper leaves rather crowded, loosely appressed when dry, erect-spreadin, recurved when moist, ca. 10 mm long, linear-lanceolate from a broad oblong sheathing base, acuminate; margin erect, coarsely dentate throughout the limb, cells of teeth very large, acute, yellowish; margin of sheathing base membranous, entire; costa excurrent as a long, dentate awn, remotely toothed (teeth often in pairs) at back above. Lamellae 45-50 at middle of the limb, margins somewhat crenulate in profile, 5-8 cells (to 0.09
Figure 16.

A. *Pogonatum alpinum* (Hedw.) Roehl var. *alpinum*. a. Moist plant, x1. b. Dry plant, x1. c. Leaves, x7. d. Marginal cells of leaf, x225. e. Cross-section of leaf, x40. f. Lamellae in section, x225. g. Profile of lamella, x225. h. Dry capsule, x7. i. Peristome teeth, x135. [Noguchi 10686]

B. *Polytrichum formosum* Hedw. var. *formosum*. j. Dry plant, x1. k. Leaves, x8. l. Marginal cells of leaf, x250. m. Cross-section of leaf, x48. n. Lamellae in section, x250. o. Profile of lamella, x250. p. Capsule, x8. [Isotype of *P. intersedens* Card.]

C. *P. commune* L. ex Hedw. q. Dry plant, x1. r. Leaves, x8. s. Marginal cells of leaf, x250. t. Cross-section of leaf, x35. u. Lamellae in section, x250. v. Profile of lamella, x200. w. Inner perichaetial leaf, x8. x. Dry capsule, x8. [Noguchi 29838]
POLYTRICHACEAE

mm) high, marginal cells retuse at apex, slightly wider than other cells in cross-section, apical walls ± thicker. Median limb-cells subquadrate, hexagonal or rectangular, thin-walled, 8.5-13 µm; cells of sheath sublinear to elongate-rectangular, thin-walled, 65-120 x 12-16 µm. Dioicus. Seta stout, usually 50-70 mm long, 0.40-0.45 mm thick, brown. Capsule cernuous, 3.5-4.0 x 2-3 mm, 4-angled, constricted below the mouth, with a distinct apophysis, separated from urn by a constriction; exothecial cells with oblong to linear pits. Operculum ca. 1.5 mm high. Peristome teeth ca. 0.4 mm high, obtuse, pale, basal membrane low, brownish. Spores 7-9 µm. Calyptra to 13 mm long. Male plants small, often with successive innovations.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed throughout the world.

This species occurs on moist soil, often along small streams near late snow areas in the subalpine or alpine zones. I consider *P. commune* var. *maximoviczii* Lindb. to be a xerophytic form of *P. commune*.

Osada (1966) reported *P. commune* var. *swartzii* (Hartm.) Moenk. from Japan. The plants are aquatic, and slender with the leaves distant. I consider the material on which Osada’s record is based, to be a form of the type variety.

4. **POLYTRICHUM OHIENSE** REN. & CARD. (Fig. 17, A)


Stems 30-40 mm long, simple. Leaves loosely appressed when dry, wide-spread or ± recurved when moist, to 8 mm long, to 1.5 mm wide at base, lanceolate from a wide-ovate sheathing base, acuminate at apex; margin erect, coarsely toothed in the upper 2/3 of the limb, the teeth unicellular, much larger than marginal cells; costa excurrent as a short brownish toothed awn, coarsely toothed at back above. Lamellae ca. 35 at middle of limb, 4-5 cells (35-60 µm) high; marginal cells brownish, ± cuneiform in profile, truncate at apices, wider than other cells in cross-section. Autoicous or dioicus. Inner perichaetial leaves with very narrow limbs, without lamellae. Seta 30-50 mm long, ca. 0.3 mm thick. Capsule ca. 4 x 2 mm, ovoid, 4-5-angled, with a large apophysis, exothecial cells lacking pits. Operculum 1.2-1.7 mm long. Peristome teeth ca. 0.25 mm long, obtuse, pale; basal membrane low, yellowish. Spores 8-10 µm. Calyptra to 8 mm long. Male plants smaller than the females, the stems with long denuded portions below. Chromosome number n = 14.

Distribution: Japan (Hokkaido, Honshu, Shikoku), Siberia, Europe, N.America.
Figure 17.
A. *Polytrichum ohioense* Ren. & Card.  
   a. Leaves (*a1*, *a2*, dorsal view), x8.  
   b. Marginal cells of leaf, x250.  
   c. Cross-section of leaf, x34.  
   d. Cross-sections of lamellae, x250.  
   e. Profile of lamella, x250.  
   f. Capsule, x8.  
   [Noguchi 14189]

B. *P. longisetum* Sw. ex Brid.  
   g. Leaves, x8.  
   h. Marginal cells of leaf, x250.  
   i. Cross-section of leaf, x34.  
   j. Lamellae in section, x250.  
   k. Profile of lamella, x250.  
   l. Capsule, x8.
This species resembles *P. formosum* in some respects. Both male and female shoots sometimes arise as innovations from a single discoid head, but in other cases successive male shoots develop from the preceding year's male heads. However, both the male and female shoots are often found separately, as clearly shown by Osada (1966), so that autoicous and dioicous forms seem to exist.

5. **POLYTRICHUM PILIFERUM** SCHRAD. EX HEDW. (Fig. 18, A)

Spec. Musc.: 90 (1801).

Plants medium-sized. Stems simple, usually 15-20 mm long, denuded at base. Upper leaves erect and strongly appressed when dry, erect-spreading when moist, lanceolate from an oblong base, ca. 5.50 x 0.45 mm, the limb slightly longer than the sheath, cuculate and canaliculate; margins entire, widely involute, covering almost all the lamellae; costa smooth at back, excurrent as a very long, hyaline, dentate, piliferous tip. Lamellae 25-35 at middle of limb, margins mammillose in profile due to projection of each cell, 7-8 cells (ca. 0.1 mm) high, marginal cells yellowish, flask-shaped or oblong in cross-section, apical walls strongly thickened, marginal cells of involute limb irregular, transversely elongate, with very thin, membranous walls, becoming thicker-walled and transversely sublinear toward the base; median cells elongate-rectangular, 40-60 x 8-12 μm. Dioicous. Inner perichaetial leaves similar to vegetative leaves but with margins less involute and less mammillose. Seta 20-25 mm long, 0.30-0.35 mm thick, reddish-brown. Capsule inclined, 2.2-3.2 x 1.0-1.5 mm, 4-5-angled, constricted between urn and the thick apophysis, exothecial cells with oblong to linear pits. Operculum with a long beak, ca. 1 mm long. Peristome teeth ca. 0.22 mm high, obtuse, with yellowish, vertical lines, basal membrane low. Spores 8-10 μm. Calyptra ca. 4.5 mm long. Male plants similar to the females.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the world.

This species occurs on exposed sandy soil in the subalpine and alpine regions. Also reported by Nakajima (1956) at 800 m alt. in Kinki district.

This species is characterised by the glaucous plants when dry, caused by the hyaline, elongate awns, which are almost as long as the limb. The leaf margins are widely involute, covering most of the lamellae, as in *P. juniperinum*. The capsules are rather small, compared with those of other members of *Polytrichum*. The short cells of the sheathing lamina are also a distinguishing character.

6. **POLYTRICHUM JUNIPERINUM** WILLD. EX HEDW. (Fig. 18, B)

Spec. Musc.: 89, t. 18, f. 6-10 (1801).
Figure 18.
A. *Polytrichum piliferum* Hedw.  
a. Dry plant, x1.  
b. Leaves (b2, dorsal view), x10.  
c. Cells at leaf margin, x180.  
d. Cross-section of leaf, x48.  
e. Lamellae in section, x250.  
f. Profile of lamella, x200.  
g. Inner perichaetial leaf, x10.  
h. Capsule, x8. [Noguchi 23515]

B. *P. juniperinum* Willd. ex Hedw.  
i. Dry plant, x1.  
j. Leaves, x10.  
k. Cross-section of leaf, x40.  
l. Cross-section of leaf, x250.  
m. Profile of lamella, x250.  
Plants large. Stems usually 70 mm or longer, simple, leaves crowded. Upper leaves appressed when dry, erect-spreading and ± recurved when moist, linear-lanceolate from oblong sheathing base, to 7 mm (or longer), canaliculate, apices cucullate; margin of the limb entire, widely involute, almost entirely covering the lamellae; costa dentate at back above, excurrent as a long coarsely toothed awn. Lamellae ca. 35, margins crenate in profile, 4-7 cells (ca. 55 µm) high at middle of limb; marginal cells of lamellae ovate, each with a large apical papilla or flask-shaped in cross-section, longer than other cells, apical walls thick. Cells of marginal portion of limb which covers the lamellae transversely and narrowly rectangular. Dioicus. Seta solitary, 40-70 mm long, reddish-brown. Capsule inclined, 3-5 x 2-3 mm long, 4-, rarely 5-angled, with a thick apophysis, exothecial cells with linear pits. Operculum with a short beak. Peristome teeth to 0.22 mm high, obtuse. Spores. 8-10 µm. Calyptra to 10 mm long. Male plants similar to the females.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East, Caucasus, Europe, Greenland, N. and S.America.

This species occurs usually on humus under subalpine coniferous forests, in rock-crevices, or in bogs.

According to Osada (1966), var. strictum (Menz. & Brid.) Nyl. & Sael. is characterised by the white tomentum densely covering the greater part of stem, by the short limb which is slightly shorter than the sheathing base, and by the smaller capsule.

7. POLYTRICHUM LONGISETUM SW. EX BRID. (Fig. 17, B)


Stems usually to 30 mm long. Leaves gradually lanceolate from an oblong base, to 8 mm long, with long, dentate awns, the area between the lamellae and the margin of the limb broader than in related species, being 8-12 cells wide, cells hexagonal, thin-walled. Lamellae 30-40, 5-7 cells (to 55 um) high; marginal cells flat or slightly inflated in profile, round as large as other cells, thin-walled. Seta usually to 50 mm, rarely longer, reddish-brown. Capsule 4-5-angled, with a small apophysis, 3.5-4.0 x 2.0 mm. Peristome teeth to 0.25 mm long. Spores 18-20 µm, finely papillose.

Distribution: Japan (Hokkaido, Honshu, Shikoku), China, Soviet Far East, Europe, Greenland, N.America, New Zealand.

This species occurs on soil under shrubs in the alpine zone.

The description of sporophyte was based on the specimens from Czechoslovakia. The lamellae seem to be higher in Japanese than in European plants.
FISSIDENTACEAE

FISSIDENTACEAE

FISSIDENS HEDW.

Stems erect or suberect, simple or sparsely branched, radiculose at base. Leaves distichous, complanate, remote to overlapping, lingu­late, oblong, lanceolate or sublinear, asymmetric, round to narrowly acute, the lower portion of adaxial side forming two vaginant laminae; margin plane, entire, crenate, serrate or erose–dentate, often bordered by narrow, elongate cells; costa single, mostly stout, rarely absent. Laminal cells usually unistratose, usually isodiametric, plane to bulging, smooth or papillose; cells of vaginant lamina similar to those of lamina, but often less convex. Dioicous, phyllodioicous, synoicous or autoicous. Perichaetium terminal or lateral. Seta straight or flexuose. Capsules erect, inclined or pendulous, symmetric to asymmetric, occasionally slightly curved. Operculum usually long-rostrate; annulus differentiated or absent. Peristome single, teeth 16, deeply forked, reflexed when dry and strongly incurved when moist (in deoperculate capsules). Spores usually medium-sized, rarely large. Calyptra cucullate or mitrate–rostrate.

Key to the Species (mainly based on Iwatsuki and Suzuki, 1982)

1. Leaves without costa, leaf cells very lax and thin-walled ........
   1. F. hyalinus
2. Leaves with costa, areolation various ................................ 2
   2. Protonema persistent, plants very small, almost stemless .... 4.
      F. protonemaecola
2. Protonema not persistent, plants of various sizes ............ 3
3. Leaves soft and flaccid, cells of apical lamina lax and large, elongate
   19-45(-54) µm long, thin-walled .................................... 4
3. Leaves firm, cells of apical lamina dense, isodiametric, usually less
   than 15 µm long, rarely more than 20 µm long (if more than 20 µm
   long, then vaginant lamina markedly unequal at upper end) ... 5
4. Leaves densely arranged to the base of stem, always overlapping,
   leaf margin without border or weakly bordered with 1-2 rows of
   elongate cells, borders always 1 cell thick in cross-section,
   rhizautoicous ......................................................... 2. F. bogoriensis
4. Leaves laxly arranged, not overlapping, leaf margin with distinct
   border all around, composed of linear, thick-walled cells, borders
   2-3 cells thick in cross-sections, dioicous? .........................
   3. F. splachnobryoides
5. Leaves at least partly bordered by elongate cells ................ 6
5. Leaves not bordered by elongate cells ............................ 21
6. Border present on apical, dorsal and vaginant laminae ....... 7
6. Border limited to the vaginant laminae (often only on perichaetial
   leaves) ................................................................. 14
7. Capsules curved, asymmetric ........................................ 8
7. Capsules straight to almost straight, symmetric ................ 9
8. Cells of apical lamina larger, 16-25-(30) µm long, upper end of
vaginant laminae usually very unequal .... 9. *F. beckettii*

8. Cells of apical lamina smaller, 7-14 \( \mu m \) long, vaginant laminae almost equal to slightly unequal .......... 8. *F. tosaensis*

9. Archegonia and setae lateral or terminal, leaves of lateral perichaetia much smaller than stem leaves .... 5e. *F. bryoides* var. *lateralis*

9. Archegonia and setae always terminal, perichaetial leaves as large as, or much larger than other stem leaves ............... 10

10. Cells at base of vaginant laminae much larger (up to 52 \( \mu m \) long) than those of apical lamina (12-22 \( \mu m \) long), axillary hyaline nodules distinct .......... 7. *F. zollingeri*

10. Cells at base of vaginant laminae slightly larger (up to 27 \( \mu m \) long) than those of apical lamina (7-14(-17) \( \mu m \) long), axillary hyaline nodules not or weakly differentiated ......... 11

11. Sterile and fertile stems often differentiated, inflorescence rhizoo- toicous, perichaetial leaves much larger than lower leaves ... 12

11. Sterile and fertile stems not differentiated, inflorescence various, perichaetial leaves not well differentiated .......... 13

12. Leaf apex narrowly acute, border distinct on sterile stems ... .......... 10. *F. strictulus*

12. Leaf apex acute, border very weak to almost lacking on sterile stems ... 5c. *F. bryoides* var. *esquirolii*

13. Plants aquatic, border usually very distinct on apical lamina, reddish or yellowish on older leaves (especially so when treated with KOH solution), base of dorsal lamina often weakly decurrent, spores larger, 16-23(-27) \( \mu m \) in diam. ............... 6. *F. geppii*

13. Plants not aquatic, border weak to distinct, usually colorless, base of dorsal lamina not decurrent, spores smaller, 10-19(-21) \( \mu m \) in diam. ............... 5. *F. bryoides*

14. Leaf cells smooth or slightly mammillose, in rare cases some marginal cells of apical lamina slightly elongate as an incomplete border .......... 15

14. Leaf cells papillose, marginal cells of apical laminae not differentiated .......... 16

15. Leaves ovate to oblong-lanceolate, spores larger, 22-32 \( \mu m \) in diam. ............... 11. *F. diversifolius*

15. Leaves lanceolate to linear-lanceolate, spores smaller, less than 19 \( \mu m \) (rarely to 21 \( \mu m \)) in diam. .... 5c. *F. bryoides* var. *esquirolii*

16. Leaf cells highly mammilllose or with 1-2 small papillae .... 17

16. Leaf cells with 4-6 papillae ............... 19

17. Cells of apical lamina larger, 10-14 \( \mu m \) long, each with a small indistinct papilla ............... 16. *F. schwabei*

17. Cells of apical lamina smaller, less than 9 \( \mu m \) long, highly mammilllose or each with 1-2 small papillae ............... 18

18. Leaf cells highly mammilllose, usually with 1 (rarely 2) small papilla, perigonia terminal, setae smooth ............... 17. *F. crenulatus* var. *elmeri*

18. Leaf cells slightly mammilllose, usually with 1-2 indistinct papillae, perigonia in axils of leaves, seta more or less scabrous ............... 15. *F. pseudohollianus*

19. Seta more or less scabrous, perigonia in axils of leaves ............... 14. *F. hollianus*
19. Seta always smooth, perigonia terminal on short branches at the base of female stems ........................................ 20
20. Leaves smaller and laxly arranged near base, upper leaves oblong-lanceolate, with round to obtuse (rarely acute) apices, costa of upper and perichaetial leaves ceasing below apex (rarely percurrent) ........ 13. F. microcladus
20. Leaves densely arranged to base of stem, lanceolate to narrowly lanceolate, leaf apex acute to narrowly acute, costa of upper and perichaetial leaves percurrent to shortly excurrent ....

........................................ 12. F. obscurirete
21. A few rows of cells at margin of apical lamina lighter in color and smooth, markedly differentiated from inner cells as a paler band ........................................ 22
21. Marginal cells not as above, usually not differentiated from inner cells, or if differentiated, then appearing darker in color because in more than 2 layers ........................................ 24
22. Small to medium-sized plants, shoots less than 10 mm long, margin of apical lamina serrulate, cells of vaginant laminae with 3-4 papillae at corners .............. 36. F. adelphinus
22. Large plants, shoots more than 10 mm long, margin of apical lamina irregularly dentate to coarsely serrate in apical region, cells of vaginant laminae slightly mammillose, papillae absent or indistinct ........................................ 23
23. Cells of apical lamina 6-10 µm long, apical lamina 1-2 cells thick, pale margin of leaves usually quite distinct ........ 38. F. cristatus
23. Cells of apical lamina 13-18(-22) µm long, apical lamina always 1 cell thick, pale margin slightly to moderately differentiated ........ 39. F. adianthoides
24. Leaf margin dark in color, being 2-4 cells thick ........ 41. F. perdecurrens
24. Leaf margin not differentiated from other laminal cells ... 42. F. grandifrons
25. Plants larger, stems usually 4-9 cm long, leaf apex distinctly and irregularly toothed, axillary hyaline nodules not differentiated ....

........................................ 37. F. nobilis
25. Plants smaller, stems 0.5-2.0 cm long, leaf apex crenulate but not toothed, axillary hyaline nodules very distinct .... 27. F. javanicus
26. Plants aquatic, leaf base distinctly decurrent .... 27. F. javanicus
26. Plants not aquatic, leaf base not decurrent ....... 29. F. javanicus
27. Leaves more or less crispate when dry, apical lamina 1 cell thick (rarely 2 cell layers near costa), costa clearly defined, surface cells of costa at median part distinctly elongate, often papillose at upper end ........ 40. F. geminiflorus var. nagasakinus
27. Leaves almost straight when dry, apical lamina 2-6 cells thick, costa obscure, surface cells of costa at median part slightly elongate, smooth ................. 28. F. geminiflorus var. nagasakinus
28. Leaf apex acute, cells of apical lamina weakly mammillose, not calciphilous ........................................ 41. F. perdecurrens
28. Leaf apex obtuse to round, cells of apical lamina almost smooth, calciphilous ........................................ 42. F. grandifrons
29. Laminal cells smooth or slightly mammillose ............... 30
29. Laminal cells papillose or distinctly mammillose .......... 36
30. Plants very small, shoots less than 1.5 mm long ........ 31
30. Plants small to fairly large, shoots more than 2.3 mm long. 32
31. Plants budlike, calyptra distinctly scabrous by papilla at upper end of each surface cell, widely distributed in Japan............. 18. F. closteri subsp. kiusiuensis
31. Plants not budlike, calyptra smooth, recorded only from the Bonin Isls. 24. F. flabellulus
32. Small plants, stems 2.3-9.0 mm long including leaves . . . 33
32. Medium to large plants, stems 14-74 mm long including leaves .............................................. 35
33. Costa often bent at junction of vaginant lamina, base of dorsal lamina slightly decurrent on stem, laminal cells thin-walled, seta longer, 2.8-4.2 mm long ............ 21. F. ganguleei
33. Costa straight to almost straight, base of dorsal lamina not decurrent, laminal cells thick-walled, seta shorter, 0.8-2.5 mm long ... 34
34. Cells of apical lamina thick- to very thick-walled, 8-13 µm long, margin of lamina often 2 cells thick, dioicous, recorded from Ryukyu Isls. 20. F. crassinervis
34. Cells of apical lamina moderately thick-walled, 12-22 µm long, lamina always 1 cell thick, synoicous (polyoicous), widely distributed in western Japan .............. 19. F. laxus
35. Leaf apex round to obtusely acute, more or less mucronate, cells of apical lamina 13-18-(22) µm long, walls clear, growing in moist habitats ........................................ 32. F. areolatus
35. Leaf apex obtuse to obtusely acute, cells of apical lamina 8-13(-16) µm long, walls obscure, growing in wet habitats .. 33. F. obscurus
36. Cells of vaginant laminae with 3-4 papillae . 36. F. adelphinus
36. Cells of vaginant laminae with one papilla in center or mamilllose ............................................. 37
37. Small to very small plants, shoots less than 2.7 mm long, margin of vaginant laminae distinctly serrate, cells of apical lamina distinctly unipapillose ........................................... 38
37. Small to large plants, shoots more than 2.7 mm long, margin of vaginant laminae almost entire to serrulate or crenulate, cells of apical lamina multipapillose or mamilllose ............. 39
38. Margin of vaginant laminae distinctly and irregularly spinose-serrate, costa ceasing 3-5 cells below apex, cell walls of apical lamina obscure .................. 22. F. papillosus
38. Margin of vaginant laminae evenly serrate, costa percurrent to shortly excurrent, cell walls of lamina clear .. 23. F. serratus
39. Seta lateral or basal, perichaetial leaves much smaller than stem leaves .......................................... 35. F. taxifolius
39. Seta terminal, perichaetial leaves not differentiated .......... 40
40. Axillary hyaline nodules very prominent ....................... 41
40. Axillary hyaline nodules not or weakly differentiated .... 42
41. Cells of apical lamina multipapillose ..................... 26. F. subangustus
41. Cells of apical lamina mamilllose ......................... 25. F. zippelianus
42. Medium-sized to large plants, shoots 15-50 mm long, 3.5-7.5 mm wide, costa percurrent ................. 34. F. plagiochiloides
42. Small to medium plants, shoots 2.5-14.0 mm long, 1.9-3.5(-4.7) mm wide, costa ceasing below apex ............ 43
43. Leaves crispate when dry, leaf apex widely acute, often mucronate
43. Leaves not crispatate when dry, leaf apex narrowly acute or obtuse to obtusely acute ........•.......•.....•.• 44

44. Cells of apical lamina smaller, 8-10(-12) μm long, distinctly mammillose, cell walls indistinct, male plants very small, growing in vaginant laminae of female plants . 30. F. gymnogynus

44. Cells of apical lamina larger, 13-16(-17) μm long, more or less mammillose, cell walls distinct, male plants similar to female plants ..... 31. F. osmundoides

45. Leaf apex narrowly acute, cells of apical lamina larger, 8-14 μm long . . . . . . . . . • . . • . . . . . . . . 28. F. mangarevensis

45. Leaf apex obtuse to obtusely acute, cells of apical lamina smaller, 5-8 μm long .................. 29. F. formosanus

1. FISSIDENS HYALINUS HOOK. & WILS. (Fig. 19, A)

In Hook., J. Bot. 3: 89, f. 2 (1840).


Plants soft, pale-green, loosely gregarious. Sterile shoots to 5 mm long, with ca. 5 pairs of leaves, ca. 3 mm wide when moist; stems without central strand. Leaves narrowly oblong to oblong-lanceolate, broadly acute at apex; upper leaves usually to 2 mm long; costa absent. Dorsal lamina narrowed toward the base and slightly decurrent; margin entire, occasionally crenulate near apex, usually with an indistinct border throughout of a single row of linear cells; laminal cells very lax; median cells hexagonal or rectangular, 40-60 x 25-35 μm, thin-walled; lower cells elongate-hexagonal, 55-65 x 20-30 μm. Vaginant laminae small, reaching to 1/3 to 1/2 the leaf-length; cells similar to those of dorsal lamina. Rhizautoicous. Perichaetium terminal on stem, the perichaetal leaves scarcely differentiated. Seta 1-2 mm long. Capsule erect, oblong-ovoid, with a wide mouth, 0.35-0.40 x 0.25-0.30 mm, greenish brown when young. Operculum rostrate. Peristome teeth ca. 0.2 mm long, spirally thickened above. Spores ca.10 μm. Calyptra campanulate. Perigonia minute, with 1-2 pairs of leaves.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu, Bonin Isls.), Taiwan, western Himalaya, eastern N.America.

This species occurs on newly eroded soil or rocks covered with thin soil in shade.
This species is remarkable in its ecostate leaves with very lax areolation.

2. FISSIDENS BOGORIENSIS FLEISCH. (Fig. 19, B)

Musci Fl. Buitenzorg 1: 22, f. 2 (1904).

Plants minute, green, in loose clusters. Leaves in 2-6 pairs, lanceolate, acuminate at apices; upper leaves much larger than lower, to 1.0 x 0.2 mm; costa yellowish, shortly excurrent, percurrent or often ceasing several cells below leaf apex. Dorsal lamina tapered downwards, extending to, or ending a little above, the leaf base; margin ±yellowish, entire; cells of dorsal and apical laminae lax, oblong-hexagonal, slightly convex, 12-16 x 9-12 µm, thin-walled, slightly smaller towards the leaf margin. Vaginant lamina extending to mid-leaf; cells elongate-hexagonal, 30-40 x 9-13 µm, narrowed towards leaf margin (marginal cells in 1-2 rows, narrow and short). Autoicous. Perichaetium terminal; perichaetal leaves similar to the upper stem leaves. Seta 2-3 mm long, brown. Capsule inclined, ovoid, slightly asymmetric, 0.15-0.35 x 0.17-0.25 mm. Operculum long-rostrate, ca. 0.35 mm long. Peristome teeth ca. 0.2 mm long, spirally thickened above. Spores 9-12 µm. Perigonium on a branch from the basal portion of the perichaetial shoot, ca. 0.35 mm long; inner leaves linear from ovate bases, ca. 0.3 mm long.


Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu, Bonin Isls.), Taiwan, Philippines, Java.

3. FISSIDENS SPLACHNOBRYOIDES BROTH. (Fig. 20, A)


Shoots with ca. 15 pairs of leaves, ca. 3 mm wide. Leaves not imbricate, narrowly oblong, broadly acute, to 2.5 x 0.4 mm; costa ending far below leaf apex. Dorsal lamina gradually tapering downwards; margin entire throughout; bordered by 2 rows of linear cells; median cells hexagonal or oblong-hexagonal, thin-walled, 20-35 x 9-12 µm; upper cells hexagonal. Vaginant laminae extending to mid-leaf; bordered by 3-4 rows of linear cells; median cells as in dorsal lamina. Dioicous? No sporophytes were found in Japan.

Distribution: Japan (Ryukyu), China, Taiwan. Widely distributed in tropical Asia.

4. FISSIDENS PROTONEMAECOLA SAK. (Fig. 20, B)


Protonema persistent. Plants scattered, very small. Stems very short; central strand lacking. Leaves in 1 or 2 pairs, upper or perichaetal leaves much larger, ovate-lanceolate, acute, 0.2-0.5 mm long; costa very weak. Dorsal lamina small, toward the base suddenly tapered, ending far above the leaf base; margin ±crenate due to bulging cells
Figure 19.

A. *Fissidens hyalinus* Hook. & Wils.  
  b. Median cells of leaf, x175.

B. *F. bogoriensis* Fleisch.  
  c. Plants, x15.  
  d. Sterile plant, x15.  
  e. Leaves, x34.  
  f. Cells at leaf apex, x250.  
  g. Cells at margin of dorsal lamina, x250.  
  h. Cells at margin of vaginant lamina, x250.  
  [c, isotype of *F. closteroides* Iwats. from Philippines; d-h, Shin 16320]
especially towards apex; laminal cells very lax, thin-walled, hexagonal. Vaginant laminae large; cells near apex hexagonal, 20–25 x 12–18 µm, at middle rhomboid-hexagonal to rectangular, 35–45 x 10–15 µm. Rhizautoicous. Seta terminal, to 2 mm long, ca. 0.65 mm thick. Capsule erect, ovoid-ovoid, to 0.45 x 0.30 mm. Operculum convex, with short beak, to 0.3 mm long. Peristome teeth to 0.2 mm long. Spores 10–13 µm, almost smooth. Calyptra conic to 0.35 mm long. Perigonium ca. 0.3 mm long.


Distribution: Japan (Honshu, Kyushu, Izu-shichito), Taiwan.

This species occurs on rocks, boulders, soil and tree base in shade.

5. **FISSIDENS BRYOIDES** HEDW.

Spec. Musc.: 153 (1801).

Key to the Varieties of *F. bryoides* (based on Iwatsuki and Suzuki, 1982)

1. Cells of apical lamina small (4–10 µm long) and mammillose, dioicous? .......................... 5d. var. *schmidii*
   1. Cells of apical lamina large (7–14 (~17) µm long); usually smooth but occasionally more or less mammillose, monoicous ............ 2
   2. Female inflorescences (and setae) lateral, rarely terminal, perichaetial leaves much smaller than stem leaves .............. 2
      2. Female inflorescences (and setae) always terminal, perichaetial leaves not well differentiated ................. 3
   3. Central strand weakly differentiated, autoicous, male inflorescences budlike (rarely naked), found in axils of stem leaves ........ 5a. var. *bryoides*
   3. Central strand lacking, synoicous (often polyoicous), or rhizautoicous, male inflorescence otherwise .................. 4
   4. Rhizautoicous, male inflorescences usually budlike at the base of female stems; sterile, female and male stems often connected at their base by rhizoids ............ 5c. var. *esquirolii*
   4. Synoicous, often polyoicous, antheridia mixed with archegonia and terminal on stems or branches, but often budlike in leaf axils (rarely at base of branches), sometimes more than two female branches and a few perigonia in the same leaf axil ...... 5b. var. *ramosissimus*

5a. VAR. **BRYOIDES**

Leaves in 3–20 pairs, lanceolate to oblong-lanceolate, acute, widest near the middle; border distinct, extending to the leaf apex; costa percurrent or shortly ecurrent. Median laminal cells hexagonal or subquadrate, 8–15 µm. Autoicous. Perichaetium terminal. Perigonium
Figure 20.
A. *Fissidens splachnobryoides* Broth.  
  a. Plant, x15.  
  b. Sterile plant, x15.  
  c. Leaves, x34.  
  d. Cells at leaf apex, x250.  
  e. Cells at margin of dorsal lamina, x250.  
  f. Cells at margin of vaginant lamina, x250.  
  [Iwatsuki & Suzuki 2667]

B. *F. protonemaecola* Sak.  
  g. Plant, x50.  
  h. Cells at upper part of leaf, x225.  
  i. Mouth of dry capsule, x90.  
  j. Male inflorescences, x50.  
  k. Protonema, x225.  
  [Noguchi 9421]
small, axillary.

Distribution: Japan (Hokkaido, Honshu). Widely distributed in the N.Hemisphere.

5b. VAR. RAMOSSISSIMUS THÉR.


Leaves in 2-9 pairs; upper leaves much larger, to 1.00 x 0.23 mm, narrowly lanceolate, acute to acuminate; costa ending near leaf apex. Dorsal lamina with margin crenate above, bordered by 1-2 rows of linear cells; median cells hexagonal, 10–12 µm, pellucid, walls very thin. Vaginant laminae reaching mid-leaf, median and marginal cells as in dorsal lamina. Autoicous or polyoicous. Perichaetium terminal; seta to 2.5 mm long. Capsule suberect, obovate, ca. 0.3 x 0.2 mm. Peristome teeth ca. 0.1 mm long. Spores 10–15 µm. Perigonium small, with 4-5 pairs of leaves; inner perigonal leaves to 0.35 mm long; vaginant lamina large, rounded, dorsal and apical lamina small.

Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), Taiwan, China.

5c. VAR. ESQUIROLII (THÉR.) IWATS. & SUZUKI (Fig. 21, A)

J. Hattori Bot. Lab. 51: 361, pl. 9 (1982).


Leaves in 3-4 pairs (6-7 pairs in sterile shoots); upper leaves lanceolate, acute, to 1.50 x 0.25 mm. Dorsal lamina extending to leaf insertion or slightly decurrent; margin serrulate throughout, scarcely bordered; costa extending to leaf apex; laminal cells hexagonal, thin-walled, hyaline; median cells of dorsal and apical lamina 10–12 µm. Vaginant laminae extending to mid-leaf; cells slightly larger than those of dorsal lamina; marginal cells narrower and longer. Rhizautoicous. Perichaetium terminal; seta ca. 1.5 mm long, yellowish. Capsule erect, oblong, ca. 0.25 x 0.15 mm. Operculum ca. 0.17 mm long. Peristome teeth ca. 0.12 mm long. Perigonium small; leaves in 2-3 pairs.

Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), Taiwan, China.
Figure 21.
A. *Fissidens bryoides* var. *esquirolii* (Thér.) Iwats. & Suzuki.  
a. Plant, x34.  
b. Sterile plant, x34.  
c. Cells at leaf apex, x385.  
d. Cells at margin of dorsal lamina, x385.  
e. Cells at margin of vaginant laminae, x385.  
[Yamamoto 2815]

B. *F. bryoides* var. *schmidii* (C.Muell.) Chopra & Kumar.  
f. Plant, x15.  
g. Leaves, x34.  
h. Cells at leaf apex, x250.  
[Shin 16004]

C. *F. bryoides* var. *lateralis* (Broth.) Iwats. & Suzuki.  
i. Plant, x12.  
j. Leaf, x23.  
k. Cells at leaf apex, x250.  
[Holotype of *F. lateralioides* Okam.]
5d. VAR. *SCHMIDII* (C.MUELL.) CHOPRA & KUMAR (Fig. 21, B)


Leaves in 10-28 pairs, crowded, narrowly oblong, to 1.30 x 0.35 mm; costa yellowish, percurrent. Dorsal lamina with margin crenulate above; border yellowish, of one cell row, ending several cells below the leaf apex; cells pellucid, mamilllose, walls thin, slightly flexuose; median cells hexagonal to rectangular, 5-8 µm. Vaginant laminae extending to about mid-leaf; bordered by 2-3 rows of yellowish cells, median cells slightly larger than in dorsal lamina. Dioicous. No sporophytes were found in Japan.

Distribution: Japan (Honshu, Shikoku, Kyushu), India, Pakistan, Sri Lanka, Philippines, Java, New Guinea.

In Japan this species occurs in the limestone areas.

5e. VAR. *LATERALIS* (BROTH.) IWATS. & SUZUKI (Fig. 21, C)


Leaves to 10 pairs, narrowly oblong-lanceolate; costa extending to leaf apex or shortly excurrent. Leaf margins distinctly bordered by 2 rows of linear cells; median cells of dorsal lamina rhomboid-hexagonal, 8-12 µm, ± thick-walled. Vaginant laminae extending to, or slightly beyond mid-leaf; cells plane, ± larger than those of dorsal lamina. Autoicous. Perichaetium lateral, leaves small. Perigonium small, usually axillary.


Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), Korea, Taiwan.

6. *FISSIDENS GEPPII* FLEISCH. (Fig. 22, A)

Musci Fl. Buitenzorg 1: 26 (1904).

Figure 22.

A. *Fissidens geppii* Fleisch.  
- b. Leaves, x34.  
- c. Cells at leaf apex, x250.  
- d. Cells at margin of dorsal lamina, x250.  
- e. Cells at margin of vaginant lamina, x250.  
  [Isotype of *F. higoensis* Sak.]

B. *F. zollingeri* Mont.  
- f. Plant, x15.  
- g. Leaves, x34.  
- h. Cells at leaf apex, x250.  
  [Shin 16792]

C. *F. beckettii* Mitt.  
- i. Plants, x15.  
- j. Sterile plant, x15.  
- k. Leaves, x34.  
- l. Cells at leaf apex, x250.  
- m. Cells at margin of dorsal lamina, x250.  
- n. Median cells of vaginant lamina, x250.  
- o. Capsule, x34.  
  [NICH 99440]
Plants small. Shoots to 10 mm long, pale green. Leaves in 10-15 pairs, narrowly oblong, acute at apex, to 2.5 x 0.5 mm; costa shortly excurrent. Dorsal lamina narrowed toward base, shortly decurrent; margin entire, distinctly bordered by linear cells, border 2-3 cells thick and 1-2 cells wide in the upper half and 3 or more cells wide in the lower half; median cells hexagonal or subquadrate, 5-8 µm. Vaginant lamina extending 1/2 to 2/3 of leaf length. Synoicous. Perichaetium terminal. Seta 5-7 mm long. Capsule erect, to 1 mm long. Operculum conic, rostellate. Peristome teeth to 0.3 mm long, spirally thickened above. Spores ca. 20 µm, smooth. Calyptra campanulate.


Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito), Korea, Taiwan, India, Sumatra, Java, Borneo.

7. **FISSIDENS ZOLLINGERI** MONT. (Fig. 22, B)


*F. xiphioides* Fleisch., Hedwigia 38(Beibl.): (125), (1899).

Stem to 3 mm long, with leaves to 2 mm wide. Leaves in 4-7 pairs, crowded; upper leaves narrowly oblong, to 1.2 x 0.3 mm, acute, often cuspidate at apices; costa stout, yellowish, percurrent, slightly flexuose above. Apical lamina bordered by 1-2 rows of linear cells, confluent at apex of costa; median cells, hexagonal, thin-walled, 15-20 x 12-15 µm, toward leaf margin smaller. Vaginant lamina extending to mid-leaf, bordered by 2-3 rows of linear cells; median cells similar to dorsal lamina, longer toward leaf base. Synoicous. Perichaetium terminal. Seta 2.0-3.3 mm long. Capsule erect, 0.4-0.9 mm long. Operculum rostellate, to 0.7 mm long. Peristome teeth to 0.25 mm long. Spores 13-18 µm. Calyptra campanulate.

Exsiccati: Fissidentaceae Asiaticae 2: 19 (1980), as *F. xiphioides*.

Distribution: Japan (Ryukyu). Widely distributed in tropical Asia, Pacific Isls., S.America.

8. **FISSIDENS TOSAENSIS** BROTH. (Fig. 23)


Fertile shoots small, with leaves in 2-6 pairs; sterile shoots to 5 mm long, including leaves ca. 2.5 mm wide, with 6-8 pairs of leaves.
Figure 23.
*Fissidens tosaensis* Broth.  

a. b. Plants, x10.  
c. Leaves, x35.  
d. Cells at leaf apex, x250.  
e. Median cells of vaginant lamina, x250.  
f. Upper cells of vaginant lamina, x250.  
g. Cells at leaf base, x250.  
h. Peristome teeth, x250.  
i. Axillary perigonium, x23.  
j. Perigonial leaves, x35.  

[a, c-j, Noguchi 15360; b, isotype of *F. tosaensis* Broth.]
Leaves of fertile shoots lanceolate, narrowly acute or shortly acuminate, to 1.5 x 0.4 mm; costa shortly excurrent. Dorsal lamina narrowed downward, ending at leaf base; margin entire, or often partially crenulate near apex, border of 1 (upper) or 2 (lower) rows of linear cells; median cells hexagonal, 8-12 µm, thin-walled. Vaginant laminae extending to mid-leaf; bordered by 3-4 rows of linear cells, median cells larger than in dorsal lamina, longer toward leaf base, to 17-30 x 6-10 µm. Autioicus, synoicus, or rhizautoicus. Perichaetium terminal or lateral. Seta 2.5-9.0 mm long, 0.05-0.09 mm thick, reddish, flexuose. Capsule suberect, inclined or pendulous, oblong or ovate, curved and asymmetric, 0.25-0.70 x 0.15-0.45 mm, with indistinct apophysis, reddish. Operculum long-conic, ca. 0.3 mm long. Peristome teeth ca. 0.25 mm long, spirally thickened above. Spores 10-15 µm, smooth. Calyptra mitrate.


Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), China, Taiwan.

9. FISSIDENS BECKETTII MITT. (Fig. 22, C)


Plants very small. Shoots to 1.7 mm wide. Leaves of fertile shoots to 5 pairs, oblong to lanceolate; apex narrowly acute; costa extending to leaf apex or shortly excurrent; dorsal lamina with margin serrulate above, entire below, bordered by 1 row (above) or 2 rows (below) of linear cells; median cells oblong-hexagonal, 16-22 x 8-12 µm, thin-walled, large below. Vaginant laminae extending to mid-leaf, bordered by 3-5 rows of linear cells, median cells longer than those of dorsal lamina, thin-walled. Longest sterile shoot with ca. 10 pairs of leaves. Rhizautoicus. Seta terminal, 2.3-3.5 mm long. Capsule inclined, ovoid, curved and asymmetric, 0.25-0.35 x 0.35 mm. Operculum long-rostrate, ca. 0.35 mm long. Peristome teeth ca. 0.25 mm long. Spores 13-18 µm. Calyptra campanulate, ca. 0.3 mm long.

Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu), China, Nepal, India, Sri Lanka, Burma.

10. FISSIDENS STRICTULUS C.MUELL. (Fig. 24)


Plants very small. Fertile plants subsessile, with 2-3 pairs of leaves (sterile shoots ca. 2 mm long, with ca. 10 pairs); upper leaves much longer than lower, to 0.70 x 0.15 mm, narrowly lanceolate (leaves
Figure 24. *Fissidens strictulus* C.Muell.  

b. Plant, x28.  
c. Leaves, x78.  
d. Cells at leaf apex, x294.  
e. Upper cells of vaginant lamina, x294.  
f. Peristome teeth, x294.  
g. Leaf of sterile plant, x78.  

[Holotype of *F. saxatilis* Tuzjpe & Nog.]

FISSIDENTACEAE
of sterile plants lanceolate to narrowly oblong, ± arcuate reflexed, apices acuminate; costa excurrent, yellowish. Dorsal lamina narrow, gradually tapered downward; margin entire, bordered by 2 rows of linear cells; median cells of apical lamina irregularly hexagonal, often rhomboid-hexagonal, 8-10 µm, pellucid, thick-walled. Vaginant lamina bordered by 3-5 rows of linear cells; median cells 12-15 µm, toward leaf base becoming rectangular and longer, 20-35 x 6.5-8.5 µm. Rhizautoicous. Seta terminal, 2-3 mm long, 0.06-0.08 mm thick. Capsule erect or inclined, oblong to ovoid, 0.4-0.6 x 0.30-0.35 mm, with wide mouth. Operculum conic-rostrate. Peristome teeth ca. 0.25 mm long, spirally thickened above. Spores to 17 µm. Perigonium at base of stem, ca. 0.35 mm long.


Distribution: Japan (Honshu, Kyushu, Izu-shichito), China, India.

11. FISSIDENS DIVERSIFOLIUS MITT. (Fig. 25)


Shoots to 5 mm long, to 2 mm wide. Leaves to 6-7 pairs, upper leaves much larger than lower, to 1.5 x 0.6 mm, oblong to ovate-oblong, obtusely apiculate or widely acute; costa stout, extending to near leaf apex. Dorsal lamina often rounded at base; median cells of 8.5-10.0 µm, slightly smaller toward leaf margin. Vaginant lamina extending to (in lower leaves), or beyond (in upper leaves) mid-leaf, widest at middle; margin bordered below by 2 to 4 rows of linear cells; median cells 12-15 µm, longer toward leaf base. Autoicous. Perichaetium terminal. Seta 2.0-3.5 mm long, 0.12-0.15 mm thick. Capsule erect, 0.65-0.85 x 0.4-0.5 mm, oblong-ovoid. Operculum ca. 0.35 mm long, convex, with short beak. Peristome teeth ca. 0.25 mm long, with indistinct spiral thickenings above. Calyptra ca. 0.5 mm long.


Distribution: Japan (Honshu, Kyushu), China, India, Burma.

12. FISSIDENS OBSCURIRETE BROTH. & PAR. (Fig. 26, A)


Figure 25.
*Fissidens diversifolius* Mitt.  
*a*. Plants, x12.  
*b*. Leaves, x28.  
*c*. Cells at leaf apex, x300.  
*d*. Cells at margin of dorsal lamina, x300.  
*e*. Cells at margin of vaginant lamina, x300.  
*f*. Capsule, x25.  
*g*. Male plant, x25.
**FISSIDENTACEAE**


Plants small. Shoots to 4 mm long, to 1.3 mm wide. Leaves in 4-7 pairs, crowded, overlapping at bases; lower leaves small, upper leaves larger, to 1.20 x 0.25 mm, lanceolate, narrowly acute to acuminate, costa percurrent or slightly excurrent, yellowish, pellucid. Dorsal lamina tapered downward; margin crenulate; median cells almost hexagonal, obscure, minutely 4-6 papillose; median cells of apical laminae 4.0-4.5 µm. Vaginant lamina extending to mid-leaf; margin crenulate, lower half bordered by 2-3 rows of rectangular, smooth cells; median cells similar to those of dorsal lamina but slightly larger and less convex. Autoicous or rhizautoicous. Perichaetium terminal. Seta 1.7-2.5 mm long, ca. 0.05 mm thick, almost straight. Capsule erect, cylindric, 0.30-0.45 x 0.25-0.30 mm. Operculum long-rostrate, ca. 0.4 mm long. Peristome teeth to 0.25 mm long, spirally thickened above. Spores 13-16 µm. Calyptra campanulate, ca. 0.5 mm long.

Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu, Bonin Isls.), Korea, Taiwan, New Caledonia.

**13. Fissidens microcladus** THWAIT. & MITT. (Fig. 26, B)


Shoots to 1.8 mm long, to 1.5 mm wide. Leaves in 4-5 pairs, lower leaves very small, upper leaves much larger, to 1.00 x 0.35 mm, narrowly lingulate, rounded-obtuse at apices; dorsal lamina, toward leaf base gradually narrowed, decurrent, or ending above the base; vaginant lamina extending to mid-leaf; margin crenulate throughout; costa pellucid, smooth, vanishing below leaf apex, often shortly forked above; cells of dorsal and apical laminae obscure, hexagonal, 4-6 µm, minutely multipapillose, thin-walled; cells of vaginant lamina similar to those of dorsal lamina, but somewhat larger, border extending upward to middle of vaginant lamina, of 3-4 rows of large, rectangular or linear, thick-walled, non-papillose cells. Rhizautoicous. Perichaetium terminal. Seta 1.5-2.5 mm long, ca. 0.08 mm thick. Capsule erect, cylindric, 0.45-0.55 x 0.25-0.35 mm, with indistinct apophysis. Operculum rostrate. Peristome teeth ca. 0.15 mm long, spirally thickened above. Spores 9-13 µm. Calyptra campanulate. Perigonium small, adhering to the base of the female plant.

Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu, Bonin Isls.), China, Taiwan, Laos, India, Sri Lanka, Thailand, Philippines, N. and S. America.
Figure 26.

A. *Fissidens obscurirete* Broth. & Par.  
   a. Plant, x20.  b. Leaves, x34.  c. Cells at margin of dorsal lamina, x385.  d. Cells at margin of vaginant lamina, x385.  e. Lower marginal cells of vaginant lamina, x385.  f. Capsule, x48.  [Shin 12678]

B. *F. microcladus* Thwait. & Mitt.  
   g. Plants, x15.  h. Leaves, x34.  i. Cells at leaf apex, x385.  j. Cells at margin of dorsal lamina, x385.  k. Cells at margin of vaginant lamina, x385.  [Noguchi 23664]

C. *F. pseudohollianus* Iwats. & Suzuki.  
   l. Plant, x20.  m. Leaves, x34.  n. Cells at leaf apex, x250.  o. Cells at margin of dorsal lamina, x250.  p. Cells at margin of vaginant lamina, x250.  q. Inner perigonial leaf, x130.  [Iwatsuki & Suzuki 8566]

D. *F. hollianus* Dozy & Molk.  
   r. Plants, x15.  s. Leaves, x48.  t. Cells at leaf apex, x250.  u. Cells at margin of vaginant lamina, x250.  [Isotype of *F. japonico-punctatus* Shin]
14. **FISSIDENS HOLLIANUS** DOZY & MOLK. (Fig. 26, D)


Shoots to 6.0 mm long and 1.5 mm wide. Leaves in 6-16 pairs, crowded, strongly incurved when dry, lanceolate to narrowly oblong, to 0.80 x 0.17 mm, apices broadly acute; costa yellowish, percurrent. Dorsal lamina extending to leaf insertion, somewhat rounded at base; cells hexagonal, 4.5-6.0 µm, each with 3-5 minute papillae, somewhat obscure. Vaginant laminae extending to mid-leaf; cells similar to those of dorsal lamina. Autoicous. Perichaetium terminal. Seta to 2 mm long. Capsule inclined to horizontal, oblong, to 1 mm long. Operculum rostrate, ca. 0.5 mm long. Peristome teeth ca. 0.25 mm long, spirally thickened above. Spores 10-12 µm, smooth. Calyptra campanulate, ca. 0.4 mm long. Perigonium axillary.

Distribution: Japan (Ryukyu, Bonin Isls.). Widely distributed in tropical Asia.

15. **FISSIDENS PSEUDOHOLLIANUS** IWATS. & SUZUKI (Fig. 26, C)


Plants minute in loose clusters. Shoots 2-4 mm long, ca. 1.5 mm wide. Leaves in 5-13 pairs, usually compact, lanceolate, apices narrowly acute, to 1.5 x 0.2 mm; dorsal lamina tapered downward, extending to, or ending above, the base of costa; vaginant lamina extending to mid-leaf; margin serrulate throughout; costa stout, extending to leaf apex, yellowish. Cells of apical and dorsal laminae hexagonal, bulging, thin-walled, each with 1-2 small papillae, marginal cells smaller; cells of vaginant lamina hexagonal, 6-9 µm, less bulging, each with 1-2 papillae; border extending to middle of vaginant lamina, composed of 2-3 rows of linear, thick-walled cells. Autoicous, rarely synoicous. Seta terminal, 1.5-2.0 mm long. Capsule inclined, oblong, to 0.35 x 0.17 mm. Operculum rostrate, 0.4-0.5 mm long. Peristome ca. 0.2 mm long, spirally thickened above, densely covered by minute papillae below. Spores 10-14 µm, smooth. Calyptra campanulate, ca. 0.5 mm long. Perigonium axillary; inner leaf ca. 0.2 mm long.

Distribution: Endemic to Japan (Bonin Isls.).

16. **FISSIDENS SCHWABEI** NOG. (Fig. 27)


Plants small. Shoots to 2 mm long, simple, occasionally with few branches. Leaves in 3-7 pairs, crowded, narrowly oblong or oblong-lanceolate, to 1.5 x 0.3 mm, acute at apices; dorsal lamina narrowed
downwards, ending at leaf base or slightly decurrent; vaginant lamina
extending to mid-leaf; margins of dorsal and apical laminae serrulate,
not bordered; margin of vaginant lamina bordered by ca. 2 rows of
linear cells; costa shortly excurrent. Median laminal cells hexagonal to
subquadrate, 9-12 µm, bulging, thin-walled, each with a small papilla.
Dioicous. Perichaetium terminal. Seta ca. 2.5 mm long, yellowish. Capsule
erect, oblong-ovoid, ca. 0.40 x 0.25 mm. Operculum long-rostrate, ca.
0.45 mm long. Peristome teeth ca. 0.2 mm long, spirally thickened above.
Spores 8-12 µm, smooth. Calyptra campanulate, ca. 0.3 mm long. Male
plant smaller than the female.

Distribution: Japan (Ryukyu), Taiwan.

17. FISSIDENS CRENULATUS VAR. ELMERI (BROTH.) IWATS. & SUZUKI
(Fig. 28, A)

J. Hattori Bot. Lab. 51: 386, pl. 23 (1982).


Plants small. Shoots 2-4 mm long, ca. 1.8 mm wide. Fertile shoots
with ca. 6 pairs of leaves. Lower leaves small and distant; upper
leaves much larger and ± dense, to 1.50 x 0.25 mm, lanceolate, acute at
apices; dorsal lamina widest at middle, tapering downward, reaching the
base of costa; vaginant lamina extending to mid-leaf; margin crenate
except for those of vaginant lamina; costa extending to leaf apex.
Laminal cells obscure, small, inflated, each with single large central
papilla; median cells of dorsal lamina hexagonal, 3.5-4.0 µm long, thin­
walled; cells of vaginant lamina similar to those of dorsal lamina but
with thicker walls; margin bordered by 2-3 rows of sublinear, smooth,
pellucid cells. Dioicous. Seta 1.5-3.0 mm long. Capsule inclined, oblong­
ovid, 0.5-0.8 x 0.3 mm. Operculum long-rostrate, 0.4-0.6 mm long. Spores
13-17 µm. Calyptra campanulate, ca. 0.5 mm long, slightly scabrous. Male
shoots smaller, ca. 0.6 mm wide. [The descriptions of operculum, spores,
and calyptra were based on Iwatsuki and Suzuki (1982)].

Distribution: Japan (Ryukyu, Bonin Isls.), Philippines, Micronesia.

18. FISSIDENS CLOSTERI SUBSP. KIUSIUENSIS (SAK.) IWATS.
(Fig. 28, B)


Stems very short, almost acaulescent. Leaves in 2-3 pairs; lower
leaves small, upper much larger, to 0.8 mm long, lanceolate; dorsal lamina
very narrow, ending in mid-leaf or above leaf insertion; vaginant lamina
extending to mid-leaf; margin not bordered, crenate (due to projecting
cells); costa pellucid, percurrent. Laminal cells smooth; cells of dorsal
lamina subquadrate to hexagonal, 10-15 x 6-10 µm, median cells of
Figure 27. *Fissidens schwabei* Nog.  
*a.* Plant, x28.  
b.* Lower leaf, x43.  
c.* Upper leaves, x43.  
d.* Cells at leaf apex, x294.  
e.* Cells at margin of dorsal lamina, x294.  
f.* Cells at margin of vaginant lamina, x294.  
[Holotype of *F. schwabei* Nog. from Taiwan]
Figure 28.

A. *Fissidens crenulatus* var. *elmeri* (Broth.) Iwats. & Suzuki.  a, b. Plants, x15.  c. Male plant, x15.  d. Leaves, x34.  e. Cells at leaf apex, x385.  f. Cells at margin of dorsal lamina, x385.  g. Cells at margin of vaginant lamina, x385. [Iwatsuki & Suzuki 13454]

B. *F. closteri* subsp. *kiusiuensis* (Sak.) Iwats.  h. Plant, x20.  i. Plant, x25.  j. Leaves, x48.  k. Cells at upper part of leaf, x180.  l. Cells at upper part of vaginant lamina, x180.  m. Capsule, x34. [Magofuku s.n.]
vaginant lamina rectangular to rhomboidal, 20-30 x 7-9 µm, thin-walled, smaller toward leaf margin. Rhizautoicous. Perichaetium terminal. Seta 1.5-3.0 mm long. Capsule erect, oblong, 0.3-0.5 x 0.2-0.3 mm. Operculum long-conic, to 0.4 mm long. Peristome teeth 0.22-0.25 mm long, spirally thickened above. Spores 10-15 µm. Calyptra conic, ca. 0.35 mm long, scabrous above. Perigonium ca. 0.15 mm long.

Distribution: Endemic to Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu, Bonin Isls.).

19. **FISSIDENS LAXUS** SULL. & LESQ. (Fig. 29, A)


*F. mittenii* Par., Ind. Bryol.: 477 (1896).

Leaves of fertile shoot in 4-5 pairs, lax; lower leaves smaller and distant; upper leaves ovate-oblong, to 1.0 x 0.3 mm, widest at middle, acute; dorsal lamina extending to leaf insertion; vaginant lamina extending to mid-leaf; margin entire, not bordered; costa stout, reaching leaf apex. Median cells of dorsal and apical laminae hexagonal, 10-13 µm, thick-walled, smooth, becoming subquadrate or rectangular toward leaf base, slightly smaller toward leaf margin, larger toward leaf apex, 15-17 µm. Polyoicous. Spores 10-15 µm.

Exsiccati: Musci Japonici 28: 1367 (1977), as *F. mittenii*.

Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu). Widely distributed in tropical Asia.

20. **FISSIDENS CRASSINERVIS** LAC. (Fig. 30, A)


Plants small, reddish-brown. Shoots to 1.5 mm wide. Fertile shoots usually 3-5 mm long, with less than 10 pairs of leaves. Lower leaves small, distant; upper leaves much larger, lax, lanceolate, to 1.80 x 0.25 mm, acute at apices; vaginant lamina reaching mid-leaf; margin entire; costa reaching leaf apex. Median cells of dorsal lamina hexagonal, 9-13 µm, pellucid, smooth, thick-walled; cells of vaginant lamina larger than those of dorsal lamina, with thicker walls. Dioicous. Seta ca. 15 mm long. Capsule ovoid, ca. 0.4 x 0.3 mm. Male plant smaller than female, ca. 0.4 mm long, with 6-7 pairs of small and remote leaves; perigonia terminal.

Distribution: Japan (Ryukyu), Singapore, Thailand, Malay Pen., Sumatra, Java, Banka, Amboina, Borneo, New Guinea.

21. **FISSIDENS GANGULEEI** NORKETT EX GANG. (Fig. 30, B)

Figure 29.
A. *Fissidens laxus* Sull. & Lesq.  
- a, b. Plants, x13. c. Leaves, x43. d. Cells at leaf apex, x294. e. Cells at margin of dorsal lamina, x294. f. Cells at margin of vaginant lamina, x294. g. Cells at leaf base, x156. [Noguchi 6154 from Taiwan]

B. *F. papillosus* Lac.  
- h. i. Plants, x25. j. Leaves, x40. k. Cells at leaf apex, x300. l. Cells at upper part of vaginant lamina, x300. m, n. Capsules, x40. [Isotype of *F. verriculosus* Shin]
Plants small. Shoots 3-5 mm long, to 1.5 mm wide. Leaves of fertile shoots to 6 pairs, ± distant, oblong, ± rounded and widely acute at apices, to 1.30 x 0.35 mm; dorsal lamina tapered; vaginant lamina reaching mid-leaf; margin serrulate throughout, not bordered; costa yellowish, reaching leaf apex or shortly excurrent. Median cells of dorsal lamina hexagonal, 10-15 µm, slightly bulging; cells of vaginant lamina similar to those of the dorsal lamina but smaller and with thicker walls. Dioicous? Seta terminal, 3.0-3.5 mm long. Capsule inclined, ovoid, 0.45-0.50 mm long, ca. 0.35 mm thick. Operculum long-rostrate, 0.45-0.50 mm long. Spores 10-16 µm. Calyptra mitrate, ca. 0.4 mm long.

Distribution: Japan (Honshu), Nepal, India.

22. **FISSIDENS PAPILLOSUS** LAC. (Fig. 29, B)


Fertile shoots to 1 mm long with 3-4 pairs of leaves. Leaves lanceolate; upper leaves larger, to 1.2 x 0.2 mm, acute at apices; dorsal lamina, gradually narrower downward; vaginant lamina extending to mid-leaf, rounded above, margin distinctly spinose-serrate; costa stout, ending 3-5 cells below leaf apex, slightly flexuose above. Laminal cells hexagonal, slightly convex and distinctly unipapillose, somewhat obscure, thin-walled; median cells of dorsal and apical laminae 8-10 µm, cells of vaginant lamina similar to those of dorsal lamina but slightly larger (9-13 µm), less convex. Rhizautoicous. Seta terminal, 0.9-2.5 mm long, ca. 0.05 mm thick, yellowish-brown. Capsule erect, 0.35-0.45 x 0.20-0.22 mm, oblong. Operculum long-rostrate, ca. 0.3 mm long. Peristome teeth ca. 0.18 mm long. Spores 10-15 µm. Calyptra long-conic, ca. 0.3 mm long.


Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), Taiwan, Philippines, Java, Borneo.

23. **FISSIDENS SERRATUS** C.MUELL. (Fig. 31, A)


Plants minute. Shoots 1.0-2.7 mm long, ca. 1.5 mm wide. Leaves in 3-4 pairs on fertile shoot, lanceolate to narrowly lanceolate, acute, to 1.2 x 0.2 mm, dorsal lamina tapering downward; vaginant lamina reaching mid-leaf; margin distinctly serrate throughout; costa stout, extending to leaf apex or slightly excurrent. Cells of apical and dorsal laminae rounded-hexagonal, 5-8 µm, with central, large papilla, thick-walled; cells of vaginant lamina similar to those of dorsal lamina but with smaller papillae. Rhizautoicous. Seta terminal, 2.0-3.5 mm long. Capsule erect, oblong-cylindric to ovoid, 0.2-0.3 mm long. Operculum long-conic
Figure 30.
A. *Fissidens crassinervis* Lac.  
   a. Plant, x10.  
   b. Sterile plant, x10.  
   c. Male plant, x10.  
   d. Leaves, x34.  
   e. Cells at leaf apex, x250.  
   f. Cells at margin of dorsal lamina, x250.  
   g. Cells at upper part of vaginant lamina, x250. [Iwatsuki 17402]

B. *F. ganguleei* Nork. ex Gang.  
   h. Plant, x15.  
   i. Sterile plant, x15.  
   j. Leaves, x34.  
   k. Cells at leaf apex, x250.  
   l. Cells at margin of dorsal lamina, x250.  
   m. Cells at upper part of vaginant laminae, x250. [Suzuki 50521]
to rostrate. Peristome teeth with spiral thickenings above. Spores 13-16 µm. Calyptra campanulate, ca. 0.4 mm long.

Distribution: Endemic to Japan (Bonin Isls.), India, Java, Sri Lanka.

24. **FISSIDENS FLABELLULUS** THWAIT. & MITT. (Fig. 31, B)

*J. Linn., Soc. Bot. 13: 324 (1873).*

Plants minute. Shoots 0.7-1.4 mm long, 1.0-1.2 mm wide. Fertile shoots with 2-7 pairs of leaves. Leaves rather dense, lanceolate, widest at middle, to 1.00 x 0.18 mm, apices acute; dorsal lamina, tapering toward base; vaginant lamina reaching mid-leaf; margin crenate (due to inflated marginal cells) throughout; costa stout, extending to the leaf apex or shortly excurrent. Median cells of dorsal lamina hexagonal, pellucid, 8-10 µm, thin-walled; cells of upper and vaginant laminae similar to those of dorsal lamina. Rhizautoicous or autoicous. Seta 2-3 mm long. Capsule ovate to short cylindric, 0.5-0.7 x 0.25 mm. Operculum long-conic to rostrate, 0.3-0.4 mm long. Spores 11-14 µm. Calyptra campanulate, ca. 0.4 mm long.

Distribution: Japan (Bonin Isls.), India, Sri Lanka, Java.

25. **FISSIDENS ZIPPELIANUS** DOZY & MOLK. (Fig. 32)

*In Zoll., Syst. Verzeichn.: 29 (1854).*


Plants in dense mats. Shoots ca. 5 mm, occasionally to 15 mm long, ca. 2.5 mm wide, often with innovations. Hyaline nodule distinct in each axil of leaf. Leaves in 5-19 pairs, dense, lanceolate, often slightly curved, 1.5-2.0 x 0.3-0.4 mm, widely acute; dorsal lamina narrow, often rounded at base; vaginant lamina wide, extending to leaf-middle; margin evenly serrulate; costa extending to leaf apex; median cells of dorsal and apical laminae round to round-hexagonal, 5-7 µm, bulging, somewhat obscure, more or less thick-walled, cells of vaginant lamina slightly larger, 6-10 µm. Dioicus. Perichaetial leaves widest near base. Seta terminal, 2.5-3.5 mm long, ca. 0.08 mm thick. Capsule erect, oblong-ovoid, 0.7-0.8 x 0.35-0.40 mm. Operculum ca. 0.5 mm long. Peristome teeth ca. 0.35 mm long. Spores minutely papillose, 10-15 µm. Calyptra mitriform, ca. 0.7 mm long. Male plants smaller than the female.

Figure 31.
A. *Fissidens serratus* C.Muell.  a, b. Plants, x20. c. Leaves, x34. d. Cells at leaf apex, x250. e. Cells at margin of dorsal lamina, x250. f. Cells at margin of vaginant lamina, x250. [Iwatsuki & Suzuki 8826]
B. *F. flabellulus* Thwait. & Mitt. g, h. Plants, x20. i. Leaves, x48. j. Cells at leaf apex, x250. k. Cells at margin of dorsal lamina, x250. l. Cells at margin of vaginant lamina, x250. [Iwatsuki & Suzuki 8556].
C. *F. mangarevensis* Mont. m. Plant, x10. n. Leaves, x20. o. Cells at leaf apex, x250. p. Cells at margin of dorsal lamina, x250. q. Cells at margin of vaginant lamina, x250. r. Capsule x20. [Magofuku s.n.]
D. *F. formosanus* Nog. s. Plant, x7. t. Leaves, x23. u. Cells at leaf apex, x250. v. Cells at margin of dorsal lamina, x250. w. Cells at margin of vaginant lamina, x250. x. Perigonial leaf, x36. [Holotype of *F. formosanus* Nog. from Taiwan]
Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu, Bonin Isls.). Widely distributed in Palaeotropics.

26. **FISSIDENS SUBANGUSTUS** FLEISCH. (Fig. 33, A)

Musci Fl. Buitenzorg 1: 47 (1904).

Plants minute. Shoots to 5 mm long, ca. 2.5 mm wide with leaves; axillary nodule present as in *F. zippelianus*. Leaves in 5-8 pairs, crowded but not imbricate, linear, acute at apices, to 2.5 x 0.3 mm; dorsal lamina tapered downward; vaginant lamina reaching leaf-middle; margin entire, but that of vaginant lamina crenate due to inflated cells; costa slender, reaching leaf-apex. Median cells of dorsal lamina obscure, hexagonal or subquadrature, 3-4 µm, inflated, with 2-4 small indistinct papillae, thin-walled; cells of vaginant lamina similar to those of dorsal lamina. Dioecious. Perichaetia terminal. Seta ca. 3 mm long. Capsule erect, oblong, ca. 0.50 x 0.25 mm. Operculum long-rostrate, ca. 0.5 mm long. Peristome teeth to 0.25 mm long; spirally thickened above. Spores 10-15 µm. Calyptra cucullate, ca. 0.6 mm long. Male plants smaller than the female.

Exsiccati: Fissidentaceae· Asiaticae 1: 7 (1980).

Distribution: Japan (Honshu, Izu-shichito, Ryukyu), Java, Sumatra.

27. **FISSIDENS JAVANICUS** DOZY & MOLK. (Fig. 33, B)

Bryol. Jav. 1: 11, t. 3 (1855).


Plants yellowish-green, in dense turfs. Shoots to 20 mm long, 4 mm wide, simple, occasionally with few innovations; axillary hyaline nodule distinct as in *F. zippelianus*. Leaves in 11-41 pairs, slightly incurved at apices when dry, lanceolate, gradually tapered to acute apices, to 3.0 x 0.4 mm, rugose-undulate; dorsal lamina extending to leaf base, rounded at base; vaginant lamina extending to mid-leaf; margin crenate throughout, bordered by several rows of yellowish, pellucid, incrassate, larger cells, occasionally bistratose at lower portion of dorsal lamina; costa yellowish, percurrent. Cells of dorsal and apical laminae rounded-hexagonal, 4-6 µm, mammillose, obscure, thick-walled; cells of vaginant lamina similar to those of dorsal lamina, toward leaf base larger and with less distinct mammillae; cells of border of vaginant lamina larger and more incrassate than those of apical and dorsal laminae. Sporophytes unknown in Japan.

Distribution: Japan (Ryukyu). Widely distributed in tropical Asia.

28. **FISSIDENS MANGAREVENSIS** MONT. (Fig. 31, C)

Figure 32. *Fissidens zippelianus* Dozy & Molk.  
*a*. Plant, x7.  
*b*. Leaves, x23.  
*c*. Cells at leaf apices, x250.  
*d*. Cells at median part of dorsal lamina, x250.  
*e*. Cells at median part of vaginant lamina, x250.  
*f*. Cells at leaf base, x250.  
*g*. Perichaetial leaves, x23.  
*h*. Capsule, x23.  
*i*. Peristome teeth, x250.  
*j*. Part of stem, showing axillary hyaline nodules, x63. [Noguchi 6767 from Taiwan]
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Shoots to 5 mm long, to 3 mm wide. Leaves in 6-17 pairs, crowded, lanceolate, ca. 2.50 x 0.26 mm; vaginant lamina extending to mid-leaf; margin crenate, not bordered; costa rather stout, yellow, extending to near leaf apex, flexuose above. Laminal cells rounded-hexagonal, bulging, ± obscure, thick-walled; median cells of dorsal and apical laminae 8.5-10.0 µm; cells of vaginant lamina hexagonal, 10-13 µm, toward margin slightly smaller, toward base larger. Autoicous. Seta terminal, 3.5-4.0 mm long, ca. 0.05 mm thick, slightly flexuose, reddish-brown. Capsule curved and asymmetric, oblong, 0.65-0.80 x 0.4-0.5 µm. Operculum long-rostrate, 0.8-0.9 mm long. Peristome teeth to 0.5 mm long. Calyptra long-conic, ca. 1 mm long. Perigonia axillary, inner leaves cymbiform, ca. 0.45 mm long.

Distribution: Japan (Honshu, Kyushu, Ryukyu, Bonin Isls.), Hong Kong, South Pacific.

29. FISSIDENS FORMOSANUS NOG. (Fig. 31, D)


Shoots to 5 mm long, ca. 4 mm wide. Leaves in 8-12 pairs, lanceolate, acute at apex; median leaves to 2.5 x 0.4 mm; vaginant lamina extending to mid-leaf; margin crenulate; costa ending below leaf apex, flexuose above. Median cells of dorsal lamina obscure, rounded-hexagonal, small, 3.5-5.0 µm, mammillose, smaller toward the leaf margin; cells of vaginant lamina similar to those of dorsal lamina. Autoicous. Perichaetium terminal; inner leaves similar to stem leaves. Seta longer than 3 mm. Perigonia axillary.

Distribution: Japan (Kyushu, Ryukyu, Bonin Isls.), Taiwan.

This species occurs on branches of shrubs.

30. FISSIDENS GYMNOGYNUS BESCH. (Fig. 34, A)

J. de Bot. 12: 292 (1898).


Plants in loose turfs, brownish with age. Shoots to 15 mm long, to 3 mm wide, simple or sparsely branched, densely leaved. Leaves in ca. 15 pairs, incurved or inrolled and ± homomallous when dry, especially at stem apex; upper leaves to 1.80 x 0.45 mm, narrowly oblong, widest above the bases, rounded-obtuse and slightly apiculate at apices; gradually narrowed downward, rounded at insertion; vaginant lamina extending to above mid-leaf; margin serrulate, not bordered but with a row of pale cells; costa rather stout, ending 3-4 cells below leaf apex. Laminal cells hexagonal, bulging, obscure, thin-walled; cells of dorsal lamina 6-8 µm; cells of vaginant lamina ± irregular in shape, smooth, 7-
Figure 33.
A. *Fissidens subangustus* Fleisch.  
a, b. Plants, x15.  
c. Leaves, x34.  
d. Cells at leaf apex, x385.  
e. Cells at margin of dorsal lamina, x385.  
f. Cells at margin of vaginant lamina, x385.  

B. *F. javanicus* Dozy & Molk.  
g. Plant, x7.  
h. Leaves, x20.  
i. Cells at leaf apex, x250.  
j. Cells at margin of dorsal lamina, x250.  
k. Cells at margin of vaginant lamina, x250.  
l. Cross-section of leaf, x250.  

[Shin 15290]
10 µm, slightly larger toward leaf base. Phyllodioicous. Perichaetium terminal; perichaetal leaves narrower than stem leaves. Seta reddish-brown, ca. 2 mm long. Capsule narrower than stem leaves, 1.0-1.8 x 0.5-0.6 mm. Operculum conic-rostrate, 1.0-1.2 mm long. Peristome teeth usually ca. 0.25 mm long. Spores 13-17 µm. Calyptra mitriform, slightly lobed at base, 1.4-1.6 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito), Korea, China, Taiwan.

31. FISSIDENS OSMUNDOIDES HEDW. (Fig. 34, B)


Plants small. Fertile shoots with 8-12 pairs of leaves, ca. 3.0-3.5 mm wide. Lower leaves small; upper leaves larger, ovate-oblong, to 2.5 x 0.8 mm. Apices widely acute, crisped and inrolled only at apical portion of leaves when dry; dorsal lamina, rounded at base; vaginant lamina wide, swollen (in outline) on ventral side, extending to 2/3 the leaf length; margin serrulate throughout; costa stout, ending slightly below the leaf apex. Laminal cells pellucid; median cells of dorsal lamina hexagonal, 10-15 µm, ± inflated, smaller toward leaf margin; upper cells 10-12 µm; median cells of vaginant lamina hexagonal, 10-12 µm. Dioicous. Seta terminal, 7-10 mm long, straight or flexuose. Capsule oblong-ovoid, 1.0-1.5 x 0.5-0.6 mm. Operculum 1.0-1.5 mm long. [Description of the sporophyte was based on a European collection].

Distribution: Japan (Hokkaido, Honshu), China, Siberia, Europe, N.America.

32. FISSIDENS ARBOLATUS GRIFF. (Fig. 34, C)


Plants large, pale green. Shoots to 50 mm long, ca. 8 mm wide, simple or sparsely branched above, flexuose when dry. Leaves in 15-47 pairs, incurved when dry, to 5.5 x 1.5 mm, narrowly lingulate, obtuse to rounded-obtuse and slightly apiculate; dorsal lamina wide, rounded and not decurrent at leaf insertion; vaginant lamina extending to mid-leaf; margin minutely serrulate above, indistinctly crenate below; costa extending to leaf apex. Median cells of apical lamina hexagonal, 12-17 µm, smaller toward leaf margin and apex, convex, pellucid, walls ± thick; cells of vaginant lamina 12-17 µm, longer toward leaf base, 17-30 µm, walls evenly thick. Dioicous. No sporophytes were found in Japan.

Figure 34.
A. *Fissidens gymnogynus* Besch.  
  a. Plant, x7.  
  b. Leaves, x34.  
  c. Cells at leaf apex, x250.  
  d. Cells at margin of dorsal lamina, x250.  
  e. Cells at margin of vaginant lamina, x250. [Noguchi 3234]

B. *F. osmundoides* Hedw.  
  f. Leaves, x20.  
  g. Cells at leaf apex, x250.  
  h. Cells at margin of dorsal lamina, x250.  
  i. Cells at margin of vaginant lamina, x250.  
  j. Capsule, x10. [European specimen]

C. *F. areolatus* Griff.  
  k. Leaves, x10.  
  l. Cells at leaf apex, x130.  
  m. Median cells of dorsal lamina, x250.  
  n. Median cells of vaginant lamina, x250. [Noguchi 6408 from Taiwan]

D. *F. obscurus* Mitt.  
  o. Part of plant, x7.  
  p. Leaves, x10.  
  q. Cells at leaf apex, x130.  
  r. Median cells of dorsal lamina, x250.  
  s. Median cells of vaginant lamina, x250. [Holotype of *F. yakumontanus* Nog.]
Distribution: Japan (Honshu, Kyushu, Ryukyu). Widely distributed in tropical Asia.

33. FISSIDENS OBSCURUS MITT. (Fig. 34, D)


Plants large. Shoots to 100 mm long, ca. 6 mm wide. Leaves in 17-44 pairs, narrowly lingulate or ensiform, 3.5-5.0 x 0.8-1.0 mm, apices obtuse; vaginant lamina wide, widest below middle, extending to mid-leaf or beyond; costa stout, yellowish, slender above and ending far below leaf apex. Median cells of apical lamina irregularly hexagonal, 8-12 \( \mu m \) long, slightly obscure, thick-walled, slightly smaller toward leaf margin; cells of vaginant lamina hexagonal, plane, thick-walled, or near leaf base rectangular. Dioicus. No sporophytes were found in Japan.


Distribution: Japan (Kyushu), China, Nepal, India.

34. FISSIDENS PLAGIOCHILOIDES BESCH. (Fig. 35, A)

J. de Bot. 12: 293 (1898).


Plants large. Shoots to 50 mm long, 4-5 mm wide. Leaves in 14-44 pairs, strongly incurved and ± contorted when dry, lanceolate to oblong, to 4.00 x 0.75 mm, acute at apices; dorsal lamina tapered downward, often rounded at base; vaginant lamina extending to mid-leaf; margin serrulate throughout, costa stout, percurrent, yellowish-brown. Cells of apical lamina hexagonal, 7-13 \( \mu m \), toward leaf margin scarcely smaller, bulging, somewhat obscure; cells of vaginant lamina hexagonal, bulging, 8-13 \( \mu m \) (cells of 2-3 rows along the laminal margin larger, irregular in shape). Dioicus. No sporophytes were found in Japan.

Distribution: Japan (Honshu, Shikoku, Kyushu), China, Taiwan, Nepal, Philippines.

35. FISSIDENS TAXIFOLIUS HEDW. (Fig. 36, A)


Figure 35.
A. *Fissidens plagiochiloides* Besch.  a. Plant, x7.  b. Leaf, x15.  c. Cells at leaf apex, x250.  d. Cells at margin of dorsal lamina, x250.  e. Cells at margin of vaginant lamina, x250. [Takaki 170]

B. *F. geminiflorus* var. *nagasakinus* (Besch.) Iwats.  f. Upper part of plant, x10.  g. Leaves, x23.  h. Cells at leaf apex, x250.  i. Cells at margin of vaginant lamina, x250.  j. Perichaetial leaves, x23. [Noguchi 7336 from Taiwan]

Shoots to 10 mm long (or longer), to 3.5 mm wide. Leaves in 7-14 pairs, dense, to 2 x 0.6 mm, oblong to lingulate, obtuse or rounded and slightly apiculate at apex, widest near bases; dorsal lamina rounded and ± undulate at base; vaginant lamina wide, extending to 2/3 the leaf length, widest near base; margin serrulate throughout, slightly bordered by one or, in the upper part, several rows of hyaline, plane, subquadrate cells; costa stout, shortly excurrent. Median cells of apical lamina hexagonal, bulging, somewhat obscure, 7-12 µm, thin-walled, scarcely smaller toward leaf margin and base; cells of vaginant lamina hexagonal, 8-10 µm, unipapillose or mammillose dorsally, larger downward. Dioicus. Perichaetium at base of stem; inner perichaetial leaf narrow, to 1.8 mm long. Seta flexuose, 10-12 mm long, reddish-brown. Capsule horizontal or inclined, asymmetric, oblong, to 1.50 x 0.75 mm. Operculum long-rostrate, 1.0-1.2 mm long. Peristome teeth 0.30-0.45 mm long, spirally thickened above. Spores ca. 15 µm, almost smooth. Calyptra campanulate, to 2 mm long. Male plant often aggregated, ca. 0.8 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu). Widely distributed in the world.

36. FISSIDENS ADELPHINUS BESCH. (Fig. 36, B)


Shoots 5-9 mm long, to 2 mm wide. Leaves somewhat incurved when dry, in 9-17 pairs, dense, imbricate, narrowly oblong to lanceolate, to 1.50 x 0.35 mm, apex acute; dorsal lamina extending to leaf insertion; vaginant lamina wide, extending to 2/3 the leaf length; margin serrulate throughout, marginal cell somewhat pellucid; costa stout, yellowish brown, percurrent, flexuose above. Cells of apical lamina rounded-hexagonal, 7-9 µm, bulging, somewhat obscure, thin-walled; cells of vaginant lamina 8-10 µm, hexagonal, with several small papillae at each cell corner, thick-walled. Dioicus. Perichaetium at base, or occasionally at middle, of stem; inner perichaetial leaves ca. 1 mm long. Seta ca. 5 mm long, ca. 0.12 mm thick. Capsule asymmetric, oblong, ca. 0.50 x 0.25 mm. Operculum ca. 0.5 mm long, long-rostrate. Peristome teeth to 0.4 mm long, spirally thickened above. Spores 15-20 µm, smooth. Calyptra campanulate, ca. 1 mm long, smooth. Male plant small.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), Korea, China, Taiwan.
Figure 36.
A. *Fissidens taxifolius* Hedw.  a. Plants, x7. b. Leaves, x20. c. Cells at leaf apex, x250. d. Cells at margin of vaginant lamina, x250. e. Cells at margin of dorsal lamina, x250. f. Perichaetial leaves, x20. [Image 51117] B. *F. adelphinus* Besch.  g. Plants, x10. h. Leaves, x34. i. Cells at leaf apex, x250. j. Cells at margin of vaginant lamina, x250. [Isotype of *F. adelphinus* Besch.]
37. **FISSIDENS NOBILIS** GRIFF. (Fig. 37)


Plants large, dark green. Shoots usually to 50 mm long (occasionally longer), ca. 10 mm wide. Leaves in 18-46 pairs, to 70 x 1.2 mm (lower leaves slightly smaller), curved downward when dry, lanceolate or ensiform, widest near base, apex acute to obtuse; dorsal lamina extending to leaf insertion, undulate at base; vaginant lamina extending to midleaf, widest at base; margin irregularly toothed (apical teeth larger and cristate), bordered by several rows of yellowish, thick-walled cells; borders of dorsal and apical laminae 2-4 cells thick; costa stout, extending to near leaf apex. Median cells of apical lamina almost hexagonal, 6-8 µm, partially bistratose, bulging, obscure; cells of vaginant lamina similar to those of dorsal lamina but slightly larger and with thicker walls, smooth. Dioicus. Perichaetium lateral at upper portion of stem, often aggregated. Inner perichaetial leaf small and narrow. Seta stout, 7-9 mm long, ca. 0.2 mm thick, reddish brown. Capsule erect, 2.0-2.5 x 0.7-0.9 mm, oblong, often asymmetric. Operculum with long and slightly curved beak, ca. 2 mm long. Peristome teeth to 0.8 mm long, transversely thickened at articulations, vertically striate above. Spores smooth, 12-15 µm. Calyptra campanulate, ca. 2 mm long, smooth. Male plant ± slenderer than the female.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu, Bonin Isls.). Widely distributed in tropical and temperate regions of Asia.

38. **FISSIDENS CRISTATUS** WILS. EX MITT. (Fig. 38, A)


Stems simple. Shoots to 40 mm long, ca. 6 mm wide, often arcuate-ascending. Leaves in 12-34 pairs, strongly incurved when dry, to 4.00 x 0.85 mm, narrowly lingulate or oblong, acute at apices, widest above base; dorsal lamina narrow or rounded at leaf insertion; margin denticate above, serrulate below, bordered throughout (except for margin of vaginant lamina) by several rows of pale, hexagonal, plane, unistratose, thick-walled cells; costa stout, yellowish, extending to leaf apex. Median cells of apical laminae rounded-hexagonal, 7-10 µm, bulging,
Figure 37.  
*Fissidens nobilis* Griff.  
a. Plant, x1.  
b. Upper part of plant, x7.  
c. Cells at leaf apex, x250.  
d. Cells at margin of vaginant lamina, x250.  
e. Cross-section of leaf, x250.  
f. Peristome teeth, x95.  
[Koie 79]
FISSIDENTACEAE

obscur, partially bistratose, cells of vaginant lamina hexagonal, 8-12 \( \mu m \), toward leaf base subquadrate or rectangular. Phyllodoioicus in Japan. Perichaetium lateral at middle of stem. Seta 8-10 mm long. Capsule suberect, asymmetric, oblong, 1.7-2.0 x 0.50-0.65 mm. Operculum long-rostrate, 1.5-2.0 mm long. Peristome teeth to 0.6 mm long, with distinct projections at the articulations above. Spores 15-20 \( \mu m \), almost smooth. Calyptra cucullate, ca. 1.5 mm long, smooth. Male plant minute, on leaves of female plants.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu). Widely distributed in the N.Hemisphere.

39. FISSIDENS ADIANTHOIDES HEDW. (Fig. 38, B)


Shoots ca. 30 mm long, ca. 6 mm wide. Leaves in 10-29 pairs, lax, 3.0-3.5 x 1.0-1.3 mm, ovate-oblong, widest near base, apex widely acute; dorsal lamina rounded at base; vaginant lamina wide, extending to beyond mid-leaf, widest near base; margin yellowish, serrulate throughout, often with teeth at leaf apex; costa extending to leaf apex, stout. Median cells of apical lamina rounded-hexagonal, 15-18 \( \mu m \), bulging, ± obscure, toward leaf margin smaller; cells of vaginant lamina rounded-hexagonal, plane. Monoicus.

Distribution: Japan (Hokkaido, Honshu). Widely distributed in the N.Hemisphere.

40. FISSIDENS GEMINIFLORUS VAR. NAGASAKINUS (BESCH.) IWATS. (Fig. 35, B)


Stems 17-58 mm long, bearing axillary hyaline nodules. Leaves in 18-63 pairs, lanceolate, 2-3 x 0.4-0.5 mm, apex obtuse and slightly apiculate; dorsal lamina long decurrent; vaginant lamina extending above
Figure 38.
A. *Fissidens cristatus* Wils. ex Mitt.  
B. *F. adianthoides* Hedw.  
  h. Leaves, x20.  i. Cells at leaf apex, x250.  j. Cells at margin of dorsal lamina, x250.  k. Cells at margin of vaginant lamina, x250. [Faurie 12682]
mid-leaf; margin serrulate throughout (due to bulging cells); costa stout, percurrent, flexuose above. Median cells of apical lamina rounded-hexagonal, 4.5-6.5 \( \mu m \), toward leaf margin slightly smaller, bulging, obscure, thin-walled; cells of vaginant lamina hexagonal, 6.0-8.5 \( \mu m \), bulging, toward leaf base slightly larger. Dioicous. Perichaetium lateral, axillary at middle of stem; inner perichaetial leaves to 2 mm long. Seta to 13 mm long, ca. 0.17 mm thick, slightly flexuose. Capsule inclined to horizontal, oblong-ovoid, ca. 0.8 x 0.5-0.6 mm. Operculum long-rostrate, to 1 mm long. Peristome teeth 0.3-0.5 mm long, reddish brown below, yellowish brown above, with distinct projections at articulations. Spores 13-17 \( \mu m \), smooth. Calyptra campanulate, ca. 1 mm long, smooth. Male plant a little smaller than the female, perigonia axillary.


Distribution: Japan (Honshu, Shikoku, Kyushu, Izu-shichito, Ryukyu), Hong Kong, China, Taiwan, Philippines, Borneo.

**41. FISSIDENS PERDECURRBNS** BESCH. (Fig. 39, A)

J. de Bot. 12: 293 (1898).


Plants blackish green, rigid. Shoots slender, to 2.5 mm wide. Leaves in 20-65 pairs, slightly altered when dry, lanceolate to narrowly lanceolate, apex obtuse to acute, to 1.50 x 0.35 mm, widest at middle; dorsal lamina extending to leaf insertion, bi- to multistratose; vaginant lamina extending to mid-leaf, mostly bistratose; margin crenate throughout (due to convex cells), one row of marginal cells pellucid; costa thick, yellowish brown, extending to near leaf apex. Median cells of apical lamina hexagonal, 6-10(-12) \( \mu m \), convex, thick-walled, smaller toward the leaf margin; cells of vaginant lamina hexagonal, 6-9(-12) \( \mu m \), less convex. Dioicous. No sporophytes were found.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu, Bonin Isls.), China, Taiwan.

**42. FISSIDENS GRANDIFRONS** BRID. (Fig. 39, B)


Plants blackish-green, rigid. Shoots elongate, to 4 mm wide, simple,
A. *Fissidens perdecurrens* Besch.  
   a. Part of plant, x10.  
   b. Leaves, x34.  
   c. Cells at leaf apices, x250.  
   d. Median cells of dorsal lamina, x250.  
   e. Median cells of vaginant lamina, x250.  
   f, g. Cross-sections of leaf (f, upper, g, lower parts), x130.  
   h. Perichaetial leaf, x34.  
   [Noguchi 5816]  
B. *F. grandifrons* Brid.  
   i. Upper part of plant, x7.  
   j. Leaves, x10.  
   k. Cells at leaf apex, x250.  
   l. Cross-section of leaf, x130.  
   [j, Tagawa 3851 from Taiwan; j-k, isotype of *F. planicaulis* Besch; l, Noguchi s.n.]
Archidiaceae

Occasionally branched, bearing axillary hyaline nodules. Leaves in 27-64 pairs, overlapping, gradually tapered to obtuse apices, 3.3–3.8 x 0.4–0.5 mm, widest at bases; dorsal lamina extending to leaf base, bi- to multistratose; vaginant lamina extending to mid-leaf, widest near base, gradually tapered upward, multistratose near costa; margin almost entire, often crenate at apex; costa extending to near leaf apex. Median cells of apical lamina rounded-hexagonal, obscure, ca. 7 µm, larger toward leaf base. Dioicous. Perichaetium lateral at upper portion of stem; inner perichaetial leaves to 4 mm long, abruptly tapered to very long, linear apices from wide vaginant laminae. Seta ca. 18 mm long, 0.20–0.25 mm thick, yellowish brown. Capsule erect, oblong, 1.3–1.5 x 0.7–0.8 mm. Operculum rostrate, ca. 1.5 mm long. Peristome teeth ca. 0.5 mm long, with distinct projections on articulations and papillose above. Spores 18–25 µm, finely papillose. Calyptra cucullate, ca. 1.6 mm long, smooth.


Distribution: Japan (Honshu, Shikoku, Kyushu), Korea, China, Taiwan, Nepal, India, Pakistan, Kashmir, Europe, N.America.

Archidiaceae

Archidiwm Brid.

Archidiwm Ohioense Schimp. Ex C.Muell. (Fig. 40, A)

Syn. 2: 517 (1851).


Plants minute, terrestrial. Stems ca. 5 mm long, simple or sparingly branched, with central strand; innovating below the inflorescence. Leaves erect-spreading, ovate- to triangular-lanceolate, shortly subulate 0.5–0.9 x 0.20–0.25 mm, keeled above, clasping at base; margins crenulate above, entire below; costa stout, usually shortly excurrent. Median laminal cells narrowly rectangular or rhomboidal, 25–30 x 8–9 µm, thin-walled; marginal cells smaller; basal cells rectangular, slightly larger than the median. Autoicous. Perichaetia terminal on a separate branch borne axillary (thus seemingly axillary) or terminal on main stem, the perichaetial leaves similar to the stem leaves, but ovate-lanceolate and with somewhat larger laminal cells, forming a comal tuft. Seta not differentiated. Capsules usually solitary, immersed, globose, cleistocarpous, 0.3–0.5 mm, thin-walled, the wall single-layered, smooth; columella and spore sac not seen; exothecial cells hexagonal, 20–30 x 20–25 µm,
Figure 40.
A. *Archidium ohioense* Schimp. ex C.Muell.  
- a. Plant, x15.  
- b. Leaves, x24.  
- c. Cells at leaf base, x140.  
- d. Inner perichaetial leaf, x24.  
- e. Part of stem with capsule, x35.

B. *Pleuridium julaceum* Besch.  
- g. Leaves, x40.  
- h. Median cells of leaf, x150.  
[Isotype of *P. julaceum* Besch.]

C. *P. subulatum* (Hedw.) Rabenh.  
- i. Plant, x15.  
- j. Cross-section of stem, x250.  
- k. Leaves, x34.  
- l. Leaf apex, x250.  
- m. Cells at leaf base, x250.  
- n. Cross-section of leaf, x250.  
- o. Capsules, x35.  
- p. Perigonial leaf, x35.  
[Noguchi 43412]
thin-walled, fragile, without stomata; vaginula globose. Spores usually 8-16 per capsule, 130-170 \( \mu m \) in diam., irregularly tetrahedral, smooth.


Distribution: Japan (Honshu, Kyushu, Ryukyu, Bonin Isls.), India, Sri Lanka, eastern N.America, E. and S.Africa.

This species grows on sandy soil near human habitats.

**DITRICHACEAE**

**Key to the Genera**

1. Leaves distichous, with a distinct sheathing base . . . 7. Distichium
1. Leaves not distichous, without distinct sheathing base ........ 2
   2. Costa occupying almost the entire width of leaf base and scarcely prominent at back .......................... 3
   2. Costa occupying less than 1/3 the width of leaf base and prominent at back .................. 5
3. Capsules subglobose to ovoid. Operculum and peristome not differentiated (cleistocarpous) .................. 4
   4. Operculate apex of capsule not dehiscent. Calyptra cucullate, wide at base .................. 1. Pleuridium
   4. Operculate apex of capsule dehiscent to near the middle of capsule. Calyptra conic-mitrate .................. 3. Eccremidium
5. Median laminal cells linear. Capsules immersed in perichaetial leaves, ovoid-oblong, not furrowed; peristome not terete. Calyptra mitriform, scabrous .................. 2. Garckea
5. Median laminal cells quadrate or rounded. Capsules exserted above perichaetial leaves, oblong, furrowed; peristome terete. Calyptra cucullate, smooth .................. 6
6. Plants bluish-green. Median laminal cells quadrate, not collenchymatous. Autoicous. Capsules symmetric or nearly so; inner perichaetial leaves scarcely differentiated; peristome tooth cleft into two filiform, flexuose, non-bordered segments . . 5. Saelania
6. Plants dark green. Median laminal cells quadrate, collenchymatous. Dioicous. Capsules asymmetric; inner perichaetial leaves differentiated, long-sheathing; peristome tooth cleft into two straight, bordered segments ............. 6. Ceratodon

1. **PLEURIDIUM** Rabenh., nom. cons.

Plants very small. Stems simple or divided, in cross-section with a central strand of narrow, thin-walled cells, the cortex 1 cell thick.
Leaves tapering to a subulate or acute apex from a sheathing base; costa stout, occupying 1/3 the width at sheathing base, almost the entire width at middle, in cross-section with distinct dorsal and weak ventral stereids. Laminal cells oblong-rhombooidal to rectangular, thin-walled towards apex, not differentiated at basal angles. Autoicous. Perichaetal leaves scarcely differentiated. Seta very short. Capsules immersed in perichaetal leaves, globose or ovoid, bluntly mucronate at apex, cleistocarpous; stomata present. Calyptra widely cucullate or mitrate. Spores papillose. Perigonial leaves slightly differentiated.

Key to the Species

1. Leaves imbricate, short, abruptly narrowed to a short acumen from an ovate or ovate-oblong base. ....... 1. *P. julaceum*
1. Leaves spreading, long-setaceous from an ovate or oblong sheathing base. ............... 2. *P. subulatum*

1. **PLEURIDIUM JULACEUM** BESCH. (Fig. 40, B)

J. de Bot. 12: 294 (1898).

Stems ca. 5 mm long, often arcuate. Leaves imbricate, lower leaves remote, ca. 0.4 x 0.2 mm, towards the stem-apex gradually larger, to 0.6 x 0.3 mm, from ovate or ovate-oblong base, rapidly short acuminate, rather blunt at the apex; margin erect, crenate above; costa occupying the entire width of leaf acumen, becoming somewhat narrower towards the leaf base, poorly defined, flat. Cells at base of leaf rectangular, thin-walled, 20-25 x 10-15 µm, towards margins smaller, hexagonal, rectangular, or sublinear, 18-25 x 6-10 µm, marginal cells at shoulder few, obliquely short-rhombooidal, crenate. Sporophyte unknown.

Distribution: Endemic to Japan (Honshu). Known only from the type locality.

This species is similar to *P. sullivantii*, but the taxonomic status is not certain as the sporophyte is unknown.

2. **PLEURIDIUM SUBULATUM** (HEDW.) RABENH. (Fig. 40, C)


Plants forming dense, yellowish-brown tufts. Stems simple, to 3 mm long, sparsely leaved. Lower leaves small; upper leaves much larger, to 3 mm long, often homomallous, long-setaceous from an oblong or ovate sheathing base, semitubulous above; margin ± involute above, with many small teeth at the tip, ± sinuose-serrulate at the shoulder; costa stout, sometimes occupying ca. 1/3 the sheathing base, with both dorsal and ventral stereid bands in cross-sections. Cells of sheathing base elongate-hexagonal or narrowly rectangular, towards shoulder becoming narrowly hexagonal or sublinear, thin-walled. Autoicous. Capsules 0.6-0.8 x 0.4-0.5 mm, ovoid to subglobose, orange-brown, leptodermous;
DITRICHACEAE

exothecial cells hexagonal, thin-walled, fragile, stomatous on the entire surface. Spores 18-25 µm, slightly papillose. Calyptra widely cucullate, ca. 0.4 mm long, brown, smooth. Antheridia in axillary buds, perigonal leaves to 2.2 mm in length, long-setaceous from a wide-ovate and ± cymbiform base.


Distribution: Japan (Honshu, Shikoku, Kyushu, Bonin Isls.), east Asia, Europe, eastern N.America.

This is a plant of open fields in the lowlands.
Crum (1973) mentions that stomata are present only on the basal part of the capsule, but in Japanese plants, as described above, stomata occur on the entire surface of the capsules.

2. GARCKEA C.MUELL.

GARCKEA FLEXUOSA (GRIFF.) MARG. & NORK. (Fig. 41, A)

Plants small, brownish-green, loosely tufted. Stems mostly to 10 mm or more long, often arcuate, simple; in cross-section with a central area of thin-walled cells. Lower leaves remote, small, ca. 1 mm long, triangular-lanceolate, appressed both when dry and moist; upper leaves much larger, to 2.0 x 0.4 mm, crowded in a comal tuft, oblanceolate, long-acuminate, keeled above; margin bistratose, entire, ± recurved above; costa excurrent, smooth on dorsal surface. Median laminal cells linear, 40-70 µm long, rather thin-walled; lower cells linear to elongate-rectangular, 15-40 x 4.5-8.0 µm, thin-walled; cells at the extreme base and basal angles rectangular, shorter and wider. Dioicus. Inner perichaetial leaves similar to upper stem leaves in shape but with a distinct oblong sheath; paraphyses none. Seta very short. Capsule immersed, ovoid-cylindric, widest near the base, ca. 0.80 x 0.45 mm, reddish-brown (reddish at the rim); annulus large; exothecial cells large, oblong-hexagonal, thin-walled; stomata not seen. Peristome teeth shortly inserted below the mouth to 0.2 mm long, cleft into 2-3 irregular divisions, but the apex often united with lax, large papillae, the basal part longitudinally striate, reddish-orange. Spores 12-15 µm, minutely papillose. Operculum ca. 0.25 mm long, conic or short-rostrate from a dome-shaped base. Calyptra conic-mitrata, ca. 0.4 mm long, covering only the operculum, papillose on the entire surface.

Distribution: Japan (Honshu, Shikoku, Kyushu), Taiwan, Philippines, and other regions of south Asia, C. and S.America.
Figure 41.
A. *Garckeia flexuosa* (Griff.) Marg. & Nork.  a. Plant, x8. b. Cross-section of stem, x250. c. Leaves, x34. d. Median cells of leaf, x385. e. Cells at leaf base, x250. f. Capsule, x20. g. Calyptra and operculum, x34. h. Peristome teeth, x250. [Thailand specimen]
B. *Eccremidium minutum* (Mitt.) Stone & Scott.  i, j, Plants, x34. k-n. Leaves (k, lower, l, m, median, n, upper leaves), x48. o. Cells at leaf apex, x250. p. Cells at leaf base, x180. q. Perichaetial leaf, x48. r. Calyptra, x63. [NICH 172149]
The most distinctive character of *G. flexuosa* is the ovate-cylindric capsule immersed among long-sheathing leaves at the apex of the stem, which easily distinguishes this species from all others.

3. **ECCREMIDIUM WILS.**

**ECCREMIDIUM MINUTUM** (MITT.) STONE & SCOTT (Fig. 41, B)


Plants very small, to 2 mm long. Stems very short, in cross-section composed of a few, homogeneous cells. Lower leaves lanceolate, ca. 0.5 mm long, upper leaves much longer, to 1.5 mm long, crowded, gradually tapering to a slightly flexuose, semicanaliculate subula from a narrowly oblong base; margins entire below, serrulate above; costa thin, pellucid, occupying the larger part of the leaf in the upper half, the cells of adaxial surface linear, in 3 rows, in cross-section composed of 2 rows of homogeneous cells. Lower laminal cells elongate-rectangular, 85-110 x 15-20 \(\mu m\), with thin walls, median laminal cells elongate-rectangular to sublinear, 60-80 x 8-12 \(\mu m\), thin-walled. Synoicus. Inner perichaetial leaves scarcely differentiated, ecostate. Seta short, ca. 0.2 mm long; vaginula cylindric. Capsule emergent, spherical, ca. 0.3 mm in diam., cleistocarpous, often dehiscent at near the middle of capsule; exothecial cells hexagonal or subquadrate, pellucid; stomata present on lower half of the capsule. Calyptra conic-mitrate, ca. 0.35 mm long, acuminate at the apex, grayish, blackish above, the surface-cells mostly isodiametric, projecting at the lower ends.

Distribution: Japan (Honshu), Australia, Tasmania, New Zealand.

In Japan this species is found on muddy soil of ponds which dry up in early autumn, just as in the case of *Micromitrium tenerum* (B.S.G.) Crosby. It is very interesting that *E. minutum*, an Australian moss, is disjunctly distributed in Japan. This may be caused by anthropogenic introduction.

4. **DITRICHUM HAMPE**

Plants small to medium-sized. Stems mostly simple or nearly so. Leaves appressed or homomallous, tapering to an arcuate, subulate point from a sheathing or ovate base, the lamina narrow above, sometimes wanting; margin erect or convolute, almost entire, occasionally with few teeth at the apex; costa broad, occupying almost the entire width of upper lamina, percurrent to excurrent, smooth or papillose at back. Median laminal cells narrowly rectangular; cells of sheathing base
rectangular, thin- or thick-walled. Dioicous or autoicous. Perichaetia terminal (with an innovation below perichaetium); perichaetal leaves scarcely differentiated but the sheathing base longer; paraphysis not seen. Seta elongate, straight, smooth. Capsule erect or ± inclined, mostly oblong-cylindric (broadest below the middle), symmetric or ± arcuate-recurved, ± asymmetric, with a poorly defined apophysis, furrowed when dry; stomata present. Operculum long-conic or conic, blunt at apex; annulus large. Peristome teeth 16, each tooth deeply split into two filiform segments, reddish-brown, densely papillose, erect. Spores mostly smooth. Calyptra cucullate. Inner perigonal leaves widely ovate, with a long-setaceous point, cymbiform.

Key to the Species

1. Stems tomentose. Leaves tapering to a long-setaceous point from a narrow base. Dioicous

1. D. flexicaule

1. Stems not tomentose. Leaves tapering to a setaceous point from a convolute sheathing base. Autoicous or dioicous

2. Leaves abruptly tapering to a scabrous subula entirely occupied by the costa

2. D. cylindricum

2. Leaves gradually or abruptly tapering to a smooth or less scabrous subula not entirely occupied by costa

3. D. divaricatum

3. Autoicous. Plants large; leaves longer than 5 mm

4. D. pallidum

3. Dioicous. Plants small; leaves shorter than 4 mm

5. D. macrorhynchum

5. Leaves gradually tapering to a subulate acumen; margins slightly recurved. Peristome teeth longer than 0.3 mm

5. D. macrorhynchum

5. Leaves abruptly tapering to a subulate acumen; margins erect. Peristome teeth usually shorter than 0.3 mm

6. D. heteromallum

6. Awn of perichaetial leaves much longer than the ovate base. Capsules widest near the base

6. D. heteromallum

6. Awn of perichaetial leaves slightly longer than the oblong base. Capsules widest near the middle

7. D. subtortile

1. DITRICHUM FLEXICAULE (SCHWAEGR.) HAMPE (Fig. 44, A)

Flora 50: 182 (1867).


Plants in loose silky tufts, greenish-brown above, dark brown below. Stems to 30 mm long, slender, arcuate-ascending, often forked, tomentose, loosely leaved. Leaves widely spreading, homomallous, or loosely appressed and ± flexuoese when dry, gradually tapering to a very long-setaceous point from an oblong or oblong-lanceolate base, to 6 mm long, semitubular above; margins convolute above, with few, small teeth at the tips; costa broad, flat, excurrent. Median laminal cells rounded-
rectangular or rhomboidal, 8-13 μm, thick-walled; juxtacostal cells long-rectangular, cell walls with localized thickenings, becoming much narrower towards the leaf margins, often forming indistinct, narrow bands (2-3 rows of narrow, hyaline, linear cells).

Distribution: Japan (Honshu, Shikoku). Widely distributed in the N. Hemisphere.

A calciphilous species, occurring on limestone covered with soil. The plants from Japan are usually large, with large leaves (up to 6 mm), large cylindrical capsules (ca. 3 mm long), and long (ca. 25 mm long) slender setae. The sporophytes are very rare in Japan.

2. **DITRICHUM DIVARICATUM** MITT. (Fig. 42)


Stems to 50 mm long, erect or arcuate-ascending, sparsely leaved, with leaves ca. 5 mm broad. Leaves homomallous and slightly flexuose when dry, long-setaceous from an oblong semitubular base, to 6.5 mm long, recurved; margins erect, crenate at apices; costa broad, occupying ca. 1/2 the width of sheathing base, slightly papillose at back. Median laminal cells rectangular, 9-13 μm long, thick-walled; cells at the shoulder irregular, thick-walled, 9-20 μm long, becoming larger toward the leaf base; cells of sheathing base usually elongate-rectangular, 65-85 x 9-20 μm, thin-walled, hyaline.


Distribution: Japan (Hokkaido, Honshu, Shikoku), Korea.

3. **DITRICHUM PALLIDUM** (HEDW.) HAMPE (Fig. 43)

Flora 50: 182 (1867).


Plants in dense, dark-green tufts. Stems to 10 mm long, usually forked. Leaves dense, erect-spreading, neither crisped nor flexuose when dry; lower leaves often homomallous, small, towards the stem apex longer, to 5.5 mm long, gradually tapering from an ovate-lanceolate base to a very long, subulate, semitubulous acumen; margins erect, denticulate or serrulate in the upper half; costa broad, flat, poorly defined, long excurrent, occupying most portion of the acumen, smooth at back. Upper part of lamina consisting of 1-2 rows of short linear cells similar to those of costa; cells of lower part of lamina narrowly rectangular, very thin-walled, 35-50 x 5-8 μm, cells of the extreme base narrow, rectangular or hexagonal, 65-120 x 9-16 μm (variable in size), smaller towards the leaf margins. Autoicous. Seta 15-30 mm long, yellow when young, becoming orange-brown with age. Capsule suberect, oblong-cylindric, ± curved, asymmetric, microstomous, 2.5-3.0 x 0.5-0.6 mm, red-
Figure 42. *Ditrichum divaricatum* Mitt.  

- **a.** Plant, x7.  
- **b.** Cross-section of stem, x180.  
- **c.** Leaves, x15.  
- **d.** Leaf apex, x180.  
- **e.** Cells at leaf shoulder, x250.  
- **f.** Cells at leaf base, x250.  
- **g.** Cross-sections of leaf (*g*, upper, *h*, lower parts), x180.  
- **i.** Perichaetial leaves, x15.  

[Iwatsuki M1098]
dish-brown. Operculum conic, long-rostrate, to 1 mm long. Peristome teeth ca. 1 mm long, ± twisted above. Spores 18-22 µm, scabrous. Calyptra 3.0-3.5 mm long narrow, pale. Inner perigonal leaves ca. 1 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Taiwan, Soviet Far East, Europe, eastern N. America.

This species is common in Japan, frequently occurring on sandy soil in city areas.

4. DITRICHUM HETEROMALLUM (HEDW.) BRITT. (Fig. 44, B)

Plants small, forming loose brownish-green tufts. Stems to 20 mm long, erect or arcuate-ascending, flexuose, densely leaved. Stem leaves appressed and flexuose or slightly homomallous when dry, erect-spread ing when moist, finely setaceous from an ovate sheathing base, recurved, semitubular above; margins erect, entire; costa broad, ± undefined, often occupying the greater part of subula, smooth at back. Median laminal cells sublinear to narrowly rectangular, thin-walled; cells of sheathing base sublinear to linear-rectangular, thin-walled. Dioicous. Seta 10-25 mm long, straight, red-brown to purple. Capsule 1.0-1.5 x 0.35-0.40 mm, oblong-cylindric, symmetric, widest below the middle, with apophysis, reddish-brown, somewhat narrowed at mouth. Operculum short, 0.4-0.6 mm long, long-conic, blunt at apex. Peristome teeth erect, to 0.35 mm long. Spores 8-10 µm, smooth. Calyptra ca. 2 mm long.

Distribution: Japan (Hokkaido, Honshu, Shikoku), China, Taiwan, Soviet Far East, Europe.

5. DITRICHUM MACRORHYNCHUM BROTH. EX CARD. (Fig. 44, C)


Stems to 10 mm long, sparsely leaved. Leaves homomallous or suberect when dry or moist, gradually tapering to a linear, arcuate, semitubular subula from an oblong or ovate-lanceolate base; lower leaves smaller; upper leaves much longer, to 3.5 mm long; margins slightly recurved, minutely dentate except the base; costa stout, occupying 1/2 the leaf width in the upper part, prominent and smooth at back. Upper laminal cells linear, walls ± thick; lower laminal cells elongate-rectangular or sublinear, 30-50 x 4.5-6.0 µm, towards the leaf margins ± narrower, thin-walled. Dioicous. Seta 8-10 mm long, almost straight, yellowish-brown. Capsule almost cylindric, 1.5-1.8 x 0.40-0.45 mm, dark-brown.
Figure 43. *Ditrichum pallidum* (Hedw.) Hampe.  

- **a.** Plant, x8.  
- **b.** Leaves, x15.  
- **c.** Cells at leaf base, x180.  
- **d.** Cross-sections of leaf, x250.  
- **e.** Inner perichaetial leaf, x15.  
- **f, g, k.** Capsules, x10.  
- **h.** Peristome teeth, x135.  
- **i.** Perigonium, x20.  
- **j.** Inner perigonal leaf, x20.
DITRICHACEAE

Operculum 0.7-1.0 mm long, long-conic. Peristome teeth ca. 0.5 mm long, erect. Spores 10-13 µm. Calyptra 1.8-2.0 mm long, pale. Perigonia large, terminal; inner leaves to 2.3 mm long.


Distribution: Endemic to Japan (Honshu, Shikoku).

This species grows on sandy soil in open fields.

6. DITRICHUM CYLINDRICUM (HEDW.) GROUT (Fig. 45, B)


Trichostomum cylindricum Hedw., Spec. Musc.: 107, t. 24, f. 7-13 (1801).

Plants small. Stems 2-3 mm long, loosely leaved. Leaves erect-spreading, flexuose when dry, widely spreading when moist, abruptly tapering to a subulate non-tubular point from an obovate-oblong base, dorsally scabrous in the upper half of awn; lower leaves ca. 0.5 mm long, becoming larger upwards, upper leaves to 3.5 mm long; costa filling the entire awn, much narrower than the sheathing base. Cells at the shoulder elongate-rectangular, 20-35 x 4.5-5.0 µm, thin-walled; cells near the leaf base elongate-rectangular, with thicker walls. Inner perichaetial leaves strongly embracing the base of seta, to 3.5 mm long. Seta yellowish-brown, 12-15 mm long. Capsule suberect, oblong-cylindric, straight or ± curved, brown, 1.2-1.5 x 0.35-0.45 mm. Several stomata present on the apophysis. Operculum conic, obtuse, 0.30-0.35 mm long. Peristome teeth to 0.3 mm long, reddish-brown and finely papillose below, yellowish and finely papillose above. Spores 9-13 µm, smooth.


Distribution: Japan (Honshu, Kyushu), Asia, Europe, N.America.

7. DITRICHUM SUBTORTILE CARD. (Fig. 45, A)


Plants small; stems to 3 mm long. Leaves compact, appressed and incurved when dry; lower leaves ca. 1 mm long, linear-lanceolate; upper leaves to 2 mm long, abruptly tapering to an elongate subula (subula slightly longer than the sheathing base) from an ovate or ovate-oblong base; margins plane, entire, but with several small teeth at tip; costa thin, occupying the subulate acumen leaving narrow bands of laminal cells along the leaf margins. Laminal cells often unequal in size and shape; cells near the shoulder of sheathing base narrowly rectangular or oblong-hexagonal, 30-40 x 4-8 µm, thin-walled; basal cells narrowly rectangular or linear-hexagonal, 40-65 x 4-8 µm. Dioicous. Inner perichaetial leaves to 2 mm long, embracing the base of seta with a
Figure 44.
A. *Ditrichum flexicaule* (Schwaegr.) Hampe.  a. Plant, x8.  b. Leaves, x15.  
c. Median cells of leaf, x250.  d. Cells at leaf base, x250. [Noguchi 33726]
B. *D. heteromallum* (Hedw.) Britt.  e. Leaves, x15.  f. Median cells of leaf, 
x250.  g. Cells at leaf base, x500.  h, i. Capsules, x15.  j. Peristome teeth, 
x135. [Noguchi 40711]
C. *D. macrorhynchum* Broth. ex Card.  k. Female plant, x8.  l. Male plant, 
x8.  m. Leaves, x20.  n. Median cells of leaf, x250.  o. Cells at leaf base, x250. 
p. Inner perichaetial leaf, x20.  q, r. Capsules, x15. [Noguchi 48812]
long-sheathing base, the awn shorter or as long as the sheathing base. Seta 7-12 mm long, brown. Capsule erect, cylindric to oblong-cylindric, symmetric, 1.2-1.5 x 0.3-0.4 mm; annulus large. Operculum conic-rostrate, 0.3-0.5 mm long, obtuse at tip. Peristome teeth filiform, ca. 0.25 mm long, finely papillose, brown. Spores 6-9 µm, smooth. Male plants longer than 5 mm, slender, loosely leaved; inner perigonial leaves ca. 2 mm long, long-subulate from an wide-ovate, concave base.

Distribution: Endemic to Japan (Honshu).

Species not Available

   Sakurai (1983) reported this species as new to Japan, but the specimens are not located in Sakurai's collection in MAK.


5. **SAELANIA** LINDB.

**SAELANIA GLAUCESCENS** (HEDW.) BROTH. (Fig. 46, A)


_Trichostomum glaucescens_ Hedw., Spec. Musc.: 112 (1801).

Plants small, bluish-green. Stems usually 10-15 mm long, branched; in cross-section with a central area of small, hyaline, thin-walled cells and a cortical layer of rounded, thick-walled cells. Leaves loosely appressed and ± contorted when dry, lower leaves remote, small; upper leaves much longer and dense, to 3 mm long, narrowly oblong or linear-lanceolate, arcuate, keeled; margins above the shoulder recurved, minutely serrate due to projecting cells; costa stout, prominent at back, shortly excurrent, with small mammillose teeth at back above. Median laminal cells rectangular to subquadrarte, 8-12 µm, uniformly thin-walled, inflated, often several cells strongly bulging, towards the leaf base longer; upper cells irregularly rectangular; lower cells sublinear, thin-walled, 40-55 x 8.5-12.0 µm. Autoicous. Perichaetia terminal; inner leaves scarcely differentiated, to 3 mm long; paraphyses not seen. Seta ca. 5 mm long. Capsule erect or suberect, straight, oblong-cylindric, 1.8-2.0 x 0.6-0.8 mm, yellowish-brown, ± furrowed when dry; exothecial cells long-rectangular or -hexagonal, thin-walled, with several stomata on the apophysis; annulus large, formed of 2-3 rows
Figure 45.
A. *Ditrichum subtortile* Card.  
  a. Plant, x15.  
  b. Leaves, x34.  
  c. Cells at leaf shoulder, x250.  
  d. Cells at leaf base, x250.  
  e. Inner perichaetal leaf, x34.  
  f. Capsules, x20.  
  g. Peristome teeth, x250.  
  h. Male plant, x15.  
  i. Inner perigonial leaf, x34.  
  j. Isosyntype of *D. subtortile* Card., Faurie 119

B. *D. cylindricum* (Hedw.) Grout.  
  j. Plant, x10.  
  k. Leaves, x20.  
  l. Cells at leaf shoulder, x250.  
  m. Cells at leaf base, x250.  
  n. Inner perichaetal leaf, x20.  
  o. Capsules, x15.  
  p. Peristome teeth, x180.  
  [Kan 570]
of cells. Operculum long-rostrate, acuminate at apex, 0.8-1.0 mm long. Peristome teeth 16, to 0.45 mm long, deeply split into 2, flexuose, terete, nodose and closely articulate divisions, often irregularly cleft at base, red-brown, densely papillose. Spores 15-18 µm. Perigonia on short branches below perichaetia; inner leaves wide-ovate, with a long acumen, ca. 1 mm long, with a thin costa; paraphyses not seen.

Distribution: Japan (Hokkaido, Honshu). Widely distributed in the world.

This species occurs on dry calcareous soil.

This species is easily distinguished from the allied species such as *Ceratodon purpureus* and *Ditrichum* spp. by its distinct bluish appearance. It seems to be most closely related to *Ceratodon*.

6. **CERATODON** BRID.

* Ceratodon purpureus* (HEDW.) BRID. (Fig. 46, B)

Bryol. Univ. 1: 480 (1826)


Plants in dense tufts. Stems usually 5-10 mm long, sometimes longer, sparsely leaved. Leaves loosely appressed and contorted when dry, oblong or ovate-lanceolate, gradually attenuate; lower leaves ca. 1 mm long; upper leaves to 2.2 x 0.5 mm, keeled; margins recurved or revolute, often toothed at apices; costa stout, shortly excurrent, prominent and smooth at back. Median laminal cells quadrate or hexagonal, 8.5-12.0 µm, collenchymatous; upper cells similar to the median; lower cells rectangular, 20-30 x 8.5-12.0 µm, thin-walled. Dioicous. Perichaetia seemingly lateral because of the formation of strong subperichaetal innovations; inner perichaetial leaves differentiated, long-sheathing, to 2.2 mm long; paraphysis absent. Seta 15-30 mm long, reddish-brown to purple. Capsule suberect or inclining, strongly inclined or horizontal when dry and empty, oblong-cylindric, straight or slightly curved, asymmetric, 1.5-2.2 x 0.5-0.6 mm, distinctly strumose at base, 4-6-angled, sulcate, the furrow deeper when dry; exothecial cells sub-linear or narrowly hexagonal, thin-walled, stomata present on the extreme base of capsule; annulus well-developed. Operculum conic, 0.5-0.6 mm long, blunt at apex. Peristome teeth 16, ca. 0.4 mm long, closely articulate below, bifid to near the base, erect, straight, linear, narrowly connected at the joint; segments with a paler border, yellowish above, reddish-brown and papillose below. Spores 9-13 µm, almost smooth. Calyptra cucullate. Male plants slender, perigonia gemmiform.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the world.
Figure 46.

A. *Saelania glaucescens* (Hedw.) Broth.  
- b. Cross-section of stem, x250.
- c. Leaves, x34.
- d. Leaf apex, x180.
- e. Median cells of leaf, x385.
- f. Cross-sections of leaf, x180.
- g. Capsules, x10.
- h. Peristome teeth, x180.
- i. Perigonium, x15.
- j. Inner perigonal leaf, x20. [Noguchi s.n.]

B. *Ceratodon purpureus* (Hedw.) Brid.  
- k. Leaves, x34.
- l. Cells at leaf apex, x250.
- m. Median cells of leaf, x385.
- n. Inner perichaetial leaf, x20.
- o. Moist capsule, x15.
- p. Dry capsule, x15.
- q. Cross-section of capsule, x34.
- r. Peristome teeth, x135. [Kumamoto Univ. Herb. 25074]
This species is very common in Japan, except for the western and southern districts, from lowlands to the alpine zone. It often forms dense tufts on wooden slate or thatch of house roof and can be recognized at a glance by its remarkable reddish setae. It is nitrophilous and occurs abundantly on exposed ground after fire.

This species is easily distinguished from the allied species by its quadrate laminal cells, sulcate capsules and its straight, horn-shaped peristome teeth.

7. **DISTICHIUM** B.S.G.

**DISTICHIUM CAPILLACEUM** (HEDW.) B.S.G. (Fig. 47)

*Bryol. Eur. 2: 156, t. 193 (1846).*

*Cynodontium capillaceum* Hedw., *Spec. Musc.*: 57 (1801).

Plants slender, forming dense, silky dark-green tufts. Stems to 20 mm long, with a node at the insertion of each leaf. Leaves distichous, 3-5 mm long, suddenly tapering to a long-setaceous, scabrous point from an oblong, whitish, glossy, ± conduplicate sheathing base; margins crenate at shoulders; costa stout, occupying almost the entire width of the subula, rough at back, becoming narrower towards the leaf base. Cells of sheathing base pellucid, linear, ± vermicular, 85-140 x 3-4 µm, thin-walled; cells becoming shorter upwards, rectangular or rhomboidal at the shoulder, and small, rectangular or subquadrate in the subula, papillose, 15-30 x 2-3 µm. Autoicous. Perichaetial leaves scarcely differentiated. Seta to 20 mm long, straight, reddish-brown. Capsule erect or slightly inclined, cylindric or oblong-cylindric, symmetric, brown, to 2.5 x 0.5 mm, with an indistinct apophysis; stomata present; annulus large. Operculum conic, to 0.5 mm long. Peristome teeth 16, inserted below the mouth, equidistant, sublinear, not or variously divided into two, ca. 0.35 mm long, reddish-orange, minutely papillose. Spores 15-20 µm, finely papillose. Calyptra cucullate, ca. 3 mm long. Perigonial leaves ca. 2 mm long, similar to the stem leaves but with a broader sheathing base; paraphyses numerous.

Distribution: Japan (Hokkaido, Honshu, Shikoku). Widely distributed in the world.

This species occurs in the subalpine or alpine zone in Japan. This species is similar to *Bryoxiphium norvegicum* in its distichous foliation. Beside the difference of their habitats, *Distichium capillaceum* is easily recognized by its less piliferous appearance and also the whitish, glossy, sheathing bases of leaves.
Figure 47.
*Distichium capillaceum* (Hedw.) B.S.G.  

- **a.** Plants, x6.  
- **b.** Upper part of plant, x13.  
- **c.** Leaves, x17.  
- **d.** Cells at leaf apex, x200.  
- **e.** Median cells of leaf, x200.  
- **f.** Cells at leaf shoulder, x200.  
- **g.** Cells at leaf base, x200.  
- **h.** Capsules, x17.  
- **i.** Peristome teeth, x200.  
- **j.** Perigonal leaves, x17.

[Noguchi s.n.]
BRYOXIPHIUM NORVEGICUM SUBSP. JAPONICUM (BERGGR.) LÖVE & LÖVE
(Fig. 48)

Bryologist 56: 197 (1953).

Eustichia japonica Berggr. in Geh., Flora 64: 290 (1881).

Plants yellowish-green to brown, in dense tufts. Stems to 30 mm long, simple, occasionally with innovations at the median part of stem. Leaves erect-appressed, overlapping, distichous, oblong-lanceolate, widest at the base; median leaves to 1.7 mm long, ca. 0.3 mm wide, vaginant lamina rounded-obtuse or emarginate above; dorsal lamina narrow, extending to the leaf base, or in the uppermost leaves, ending far above the leaf base; margins entire or crenulate, but often serrate on the subula of upper leaves; costa stout, becoming narrower downward, shortly excurrent (long excurrent in the upper leaves), with minute serration. Median cells of vaginant lamina hexagonal to subquadrate, 12-25 x 10-12 µm, evenly thin-walled, the cells in the external outer half of sheathing base linear, 30-45 µm long; cells in upper part of lamina narrower than the inner cells of sheathing base, lower cells similar to median cells. Dioicous. Perichaetia terminal; perichaetial leaves with a very long piliferous, hyaline, serrulate point, to 5 mm long, vaginant lamina gradually narrowed upward and extending the leaf apex, serrate; dorsal lamina narrow, extending downward along costa but ending far above the leaf base; margins of subula serrate to crenate; external and internal areolations not clearly different. Seta flexuose when dry, cygneous when moist, 2.5-3.0 mm long. Capsule drooping, almost globose, 0.7-1.0 mm long. Operculum ca. 0.7 mm long, with an oblique beak. Calyptra cucullate, ca. 1 mm long, wide at base. Male plant similar to the female both in shape and size. Perigonia terminal; inner perigonial leaves to 5 mm long, vaginant lamina large, rounded-obtuse at apex, serrulate above; paraphyses few.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Taiwan, Philippines, Lombok Isl., Soviet Far East (incl. Kamchatka).

In Japan this species is usually seen on volcanic rocks such as andesite and basalt, rarely on quartz porphyry, etc. Large tufts are found on moist or dry but shaded rock faces. Plants in caves have longer hair points which afford the plant a distinct by hairy appearance.
Figure 48.
*Bryoxiphium norvegicum* subsp. *japonicum* (Berggr.) Löve & Löve.  
a. Plant, x5.  
b. Leaves, x34.  
c. Cells at leaf apex, x250.  
d. Cells at leaf base, x250.  
e. Cells at upper part of leaf, x250.  
f. Inner perichaetial leaf, x34.  
g. Capsule and perichaetial leaves, x10.  
h. Capsule, x20.  
i. Tip of male plant, x10.  
j. Inner perigonial leaf, x34.  
[Kumamoto Univ. Herb. 29118]
Sporophytes are rarely found in Japan, and fertile plants seem to be restricted to high latitudes or high altitudes.

**SELIGERIACEAE**

**Key to the Genera**

1. Basal and alar regions of leaves differentiated, the cells lax, reddish-brown. Dioicous .......................... 1. *Blindia*

2. Leaves gradually tapering to a linear or subulate point from a ± narrow base. Capsules not sulcate when dry, annulus none. Peristome teeth not truncate. Calyptra cucullate .......................... 2. *Seligeria*


1. **BLINDIA** B.S.G.

Plants small, brownish-green. Leaves linear-lanceolate or gradually tapered to an elongate, subulate acumen from an ovate-oblong base, concave; margins erect to involute, often with small teeth at tips; costa occupying a large part of subulate acumen. Median laminal cells narrowly rectangular; basal cells ± larger, brownish; alar areas distinct, brown, the cells subquadrate, thick-walled. Dioicous. Inner perichaetial leaves with a large sheathing base. Seta elongate, straight or curved. Capsule erect or drooping, ovoid to obovoid; annulus none. Operculum rostrate. Peristome teeth 16, lanceolate, acuminate, not split at tips, smooth, reddish-brown.

**Key to the Species**

1. Plants large, stems to 20 mm long or more. Acumina of inner perichaetial leaves shorter than vaginant laminae. Seta straight when dry and moist. Capsules erect to suberect .......................... 1. *B. acuta*

2. Plants small, ±10 mm long. Acumina of inner perichaetial leaves much longer than vaginant laminae. Seta flexuose and cygneous when dry, arcuate-curved when moist. Capsules drooping .......................... 2. *B. japonica*

1. **BLINDIA ACUTA** (HEDW.) B.S.G. (Fig. 49, B)


Stems usually ca. 20 mm long or more. Leaves appressed, not crisped or incurved when dry; lower leaves linear-lanceolate, ca. 1.5 mm
long; upper leaves linear-lanceolate, somewhat sheathing at bases, semicanaliculate, to 3 mm long; margins involute or erect, entire, but with several small teeth at tips; costa thin, running into the acumen. Median laminal cells narrowly rectangular or sublinear, 20-35 x 4-6 \( \mu \text{m} \), thick-walled; lower cells similar to the median; alar areas distinct, brown, the cells subquadrate or hexagonal, 10-20 \( \mu \text{m} \), thick-walled. Inner perichaetial leaves to 2.5 mm long, embracing the base of seta with a large sheathing base, the acumen shorter than the sheathing base. Seta 4-5 mm long, straight or \( \pm \) flexuose. Capsules erect, obovoid, 0.9-1.2 x 0.6-0.7 mm. Male plants similar to the female.

Distribution: Japan (Hokkaido, Honshu), Aleutians, N. America, Greenland, Europe.

As I could not obtain an adequate Japanese collection, the above description and illustration were based on the European material.

2. **BLINDIA JAPONICA** BROTH. (Fig. 49, A)


Plants small, yellowish-green. Stems simple or forked, ca. 10 mm long, densely leaved. Leaves appressed to stem and somewhat flexuose when dry, somewhat homomallous when moist, abruptly tapering to a very long-subulate, semicanaliculate point from an ovate or lanceolate, somewhat sheathing base; lower leaves small, gradually larger upwards, to 2.5 mm long; margins minutely denticulate at tips; costa broad, ca. 65 \( \mu \text{m} \) wide at base, poorly defined, occupying the entire width of subula, almost smooth at back. Median laminal cells of sheathing base rectangular to narrowly so, 17-30 x 4-5 \( \mu \text{m} \), thick-walled, towards margin shorter; basal cells, especially those of alar regions, differentiated, the cells larger, inflated, rectangular to subquadrate, 6-15 \( \mu \text{m} \), reddish-brown. Dioicous. Perichaetium terminal; inner perichaetial leaves similar to the upper stem leaves but the sheathing base much larger. Seta largely flexuose and cygneous when dry, arcuate and cygneous when moist, 2.5-3.0 mm long, ca. 80 \( \mu \text{m} \) thick, yellowish, smooth. Capsule ovoid to subglobose, microstomous, with a distinct apophysis, drooping when moist, 0.7-1.0 x 0.4-0.5 mm, brown; stomata present; annulus wanting. Operculum conic, acuminate at tip, 0.4-0.5 mm long. Peristome teeth irregularly lanceolate, finely attenuate, widest at bases, closely articulate, to 0.2 mm long, orange-red, pale above, smooth. Spores 10-13 \( \mu \text{m} \), verrucose. Calyptra widely cucullate, with a short beak, ca. 1 mm long. Male plant smaller. Perigonia terminal, the inner leaves cymbiform with long-subulate points, ca. 1 mm long; paraphyses numerous.


Distribution: Japan (Honshu, Shikoku, Kyushu), China.

This species seems to prefer to volcanic rocks. This species resembles *Campylopodium euphorocladum* (C.Muell.)
Besch. in the cygnoeous setae, but can be easily distinguished under the microscope by the remarkable group of inflated, reddish-brown cells at the leaf base. By the same feature this species is also separated from other allied taxa as *Dicranella*. It may be noted that the cells often remain on the stem when the leaves are detached.

2. **SELIGERIA** B.S.G.

Plants minute. Leaves crowded above, smaller below, usually subulate from an ovate or oblong or sublinear base; margins erect, entire; costa percurrent to excurrent, broad, occupying almost the entire width of awn, smooth on the dorsal surface. Laminal cells plane, somewhat obscure; median cells rounded to rhomboidal, thick-walled; lower cells larger, rectangular to linear, thin-walled; alar cells not differentiated. Autoicous. Inner perichaetial leaves scarcely differentiated. Seta terminal, stout, long. Capsule erect, oblong to obovate, macrostomous, with or without apophysis. Operculum long-rostrate. Annulus absent; stomata present. Peristome teeth short, obtuse, smooth. Calyptra cucullate. Perigonia terminal. Perigonal leaves ovate; paraphyses not seen.

Key to the Species

1. Leaves in many rows, long-setaceous, from a short ovate or oblong base, acute at tip; costa consisting of 3 layers of cells . . . . . .
   ........................................................................................................ 1. *S. pusilla*

1. Leaves in 3 rows, gradually tapered to an obtuse tip; costa thin, consisting of 2 layers of cells . . . . . . . 2. *S. austriaca*

1. **SELIGERIA PUSILLA** (HEDW.) B.S.G. (Fig. 50, A)

*Bryol. Eur. 2: 10, pl. 110 (1846).*

*Weissia pusilla* Hedw., Spec. Musc.: 64 (1801).

Plants with very short stems, deep green. Lower leaves small, sublinear, upper leaves larger and crowded, long-setaceous from a short, ovate or oblong, concave base, to 1.5 mm long, acute or subacute; margins entire; costa excurrent, consisting of 3 layers of cells in cross-section in the lower part, delimitation between costa and lamina in cross-section clear. Median laminal cells rectangular, 15-20 x 6-7 µm, thin-walled; lower cells longer. Perichaetial leaves with oblong base, gradually tapering to a broadly subacute apex, to 1 mm long, wider than upper stem leaves; costa weak. Seta ca. 0.8 mm long, ca. 80 um thick, straight. Capsule erect, subglobose to obovate, with an indistinct apophysis. Operculum convex, with a short, oblique beak, 0.25-0.30 mm long. Peristome teeth widely lanceolate, obtuse, ca. 0.15 mm long, reddish-brown. Perigonia ca. 0.35 mm long; inner perigonal leaves ovate, shortly narrowed at apex, weakly costate; paraphyses not seen.
Distribution: Japan (Honshu, Shikoku), Caucasus, Europe, Alaska, eastern N. America.

This tiny moss grows on cliffs and the dry floors of small limestone caves, not associated with other mosses. The sporophytes are very rare.

2. **SELIGERIA AUSTRIACA** SCHAUER (Fig. 50, B)

*Nov* *Hedwigia* 14: 323, f. 7-12 (1967).

Leaves in 3 rows, linear from oblong base, blunt at tip; median leaves ca. 0.45 mm long; upper leaves to 1.2 mm long; margins almost entire; costa broad, excurrent, delimitation between costa and lamina in cross-section indistinct, consisting of 2 layers of cells in cross-section. Median laminal cells thin-walled, rectangular to subquadrate, 8-13 x 6-8 µm, becoming longer below; lower cells narrowly rectangular, 15-20 x 4.0-4.5 µm.

Distribution: Japan (Honshu, Shikoku, Kyushu), Europe.

This species occurs on exposed limestone.

Species not Available


3. **BRACHYDONTIUM** FUERNR.

**BRACHYDONTIUM TRICHODES** (WEB.) Mild. (Fig. 50, C)

*Bryol. Siles.*: 89 (1869).


Plants minute, almost acaulescent. Leaves crowded above, gradually tapering to a subulate apex from an ovate or oblong, concave base; median leaves ca. 1 mm long; upper leaves to 1.7 mm long; margins erect, entire; costa occupying the entire width of leaves in the upper half. Median laminal cells rounded, 4-5 µm, thick-walled, ± obscure; lower cells rectangular, 20-35 x 8-10 µm, thin-walled, toward the leaf margin becoming narrower; alar cells not differentiated. Autoicous. Perichaetia terminal, the leaves similar to the upper stem leaves, but the sheathing base wider. Seta 1.5-2.5 mm long, straight. Capsule erect, oblong, 0.4-0.5 x 0.25-0.30 mm, sulcate when dry, stomata present; annulus large.
Figure 49.
A. Blindia japonica Broth. a. Plants, x1. b. Dry plant, x11. c. Leaves, x23. d. Cells at leaf apex, x130. e. Cells at leaf base, x130. f. Inner perichaetial leaf, x23. g. h. Capsules, x11. i. Peristome teeth, x130. j. Perigonium, x11. k. Inner perigonal leaf, x23. [Noguchi 16112b]
B. B. acuta (Hedw.) B.S.G. l. Plant, x10. m. Leaves, x34. n. Median cells of leaf, x250. o. Cells at leaf base, x250. p. Inner perichaetial leaf, x34.
q. Male plant, x10. r. Inner perigonal leaf, x20. [European specimen]
Figure 50.

A. *Seligeria pusilla* (Hedw.) B.S.G.  a. Plant, x34.  b. Leaves, x48.  c. Cells at leaf apex, x245.  d. Median cells of leaf, x245.  e. Cells at leaf base, x245.  f. Inner perichaetial leaf, x48.  g. Capsule, x34.  h. Peristome teeth, x180.  i. Perigonium, x48. [Takaki 12176]

B. *S. austriaca* Schauer.  j. Leaves, x48.  k. Cells at leaf apex, x250.  l. Cells at leaf base, x250. [Noguchi 36369]

C. *Brachydontium trichodes* (Web.) Mild.  m. Plant, x20.  n. Leaves, x34.  o. Cells at leaf apex, x250.  p. Median cells of leaf, x250.  q. Cells of leaf base, x250.  r. Inner perichaetial leaf, x34.  s. Perigonium, x34.  t. Inner perigonal leaf, x48. [Noguchi 36981]
Operculum long-rostrate, ca. 0.25 mm long. Peristome teeth very short, scarcely exserted above the rim, truncate at apex, smooth. Calyptra mitriform, lobed at base, ca. 0.5 mm long. Perigonia below the perichaetia, ca. 0.65 mm long; inner perigonal leaves ovate, shortly attenuate, ca. 0.45 mm long; paraphyses none.

Distribution: Japan (Honshu), Europe, N. America.

The oblong, sulcate capsules and the very short peristome teeth are characteristic. Iwatsuki (1956) reported this species from a vertical acid rock on a sunny slope at an altitude of ca. 2400 m on Mt. Tateyama.

**DICRANACEAE**

Key to the Genera

1. Capsule with a long apophysis ........................................... 2
2. Capsule without distinct apophysis ...................................... 3
3. Seta not longer than the capsule. Operculum and peristome not differentiated ......................................................... 1. Bruchia
4. Seta longer than the capsule. Operculum and peristome differentiated ................................................................. 2. Trematodon
5. Operculum and peristome not differentiated ... 4. Pseudephemerum
6. Operculum and peristome differentiated ........................................ 4
7. Seta flexuose when dry ........................................................ 5
8. Seta straight (excl. Oreas and Campylopus) when dry ............. 7
9. Alar cells of leaves differentiated .................................... 8. Dicranodontium
10. Alar cells of leaves not differentiated ........................................ 6
11. In cross-section, costa lacking both guide cells and stereids .......................... 10. Brothera
12. In cross-section, costa with guide cells and stereids .................. 6. Campylopodium
13. In cross-section, costa lacking guide cells and stereids ........... 8
14. Plants soft. Stems shorter than 10 mm, often with clustered, linear brood leaves at the stem apex. Peristome teeth not divided .......................... 12. Oreas
16. Alar cells of leaves scarcely differentiated ............................. 10
17. Alar cells of leaves differentiated ...................................... 19
18. Seta cygneous when moist .................................................. 11
19. Seta straight when moist .................................................. 12
20. Leaf costa much narrower than the width of acumen. Capsules almost globose. Peristome teeth not divided .......................... 12. Oreas
22. Inner perichaetial leaves ending far below the capsule ........... 13
DICRANACEAE

12. Inner perichaetal leaves extending to or over the capsule ........................................ 18. Holomitrium
13. Leaves lanceolate, ovate or elliptic, obtuse to shortly acuminate .................................. 14
13. Leaves from an ovate or oblong sheathing base to an elongate or subulate acumen ..................... 15
14. Laminal cells flat ........................................ 3. Aongstroemia
14. Laminal cells bulging ...................................... 15. Dichodontium
15. Plants minute. Peristome teeth smooth ........................................ 11. Rhabdoweisia
15. Plants rather large. Peristome teeth striate below, papillose above .................................. 16
16. Peristome teeth longitudinally bifid above ........................................ 17
17. Leaves crispate or contorted when dry. Capsules inclined, often with a crop at base ............... 17. Oncophorus
17. Leaves scarcely crisped nor contorted when dry. Capsules erect or nearly so, usually without crop ........................................ 18
18. Capsule sulcate when dry .................................. 13. Cynodontium
18. Capsule not sulcate when dry .................................. 5. Dicranella
19. Alar regions of leaves delimited by a large-cell group, the cell walls as thick as those of the upper laminal cells. Peristome teeth undivided ........................................ 16. Dicranoweisia
19. Alar regions of leaves distinctly delimited due to large cells with brownish or delicate walls. Peristome teeth bifid or perforate along the median line ........................................ 20
20. Costa broad, occupying 1/3 to 1/2 width at the leaf base ........................................ 21
20. Costa occupying less than 1/3 width at the leaf base ........................................ 22
21. Leaves ± incurved, flexuose or secund when dry, gradually or abruptly narrowed to a setaceous point from a lanceolate base. In cross-section, stereid cells form a wide band . . . 8. Dicranodontium
21. Leaves erect or nearly so and appressed when dry, gradually narrowed to a setaceous point from an ovate or lanceolate base. In cross-section, stereid cells form a small group but not a wide band ........................................ 7. Campylopus
22. In cross-section, leaf costa lacking stereids ........................................ 22. Dicranoloma
22. In cross-section, leaf costa with stereids ........................................ 23
23. Leaf margins distinctly bordered by hyaline, linear cells ........................................ 23. Leucoleoma
23. Leaf margins not bordered ........................................ 24
24. Peristome teeth not bifid, longitudinally perforated ........................................ 19. Arctoa
24. Peristome teeth bifid, occasionally trifid ........................................ 25
25. Capsule ovoid to oblong-ovoid, often with a small crop at base ........................................ 20. Kiseria
25. Capsule cylindric to oblong-cylindric, without crop at base ........................................ 21. Dicranum
1. **BRUCHIA** SCHWAEGR.

**BRUCHIA MICROSPORA** NOG. (Fig. 51)


Plants minute, terrestrial. Stems to 4 mm long, simple or sparingly branched. Lower leaves small; upper leaves much larger, to 1.8 mm long, dense, somewhat flexuose when dry, erect-spreading and somewhat recurved when moist, abruptly tapering to subulate acumen from ovate, concave base, canaliculate above; margins often crenulate above; costa stout, extending almost to leaf apex. Median laminal cells rectangular, thin-walled, narrower towards leaf margins; upper cells rectangular with thicker walls, 15-25 x 5-6 µm; lower cells rectangular to narrowly hexagonal, 30-45 x 9-12 µm. Synoicous. Perichaetia terminal, inner leaves similar to upper stem leaves but larger, cochleariform. Seta short, 0.8-2.5 mm long, yellowish-brown, curved when dry. Capsule erect, cleistocarpous, ovoid, obovoid or ellipsoid, with large apophysis (almost as large as the fertile area), 1.3-20 x 0.50-0.65 mm, yellow to yellowish-brown, with a few stomata, apophysis rugose when dry. Spores with dense spinous or long papillae or reticulate, 17-28 µm. Calyptra mitriiform, lobed at base, smooth, ca. 0.55 mm long, covering ca. 1/3 the length of capsule.


Distribution: Japan (Kyushu).

2. **TREMATODON** MICHX.

Stems short, usually simple. Leaves suddenly tapering to elongate, semicanaliculate awns from oblong or ovate, clasping bases; margins entire; costa stout, usually occupying almost the entire width of awn, thin in the sheathing base. Laminal cells subquadrate, rectangular, or narrowly hexagonal, becoming longer toward the leaf base, thin-walled; alar cells not differentiated. Autoicous. Perichaetia terminal; inner perichaetial leaves differentiated, the sheathing part larger than in stem leaves. Seta elongate, yellow, contorted and flexuose when dry. Capsule straight or slightly curved, asymmetric, cylindrical, apophysis slender, as long as or longer than the urn, occasionally shorter, strumose; annulus present. Operculum with elongate, oblique beak. Peristome teeth 16, linear-lanceolate; several stomata on apophysis. Spores medium-sized, densely papillose. Calyptra cucullate, smooth. Male shoot on the basal part of female plant, with many leaves; inner perigonal leaves abruptly subulate from ovate, inflated base; costa weak or absent; paraphyses and archegonia few.

This genus is easily distinguished by its arcuate capsule with a very long apophysis on an elongate seta.
Figure 51. 
Bruchia microspora Nog.  
b. Dry plant, x14.  
c. Leaves, x31.  
d. Cells at leaf apex, x180.  
e. Cells at leaf base, x117.  
f. Inner perichaetal leaf, x31.  
g. Capsule, x14.  
h. Calyptra, x14.  
i. Spores, x327.  
j. Inner perigonial leaf, x31.  
[Holotype of B. microspora Nog.]
Key to the Species

1. Costa occupying ca. 1/2 the width of the awn; apophysis much longer than the urn .......................... 1. T. longicollis  
1. Costa occupying the entire width of the awn; apophysis almost as long as the urn .................................................. 2  
2. Peristome teeth evenly and minutely papillose, scarcely barred on the outer surface ................................. 4. T. mayebarae  
2. Peristome teeth vertically barred on the outer surface .... 3  
3. Awns of the upper stem leaves shorter than the heathing base; urn narrowly oblong-ovate .............................. 2. T. ambiguus  
3. Awns of the upper stem leaves as long as or longer than the sheathing base; urn rounded ...................... 3. T. semitortidens

1. TREMATODON LONGICOLLIS MICHX. (Fig. 52, A)

Fl. Bor. Am. 2: 289 (1803).


Stems 3-5 mm long, densely leaved. Lower leaves gradually tapered to narrow awns from short, ovate-oblong bases, ca. 1 mm long; upper leaves larger (to 2 mm long and 0.5 mm wide), somewhat flexuose when dry, erect-spreading or homomallous when moist, rather narrow with a broadly ovate or obovate, sheathing base and an elongate, incurved or flexuose, semicanaliculate subula; margins slightly involute, entire but crenate at extreme apices; costa percurrent, occupying ca. 1/2 the width of awn. Median cells of sheathing base elongate hexagonal or rectangular, 30-40 µm long, shorter towards leaf shoulder, much larger toward leaf base, sublinear, 55-75 x 8-10 µm; cells of subulate lamina (in 2-3 rows) subquadratic or rectangular, 8-10 µm. Inner perichaetial leaves subulate from elongate, clasping sheathing bases, the awn as long as or shorter than the sheathing base, to 3.5 mm long. Seta 15-30 mm long, slightly flexuose, yellowish-brown. Urn cylindric, 2-3 x 0.45-0.65 mm, slightly arcuate, often with oblique mouth; apophyses elongate, at least three times as long as urn, 3.5-6.0 mm long, reddish-brown. Peristome teeth to 0.5 mm long, yellowish-brown, bifid, densely, vertically barred. Spores scabrous, 20-25 µm. Calyptra 2.5-3.5 mm long.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu, Bonin Isls.). Widely distributed in the N.Hemisphere.
Figure 52.
A. *Trematodon longicollis* Michx. a. Plants, x1. b. Leaves, x23. c. Median cells of leaf, x250. d. Cells at leaf shoulder, x250. e. Cross-sections of leaf, x385. f. Inner perichaetial leaf, x23. g, h. Capsules, x10. i. Peristome teeth, x135. j. Inner perigonial leaf, x34. [Faurie 763]

B. *T. ambiguus* (Hedw.) Hornsch. k. Plants, x1. l. Plants, x15. m. Leaves, x34. n. Cells at leaf shoulder, x250. o. Cells at leaf base, x250. p. Inner perichaetial leaf, x34. q. Inner perigonial leaf, x34. [Isotype of *T. lunariaceus* Besch.]
This species is common on the ground in exposed fields or on disturbed ground near human inhabitation.

Although the size of capsules is very variable, the long, slender apophysis affords this plant a very remarkable character. The subula, long in proportion to the sheathing base, and the narrow costa not occupying the entire width of subula are also helpful characters in separating the species from other species of Trematodon.

2. **TREMATODON AMBIGUUS** (HEDW.) HORN SCH. (Fig. 52, B)

Flora 2: 88 (1819).


Plants small, almost acaulescent. Lower leaves small, upper leaves larger, to 1.5 mm long and 0.5 mm wide, abruptly tapering to a short subulate point from an oblong, sheathing base; awn longer than or almost as long as the sheathing base, blunt at tip; margins entire but crenate at apex; costa occupying the full width of awn. Median laminal cells of sheathing base lax, elongate-rectangular, 35-55 x 9-13 µm, thin-walled; cells of leaf shoulder rectangular or subquadrate, 8-12 µm, thick-walled. Inner perichaetial leaves to 2 mm long, base broadly oblong and clasping; costa extending into awn, the awn shorter than the sheathing base. Seta ca. 7 mm long (or longer), flexuose, yellow. Capsule slightly curved; urn 1.0-1.2 x 0.5-0.6 mm, brown; apophysis almost as long as the urn. Peristome teeth ca.0.25 mm long, linear-lanceolate, vertically barred, minutely papillose above, reddish-brown. Spores 20-30 µm. Calyptra ca. 1.5 mm long.

Distribution: Japan (Hokkaido, Honshu), China, Soviet Far East (incl. Kamchatka), Europe, N.America.

A characteristic of this species is that the stem leaves are abruptly tapered to rather short awns from broad sheathing bases.

3. **TREMATODON SEMITORTIDENS** SAK. (Fig. 53, A)


Stems to 0.7 mm long. Lower leaves small, upper leaves much larger, to 2 mm long, setaceous from oblong, concave sheathing bases, slightly incurved when dry; margins entire; costa occupying the entire width of awn. Median cells of sheathing base narrowly hexagonal, 45-70 x 8.5-13.0 µm, very thin-walled, narrower towards leaf margins; lower cells similar to the median. Inner perichaetial leaves ca. 1.8 mm long, the sheathing portions longer than awn. Seta short, ca. 1.8 mm long,
Figure 53.

A. *Trematodon semitortidens* Sak.  
   a. Plant, x15.  
   b. Leaves, x34.  
   c. Cells at leaf shoulder, x180.  
   d. Cells at leaf base, x180.  
   e. Inner perichaetial leaf, x34.  
   f. Peristome teeth, x180.  
   g. Calyptra, x20.  
   h. Inner perigonial leaf, x34.  
   [Iwatsuki 28732]

B. *T. mayebarae* Tak.  
   i. Plants, x10.  
   j. Leaves, x20.  
   k. Cells at leaf shoulder, x250.  
   l. Cells at median part of sheathing base, x250.  
   m. Cells at leaf base, x250.  
   n. Inner perichaetial leaf, x20.  
   o. Capsule, x10.  
   p. Peristome teeth, x180.  
   q. Inner perigonial leaf, x34.  
   [Mayebara 1084]
ca. 80 μm thick, curved. Capsule inclined or slightly pendent, curved when dry, with apophysis to 1.2 mm long and 0.45 mm wide, the apophysis as long as the subglobose urn. Operculum 0.45-0.50 mm long. Peristome teeth linear-lanceolate, ca. 0.25 mm long, loosely and obliquely barred, and papillose on the outer surface. Spores 30-35 μm, minutely papillose, brown. Calyptra 0.9-1.0 mm long.

Distribution: Endemic to Japan (Honshu, Kyushu).

This species is characteristic in the following respects: (1) the thin-walled laminal cells; (2) the short seta; and (3) the subglobose urn.

4. **TREMATODON MAYEBARAE** TAK. (Fig. 53, B)


Stems short. Lower leaves linear-lanceolate; upper leaves larger, to 3 mm long, abruptly subulate from long, oblong, concaved base, the base as long as awns; margins entire; costa occupying the entire width of awn. Median cells of sheathing base rectangular to narrowly hexagonal, 20-40 x 8-10 μm, thick-walled, smaller towards shoulders; lower cells rectangular to elongate-rectangular, thin-walled. Perichaetial leaves similar to upper stem leaves both in shape and size. Seta 4-15 mm long, yellow. Urn brown, 3.5-4 mm long, slender, cylindric, slightly curved; apophysis as long as the urn. Operculum long-rostrate, to 1.2 mm long. Peristome teeth linear, blunt at tip, ca. 0.35 mm long, evenly, densely and minutely papillose on both surfaces. Spores 10-13 μm, finely papillose. Calyptra 2.0-2.7 mm long.

Distribution: Endemic to Japan (Kyushu).

In this species the peristome teeth are very characteristic, being not perforated but densely papillose and indicating relationships with *Ditrichum*. As to the taxonomic status of this curious species I am not certain, and follow the original author’s idea at present.

3. **AONGSTROEMIA** B.S.G.

Plants small. Stems julateous. Leaves appressed, ovate to oblong; margins erect, often with small teeth above; costa stout, extending close to leaf apex or ending far below. Median laminal cells ovate to rhomboidal, slightly vermicular, thick-walled, longer towards leaf base, shorter towards leaf margins. Seta smooth, erect; capsule erect, ovoid-cylindric; peristome teeth when present inserted below rim, often split or perforate.

Key to the Species

1. Leaves not imbricate, often secund to recurved, acute to acuminate;
margins crenate above due to projection of bulging cell; costa extending to near the leaf apex ............ 1. *A. orientalis*

1. Leaves closely imbricate, neither secund nor recurved, apex rounded; margins crenate, toothed above, the tooth often in pairs; costa ending far below the leaf apex ............ 2. *A. fuji-alpina*

1. **AONGSTROEMIA ORIENTALIS** MITT. (Fig. 54, A)


Plants lustrous, small, yellowish-brown above, brown below. Stems slender, arcuate, to 5 mm long, julaceous. Leaves not imbricate, often homomallous in the upper part of stem both when dry and moist, ovate, acute to acuminate, to 0.6 x 0.3 mm, recurved, concaved, margins slightly incurved, irregularly toothed only at middle; costa stout, ca. 40 µm at base, extending to just below the leaf apex, yellowish, smooth. Median laminal cells hexagonal to subquadrate, 4.5-6.5 µm, evenly thin-walled (thicker in the older leaves); the marginal cells in one or two rows obliquely long-rhomboidal, suggestive of a poorly developed border; upper cells similar to the median cells but slightly longer; lower and alar cells clathrate, quadrate to hexagonal, thin-walled. Seta 8-10 mm long; capsule erect; peristome lacking.

Distribution: Japan (Honshu), China, Taiwan, Burma, Himalaya, Philippines, Borneo, C.America.

In Japan this species is rare, being found in dry grassland of the subalpine zone in Chichibu district.

The above description of sporophytes is based on Bartram's "Mosses of Guatemala".

2. **AONGSTROEMIA FUJI-ALPINA** (TAK.) IWATS.


Plants slender, soft, yellowish-green above, brownish below. Stems simple or forked, densely leaved, terete. Leaves imbricate, elliptic to ovate-oblong, 0.5-0.6 x 0.4 mm, rounded-obtuse, cochleariform, concave; margins entire below, mammilllose-crenate in the upper half; the teeth often composed of two compound cells which are slightly bent from each other; costa stout below, scarcely narrower upwards, ceasing far below the leaf apex, occasionally shortly branched. Median laminal cells subquadrate or shortly hexagonal, thin-walled; upper cells somewhat smaller, rhomboidal, thick-walled, the delimitation between cells obscure; lower cells lax, rectangular. Gemmae present.

Distribution: Japan (Honshu), Himalaya.

Few collections of this species have been made. Sporophytes were
found in the collection made on Mt. Fuji but they were too young to show the detailed structure.

4. PSEUDEPHEMERUM (LINDB.) HAG.

PSEUDEPHEMERUM NITIDUM (HEDW.) REIM. (Fig. 54, B)


Plants minute. Stems short, simple. Lower leaves small, remote, linear-lanceolate; upper leaves much larger, dense, crowded at the stem apex, oblong-lanceolate, acuminate, to 2 mm long; margins serrulate above; costa slender, extending to near leaf apex. Laminal cells pellucid, thin-walled; median cells elongate-hexagonal or -rectangular, 50-75 x 12-15 \( \mu m \); upper cells sublinear each with a papilla on the upper corner; lower cells lax, rectangular, smaller towards leaf margins. Synoicous. Seta very short. Capsule emergent or immersed, globose, apiculate, cleistocarpous, 0.25-0.30 mm long, reddish-brown, with stomata on the apophysis. Spores 30-45 \( \mu m \), indistinctly papillose. Calyptra wide-cucullate, 0.20-0.25 mm long. Antheridia occurring near the archegonia.

Distribution: Japan (Kyushu), Europe, northern and central Africa, S.America.

5. DICRANELLA (C.MUELL.) SCHIMP.

Stems simple or often forked by innovations. Leaves usually tapering to long-setaceous points, margin serrulate above or entire except near apex, costa occupying a large part of subula, occasionally with several teeth at back above. Median cells of sheathing base rectangular to linear, larger towards leaf base; alar cells not differentiated. Dioicous. Perichaetia terminal, base of inner leaves usually longer and more clasping than those of stem leaves. Seta elongate, smooth. Capsule erect or inclined, oblong or cylindric-oblong, usually with small apophysis, occasionally strumose. Peristome teeth 16, linear-lanceolate, reddish-brown below, 1/2 bifid, yellowish, papillose, divisions not trabeculate. Calyptra cucullate. Perigonia terminal, the leaves long-subulate from widely ovate, cymbiform bases; innermost leaf often having short subula.

Key to the Species

1. Leaves usually obtuse with costa ending below leaf apex and not toothed at back. Capsule with stomata but lacking an annulus.
   Operculum without distinct beak ...................... 2

1. Leaves usually acuminate with costa extending to leaf apex and
Figure 54.
A. *Aongstroemia orientalis* Mitt.  
  b. Leaves, x63.  
  c. Cells at leaf shoulder, x385.  
  d. Cells at leaf base, x385. [Shimidu 29313a]

B. *Pseudephemerum nitidum* (Hedw.) Reim.  
  e. Plants, x34.  
  f. Lower leaves, x34.  
  g. Upper leaves, x34.  
  h. Cells at leaf apex, x180.  
  i. Median cells of leaf, x180.  
  j. Cells at leaf base, x180. [NICH 172115]
toothed at back. Capsule lacking stomata; annulus present. Operculum with long, acuminate beak ........................................ 7
2. Stems usually less than 10 mm in length, plants usually reddish-brown ........................................ 1. D. varia
2. Stems longer than 20 mm, plants usually yellowish- or blackish-green ........................................ 5
3. Leaves not squarrose, apices scarcely reflexed ........................................ 4
3. Leaves squarrose, apices reflexed ........................................ 5
4. Aquatic. Leaves gradually tapering from oblong bases .............................. 6
4. Not aquatic. Lower leaves narrowly triangular-lanceolate; upper leaves abruptly tapering from ovate bases . 3. D. globuligera
5. Leaves serrate at apices; costa toothed at back above ........................................ 7
5. Leaves entire to crenulate; costa not toothed at back above ........................................ 6
6. Plants large, with leaves more than 5 mm wide. Operculum long-conic, not apiculate .............................. 5. D. palustris
6. Plants small, with leaves less than ca. 3 mm wide. Operculum shortly conic, apiculate ........................................ 6. D. brachyphylla
7. Costa wide. Seta yellow ........................................ 8
7. Costa narrow. Seta brown to red ........................................ 9
8. Leaves abruptly tapering from oblong, sheathing bases, distinctly serrate above. Capsule not strumose .............. 9
9. Capsule inclined, curved, asymmetric, with mouth oblique when dry due to a constriction below the rim on the underside ........................................ 9. D. heteromallia
9. Capsule erect, not curved, symmetric, mouth straight when dry ...................... 10
10. Upper leaves without sheathing base. Awn of the inner perichaetial leaves as long as or shorter than the sheathing base ........................................ 7. D. dilatatinervis
10. Upper leaves with distinct sheathing base. Awn of the inner perichaetial leaves longer than the sheathing base ........................................ 10. D. coarctata
12. Leaves with sheathing base. Capsules sulcate when dry ...................................... 13
13. Capsules longer than 1 mm ........................................ 14. D. subsecunda
13. Capsules shorter than 1 mm ........................................ 13. D. ditrichoides

1. DICRANELLA VARIA (HEDW.) SCHIMP. (Fig. 55, A)

Coroll.: 13 (1856).

Plants small, reddish-brown, often gregarious. Stems to 10 mm long, usually shorter, sparsely foliate. Leaves slightly flexuose, the apical leaves crowded, often strongly falcate-secund when dry, gradually tapering to elongate, lanceolate, arcuate, semicanaliculate limbs from oblong, non-sheathing bases, to 1.8 mm long, acuminate; margins entire but the apices crenate or bluntly denticulate; costa thin, ending near the leaf apex, occupying ca. 1/2 the width of subula, smooth at back. Median laminal cells elongate-rectangular or -rhomboidal, large, 45-65 x 10-13 µm, thin-walled; shoulder cells sublinear; lower cells larger. Inner perichaetial leaves similar to the upper stem leaves. Seta 3-5 mm long, often geniculate at base, somewhat flexuose, 0.10-0.12 mm thick, purple. Capsule erect or suberect, oblong, with indistinct apophysis, 0.7-1.0 x 0.45-0.50 mm, reddish-brown, scarcely sulcate when dry; stomata present; annulus not seen. Operculum conic or rostellate, 0.45-0.50 mm long. Peristome teeth lanceolate, ca. 0.25 mm long, united with each other and forming a cylindrical basal membrane, hyaline and papillose above, orange-brown and vertically papillose-striolate below. Spores 12-16 µm. Calyptra ca. 0.9 mm long.

Distribution: Japan (Hokkaido, Honshu, Shikoku), Korea, Soviet Far East, Europe, N.America.

2. DICRANELLA YEZOANA CARD. (Fig. 55, B)

Plants small, blackish. Stems 10-15 mm long, here and there with rhizoids. Leaves distant, erect-spreading or ± homomallous, gradually tapering to an elongate, often recurved, semicanaliculate subula from an oblong; scarcely sheathing base; lower leaves small; upper leaves larger, to 2.5 mm long, obtuse; margins erect, entire, but often crenulate at the extreme tip; costa stout, reaching leaf apex, occupying ca. 1/3 the width of subula. Median laminal cells linear, prosenchymatous, 40-50 x 6-8 µm, thin-walled, cells of subula and of lower lamina similar to median cells.

Distribution: Endemic to Japan (Hokkaido).

3. DICRANELLA GLOBULIGERA CARD. (Fig. 56, A)

Stems to 10 mm long. Leaves crowded, lower leaves distant, ca. 1.2 mm long; upper leaves to 2.5 mm long, gradually tapering to an elongate, semicanaliculate subula from an ovate base; margins entire below,
crenate at apices; costa well-defined, percurrent, smooth on back. Median laminal cells elongate-rectangular, large, 40-65 x 8.5-10.0 µm, thin-walled; cells of subula similar to the median cells; lower cells somewhat wider. Perichaetial leaves similar to the upper stem leaves but basal parts broader. Seta 4-5 mm long, ca. 0.12 mm thick, yellowish-brown. Capsule erect, globose, without apophysis, 0.6-0.7 x 0.50-0.65 mm, scarcely furrowed when dry, brown; stomata present. Annulus lacking. Operculum 0.50-0.55 mm long, conic or rostellate, obtuse.

Distribution: Endemic to Japan (Hokkaido).

4. **DICRANELLA SCHREBERIANA** (HEDW.) HILF. EX CRUM & ANDERS.  
(Fig. 56, B)


Plants yellowish-green. Stems to 30 mm long. Leaves erect-spreading when dry or moist; lower leaves ca. 1 mm long, upper leaves larger, to 3 mm long, abruptly narrowed to a lanceolate, semicanaliculate, reflexed, limb from widely ovate or obovate sheathing base; margins serrate above; costa stout, percurrent, occupying about 1/3 the width of subula, toothed on back above. Median cell of sheathing base elongate-rectangular, 55-85 x 12-14 µm, thin-walled, cells of shoulder rectangular, 20-30 x 8.5-11.0 µm. Inner perichaetial leaves similar to upper stem leaves. Seta 4-6 mm long, 0.10-0.13 mm thick, ± flexuose, reddish-brown to orange. Capsule cernuous, ovate with apophysis, slightly curved, variable in size (0.7-1.2 x 0.5-0.7 mm), yellowish-brown, scarcely furrowed when dry; annulus not seen. Operculum conic, usually with an indistinct beak, 0.6-0.7 mm long; stomata few. Peristome teeth to 0.5 mm long, 1/3-bifid into slender divisions, reddish below. Spores 12-16 µm, scabrous.

Distribution: Japan (Hokkaido), Soviet Far East, Europe, N.America.

5. **DICRANELLA PALUSTRIS** (DICKS.) CRUNDW. EX WARWB. (Fig. 57, A)  


Plants robust, yellowish-green, blackish with age, large, with leaves to 6 mm wide. Leaves squarrose, gradually tapering to lanceolate or linear-lanceolate, reflected, semicanaliculate limbs from an oblong, clasping base, with rounded apices, to 4.5 mm long; margins slightly incurved, almost entire; costa stout, ending near the leaf apex, smooth at back. Median laminal cells elongate-rectangular or -hexagonal, very large (85-110 x 13-20 µm), thin-walled, shoulder cells narrower; upper cells elongate-rectangular, 30-40 x 6-8 µm; basal cells similar to median cells. Inner perichaetial leaves similar to the upper stem leaves but the
Figure 55.
A. *Dicranella varia* (Hedw.) Schimp.  
  a. Female plant, x10.  
  b. Male plant, x10.  
  c. Leaves, x34.  
  d. Cells at leaf apex, x250.  
  e. Cells at leaf base, x180.  
  f. Capsule, x15.  
  g. Peristome teeth, x180.  
  h. Calyptra, x15.  
  i. Inner perigonial leaf, x30.  
  [Noguchi 12620]

B. *D. yezoana* Card.  
  j. Male plant, x10.  
  k. Leaves, x20.  
  l. Cells at leaf apex, x250.  
  m. Median cells of leaf, x20.  
  n. Cells at leaf base, x180.  
  [Isotype of *D. yezoana* Card.]
Figure 56.
A. *Dicranella globuligera* Card.  
  a. Female plant, x10.  
  b. Male plant, x10.  
  c. Leaves, x20.  
  d. Cells at leaf apex, x250.  
  e. Cells at leaf base, x180.  
  f. Dry capsule, x20.  
  g. Inner perigonial leaf, x34. [Isotype of *D. globuligera* Card.]

B. *D. schreberiana* (Hedw.) Hilf. ex Crum & Anders.  
  h. Female plant, x10.  
  i. Male plant, x10.  
  j. Leaves, x24.  
  k. Cells at leaf apex (dorsal view), x245.  
  l. Median cells of leaf, x245.  
  m. Cells at leaf shoulder, x190.  
  n. Capsules, x10.  
  o. Peristome teeth, x95.  
  p. Perigonial leaves, x20. [Saito s.n.]
Figure 57.
B. *D. brachyangia* Card.  l. Female plant, x10.  m. Male plant, x10.  n. Leaves, x20.  o. Capsule, x20.  p. Calyptra, x20. [Isotype of *D. brachyangia* Card.]
sheathing base longer. Seta 15–22 mm long, 0.20–0.27 mm thick, ± flexuose, red. Capsule inclined, oblong to ovate, purple, with an apophysis, 0.9–1.5 x 0.7–0.8 mm; stomata present. Periculum long–conic, 1.0–1.5 mm long; annulus not seen. Peristome teeth linear–lanceolate, ca. 0.6 mm long, reddish, ca 1/3-bifid. Spores 13–18 µm. Calyptra 2.3–2.5 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), China, Caucasus, Europe, N. America.

This species occurs in moist or damp stations, often in running water.

The squarrose foliation, the rounded leaf apices and the large laminal cells with thin walls are the characteristic features of this species.

6. **DICRANELLA BRACHYANGIA** CARD. (Fig. 57, B)


Stems ca. 8 mm long. Lower leaves ca. 1.5 mm long; upper leaves to 2.5 mm long, abruptly tapering to a lanceolate, semicanaliculate limbs from an oblong or obovate, clasping base, apex obtuse, usually reflexed; margins entire, crenate at extreme tip; costa thin, ending near the leaf apex. Median laminal cells elongate–rectangular, 40–60 x 8–10 µm, thin-walled; cells of shoulder somewhat shorter; lower cells similar to median cells. Perichaetial leaves similar to the upper stem leaves. Seta brown, ca. 3 mm long, ca. 0.15 mm thick. Capsule suberect, oblong, ca. 0.70 x 0.45 mm, with indistinct apophysis, scarcely furrowed when dry, brown. Operculum conic, apiculate, ca. 0.45 mm long. Calyptra 1.0–1.2 mm long.

Distribution: Endemic to Japan (Honshu).

7. **DICRANELLA DILATATINERVIS** DIX. (Fig. 58)


Plants slender, forming dense tufts, blackish-green, lower portions becoming black. Stems ca. 50 mm long. Leaves loosely appressed, apical leaves somewhat falcate when dry; upper leaves almost as long as lower leaves, gradually tapering to a linear–lanceolate, semicanaliculate apex from ovate-oblong base, to 2.5 mm long, ca. 0.5 mm wide at insertion; margin with several indistinct teeth, elsewhere entire; costa pellucid, broad, occupying larger part of subula, the border between lamina and costa indistinct. Laminal cells evenly narrowly rectangular, 35–60 x 7–8 µm, thin-walled; marginal cells ± narrower; lower cells wider, rectangular, 30–45 x 8.5–12.0 µm, thin-walled, not inflated; cells of shoulder scarcely differentiated. Inner perichaetial leaves, abruptly narrowed
Figure 58. *Dicranella dilatatinervis* Dix.  

- **a.** Dry plant, x10.  
- **b.** Leaves, x20.  
- **c.** Cells at leaf shoulder, x180.  
- **d.** Cells at leaf base, x180.  
- **e.** Inner perichaetal leaf, x20.  
- **f, g.** Capsules, x15.  
- **h.** Peristome teeth, x135.  
- **i.** Outer perigonial leaf, x15.  
- **j.** Inner perigonial leaf, x15.  

[a–d, Ihsiba 8757; e–j, Noguchi 78212]
to long awns from oblong base, the awn almost as long as the sheathing base, ca. 1.8 mm long; costa broad; paraphyses absent. Seta 7-10 mm long, yellowish. Capsule erect, oblong, 1.0-1.2 x 0.50-0.65 mm, brown, slightly furrowed when dry; stomata not seen. Operculum 0.8-0.9 mm long, with a long, oblique beak. Peristome teeth to 0.3 mm long, irregularly bifid, minutely papillose, the papillae somewhat vertically arranged. Spores 16-21 µm, finely papillose. Calyptra ca. 1.7 mm long.

Distribution: Endemic to Japan (Honshu).

8. DICRANELLA CERVICULATA (HEDW.) SCHIMP. (Fig. 60, A)

Stems short. Leaves dense appressed or somewhat homomallous when dry, lower leaves ca. 0.8 mm long; upper leaves gradually larger, to 3 mm long, tapering to an elongate, semicanaliculate limb from an oblong base; margin ± incurved, indistinctly crenate at tips; costa wide, undefined, smooth at back. Median cells of base rectangular, 65-85 x 10-15 µm, thin-walled; cells of shoulder subquadrate, 10-15 µm long. Inner perichaetial leaves gradually tapering to a very long setaceous point from a narrowly oblong base, 2.5-3.0 mm long; costa indistinct. Seta 10-15 mm long, 0.08-0.10 mm thick, yellow, flexuose or straight. Capsule inclined or suberect, variable in size (0.65-0.80 x 0.4-0.6 mm), swollen and arcuate, oblong or obovoid, asymmetric, usually strumose, brown, slightly sulcate when dry. Operculum 0.65-0.80 mm long with long beak. Peristome teeth ca. 0.35 mm long. Spores 17-24 µm. Calyptra brownish, ca. 1.5 mm long.

Distribution: Japan (Hokkaido), Sakhalien, China, Europe, Greenland, N.America.

9. DICRANELLA HETEROMALLA (HEDW.) SCHIMP. (Fig. 59)

Plants yellowish-brown. Stems to 10 mm long, mostly simple, arcuate above. Leaves dense, often homomallous when dry; lower leaves triangular at base; upper leaves falcate when dry, gradually larger, to 2.5 mm long, gradually tapering to an elongate, semicanaliculate subula (about 8-10 times as long as the sheathing base), from an ovate or oblong sheathing base; margin usually serrate above, occasionally almost entire; costa wide, occupying the larger portion of subula and 1/5-1/3 the width of leaf at the base, usually toothed at back above. Median cells of sheathing base rectangular, 10-13 x 5.0-6.5 µm; lower cells rectangular to subquadrate, broader, 10-20 x 7-12 µm; cells at leaf insertion larger. Inner perichaetial leaves similar to the upper stem
Figure 59. *Dicranella heteromalla* (Hedw.) Schimp. a. Plant, x10. b. Leaves, x31. c. Cells at leaf apex (dorsal view), x327. d. Median cells of leaf, x327. e. Cells at leaf base, x173. f. Inner perichaetial leaf, x31. g. Capsules, x13. h. Dry capsule, x10. i. Peristome teeth, x173. j. Perigonial leaves, x27.
Figure 60.
A. *Dicranella cerviculata* (Hedw.) Schimp.  
a. Male plant, x15.  
b. Leaves, x24.  
c. Cells at leaf apex, x197.  
d. Cells at leaf shoulder, x140.  
e, f. Capsules, x10.  
g. Dry capsule, x20.  
h. Peristome teeth, x140.  
i. Perigonial leaves, x20.  
[a–d, Kamimura s.n.; e–i, Noguchi 29402]

B. *D. subulata* (Hedw.) Schimp.  
j. Female plant, x10.  
k. Male plant, x10.  
l. Leaves, x20.  
m. Cells at leaf apex, x250.  
n. Cells at leaf shoulder, x250.  
o. Cells at leaf base, x250.  
p. Inner perichaetial leaf, x20.  
q. Capsule, x15.  
r. Dry capsule, x15.  
s. Perigonial leaves, x15.  
[Noguchi 27812]
Figure 61.  
*Dicranella ditrichoides* Broth.  
* a. Plant, x10.  
* b. Leaves, x35.  
* c. Cells at leaf apex, x200.  
* d. Cells at leaf shoulder, x200.  
* e. Cells at leaf base, x200.  
* f. Inner perichaetial leaf, x35.  
* g. Capsule, x17.  
* h. Dry capsule, x27.  
* i. Peristome teeth, x127.  

[Isotype of *D. ditrichoides* Broth.]
leaves but with larger, obovate sheathing base. Seta 10-15 mm long, yellowish, tortile and flexuose when dry, strongly flexuose, occasionally curved downwards or cygneous when moist. Capsule inclined, brownish, subcylindric, slightly curved, asymmetric, widest below the oblique mouth, with tapering neck, occasionally with an indistinct crop, strongly sulcate and strongly contracted below the mouth when dry, 1.2–1.5 x 0.50–0.55 mm. Operculum with a long oblique beak; annulus poorly developed. Peristome teeth ca. 0.4 mm long, reddish-brown below, yellowish and papillose above. Spores 15–20 µm, indistinctly papillose. Calyptra 1.5–2.0 mm long, blackish-brown.

This species is often confused with the allied species, such as *D. coarctata* or certain species of the other genera, such as *Ditrichum*, *Dicranodontium*, or small sterile plants of *Dicranum* spp. It may be noted that the cells at the leaf insertion are rectangular or subquadrate, and larger than those of the allied species. When sterile, the absence of differentiated alar cells separate this species from those of *Dicranodontium* and *Dicranum*, but it is very difficult to distinguish this from species of *Ditrichum* which also lack differentiated alar cells. On the other hand, it is easy to separate *Dicranella heteromalla* from allied species when the plants bear sporophytes, because the asymmetric, deeply sulcate and somewhat clavate capsules, strongly constricted below the oblique mouth when dry, are characteristic.

9a. VAR. HETEROMALLA

Setae largely curved when moist. Capsules inclined, subcylindric, slightly curved, asymmetric, widest below the mouth.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Ryukyu). Widely distributed in the N.Hemisphere.

In Japan this circumboreal species is common on rocks or ground in volcanic districts, but is rare in the lowlands.

9b. VAR. CURVIPES LINDB.


Setae curved downwards, cygneous when moist. Capsules inclined.

Distribution: Japan (Honshu, Kyushu), Korea.
Figure 62.

*Dicranella coarctata* (C. Muell.) Bosch & Lac.  
 c. Cells at leaf apices, x250.  d. Cells at leaf shoulder, x180.  e. Cells at leaf base, x180.  
 f. Perichaetial leaves, x20.  g. Capsule, x10.  h. Dry capsule, x20.  
 i. Peristome teeth, x180.  j. Perigonial leaves, x20.  
[a-f, i, Faurie 68 from Taiwan; g, h, j, holotype of *Dicranella salsuginosa* Okam.]
9c. VAR. **ORTHOCARPA** (HEDW.) JAEG.


*Dicranum orthocarpum* Hedw., Spec. Musc.: 131, t. 30 (1801).

Setae somewhat curved. Capsules suberect, almost symmetric.

Distribution: Japan (Honshu), Europe, N.America.

10. **DICRANELLA COARCTATA** (C.MUELL.) BOSCH & LAC. (Fig. 62)

Bryol. Jav. 1: 84, t. 70 (1858).


Stems usually ca. 10 mm long. Leaves dense, erect-spreading, often homomallous; lower leaves ca. 1.5 mm long, gradually tapering to a setaceous point from oblong base; upper leaves much larger, to 6 mm long, abruptly tapering to a long, slender semicanaliculate apex from an obovate or oblong, clasping base; margins with several, small teeth at tip; costa thin, smooth at back. Median cells of sheathing base yellowish, narrowly rectangular, somewhat thick-walled, 45-80 x 4.5-7.0 µm, shorter towards the leaf margin, cells of the shoulder elongate-rectangular or -rhomboidal, 12-20 µm long; lower cells elongate-rectangular, 45-85 x 8-13 µm, narrower towards leaf-margin. Inner perichaetial leaves ca. 5 mm long, clasping base obovate, leaf base narrower than the shoulder. Seta 12-15 mm long, 0.09-0.12 mm thick, yellowish, brownish with age. Capsule erect, 1.2-1.5 x 0.60-0.65 mm, oblong, symmetric, with an indistinct apophysis, reddish-brown, becoming blackish with age, sulcate when dry. Operculum with long beak, 1.0-1.3 mm long; annulus in 3 rows of large cells. Peristome teeth to 0.35 mm long, reddish-orange below. Spores 20-25 µm.


Distribution: Japan (Honshu, Shîkoku, Kyushu, Ryukyu, Bonin Isls.), Taiwan, Philippines, Java, Sri Lanka, Australia.

*Dicranella coarctata* usually grows on dry rocks covered by sandy soil or among grasses under shrubs. Okamura (1911) reported *D. salsuginosa* Okam. (which is now synonymous with *D. coarctata*) as occurring on rocks near the seashore, where it is often sprayed by sea water. According to him the tuft of this moss contains 28.6% salt. This seems to be too high a degree of inorganic contamination to permit survival. According to Mizutani (1975) who examined the type material, it is doubtful whether the salt content was so high.
Figure 63.
A. *Dicranella gonoii* Card.  
- b. Leaves, x25.  
- c. Cells at leaf apex, x250.  
- d. Cells at leaf base, x150.  
- e. Inner perichaetial leaf, x25.  
- f. Capsules, x15.  
- g. Dry capsule, x15.  
- h. Peristome teeth, x180.  

B. *D. subsecunda* Besch.  
- j. Leaves, x20.  
- k. Leaf apex, x250.  
- l. Cells at leaf shoulder, x250.  
- m. Cells at leaf base, x250.  
- n. Dry capsule, x20.  

[Isotype of *D. subsecunda* Besch.]
11. **DICRANELLA SUBULATA** (HEDW.) SCHIMP. (Fig. 60, B)

Coroll.: 13 (1856).


Stems usually 10-15 mm long. Leaves dense, erect-spreading, ± homomallous when moist, lower leaves ca. 1.5 mm long, upper leaves to 3 mm long, abruptly tapering to an elongate, semicanaliculate subula from an oblong or obovate, sheathing base; apex acute, crenate; margins erect or ± involute; costa thin, occupying the larger part of subula, smooth, occasionally with several mammillate teeth at back above. Median cells of sheathing base elongate-rectangular, 35-55 x 6.0-7.5 µm, thick-walled, cells of shoulder, rectangular; lower cells similar to median cells but somewhat larger. Inner perichaetial leaves with longer, clasping, sheathing bases than upper stem leaves. Seta red, 12-15 mm long, ca. 0.08 mm thick, straight. Capsule inclined, 0.8-1.0 x 0.5-0.7 mm, oblong, with an indistinct apophysis, ± asymmetric, brown, ± sulcate when dry. Operculum conic, with long beak, 1.2-1.5 mm long. Peristome teeth ca. 0.35 mm long. Spores 13-15 µm. Calyptra ca. 1.7 mm long.

Distribution: Japan (Hokkaido, Honshu), Europe, northern N.America.

This species is allied to *D. heteromalla*, but is distinguished by its red seta, differently shaped capsules, parenchymatous areolations of leaves and the weak serration of leaf margins.

12. **DICRANELLA GONOI** CARD. (Fig. 63, A)

*Bull. Herb. Boiss. sér. 2, 7: 713 (1907).*


Plants small. Leaves gradually tapering to a subulate, semicanaliculate point from an ovate base; upper leaves to 3 mm long, often fragile above; upper margin involute, with several teeth at tip; costa yellowish- to reddish-brown, smooth on back, occupying the larger part of subula, leaving a lamina of ca. 3 rows of linear cells. Median laminal cells of leaf base sublinear, 50-65 x 4-6 µm, lower cells rectangular to subquadrangular, lax, and slightly inflated, 20-40 x 10-15 µm. Seta 3-4 mm long, 0.08-0.10 mm thick, straight, yellowish-brown. Capsule erect, oblong, with indistinct apophysis, ca. 0.70-0.85 x 0.4-0.5 mm, brown, sulcate when dry; annulus in 3 rows; stomata not seen. Operculum ca. 0.9 mm long, with long, oblique beak. Peristome teeth ca. 0.25 mm long, orange-brown below. Spores 20-25 µm, minutely papillose. Calyptra 1.3-1.5 mm long.

DICRANACEAE

Distribution: Endemic to Japan (Shikoku).

13. **DICRANELLA DITRICHOIDES** BROTH. (Fig. 61)

Stems to 6 mm long. Leaves dense, homomallous, abruptly tapering to an elongate, semicanaliculate subula from an ovate or obovate, sheathing base; upper leaves to 4 mm long; margin indistinctly crenulate at extreme apex or entire; costa occupying most of the subula, smooth at back. Median cells of sheathing base sublinear, 50–60 x 5–7 µm, narrower towards margin, with thinner walls; lower cells elongate-rectangular, 40–50 x 7.0–8.5 µm, thin-walled, not inflated. Inner perichaetial leaves similar to upper stem leaves. Seta 4–7 mm long, straight, reddish- to dark-brown. Capsule erect, variable in size (0.5–0.9 x 0.3–0.5 mm), oblong, brown, sulcate when dry, apophysis indistinct. Operculum long-rostrate, ca. 0.8 mm long. Peristome teeth ca. 0.4 mm long. Spores 12–15 µm, almost smooth.

Distribution: Endemic to Japan (Honshu).

14. **DICRANELLA SUBSECUNDA** BESCH. (Fig. 63, B)

Stems to 20 mm long, densely leaved. Upper leaves contracted to an elongate semicanaliculate subula from an ovate or oblong base, to 3 mm long; margins erect, with several teeth at apex; costa broad, smooth at back above. Median cells of sheathing base rectangular or oblong-hexagonal, 30–45 x 9–13 µm, thin-walled, smaller towards shoulder; lower cells subquadrate to hexagonal, 12–20 x 12–15 µm. Perichaetial leaves similar to upper stem leaves. Seta straight, ca. 10 mm long, orange. Capsule ca. 1.2 mm long, erect, strongly sulcate when dry, black with age.

Distribution: Endemic to Japan (Honshu).

6. **CAMPYLOPODIUM** (C.MUELL.) BESCH.

**CAMPYLOPODIUM EUPHOROCLADUM** (C.MUELL.) BESCH. (Fig. 64)

Plants small, brownish-green to yellowish-brown. Stems to 15 mm long, simple, occasionally forked, with central strand. Leaves flexuose when dry, erect-spreading when moist; upper leaves to 5.5 mm long, abruptly tapering to a long, setaceous, flexuose awn from an oblong or obovate sheathing base; margin entire or crenulate at apex, but some-
times crenate at shoulder; costa broad, flat at base, occupying the entire width of awn, terete and smooth, with dorsal stereids in cross-section. Median cells of sheathing base elongate-hexagonal, 40-50 x 5.0-6.5 µm, thin-walled, somewhat larger towards the leaf base; cells of shoulder quadr rate; cells of alar region not differentiated. Dioicous. Perichaetia terminal; inner leaves longer than upper stem leaves and with longer sheathing base. Seta solitary, strongly flexuose and cygneous when dry, strongly cygneous or semicircinate when moist, 4-6 mm long, yellow to yellowish-brown. Capsule drooping, oblong with stomatous apophysis, reddish-brown, somewhat sulcate when dry, 0.7-0.9 x 0.4-0.5 mm. Operculum long-rostrate. Annulus large. Peristome teeth 1/2-bifid, reddish-brown and vertically striolate below, ca. 0.25 mm long, yellowish and papillose above. Spores 15-20 µm, verrucose. Calyptra cucullate, ca. 1 mm long. Male plants similar to the female. Perigonium terminal; inner leaves similar to upper stem leaves, with cymbiform base.

Exsiccati: Musci Japonici 7: 308 (1953).

Distribution: Japan (Honshu, Kyushu, Ryukyu), Taiwan, Philippines, Java, New Guinea, Oceania, Australia, New Zealand, Africa.

When the sporophytes are present, this small moss is easily recognized by the cygneous setae.

In Japan, it seems to be restricted to the volcanic regions. The habitat of this species is fully discussed by Iwatsuki and Kiguchi (1979).

7. CAMPYLOPUS BRID.

Stems usually simple, densely tomentose. Leaves stout, straight, gradually or abruptly tapering to a subulate or piliferous, semicanal liculate point from an oblong or oblong-ovate base, often auriculate at basal angles; margins erect or involute, entire, but serrate or dentate above; costa broad, flat, occupying 1/3 (or more) of the leaf base, hyaline at apex, often longitudinally ribbed at back, often with dense rhizoids at the leaf insertion. Cells in upper part of lamina rhomboidal, oblong, elongate-hexagonal or sublinear, thick-walled; cells of leaf base and alar area larger. Perichaetia aggregated on tip of stem. Inner perichaetial leaves similar to upper stem leaves. Seta flexuose when dry, cygneous when moist. Capsule drooping, oblong, sometimes rough at apophysis; stomata absent; annulus present. Operculum long-conic, ± rostrate. Peristome teeth filiform, densely papillose above, vertically striolate below. Calyptra cucullate, fringed at base. Perigonia aggregated in comal head; inner perigonal leaves ovate.

Takaki (1967) recognized 7 species of Campylopus in Japan.

Key to the Species (mainly based on Takaki, 1967)

1. Stereids on both dorsal and ventral sides of the costa . . . . . . . . .
Figure 64. *Campylopodium euphorocladum* (C.Muell.) Besch. a. Moist plant, x7. b. Dry plant, x7. c. Leaves, x23. d. Cells at leaf apex, x387. e. Cells at leaf shoulder, x387. f. Cross-section of awn, x327. g. Cross-section of leaf base, x327. h. Inner perichaetial leaf, x23. i. Capsule, x15. j. Dry capsule, x15. k. Operculum and calyptra, x15. l. Peristome teeth, x200. [Noguchi 1733]
1. **CAMPYLOPUS UMBELLATUS** (ARN.) PAR. (Fig. 65, A)

Ind. Bryol.: 264 (1894).


Plants yellowish-brown above, blackish below. Stems 30-50 mm long, tomentose, sterile stem often caudate at apex (with small appressed leaves) when dry; fertile stem with a conal head (caused by larger, clustered, and widely spreading leaves). Leaves appressed when dry, erect-spreading when moist, tapering to a subulate point from an oblong-lanceolate base, 3-4 mm long, 0.5-0.7 mm wide, lacking auricles; margins serrulate above, involute at middle; costa occupying 1/3 the leaf base, multiridged at back, in cross-sections the stereid cells present on dorsal or both dorsal and ventral sides of the median layer of guide cells, or wanting. Median laminal cells rhomboid to fusiform, 12-15 x 4-5 µm; cells of basal part brown, quadrate to shortly rectangular in diagonal rows, 25-35 x 12-20 µm, narrower towards alar areas. Dioicous. Perichaetia clustered in a conal head of female plant. Seta aggregated, strongly flexuose, twisted when dry, cygneous when moist, 4-5 mm long, brown. Capsule oblong, 1.0-1.5 x 0.6-0.8 mm, brown; apophysis distinct and ± mammillose; stomata not seen; annulus large. Operculum long-conic or rostrate from conic base. Peristome teeth to 0.7 mm long, yellowish-brown and densely papillose on both surface above, reddish-brown and longitudinally striolate below. Spores smooth, 8-10 µm. Calyptra cucullate, 1.3-1.6 mm long, laciniate below. Perigonia ca. 1 mm long; innermost perigonal leaf widely ovate, ca. 0.8 mm long, with weak costa.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu, Bonin Isl.s.), southern Asia.
Figure 65.
A. *Campylopus umbellatus* (Arn.) Par.  a. Dry, sterile plants, x1.  b. Female plant, x2.  c. Male plant, x2.  d. Sterile plant, x2.  e. Leaves (e2, dorsal view), x15.  f. Median cells of leaf, x385.  g. Cells at leaf base, x180.  h. Cross-sections of leaf, x250.  i, j. Capsules, x15.  k. Calyptra, x15.  l. Peristome teeth, x135.  m. Clustered perigonia, x20.  n. Inner perigonal leaf, x34.  [b-n, Noguchi 7078 from Taiwan]
B. *Oreas martiana* (Hoppe & Hornsch.) Brid.  o. Plant, x20.  p. Cross-section of stem, x250.  q. Leaves, x34.  r. Cross-sections of leaf (r1, apical, r2, lower parts), x250.  s. Cells at leaf apex, x250.  t. Cells at leaf base, x250.  u. Peristome teeth, x180.  v. Calyptra, x20.  [o, u, v, herb. Noguchi 71650 from Distr. Asiatic Russia; p-t, Ohinata s.n.]
2. CAMPYLOPUS FRAGILIS (BRID.) B.S.G. (Fig. 66, A)


Plants to 20 mm long, yellowish-brown in herbaria. Gemmae numerous, clustered on stem apex, linear, curved, 0.8–1.0 mm long. Leaves uniformly erect-spreading when moist, fragile, gradually long-subulate from a narrowly oblong base, 4–5 mm long, dentate at apices, contracted and not auriculate at base; margins involute, entire except at apex; costa occupying 1/2 or more of leaf base, pellucid, shallowly furrowed at back above, in cross-section consisting of a median layer of guide cells, and dorsal layer of small and thick-walled cells, the ventral side consisting of a layer of large, rectangular and thin-walled cells. Inner area of the sheathing base occupied by large, inflated cells, and extending upwards to a considerable length.

Distribution: Japan (Honshu, Shikoku), Korea, Taiwan, China, Soviet Far East, Europe, N.America.

3. CAMPYLOPUS JAPONICUS BROTH. (Fig. 66, B)

Hedwigia 38: 207 (1899).


Plants in dense tufts, to 20 mm long, blackish below, yellowish-green and ± glossy above, upper portions fragile. Lower leaves very small, appressed; upper leaves large, erect-spreading when dry, gradually narrowed to semicanaliculate apices, to 10 mm long, scarcely piliferous, not auriculate at base, lamina narrow above; margins involute, apical part dentate; costa wide, occupying 1/2 the leaf-middle, shallowly furrowed at back, in cross-section consisting of a median layer of guide cells, with dorsal stereid, and the ventral side consisting of large, quadrate, hyaline cells. Median laminal cells rhomboid, fusiform or rectangular, 15–35 µm, smaller towards leaf margins, thin-walled; lower and alar cells distinctly differentiated, reddish-brown, rectangular, 25–35 x 12–20 µm, inflated, thin-walled.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Taiwan.

This species occurs on open and dry rocks, often forming a large green tuft.
Figure 66.
A. *Campyliopus fragilis* (Brid.) B.S.G. a. Leaves, x15. b. Leaf apex, x180. c. Median cells of leaf, x250. d. Cells at leaf base, x180. e. Cross-sections of leaf, x250. [Isotype of *C. akagiensis* Broth. & Yas.]
B. *C. japonicus* Broth. f. Dry plants, x1. g. Leaves, x15. h. Leaf apex, x250. i. Median cells of leaf, x250. j. Cells at leaf base, x180. k. Cross-sections of leaf, x250. [Noguchi 23328]
4. **CAMPYLOPUS ATRO-VIRENS** DE NOT. (Fig. 67, A)


Plants to 30 mm long, yellowish-brown above, blackish below. Stems densely leaved. Leaves straight, neither crisped nor incurved, loosely appressed when dry, gradually tapered to a subulate, semicanalicate apices from an oblong, slightly auriculate base, to 5 mm long; margins involute, entire except for denticulate hyaline apex; costa occupying ca. 2/3 the width at the leaf base, in cross-section composed of an ventral layer of large, subquadrate or rectangular cells, a median layer of guide cells and dorsal layer of poorly developed stereids. Cells rhomboidal or subquadrate at the shoulder of lamina, 13-20 x 6-9 µm, becoming rhomboidal downward; alar region distinct, composed of large, subquadrate, inflated, thin-walled, brownish cells.

Distribution: Japan (Honshu, Kyushu), China, Europe, N.America.

5. **CAMPYLOPUS YAKUSIMENSIS** SAK. (Fig. 67, B)


Plants rigid, to 70 mm long, yellowish-brown above, blackish below. Leaves appressed when dry, uniformly erect-spreading when moist, 5.5-8.5 mm long, long-subulate from a narrowly oblong base, apex often fragile; margins involute; costa occupying 2/3-3/4 the leaf base, pel­lucid, not furrowed at back, in cross-section consisting of a median layer of guide cells, and dorsal layer of small, thick-walled cells, the ventral side consisting of a layer of large, rectangular or quadrate, thin-walled cells. Median cells of lamina sublinear, 50-60 µm long, thick­walled; basal cells large, 30-35 x 15-25 µm, rectangular or subquadrate, brown, thin-walled, inflated.

Distribution: Endemic to Japan (Kyushu).

This species is related to *C. japonicus* Broth. in general aspects, but has linear laminal cells.

8. **DICRANODONTIUM** B.S.G.

Stems usually simple, sometimes sparsely branched, radiculose, with a broad central strand of small thin-walled cells. Leaves almost uniform, abruptly long-subulate from wider base; costa broad, excur­rent, smooth or toothed at back above; in cross-section with abaxial and adaxial bands of stereid-cells around a median row of large, hyaline cells. Median cells of sheathing base large, rectangular to hexagonal, narrower towards margins; lower and alar cells very large, rectangular or subquadrate, inflated, thin-walled, hyaline and colorless. Inner perichaetial leaves slightly differentiated, sheathing bases ± longer. Seta strongly flexuose and twisted when dry, cygneous when moist.
Figure 67.
A. *Campylopus atro-virens* De Not.  
  a. Leaves, x20.  
  b. Leaf apex, x180.  
  c. Upper part of sheathing base, x250.  
  d. Cells at leaf base, x180.  
  e. Cross-section of leaf, x250. [Noguchi 381]

B. *C. yakushimensis* Sak.  
  f. Leaves (*fl*, dorsal view), x10.  
  g. Upper part of sheathing base, x250.  
  h. Cells at leaf base, x180.  
  i. Cross-sections of leaf, x250. [Noguchi 63782]
Capsule pendulous, oblong or cylindric; stomata and annulus lacking. Operculum rostrate. Peristome teeth 16, sublinear, bifid to near base, yellowish-brown, longitudinally striate on almost entire outer surface, papillose at apex. Calyptra cucullate.

Key to the Species

1. Inner area of sheathing base without lax areolation, not distinctly delimited from the rest of lamina; costa not well-marked; cell walls rather thick; leaf base not distinctly bordered; basal cells somewhat fragile .......... 1. *D. denudatum*

1. Inner area of sheathing base with very lax areolation, distinctly delimited from the rest of lamina; cell walls very thin; leaf base distinctly bordered; basal cells fragile .......... 2

2. Leaves falcate-secund, scarcely deciduous, sheathing base large, ovate to ovate-oblong. Border between the lax-celled area of sheathing base and the upper area distinct. Shoulder of sheathing base entire .......... 2. *D. uncinatum*

2. Leaves flexuose, spreading, often homomallous, readily deciduous, sheathing base small, ovate. Lax cells of sheathing base gradually smaller towards margin and apex. Shoulder of sheathing base serrulate .......... 3. *D. asperulum*

1. *DICRANODONTIUM DENUDATUM* (BRID.) BRITT. IN WILLIAMS (Fig. 68, A)

N. Am. Fl. 15: 151 (1913).


Plants deep-green, slightly glossy. Stems to 20 mm long, simple or sparsely branched, leaves crowded at apex. Leaves erect-spreading, often falcate-secund both when dry and moist, deciduous, abruptly tapered to a long, finely setaceous, semicanalicate points from an ovate-oblong, ± sheathing base, auriculate at base, 3.5-5.0 mm long; margins serrulate above; costa pellucid, poorly defined, occupying 1/3-1/2 the width of leaf base, smooth at back; long excurrent. Upper and median cells of subula elongate-rectangular, sublinear towards leaf base. Median cells of sheathing base rectangular, 20-35 x 5-8 μm, each with a small papilla in the upper corner, gradually narrower towards leaf margin, but not forming band, basal area well-marked, with rectangular or subquadrate (20-35 x 12-20 μm), hyaline (occasionally brownish) cells, walls thin. Dioicous. Seta flexuose when dry, cygneous when moist, 5-8 mm long, yellow. Capsule pendulous, oblong, 1.0-1.2 x 0.50-0.55 mm, yellowish-brown. Operculum slightly shorter than the capsule. Peristome teeth separate to below the mouth, ca. 0.25 mm long, yellowish-brown (but the base ± reddish). Spores 10-13 μm. Calyptra ca.1.7 mm long.

Exsiccati: Musci Japonici 2: 53 (1948); 8: 357 (1954); 14: 678 (1959); 33: 1613 (1982).
Figure 68.
A. *Dicranodontium denudatum* (Brid.) Britt.  a. Plants, x1.  b. Part of stem, x10.  c. Cross-section of stem, x250.  d. Leaves, x20.  e. Leaf apex, x250.  f. Cells at leaf shoulder, x250.  g. Cells at leaf base, x180.  h. Capsules, x15.  i. Peristome teeth, x180.  [Noguchi 24206]
B. *D. uncinatum* (Harv.) Jaeg.  j. Leaves, x10.  k. Leaf apex, x135.  l. Median cells of leaf, x250.  m. Cells at leaf base, x135.  n. Cross-sections of leaf, x250.  o. Capsule, x10.  p, q. Inner perigonial leaves, x20.  [Noguchi 67057]
Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the N.Hemisphere.

In Japan the present species is not rare on decayed logs and humus-covered rocks in humid mountain forests.

When sterile *Dicranodontium denudatum* is often confused with small species of *Dicranum*, such as *D. leiodontum* or *D. fulvum*. The leaves of *Dicranodontium denudatum* are deciduous due to the fragile walls of leaf cells at leaf insertion. This character, as well as the broader costa, easily distinguishes *Dicranodontium denudatum* from *Dicranum* spp.

2. **DICRANODONTIUM UNCINATUM** (HARV.) JAEG. (Fig. 68, B)


*Thysanomitrium uncinatum* Harv. in Hook., Icon. Pl. Rar. 1: 22, f. 5 (1836).

Plants stout, to 10 cm long, pale brown, less glossy. Stems flexuose or curved, sparsely branched. Leaves ± lax, strongly falcate-secund (especially the upper leaves), scarcely altered when dry, to 8 mm long, tapering to a subulate, arcuate, semicanalicate point from an ovate to ovate-oblong sheathing base; leaf base somewhat auriculate; leaf margin involute, serrulate in the upper half or almost entire length; costa occupying 1/5-1/4 the width at base, slightly longitudinally furrowed and often dentate at back above. Median area of sheathing base well-marked, with large hyaline cells, 40-65 x 16-20 µm, elongate-rectangular, inflated, walls thin, narrower towards leaf margin, which composed of several rows of narrow linear cells; basal and alar areas fragile, cells very large, elongate-hexagonal or rectangular, 65-110 x 20-40 µm, hyaline, inflated, cell walls very thin; upper laminal cells rectangular to sublinear, small. Seta 8-12 mm long, yellow, strongly flexuose when dry, cygneous when moist. Capsule narrowly oblong, 1.7-2.0 x 0.8 mm, brown.

Distribution: Japan (Honshu, Shikoku, Kyushu), Taiwan, Philippines, Himalaya, Sri Lanka, Java, Mollucca, Europe.

This species is rare in Japan, growing on humus-covered rocks in the subalpine zone.

3. **DICRANODONTIUM ASPERULUM** (MITT.) BROTH. (Fig. 69)


Plants to 50 mm long, greenish-brown. Stems flexuose, slender, sparsely branched. Leaves deciduous, flexuose and falcate when dry, erect-spreading when moist, upper leaves often hamate, abruptly nar-
Figure 69. *Dicranodontium asperulum* (Mitt.) Broth.  

- a. Male plant, x8.  
- b. Leaves, x10.  
- c. Leaf apex, x250.  
- d. Median cells of leaf, x250.  
- e. Cells at leaf base, x135.  
- f. Cross-sections of leaf, x250.  
- g. Inner perichaetial leaf, x20.  
- h, i. Capsules, x15.  
- j. Inner perigonial leaf, x20.  
- k. Inner perigonial leaf, x30.  

[Noguchi 41084]
rowed to a very long, arcuate, semicanaliculate awn from an ovate, convolute base, to 7 mm long, not auriculate at base; serrulate in the upper half or to the shoulder of sheathing base, occasionally entire, apex dentate; costa broad, occupying 1/4-1/3 the width of leaf base, spinulose at tip, with several serrulate ridges or teeth or occasionally almost smooth at back. Median large-celled area of sheathing base ± distinct, cells rectangular or hexagonal, 35-50 x 13-20 µm, inflated, thin-walled, gradually becoming narrower upwards and abruptly narrower towards leaf margins and forming an indistinct marginal band. Basal and alar areas readily fragile, cells rectangular or subquadrate, large, 30-60 x 20-30 µm, inflated, walls very thin; upper laminal cells sublinear, small. Seta yellow, strongly flexuose when dry, cygneous when moist, 8-10 mm long. Capsule oblong or oblong-cylindric, 0.6-1.0 x 0.3-0.5 mm, brown. Operculum long-rostrate, 0.8-1.0 mm long. Peristome teeth ca. 0.25 mm long. Calyptra ca. 2 mm long.

Distribution: Japan (Honshu, Shikoku, Kyushu), Taiwan, China, Europe, N.America.

This species occurs on rocks in subalpine forests.

The awn of this species is proportionally narrower than in other Japanese species of *Dicranodontium*.

9. **PARALEUCOBRYUM** (LIMPR.) LOESKE

Plants large. Stems usually simple, radiculose; central strand distinct. Leaves gradually narrowed to a long subulate acumen from an oblong-lanceolate base or lacking long subula; costa flat, very broad, occupying the greater part of the subula; in cross-section lacking stereids, composed of thick-walled, ± chlorophyllose cells on ventral and dorsal sides. Marginal laminal cells narrower than median cells; basal and alar regions well differentiated, cells quadrate, rectangular or hexagonal, thin-walled, inflated. Dioicous. Inner perichaetial leaves differentiated. Seta elongate. Capsule erect, large, oblong to oblong-cylindric. Operculum with somewhat oblique, long-subulate beak. Calyptra cucullate.

**Key to the Species**

1. Leaves gradually narrowed to a long-subulate acumen from an oblong-lanceolate base, often homomallous; margins serrate above; costa rough above, occupying ca. 1/2 the width of sheathing base .... 1. *P. longifolium*

1. Leaves oblong-lanceolate, lacking a long subula, less homomallous; margins entire, sometimes with small teeth at apices; costa smooth, occupying most of the sheathing base .... 2. *P. enerve*

1. **PARALEUCOBRYUM LONGIFOLIUM** (HEDW.) LOESKE (Fig. 70, A)

Hedwigia 47: 171 (1908).
Dicranum longifolium Ehrh. ex Hedw., Spec. Musc.: 130 (1801).

Plants pale- to bright-green, silky. Stems simple, sometimes with microphyllous, flagelliform branches above, usually ca. 50 mm long. Leaves homomallous, falcate especially at the stem apex, scarcely crisped when dry, to 6 mm long, gradually narrowed to a long, falcate subulate acumen from an oblong-lanceolate base; margin serrate above, usually almost entire; costa occupying ca. 1/2 the width of sheathing base, slightly narrower at base, ± ridged and toothed at back above. Cells of sheathing base rectangular, 45-65 x 8-9 µm, walls thin, with somewhat localized thickenings; basal and alar regions pellucid, often brownish, cells quadrate to hexagonal, 20-35 x 15-20 µm. Inner perichaetial leaves with long subulate points, canaliculate, to 5 mm long. Seta solitary, to 20 mm long, straight, yellowish. Capsule 2.0-2.5 x 0.65-0.75 mm, oblong-cylindric, rarely slightly curved. Operculum slightly shorter than the urn, 1.7-2.0 mm long. Annulus wanting. Calyptra ca. 3.5 mm long.

Distribution: Japan (Hokkaido, Honshu). Widely distributed in the N. Hemisphere.

2. Paraleucobryum enerve (Thed.) Loeske (Fig. 70, B)

Hedwigia 47: 171 (1908).

Dicranum enerve Thed. in Hartm., Handb. Skand. Fl. ed. 5: 393 (1849).

Plants light-green. Leaves erect-spreading or slightly secund; margin entire, sometimes with several teeth at apex; costa smooth at back above, very wide, occupying most part of the sheathing base. Lamina in sheathing base very narrow, only 5-6 cells wide at leaf base, cells large, rectangular to hexagonal. Capsule erect, oblong-cylindric. Annulus present.

Distribution: Japan (Hokkaido, Honshu). Widely distributed in the N. Hemisphere.

10. Brothera C. MueLL.

Brothera leana (Sull.) C. MueLL. (Fig. 71)

Gen. Musc. Fr.: 259 (1900).

Leucophanes leanum Sull., Musci Allegh.: 41 (1846).

Plants small, in dense, pale green, silky tufts. Stems simple or sparingly branched, ca. 10 mm long, densely leaved, in cross-section round, ca. 0.15 mm thick, central strand slightly developed, the cortical layer consisting of thin-walled cells. Brood leaves linear, deciduous,
seemingly as leaflets (0.3-0.6 mm long), clustered, forming a large head on tip of stem apex or lateral on stem. Leaves erect-flexuose when dry, erect-spreading or somewhat homomallous when moist, 2-3 mm long, gradually tapering to a linear, semicanalliculate subula from a narrowly oblong, clasping base; margin entire; costa broad, occupying the greater portion of leaf and ca. 1/2 the leaf-width at base; in cross-section consisting of a median row comprising groups of small chlorophyllose cells between dorsal and ventral rows of large, hyaline cells. Median laminal cells pellucid, elongate-rectangular or -rhomoidal, 35-50 x 4.5-5.5 µm, thin-walled; lower cells elongate-hexagonal to -rectangular, 40-60 x 9-12 µm, thin-walled, narrower towards margins. Dioicous. Perichaetia terminal, solitary; leaves similar to stem leaves. Seta strongly flexuose when dry, cygneous when moist, 5-6 mm long, ca. 0.1 mm thick, yellow, smooth. Capsule pending, oblong, 0.85-1.00 x 0.40-0.45 mm. Operculum long, 0.65-0.70 mm, rostrate. Annulus large, 2-3 rows. Peristome teeth 16, sublinear, strongly attenuate, 0.20-0.25 mm long, not split, indistinctly papillose and pellucid above, reddish-brown and indistinctly and obliquely papillose-striolate below, slightly papillose on the inner surface. Spores finely papillose, 10-13 µm. Calyptra pale, long-conic and long split on one side below, 1.2-1.5 mm long, fringed at base, the filaments pellucid.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Taiwan, China, Philippines, Soviet Far East, eastern N.America.

In Japan, it is not rare on the base of conifers such as Cryptomeria and Chamaecyparis, but it occasionally grows on conifer bark on house roofs.

As the sporophyte is very rare, its detailed structure is not well known.

As to the seta, Ando and Takaki mentioned merely that the seta is somewhat flexuose, and twisted to the left. My observation show that the seta is strongly flexuose when dry and becomes cygneous when moist.

11. RHABDOEISIA B.S.G.

RHABDOEISIA CRISPATA (WITH.) LINDB. (Fig. 72)


Figure 70.
A. *Paraleucobryum longifolium* (Hedw.) Loeske.  
d. Leaf apex, x180.  e. Cells at leaf base, x180.  
f. Cross-sections of leaf, x250.  
g. Inner perichaetial leaf, x15.  
h. Capsules, x10.  i. Outer perigonial leaf, x15.  j. Inner perigonial leaf, x15.  
[Noguchi 23528]

B. *P. enerve* (Thed.) Loeske.  
k. Cross-section of stem, x160.  
l. Leaves, x9.  
m. Cells at leaf apex, x160.  
n. Cells at leaf base, x160.  
o. Peristome teeth, x160.  
[Noguchi 6459 from Taiwan]
Plants minute, in dense mats. Stems to 5 mm long, usually simple, sparsely leaved, without central strand. Leaves appressed when dry, erect-spreading when moist, narrowly lingulate, slightly arcuate, keeled; lower leaves small; upper leaves much larger, to 2.5 mm long, ca. 0.25 mm wide; margins plane or erect, often remotely crenate above; costa stout, extending to below leaf apex. Median laminal cells usually quadrate to rectangular, variable in size, 15-20 x 10-15 µm, thick-walled, smaller and becoming equal in size towards leaf margins; upper cells rounded-quadrate, transversally elongate or hexagonal, 10-15 µm long; basal cells rectangular, 40-60 x 10-20 µm, hyaline, thin-walled; alar cells not differentiated. Autoicous. Perichaetia terminal; perichaetal leaves not differentiated. Seta 2-4 mm long, 0.05-0.06 mm thick, straight, yellowish. Capsule erect, ovoid or ovoid-oblong, 0.35-0.60 x 0.25-0.40 mm, 8-furrowed when dry, yellowish-brown. Operculum long and obliquely rostrate from conic base, 0.35-0.50 mm long (as long as the urn). Annulus lacking. Stomata few. Peristome teeth 16, remote, inserted below the mouth of urn, linear from a triangular or lanceolate base, undivided, usually ca. 0.15 mm long, occasionally to 0.23 mm long, laxly barred, almost smooth, orange, often fragile. Spores minutely papillose, (15-)20-25 µm. Calyptra cucullate, 0.8-1.0 mm long. Perigonium below the perichaetium; inner perigonial leaves ovate.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Java, Soviet Far East, Caucasus, Europe, N. and S. America, Hawaii.

This species is often confused with Weissia controversa in the field, but may be distinguished by the characteristic peristome teeth and smooth leaf cells.

12. OREAS BRID.

OREAS MARTIANA (HOPPE & HORNSCH.) BRID. (Fig. 65, B)

Bryol. Univ. 1: 383 (1826).

Weissia martiana Hoppe & Hornsch. in Hook., Musci Exot. 2: 104 (1819).

Plants in very compact mats. Stems slender, ca. 4 mm long, densely leaved; in cross-section rounded, the cortical cells small and thin-walled, the central strand slightly developed. Stem leaves rather abruptly tapered to a linear-lanceolate, semicanaliculate or keeled point from an oblong, concave base, to 2 mm long; apex acuminate; margin plane or somewhat recurved, bistratose, crenate at apex; costa stout, ending near leaf-apex, smooth on the dorsal surface, with a poor dorsal stereid. Median laminal cells rectangular or irregularly subquadrate,
Figure 71.

_Brothera leana_ (Sull.) C.Muell.  

a. Habit, x1.  
b. Plants, x10.  
c. Cross-section of stem, x250.  
d. Leaves, x34.  
e. Median cells of leaf, x180.  
f. Cells at leaf base, x180.  
g. Cross-sections of leaf, x250.  
h. Capsule, x20.  
i. Peristome teeth, x250.  
j. Calyptra, x20.  
k. Clusters of gemmae, x20.  
l. Gemmae, x34. [Noguchi 74531]
8-13 x 4-5 µm, bulging on both sides, slightly obscure, uniformly thick-walled; upper cells similar to the median cells; lower and alar cells elongate-rectangular, 20-35 x 5-6 µm, scarcely bulging, thin-walled. Autoicous? Perichaetia terminal; inner perichaetial leaves similar to stem leaves but longer. Seta curved or flexuose when dry, cygneous when moist, 1.5-2.0 mm long, ca. 0.13 mm thick, yellow. Capsule almost globose, ca. 0.7 mm long, with a distinct apophysis, 8-ribbed, the rib yellowish; annulus present. Operculum shortly rostrate from a convex base, ca. 0.35 mm long. Peristome teeth 16, triangular, gradually acuminate above, widest at base, ca. 0.25 mm long, yellowish-brown, vertically striolate throughout. Spores 20-25 µm, papillose. Calyptra widely cucullate, ca. 0.7 mm long.

Distribution: Japan (Honshu), China, India, Sikkim, Caucasus, Europe, Greenland, N. America.

In Japan the present species has been recorded only once, from Mochizuki, central Honshu by Ohinata (1912).

Oreas is a monotypic genus, widely distributed in the N. Hemisphere, and is considered to be ancient and primitive. According to Steere (1958), it was apparently more widely distributed during the periods of warmer pre-Pleistocene or interglacial climate than at present.

13. CYNODONTIUM SHIMP.

Plants medium-sized. Stems erect to ascending, simple or with a few branches, densely leaved, with central strands. Leaves crisped to flexuose when dry, erect-spreading when moist; gradually narrowed upwards to an elongate, keeled acumen from an oblong or ovate base, or linear-lanceolate; acute to acuminate at apex; margin plane or recurved, remotely denticulate and usually bistratose in the upper half; costa strong, prominent at back, extending to the leaf apex, scabrous at back, usually with dorsal and ventral stereids at base. Median laminal cells obscure, hexagonal to rectangular, with or without papillae, thin-walled, longer towards leaf base; basal cells of lamina pellucid, lax, rectangular, smooth; alar cells scarcely differentiated. Autoicous. Perichaetia terminal, solitary; inner leaves similar to upper stem leaves. Seta long, smooth. Capsule almost erect or cernuous, oblong, usually furrowed when dry; annulus present; stomata few. Operculum obliquely rostrate from a conical base. Peristome teeth linear-lanceolate, ca. 1/2-bifid, vertically striate and reddish-brown in the lower half, yellowish and densely papillose in the upper half. Calyptra cucullate, with a long beak. Perigonia below the perichaetium, usually with two perigonial leaves.

Key to the Species

1. Costa papillose almost in the entire length, the papillae spinous.
   Median laminal cells unequal in shape and size, obscure, highly mammillose or with large papillae on both surfaces . . . . . . . . . . . .
Figure 72.
Rhabdoweisia crispata (With.) Lindb.  a. Plant, x15.  b. Leaves, x30.  c. Cells at leaf apex, x173.  d. Median cells of leaf, x330.  e. Moist capsule, x30.  f. Dry capsule, x30.  g, h. Capsules, x30.  i. Peristome teeth, x173.  j. Perigonium, x30. [a–c, g, i, Noguchi s.n.]
C. gracilescens

1. Costa usually papillose in the upper half, the papillae small and rounded. Median laminal cells almost equal in shape and size, rather pellucid, mammillose on both surfaces, the mammillae rounded (often indistinct on ventral surface) .......................... 2

2. Leaves very narrowly attenuate; margin strongly revolute almost throughout. Capsules curved, asymmetric and sometimes strumose ........................................... 1. C. polycarpum

2. Leaves broadly attenuate; margin slightly or scarcely revolute. Capsules straight, symmetric, not strumose ............ 2. C. fallax

1. CYNODONTIUM POLYCARPUM (HEDW.) SCRIMP. (Fig. 73, A)

Coroll.: 12 (1856).


Plants small, in dull yellowish-green tufts. Stems to 15 mm long. Leaves appressed and incurved or ± contorted when dry, linear-lanceolate, finely tapering at apex; lower leaves small; upper leaves gradually larger, to 4 mm long; margin strongly revolute, bistratose and denticulate except in the lowest portion; costa ca. 0.08 mm thick at base, papillose at back in the upper 1/3. Median laminal cells rather pellucid, rectangular, 9-15 x 5-8 µm, bulging on both surfaces (projections on ventral surface often indistinct), walls moderately thick, regularly arranged in longitudinal rows; upper cells somewhat shorter, subquadrate; lower cells elongate-rectangular, 30-65 x 6.5-10.0 µm (variable in size), thin-walled; cells at leaf insertion broader, light brown. Inner perichaetial leaves slightly differentiated. Seta 8-15 mm long, 0.10-0.15 mm thick, yellowish. Capsule suberect, oblong to oblong-cylindric, with or without crop, straight or slightly curved, symmetric or asymmetric, variable in size (1.0-1.8 x 0.4-0.7 mm). Operculum 0.7-0.9 mm long, shorter than urn. Peristome teeth 0.40-0.45 mm long. Spores 15-21 µm. Calyptra 2.0-2.3 mm long. Inner perigonial leaves obtuse at apex.


Distribution: Japan (Hokkaido, Honshu). Widely distributed in the N.Hemisphere.

This species is common in the alpine regions in Japan, growing on moist soil-covered rocks or in rock crevice.

2. CYNODONTIUM FALLAX LIMPR. (Fig. 73, B)


Similar to C. polycarpum but more robust. The leaves incurved, contorted or ± crispate when dry, widely spreading when moist; margin slightly recurved; costa with small teeth above. Median laminal cells 9-14 µm, mammillose (occasionally indistinct on the ventral surface).
Figure 73.

A. *Cynodontium polycarpum* (Hedw.) Schimp.  
- a. Leaves, x23.  
- b. Cross-section of leaf, x130.  
- c. Cells at leaf apex, x130.  
- d. Median cells of leaf (dorsal view), x245.  
- e. Capsules, x10.  
- f. Dry capsule, x10.  
- g. Peristome teeth, x130.  

B. *C. fallax* Limpr.  
- h. Leaves, x23.  
- i. Cells at leaf apex (dorsal view), x130.  
- j. Median cells of leaf, x245.  
- k. Perichaetial leaf, x23.  
- l. Capsule, x10.  
- m. Dry capsule, x10.  

C. *C. gracilescens* (Web. & Mohr) Schimp.  
- n. Plant, x8.  
- o. Leaf, x10.  
- p. Leaf apex (dorsal view), x245.  
- q. Median cells of leaf, x245.  
- r. Dry capsule, x15.  
- s. Capsule, x15.  

[Noguchi 15918]  
[Tatebe 716]  
[Noguchi 36989]
Capsule almost erect and straight, symmetric, not strumose. Operculum shorter than urn.

Distribution: Japan (Honshu), Siberia, Europe, N.America.

This species is rare and known only from restricted localities in Japan.

3. **CYNODONTIUM GRACILESCENS** (WEB. & MOHR) SCHIMP. (Fig. 73, C)

Leaves broader and more obtuse at apex than those of *C. polycarpum*; costa bearing dense, long, sharp papillae at back throughout the entire length; margin revolute in the lower half. Median laminal cells more obscure than those of *C. polycarpum*, with larger, spinous papillae on both surfaces, irregular in size (5-10 µm) and shape (hexagonal, quadrate, or transversely rectangular). Seta flexuose when dry, curved when moist. Capsule somewhat cernuous. Operculum with beak almost as long as urn.


Distribution: Japan (Honshu), Korea, China, Europe, N.America.

This species is similar to *C. polycarpum* in the general appearance. In addition to the characters mentioned in the key, it is distinguished from the latter in the following respects: the leaf margins are less recurved; the capsules are somewhat drooping on flexuose seta; the operculum is almost as long as the urn.

Species not Available


Narita (1950) reported this species from Japan. However, the specimens is not available.

14. **OREOWEISIA** (B.S.G.) DE NOT.

**OREOWEISIA LAXIFOLIOA** (HOOK. f.) KINDB. (Fig. 74)


Plants dark-green above, brownish below, in loose tufts. Stems ca. 30 mm long, sparingly branched, rather sparsely leaved, with papillose
Figure 74. *Oreoweisia laxifolia* (Hook.f.) Kindb.  

a. Plant, x10.  
b. Cross-section of stem, x333.  
c. Leaves, x27.  
d. Cross-sections of leaf (*d1*, lower, *d2*, upper parts), x333.  
e. Cells at leaf apex (dorsal view), x333.  
f. Cells at leaf base, x333.  
g. Peristome teeth, x240.  

[Kumamoto Univ. Herb. K29950]
radicles and central strand, without gemmae. Leaves contorted when dry, erect-spreading when moist; lower leaves narrowly lingulate from an oblong, concave base, keeled above, ca. 2.5 x 0.6 mm; upper leaves lanceolate or narrowly lingulate from an oblong base, ca. 3.0 x 0.4 mm, narrower than lower leaves; margin plane or slightly undulate above, slightly revolute below, serrate by projecting cells above, serration stronger upwards; costa stout, ca. 0.1 mm thick at base, brownish below, ending below leaf apex, spinose at back above, papillose below, with thin ventral stereids. Median laminal cells obscure, quadrate or hexagonal, 8.5-10.0 µm, bulging, spinose on both surfaces; upper cells similar to the median, a single row of marginal cells pellucid; lower cells elongate-hexagonal to -rectangular, 35-50 x 9-12 µm, scarcely bulging and without papillae, pellucid, thin-walled; alar cells scarcely delimited, but rectangular to hexagonal, 20-40 x 12-16 µm, scarcely bulging, not papillose, pellucid, thin-walled. Autoicous. Perichaetia terminal; inner leaves similar to stem leaves, but with long sheathing base. Setae often in pairs, yellow, 8-10 mm long, 0.8-0.9 mm thick. Capsule erect, oblong-cylindric, 1.0-1.2 x 0.4-0.5 mm. Operculum somewhat obliquely rostrate from a conic base, 0.4-0.5 mm long. Annulus and stomata absent. Peristome teeth inserted below the rim of capsule, gradually tapering to a filiform, somewhat flexuose, not divided, faintly papillose, yellowish, ca. 0.35 mm long, faintly striate (extreme base smooth), orange below. Spores 16-20 µm, scabrous. Calyptra cucullate, ca. 2.2 mm long, yellowish.


Distribution: Japan (Honshu), China, Taiwan, Himalaya, S. India.

This species is common in the Himalaya and the subalpine region of Taiwan. In Japan it is very rare, only once reported from Mt. Komagatake, central Honshu.

From the external appearance this species is more likely to be considered by students as a member of the family Pottiaceae than of the Dicranaceae.

In the gametophyte, this species seems to be related to the genus Dichodontium, but the peristome is distinct from that of the most dicranoid plants.

15. DICHOdontium SCHIMP.

DICHOdontium PELLUCIDUM (HEDW.) SCHIMP.

Coroll.: 12 (1856).

Dicranum pellucidum Hedw., Spec. Musc.: 142 (1801).

Plants in dense, yellowish- to dark-green tufts, not glossy. Stems erect, simple or forked, to 20 mm long, densely leaved, with non-
Figure 75.
papillose radicles below; central strand present; gemmae axillary, ovoid or fusiform, 85-110 \( \mu m \) long. Stem leaves incurved and contorted when dry, widely spreading when moist, keeled, narrowly lingulate to lanceolate, 2.0-2.5 x 0.3-0.4 mm, usually acute or bluntly acute at apex; margin almost entire below, coarsely toothed above, the teeth pellucid and somewhat blunt; costa single, stout, reaching just below the leaf apex, yellowish-brown, rough at back above; in cross-section consisting of a median layer of guide cells, and ventral and dorsal stereids. Median laminal cells rounded-hexagonal, 8-12 \( \mu m \), bulging, ± obscure, thin-walled; upper cells hexagonal to subquadrate, somewhat smaller, bulging, ± obscure, thin-walled; marginal cells in 3-4 rows subquadrate, pellucid, running down to leaf base; inner basal cells narrowly rectangular, pellucid, 35-50 x 10-15 \( \mu m \), thin-walled; alar cells not differentiated, rectangular, 12-16 x 8-12 \( \mu m \), walls uniformly thin. Dioicous. Inner perichaetial leaves similar to stem leaves. Seta solitary, yellow, ca. 10 mm long, ca. 0.15 mm thick, strongly flexuose. Capsule inclined to suberect, oblong or obovoid, ca. 1.2 x 0.9 mm, with small apophysis, ± contracted below the rim when dry and empty; stomata present. Operculum obliquely rostrate from a conical base, ca. 0.9 mm long. Annulus absent. Peristome teeth lanceolate, ca. 0.5 mm long, divided into half way down, yellowish, papillose, vertically striolate and reddish-brown below. Spores finely papillose, 12-20 \( \mu m \). Calyptra cucullate, 1.5-1.7 mm long.

a. VAR. **PELLUCIDUM** (Fig. 75, A)

Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Himalaya, Aleutians, Europe, Greenland, N.America.


b. VAR. **YEZOENSE** NOG. (Fig. 75, B)

J. Hattori Bot. Lab. 8: 18, f. 9 (1952).

Distribution: Endemic to Japan (Hokkaido, Honshu).

This variety is characterised by its widely lingulate leaves with obtuse apex and its obovate capsules.

Species not Available

Figure 76.

Dicranoweisia crispula (Hedw.) Mild.  a. Leaves, x24.  b. Cross-sections of leaf (b1, upper, b2, median, b3, lower parts), x300.  c. Median cells of leaf, x300.  d. Cells at leaf base, x300.  e. Outer perichaetial leaf, x24.  f. Inner perichaetial leaf, x24.  g. Capsule, x18.  h. Dry capsule, x24.  i. Peristome teeth, x216.  j. Inner perigonial leaf, x41. [Noguchi 43051]
16. DICRANOWEISIA LINDB. EX MILD.

DICRANOWEISIA CRISPULA (HEDW.) MILD. (Fig. 76)

Weissia crispula Hedw., Spec. Musc.: 68, t. 12, f. 1-6 (1801).

Plants brown above, blackish below, not glossy. Stems forked, to 20 mm long, densely leaved; central strand present. Leaves contorted, crisped or cirrate when dry, widely spreading and recurved or homomallous when moist, gradually tapering to an elongate, semicanaliculate, curved or strongly flexuose subulae from a narrowly oblong, clasping base, to 4 mm long; margin erect or slightly incurved, entire throughout or crenate at apex; costa stout, yellowish-brown, extending to leaf apex, smooth at back, in cross-section with a median layer of guide cells, and ventral and dorsal stereids. Median laminal cells almost quadrate, in regularly longitudinal rows, 6-9 µm, bulging, often papillose in younger leaves, thick-walled; basal and alar cells delimited, elongate-rectangular, 25-35 x 8-12 µm, usually pachydermous. Autoicous. Perichaetia terminal, solitary; inner perichaetal leaves long-sheathing, shortly attenuate or obtuse, convolute, ca. 2.5 mm long; paraphyses not seen. Seta straight, 10-15 mm long, brownish. Capsule erect, oblong or oblong-cylindric, 1.5-1.7 x 0.7 mm, leptodermous, longitudinally ridged. Annulus absent. Stomata few. Operculum long-rostrate. Peristome teeth 16, brownish, ca. 0.25 mm long, not divided, strongly papillose on both surfaces, the papilae occurring in ± vertically or obliquely in lower portions of teeth. Spores 12-15 µm. Calyptra cucullate, 1.8-2.0 mm long. Perigonia ca. 0.8 mm long, a little below the perichaetium, solitary; inner perigonal leaves cymbiform, ca. 0.6 mm long. Antheridia and paraphyses many.

Distribution: Japan (Hokkaido, Honshu), Himalaya, northern and central Asia, Asia minor, Africa, Europe, Greenland, N. America.

This species occurs on acid rocks in the alpine zone.

The undivided peristome teeth of the species are unique in the family Dicranaceae, but the surface texture of the teeth is that of a dicranoid moss.

17. ONCOPHORUS (BRID.) BRID.

Plants small to medium-sized. Stem sparingly branched, with a central strand. Leaves crisped when dry, spreading when moist, gradually or abruptly tapering to an elongate, keeled subula from an oblong, ovate, or obovate sheathing base, apex acuminate; margin erect, bistratose and crenate above; costa stout, percurrent, often crenate at back above, in cross-section consisting of a single row of guide cells, and usually with dorsal and ventral stereids. Laminal cells sometimes
bistratose except in the sheathing base; median laminal cells subquadrate to irregular, scarcely bulging, thick-walled; lower cells elongate-rectangular to -hexagonal, narrower and not bulging towards the leaf margin. Autoicous. Perichaetia terminal, solitary; paraphyses absent. Seta elongate, smooth. Capsule inclined, oblong to cylindric, strumose, asymmetric, curved and constricted below the mouth when dry or empty. Operculum with elongate, oblique beak. Annulus absent or present. Stomata few. Peristome teeth incurved when dry, lanceolate, ca. 1/2-bifid, articulate above, densely trabeculate, vertically striolate, mostly reddish-orange, becoming yellowish to orange and papillose at apex, with dividual lines and with large distant bars on the inner surface. Spores scabrous. Calyptra cucullate. Perigonia axillary below the perichaetium, usually with few cymbiform and obtuse leaves; paraphyses few.

The present genus is so closely related to *Cynodontium* in many important characters that the two are not always clearly delimited. In *Oncophorus*, the laminal cells lack mammillae and papillae, and the capsules consistently bear large crops at the base. These characters may be interpreted as delimiting *Oncophorus* as a distinct genus.

Key to the Species

1. Leaves appressed and incurved or slightly crisped when dry; margin in the lower half. Capsules distinctly sulcate when dry ....

1. Leaves erect or widely spreading and usually strongly crisped when dry; margin erect. Capsules scarcely sulcate when dry .... 2

2. Leaves crisped when dry, subulate from an oblong sheathing base, scarcely reflexed ...

1. Leaves strongly crisped when dry, abruptly subulate and sharply reflexed from an obovate, strongly sheathing and clasping base ...

1. **ONCOPHORUS CRISPIFOLIUS** (MITT.) LINDB. (Fig. 77)


Plants in dense tufts, yellowish-green above, dark-green or brownish below. Stems to 30 mm long, arcuate; usually with few branches, densely leaved. Leaves crisped when dry, widely spreading when moist, to 6 mm long, tapering (abruptly narrowed in the upper leaves) to a very long, incurved subula from an obovate, sheathing (but scarcely clasping) base; margin erect, remotely crenate to subentire and bistratose above; costa ca. 0.09 mm thick at base. Median laminal cells somewhat obscure, subquadrate or rectangular, 5–8 µm, marginal cells somewhat smaller; cells of sheathing base lax, pellucid, elongate-rectangular, ca. 40 x 12 µm, thin-walled; upper part of lamina usually
DICRANACEAE

bistratose. Inner perichaetial leaves similar to upper stem leaves, but with a larger sheathing base, to 4 mm long. Seta elongate. Capsule 1.0–1.3 x 0.5–0.6 mm, almost oblong but widest at mouth, asymmetric, distinctly strumose. Peristome teeth to 0.55 mm long, reddish-orange below, orange above. Spores 12–16 \( \mu \text{m} \). Calyptra 1.8–2.0 mm long. Inner perigonial leaves ca. 0.5 mm long.

1a. VAR. *CRISPIFOLIUS*

Seta 4–5 mm long.

Exsiccati: Musci Japonici 2: 54 (1948); 4: 160 (1950); 7: 333 (1953).

Distribution: Japan (Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East.

This variety is common on rocks or boulders in forests in southern and western Japan.

1b. VAR. *BREVIPES* (CARD.) THÉR.


Seta 1–2 mm long.


Distribution: Japan (Honshu, Shikoku, Kyushu), China.

2. *ONCOPHORUS VIRENS* (HEDW.) BRID. (Fig. 78, A)

Bryol. Univ. 1: 399 (1826).

*Dicranum virens* Hedw., Spec. Musc.: 142 (1801)

Plants yellowish-brown above, blackish-brown below. Stems to 30 mm long, ascending, with few, long branches. Leaves somewhat crisped when dry, erect-spreading when moist, gradually tapering to a linear-lanceolate, slightly crisped, keeled acumen from an oblong, scarcely clasping base, 3.5–5.0 mm long, somewhat fragile; margin recurved in the lower half, plane and serrulate above, usually unistratose; costa brownish, prominent at back, mammillose above. Median laminal cells rectangular, 9–13 x 6–7 \( \mu \text{m} \), thick-walled; marginal cells somewhat shorter; upper cells rectangular, strongly bulging or mammillose, thick-walled; most cells of leaf base much larger; median basal cells rectangular, 40–65 x 12–16 \( \mu \text{m} \), rather thick-walled. Inner perichaetial leaves similar to upper stem leaves but the base longer and more sheathing. Seta
Figure 77. *Oncophorus crispifolius* (Mitt.) Lindb. a. Dry plant, x12. b. Cross-section of stem, x300. c. Leaves, x18. d. Cross-sections of leaf (*d1*, upper, *d2*, median, *d3*, lower parts), x300. e. Cells at leaf apex, x300. f. Median cells of leaf, x300. g. Cells at leaf base, x216. h. Inner perichaetial leaf, x18. i, j. Capsules, x12. k. Dry capsule, x24. l. Peristome teeth (with ventral view at right), x162. [Noguchi 37552]
10-12 mm long, 0.13-0.15 mm thick, yellowish-brown. Capsule oblong, 1.3-1.5 x 0.50-0.75 mm, brown, somewhat furrowed when dry. Annulus present. Operculum 0.6-0.7 mm long. Peristome teeth to 0.4 mm long. Spores 16-20 µm. Calyptra ca. 2.3 mm long. Perigonia just below the perichaetium; inner perigonial leaves ca. 0.5 mm long.

Distribution: Japan (Honshu), Korea, China, Siberia, Caucasus, Europe, Greenland, N. America.

This species is considerably different from O. crispifolius and O. wahlenbergii and resembles species of Cynodontium, such as C. polycarpon and C. fallax in the strongly bulging upper laminal cells, the presence of an annulus, and the capsules furrowed when dry.

3. **ONCOPHORUS WAHLENBERGII** BRID. (Fig. 78, B)

Plants yellowish-green above, blackish below. Stems to 50 mm long, with a few long branches; shoots ca. 5 mm wide. Leaves strongly crisped when dry, widely spreading, occasionally hamate when moist, abruptly narrowed to an elongate, keeled subula from a rather long sheathing base which is much wider at the shoulder than at the insertion; the subula sharply reflexed, but incurved or recurved above, to 6 mm long; margin erect to slightly recurved, irregularly and remotely serrate, and often bistratose above, remotely crenate and unistratose below, entire and ± recurved at the shoulder of the sheathing base; costa with many teeth at back above. Median laminal cells quadrate to rectangular, 8-10 µm; marginal cells quadrate, cells near base of the subula sub-quadrate to shortly rectangular; cells of leaf base narrowly rectangular, with delicate walls; median basal cells 40-55 x 5.0-8.5 µm. Inner perichaetial leaves similar to upper stem leaves but with a longer sheathing base. Seta 8-30 mm long, yellow. Capsule oblong, with rather wide mouth, ± constricted below the mouth, 0.85-1.00 x 0.60-0.65 mm, somewhat wrinkled when dry. Peristome teeth ca. 0.55 mm long. Inner perigonial leaves ca. 1.5 mm long.

3a. **VAR. WAHLENBERGII**

Leaves to 4 mm long. Seta 8-12 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu). Widely distributed in the N. Hemisphere.

This variety is not common, usually on logs in the subalpine region.

3b. **VAR. LONGISETUS** NOG.

Figure 78.

A. *Oncoporus virens* (Hedw.) Brid.  
a. Dry plant, x12.  
b. Leaves, x24.  
c. Cells at leaf apex, x216.  
d. Median cells of leaf, x300.  
e, f. Capsules, x12.  
[Noguchi 24537]

B. *O. wahlenbergii* Brid.  
g. Dry plant, x12.  
h. Leaves, x12.  
i. Cross-sections of leaf (i1, upper, i2, lower parts), x195.  
j. Cells at leaf apex (dorsal view), x195.  
k. Cells at leaf shoulder, x162.  
l. Peristome teeth (with ventral view at right), x195.  
m. Perigonium, x33.  
[Noguchi 22842]
Plants larger than those of var. wahlenbergii. Leaves loose, to 6 mm long, with fewer teeth on margin. Seta 20-30 mm long. Capsule 1.2-1.8 x 0.7-0.9 mm.

Distribution: Japan (Honshu), Taiwan.

18. HOLOMITRIUM BRID.

HOLOMITRIUM DENSIFOLIUM (WILS.) WIJK & MARG. (Fig. 79)

Taxon 11: 221 (1962).


Plants yellowish-brown and scarcely glossy above, blackish below, in dense tufts. Stems erect, ca. 20 mm long, with dense radicles, sparingly branched; central strand present; branches ascending, densely leaved and radiculose, often with several flagella above. Leaves crisped when dry, widely spreading and incurved at tip when moist, abruptly narrowed to a linear-lanceolate, often reflexed, keeled acumen from an oblong sheathing base, 3-4 mm long; margin erect, entire, cells incrassate; costa stout, ca. 0.1 mm wide at base, extending to leaf apex, smooth at back. Median laminal cells rounded or irregular-hexagonal, somewhat obscure, 8-10 µm, mammillose on both surfaces, walls incrassate, collenchymatous; cells smaller towards leaf margin, longer towards leaf base; upper cells of sheathing base elongate, linear, the walls sinuose; cells near leaf insertion larger, elongate-rectangular, thin-walled; alar cells not differentiated. Phyllodioicus. Inner perichaetial leaves narrowed to a very long setaceous apex from an elongate sheathing base, rolled, to 10 mm long, extending above the mouth of capsule, or sometimes ending below the base of the urn; costa weak. Paraphyses not seen. Seta 5-8 mm long, brown. Capsule erect, subcylindric with wider base, 1.5-2.3 x 0.6-0.7 mm, slightly rugose when dry, brown; annulus absent; stomata present. Operculum long rostrate, ca. 1.5 mm long. Peristome teeth to 0.3 mm long, linear-lanceolate, inserted below the rim, coarsely papillose throughout, split or with median perforation below, pellucid above. Spores 8.5-10.0 µm, almost smooth. Calyptra cuculate, ca. 4 mm long. Dwarf male plants to 0.8 mm long; inner perigonial leaves cymbiform, acute, ca. 0.35 mm long; antheridia several.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu), Korea, China, Taiwan, Philippines, Himalaya.
Figure 79.
Holomitrium densifolium (Wils.) Wijk & Marg. a. Dry plant, x1. b. Leaves, x24. c. Cells at leaf apex (dorsal view), x300. d. Median cells of leaf, x462. e. Cells at leaf base, x162. f. Inner perichaetal leaf, x12. g. Capsule, x12. h. Peristome teeth, x216. i. Dwarf male, x24. [Noguchi 25296]
This species is similar in appearance to species of *Dicranum*. When fertile, however, it is clearly distinguished from *Dicranum* species by the long perichaetal leaves which extend to or beyond the capsule, and when sterile by the strongly incrassate areolation of leaves.

19. **ARCTOA** B.S.G.

**ARCTOA FULVELLA** (DICKS.) B.S.G.


*Bryum fulvellum* Dicks., Pl. Crypt. Brit. fasc. 4: 10, pl. 11, f. 1 (1801).

Plants small, forming dense tufts, brown above, blackish below, not glossy. Stems to 10 mm long, simple or with few branches, with central strand and large-celled cortical layers. Leaves erect-spreading or secund, ± contorted but scarcely crisped when dry; lower leaves either linear-lanceolate or gradually tapering to a long-subulate acumen from an ovate base, ca. 1.5 mm long; upper leaves rather abruptly narrowed to a very long, semicanaliculate acumen from an oblong or ovate-oblong, semisheathing base; margin erect, almost entire (but ± dentate at apex), unistratose (except for apical portions); costa narrow below, reaching leaf apex, smooth on the dorsal surface; in cross-section consisting of several layers of homogeneous cells and median guide cells, without stereids. Median laminal cells elongate-rectangular, 40-65 x 5-8 µm, thick-walled; marginal cells shorter; median basal cells narrowly rectangular, 50-65 x 8-13 µm, rather thin-walled; alar area delimited, of broad, blackish, rectangular to subquadratce cells, 13-30 x 13-17 µm (lower cells longer), thick-walled. Autoicous. Inner perichaetal leaves similar to upper stem leaves but with a longer sheathing base and a delicate costa. Seta 2-3 mm long, straight. Capsule erect, ovoid to oblong with indistinct apophysis, 0.7-1.0 x 0.5-0.6 mm, vertically furrowed when dry and empty; annulus in 3 rows of small cells; stomata present. Operculum 0.5-0.8 mm long, with long, oblique beak. Peristome teeth widely spreading, incurved at apex when dry, lanceolate, often vertically perforated at middle or bifid, to 0.4 mm long, vertically striate (not papillose-steriate) and brown below, papillose and yellowish above; inner surface with dense trabeculae and loose papillae. Spores 17-23 µm, scabrous. Calyptra cucullate, 1.3-1.5 mm long. Perigonia budlike, terminal on short shoot below the perichaetium; inner leaves widely ovate, cymbiform, obtuse, ca. 0.5 mm long; paraphyses few.

**a. VAR. FULVELLA** (Fig. 80, A)

Capsules exserted.


Distribution: Japan (Hokkaido, Honshu), Europe, Greenland, N. America.
Figure 80.

A. *Arctoa fulvella* (Dicks.) B.S.G. var. *fulvella*. a. Plants, x1. b. Cross-section of stem, x300. c. Leaves, x18. d. Cross-sections of leaves (d1, upper, d2, median, d3, lower parts), x300. e. Median cells of leaf, x300. f. Alar cells, x216. g. Inner perichaetal leaf, x18. h. Capsules, x18. i. Dry capsule, x18. j. Dry capsule, x41. k. Peristome teeth (with ventral view at right), x216. l. Perigonium, x12. m. Inner perigonial leaf, x24. [Noguchi 25438]

B. *A. fulvella* var. *longisetacea* (Card.) Hor. n. Plant, x9. [Noguchi 43097]
b. **VAR. *LONGISETACEA* (CARD.) HOR.** (Fig. 80, B)

Hikobia 1: 91 (1951).


Stem leaves longer; perichaetial leaves longer (to 7 mm long) extending beyond the capsule.

Distribution: Endemic to Japan (Hokkaido, Honshu).

In Japan this arctic-alpine moss is not rare in alpine zone of volcanos in central Honshu, occurring on ledges and in crevices of non-calcareous rocks.

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20. **KIAERIA** HAG.

Central strand of stem slightly developed. Leaves tapering to an elongate, semicanaliculate subula from an ovate or oblong or lanceolate base, slightly papillose at back above; margin entire to crenulate; costa thin, composed of almost homogeneous cells, without stereids. Median laminal cells rectangular to subquadrate, rather thin-walled, not porous; alar cells more or less differentiated. Autoicous. Seta elongate, straight. Capsules inclined, ovoid to oblong-ovoid, often ± strumose, curved, asymmetric. Operculum with an elongate, oblique beak. Annulus and stomata present. Peristome teeth linear-lanceolate, bifid to middle, vertically striolate and red-brown below, yellowish with large papillae above, the inner side with lax, delicate lamellae and papillae. Spores scabrous. Calyptra cucullate. Perigonium below the perichaetium, budlike, paraphyses present.

Some authors include the present genus in *Dicranum*, but may be distinguished by its costa, which is homogeneous and lacks stereids, and its strumose capsules.

**Key to the Species**

1. Leaves usually erect-spreading, rarely falcate. Upper leaf cells elongate-rectangular; alar area defined, the cells inflated, blackish-brown. Capsules elongate, oblong-ovoid, furrowed when dry .... 1. *K. starkei*  
   1. Leaves usually falcate. Upper leaf cells subquadrate to shortly rectangular; alar area not sharply defined, the cells brownish, scarcely inflated. Capsules ovoid, scarcely furrowed when dry .  
      2. *K. falcata*  

1. **KIAERIA STARKE!** (WEB. & MOHR) HAG. (Fig. 81, A)

Figure 81.
  a. Leaves, x34.  
  b. Cells at leaf apex, x250.  
  c. Median cells of leaf, x250.  
  d. Alar cells, x250.  
  e. Capsule, x15.  
  f. Dry capsule, x15.  
  g. Peristome teeth (with ventral view at right), x135. [Herb. Noguchi 74151 from Canada]

B. *K. falcata* (Hedw.) Hag.  
  h. Plant, x1.  
  i. Plant, x8.  
  j. Leaves, x20.  
  k. Median leaf cells, x250.  
  l. Cells at leaf base, x250.  
  m. Capsule, x15.  
  n. Dry capsule, x15.  
  o. Perigonium, x15.  
  p. Inner perigonial leaf, x55. [Ihsiba s.n.]

Plants large. Leaves erect-spreading, occasionally homomallous when moist, tapering to a linear-lanceolate, semicanaliculate subula from an oblong or lanceolate base, to 2.5 mm long, often fragile at the tip; margin ± incurved, crenate above, elsewhere entire; costa excurrent, thin below, papillose-crenate at back above. Median laminal cells elongate-rectangular, 30-40 x 4-5 µm, smooth, rather thin-walled, towards the leaf margin shorter; upper cells rectangular, 10-15 x 4.5-5.0 µm; lower median cells linear, 35-45 µm; alar regions delimited, blackish-brown, the cells rectangular, 20-35 x 16-20 µm, thin-walled, inflated. Inner perichaetial leaves similar to the stem leaves but with a longer sheathing base, to 3 mm long. Seta 10-12 mm long, yellowish. Capsules elongate, oblong-cylindric, with an apophysis, 1.5-1.8 x 0.6-0.8 mm, furrowed when dry. Operculum ca. 1 mm long; annulus 2-3 rows of cells. Peristome teeth ca. 0.55 mm long, yellowish. Spores 12-16 µm. Calyptra ca. 1.8 mm long. Perigonium below the perichaetium, sessile.

Distribution: Japan (Hokkaido, Honshu), Asia, Australia, Caucasus, Europe, Greenland, N. and S. America.

2. Kiaeria falcata (Hedw.) Hag. (Fig. 81, B)


Dicranum falcatum Hedw., Spec. Musc.: 150, t. 32, f. 1-7 (1801).

Leaves secund both in dry and moist, tapering to a very long, narrow, semicanaliculate subula from a lanceolate or oblong base, strongly arcuate, to 3 mm long; margin incurred, apex crenate; costa long-excurrent, thin, papillose-crenate at back above. Median laminal cells rectangular, 8-12 x 4-5 µm, ± thin-walled, ± bulging, towards the leaf base much larger, elongate-rectangular, 35-50 x 4-6 µm, thin-walled; alar areas not sharply defined, the cells lax, rectangular or quadrate, 16-20 x 9-13 µm, scarcely inflated, brownish. Inner perichaetial leaves to 2.5 mm long. Seta 7-8 mm long, yellowish-brown, becoming blackish with age. Capsules ovoid to obovoid, 0.7-0.9 x 0.5-0.7 mm, slightly furrowed when dry. Operculum ca. 0.7 mm long. Peristome teeth to 0.35 mm long, red-brown. Spores 12-17 µm. Perigonium below the perichaetium, sessile; inner perigonal leaves ca. 0.6 mm long; paraphyses numerous.

Distribution: Japan (Hokkaido, Honshu), Asia, Europe, Greenland, N. America.

Species not Available


Voucher specimens of the above two taxa from Japan are not available.

21. **DICRANUM** HEDW.

Stems simple or branched, densely tomentose, with a large central strand. Leaves crisped, incurved, appressed or secund when dry, gradually or abruptly narrowed to an elongate, arcuate subula from an ovate or oblong base; margin with large teeth to almost entire; costa stout, usually well-defined but narrow, ending below the leaf apex, percurrent or excurrent, smooth or with numerous teeth or serrate lamellae at back above; in cross-section containing a central row of large guide cells and both dorsal and ventral stereids. Median laminal cells quadrate to elongate-rectangular, thin- or thick-walled, towards the leaf base larger, the walls thick and sinuose or thin and not straight; lower median cells linear to rectangular; alar area well-defined, inflated, blackish-brown, uni- or multi-stratose, the cells large, quadrate to rectangular. Dioicus or phyllodioicus. Perichaetia terminal; sporophyte solitary or aggregated. Perichaetial leaves large, with a long and strongly convolute-sheathing base; costa weak; paraphyses not seen. Seta elongate, smooth. Capsules erect or inclined, oblong to cylindric, scarcely furrowed when dry. Operculum long and obliquely rostrate. Annulus present or wanting. Stomata present. Peristome teeth linear-lanceolate, bifid to about the middle, trabeculate, reddish-brown and striolate, rarely papillose below, the apex yellowish and papillose, the inner side distantly barred. Spores scabrous. Calyptra long-cuculate, straight, not hairy. Inner perigonial leaves subulate or acuminate from a cymbiform base.

A monographic revision of the Japanese *Dicranum* was published by Takaki (1964).

**Key to the Species** (mainly based on Takaki, 1964)

1. Capsule erect and symmetric, cylindric; alar cells of leaf mostly unistratose ........................................ 2
2. Capsule curved and asymmetric; alar cells of leaf mostly bi- or often multistratose ........................................ 7

3. Flagelliform branchlets present in the axils of the upper leaves ........................................ 3
4. Flagelliform branchlets absent ........................................ 4

5. Cells in the upper part of lamina and of the costa strongly mammillose on the back; costa usually broad and protruding on the dorsal side ........................................ 1. *D. mayrii*
6. Cells in the upper part of lamina and of the costa nearly smooth or slightly mammillose; costa comparatively narrow and less protruding on the dorsal side ........................................ 2. *D. flagellare*

7. Leaves fragile ........................................ 5
8. Leaves not fragile ........................................ 6

9. Plant of medium size, 2-5 cm high; costa 1/3 or more of the width
of the leaf base ........................................ 4. D. fulvum
5. Plant small, up to 2 cm high; costa less than 1/3 of the width of the leaf base ........................................ 3. D. viride var. hakkodense
6. Costa excurrent in a setaceous subula .......................... 5. D. leiodontum
6. Costa percurrent, not filling the upper part of leaf ........... 6. D. hamulosum
7. Leaves transversely undulate ................................... 8
7. Leaves not transversely undulate ................................ 11
8. Upper leaf cells narrowly elongate, with pitted walls ........ 9
8. Upper leaf cells quadrate or short-rectangular, irregular, with unpitted walls ........................................ 10
9. Sporophyte 2-3 in each perichaetium ............................. 8. D. polysetum
10. Cells on back of the upper part of costa and lamina highly mammilllose or with spine-like projections ................ 10. D. elatum
10. Cells on back of the upper part of costa and lamina flat or slightly mammilllose ........................................ 16. D. undulatum
11. Setae generally aggregate; the upper dorsal portion of the lamina mammilllose or spinose ................................... 12
11. Setae solitary; upper dorsal portion of the lamina smooth (except D. fuscescens) ........................................ 14
12. Costa narrow, about 1/10 the width of the widest part of leaf; the upper leaf cells elongate ......................... 9. D. majus
12. Costa wide and strong, about 1/6-1/3 the width of the widest part of leaf; the upper leaf cells quadrate or short-rectangular ........................................ 13
13. Alar region multistratose; lowland plants ...................... 11. D. caesium
14. Leaves with an obtuse or shortly acute apex .................... 13. D. nipponense
14. Leaves with a long, setaceous apex ................................ 15
15. Leaves when dry straight or nearly so, and appressed ........ 16
15. Leaves when dry erect-spreading, falcate-secund or crisped, not appressed ........................................ 17
16. Leaves fragile, the costa long-excurrent ......................... 7. D. yezomontanum
16. Leaves not fragile, the costa ending in the apex or shortly excurrent ........................................ 14. D. groenlandicum
17. Cells in the lower part of the lamina elongate rectangular, strongly incrassate and with cell walls thicker than the lumen ........ 15. D. setifolium
17. Cells in the lower part of lamina rectangular, with cell walls much thinner than the lumen .............................. 18
18. Upper leaf cells rounded-quadrate, or rounded-rectangular, irregular ........................................ 17. D. fuscescens
18. Upper leaf cells elongate, arranged longitudinally .......... 19
19. Stems often covered by white rhizoids. Leaves usually erect- or wide-spreading when dry, widely keeled above ... 18. D. japonicum
19. Stems often covered by brownish rhizoids. Leaves often secund or homomallous when dry, grooved above ........ 19. D. scoparium
1. **DICRANUM MAYRII** BROTH. (Fig. 82)

_Hedwigia_ 38: 207 (1899).


Plants yellowish-green above, blackish below, scarcely glossy, occasionally with several flagelliform branches in the upper part. Leaves crisped when dry, erect- or arcuate-spreading when moist; lower leaves lax, to 3.5 mm long; upper leaves crowded to 5.5 mm long, gradually tapering to an elongate, arcuate, semicanaliculate subula from an oblong, base; margin erect or incurved, serrate or crenate above; costa occupying 1/6-1/5 the width at the leaf base (ca. 0.17 mm thick), percurrent, crenate or serrate in the upper half. Median and upper laminal cells quadrate or transversely rectangular, 6-9 µm, somewhat thick-walled, not sinuose, mammillose or occasionally smooth at back; towards the leaf base cells longer, with thicker but not sinuose walls; alar area extending to costa, brown, the cells rectangular, 16-20 x 10-16 µm, slightly bulging. Dioicous. Innermost perichaetial leaf to 6.5 mm long, with a long (as long as the lamina) arista, convolute; costa stout. Seta 12-15 mm long, brown. Capsules erect, cylindric to oblong-cylindric, without apophysis, 2.2-2.6 x 0.8-1.0 mm, yellowish-brown. _Oerculum_ 1.7-2.0 mm long. Peristome teeth lanceolate, to 0.4 mm long, bifid or trifid to near the base, each division often perforate to near the base, the basal part light-brown and smooth or indistinctly striolate, the upper part yellowish, with large but indistinct papillae, the inner surface with large, indistinct papillae. Annulus in 3, rarely 4 rows of large cells. Spores 12-18 µm.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Taiwan, Saghalien.

2. **DICRANUM FLAGELLARE** HEDW. (Fig. 83, B)

_Spec. Musc._: 130 (1801).

Plants in compact tufts, greenish-brown above, blackish-brown below, not glossy. Stems to 30 mm long, producing several (ca. 2 mm long), straight flagelliform branches with distant, scale-like, minute, ecostate leaves in the axes of the upper leaves. Stem leaves crisped when dry, erect-spreading, occasionally falcate when moist, tapering to an elongate, arcuate, ± tubulous subula from an ovate-oblong base, to 3.5 mm long; margin incurved, dentate above, elsewhere almost entire; costa occupying 1/7-1/5 the width at the leaf base, much narrower than the leaf blade at the apex, ending below the leaf apex; margin crenate above, elsewhere smooth. Median laminal cells subquadrate or irregular, 6-8 µm, evenly thick-walled; upper cells similar to the median cells;
alar area ending a little apart from the costa, the cells brown, rectangular or hexagonal, 30-40 x 20-25 µm, bulging, thin-walled. Innermost perichaetial leaf to 3 mm long, oblong or lingulate, retuse at the apex, costa weak but extending into a cuspidate point. Seta 18-30 mm long, reddish-brown. Capsules erect, cylindric, slightly curved, attenuate at the base and with a long apophysis, 3.0-3.2 x 0.5-0.6 mm. Operculum 2.0-2.2 mm long. Annulus present, in 2 rows of small cells. Peristome teeth to 0.5 mm long, linear-lanceolate, bifid to the middle and often with large perfolations to the base, reddish-brown (except the faintly papillose apex), faintly striolate, often with fragmentary preperistome. Spores 16-22 µm. Calyptra ca. 4 mm long.

Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East, Caucasus, Europe, Canary, Africa, N.America.

\textit{Dicranum flagellare} is common on humus or on logs or at the base of tree trunks in open forest in northern Japan. In southern and western Japan this species occurs in montane or subalpine regions.

3. \textbf{DICRANUM VIRIDE} \textbf{VAR. HAKKODENSE} (CARD.) TAK. (Fig. 83, A)


Plants dark-green, not glossy, often forming clustered tufts. Stems to ca. 20 mm long, branched at base. Leaves rigid, straight and appressed when dry, erect–spreading when moist, tapering to an elongate, canalicate subula from a lanceolate, base, ± arcuate, 2-3 mm long, bistratose and fragile above; margin incurved, crenate, with several, large teeth at the apex; costa long-excurrent, occupying 1/5-1/4 the width at the leaf base, and the most part of leaf above, almost smooth at back above. Median laminal cells rectangular, 15-25 x 4-5 µm, the walls rather thick, not sinuose; alar area extending to the costa, the cells rectangular, 30-40 x 12-15 µm, pellucid, the walls thick but not sinuose. Perichaetia solitary. Innermost perichaetial leaf ca. 2.5 mm long, apex truncate to emarginate, convolute; costa shortly excurrent; median leaves longer, ca. 3.5 mm long with the costa excurrent as an arista as long as the leaf blade. Seta 8-10 mm long, straight, yellowish, becoming blackish with age. Capsules erect, oblong-cylindric, 1.2-1.8 x 0.5-0.6 mm, attenuate at the base. Operculum 1.5-1.7 mm long. Peristome teeth broadly lanceolate, ca. 0.2 mm long indistinctly papillose, upper yellowish, lower orange-brown. Annulus persistent. Spores 13-16 µm. Calyptra 1.8-2.2 mm long. Male plants as large as the females; inner perigonal leaves ca. 1 mm long; paraphyses several.


Distribution: Endemic to Japan (Hokkaido, Honshu, Shikoku, Kyushu).
Figure 82.

*Dicranum mayrii* Broth.  

a. Dry plant, x1.  
b. Moist plant, x9.  
c. Leaves, x12.  
d. Leaf apex, x300.  
e. Median cells of leaf (dorsal view), x300.  
f. Alar cells, x216.  
g. Inner perichaetial leaf, x12.  
h. Peristome teeth (with ventral view at right), x216.  

[a, b, g, h, Noguchi 19259; c-f, Faurie 14796]
D. viride var. hakkodense is common on trunks and branches of trees in compact clusters in subalpine and montane regions. 

D. viride var. hakkodense resembles closely D. viride var. viride from Europe. It is smaller, but this does not warrant recognizing them as separate species.

This species is very characteristic in its fragile leaves. It is difficult to find full grown leaves with a complete, subulate apex.

4. DICRANUM FULVUM HOOK. (Fig. 84, B)

Musci Exot. 2: 149 (1819).


Plants medium-sized, rigid, yellowish-brown above, scarcely glossy, blackish below. Stems ca. 20 mm long, simple, rarely dichotomous, densely leaved. Leaves appressed and slightly crisped when dry, erect-spreading when moist, tapering to a subulate acumen from a short oblong-ovate base, to 8 mm long, fragile above, semicanaliculate or canaliculate throughout; margin strongly involute, sparingly dentate at the apex, elsewhere entire; costa broad, ca. 0.15 mm wide and 1/4 the width at the base, occupying a large part of subula in the upper half, the delimitation between costa and lamina obscure, almost smooth at back. Median laminal cells subquadrate or shortly rectangular, 8-12 x 4-5 µm, thick-walled; upper ones bistratose, rounded or subquadrate, thick-walled, obscure; lower cells rectangular, 15-22 x 6-9 µm, with thick, but not porous walls; alar area extending to the costa, the cells large, quadrate, brown. Seta solitary, ca. 12 mm long. Capsules erect, cylindric, slightly curved, ca. 1.5 x 0.5 mm; annulus in 2 rows.

Distribution: Japan (Honshu, Shikoku, Kyushu), Korea, China, Soviet Far East, Europe, N.America.

5. DICRANUM LEIODONTUM CARD. (Fig. 84, A)


Plants yellowish-green, somewhat glossy, forming loose cushions. Stems to 15 mm long, densely leaved. Leaves erect-spreading, somewhat flexuose and circinate when dry, spreading when moist, ca. 4 mm long, rather abruptly tapering to a long, fine canaliculate subula from an ovate base, not fragile; margin involute, unistratose, with or without small teeth above but with several long teeth at the tip, elsewhere entire; costa occupying 1/5-1/4 the leaf width at the base (ca. 0.1 mm wide), percurrent, flat, indistinctly distinguished from the lamina, with small teeth on the back at the apex. Median laminal cells rectangular or subquadrate, 12-20 x 4.5-6.5 µm, not porous, in 5-6 rows between costa and margin; upper cells similar to the median; lower cells elongate-rectangular, 35-45 x 7-9 µm, the walls not porous; basal and alar cells subquadrate, 20-30 µm. Dioicus. Innermost perichaetial leaf to 6.5 mm long, long-sheathing, apex truncate or rounded and erose-dentate;
Figure 83.
A. *Dicranum viride* var. *hakkodense* (Card.) Tak.  
a. Dry plant, x1.  
b. Leaves, x23.  
c. Cells at leaf apex, x245.  
d. Median cells of leaf, x245.  
e. Alar cells, x250.  
f. Perichaetium with capsule, x10.  
g. Innermost perichaetial leaf, x20.  
h. Perichaetial leaf, x20.  
i. Capsule, x10.  
j. Peristome teeth (with ventral view at right), x250.  
k. Calyptra, x15.  
l. Part of stem with perigonia, x10.  
m. Inner perigonal leaf, x20.  

[a-e, Faurie 284; f-m, Noguchi s.n.]

B. *D. flagellare* Hedw.  

n. Dry plant, x1.  
o. Moist plant, x8.  
p. Leaves, x15.  
q. Cells at leaf apex (dorsal view), x250.  
r. Median cells of leaf, x250.  
s. Alar cells, x135.  
t. Inner perichaetial leaves, x15.  
u. Peristome teeth (with ventral view at right), x135.  

[Hattori s.n.]
margin strongly involute; costa weak but extending to a long acumen (as long as the lamina). Seta solitary, 10-15 mm long, somewhat flexuose when moist, yellowish. Capsules erect, cylindric to oblong-cylindric, with an indistinct apophysis, tapering to the seta, 1.5-2.5 x 0.5-0.7 mm, yellowish-brown, not furrowed when dry. Operculum 1.2-1.5 mm long. Annulus in 2 rows of large cells. Peristome teeth to 0.35 mm long, brownish-orange and almost smooth below, pellucid and with large papillae above; the inner surface sparsely papillose. Spores 15-20 μm.


Distribution: Endemic to Japan (Hokkaido, Honshu, Shikoku, Kyushu).

This species is corticolous, or occasionally rupestral, and is very common in the montane forest of western and southern Japan. The sporophytes are rarely found.

D. leiodontum is very similar to Dicranodontium. The distinction between them see the chapter of Dicranodontium denudatum.

6. DICRANUM HAMULOSUM MITT. (Fig. 85, A)


Plants yellowish-green, not glossy, forming compact tufts. Stems ca. 20 mm long, densely leaved. Upper leaves usually falcate when dry, ± flexuose when moist, tapering to long, linear, often arcuate, keeled, occasionally ±flexuose subula from an oblong to ovate-oblong, base, to 7 mm long; margin erect or slightly incurved, bistratose and serrate above, the teeth large and remote; costa narrow, but prominent at back, occupying 1/7-1/6 the leaf width at the base, shortly excurrent, well-distinguished from lamina, dentate at back in the upper half, the teeth large and often forming longitudinal ridges. Median laminal cells rectangular or irregularly hexagonal, 13-25 x 6.5-8.5 μm, the walls not porous, arranged in about 10 or more rows between costa and leaf margin; upper laminal cells similar to the median; lower cells elongate-rectangular, 40-70 x 8-11 μm, ± bulging, the walls thick and slightly flexuose; basal and alar parts unistratose, the cells quadrate or rectangular, 20-30 x 25 μm, bulging; brown. Phylloioicous. Innermost perichaetal leaf elongate-sheathing, cuspidate and emarginate at the apex, ca. 3 mm long; outer ones longer, with a longer subulate costa. Seta solitary, 10-15 mm long, straight or ±flexuose. Capsules erect, cylindric to oblong-cylindric, 1.5-2.5 x 0.6-0.8 mm, attenuate at the base, yellowish-brown, furrowed when dry. Operculum 1.5-2.0 mm long. Peristome teeth linear-lanceolate, bifid to near the base, ca. 0.4 mm long, smooth, orange
Figure 84.
A. *Dicranum leiodontum* Card.  a. Male plant, x7.  b. Leaves, x15.  c. Cross-sections of leaves (c1, upper, c2, median, c3, lower parts), x250.  d. Cells at leaf apex, x200.  e. Upper cells of leaf, x200.  f. Median cells of leaf, x200.  g. Cells at leaf base, x200.  h. Alar cells, x135.  i. Inner perichaetal leaf, x10.  j, k. Capsule, x10.  l. Peristome teeth (with ventral view at right), x180.  m. Outer perigonial leaf, x20.  n. Inner perigonial leaf, x20.  [Isotype of *D. leiodontum* Card.]

below, yellowish above. Annulus in 2 rows of small cells. Spores 16-20 
\(\mu m\). Calyptra ca. 3.5 mm long. Male plants very minute, 0.6-1.7 mm long, on 
the rhizoids of females; inner perigonial leaves cymbiform, acute, 
c. 0.5 mm long, outer perigonial leaves with a long subula, ca. 1.2 mm 
long; antheridia few; paraphyses none.

Exsiccati: Musci Japonici 5: 235(1951), as Orthodicranum hamulosum; 

Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Saghalien.

The present corticolous moss is common in the northern region of 
Honshu and Hokkaido, but is less abundant in Kyushu and Shikoku.
The sterile plants are similar to D. fuscescens.

7. Dicranum yezomontanum NOG. (Fig. 85, B)

J. Hattori Bot. Lab. 8: 18, f. 9 (1952).

Plants medium-sized, yellowish-green, soft. Stems to 20 mm long, 
simple, occasionally with few short branches at the apex, densely 
leaved. Leaves appressed and not homomallous nor crisped when dry, 
erect-spreading when moist, tapering to a very long and straight subula 
from an oblong-ovate base, grooved above, to 7 mm long, lower ones ca. 5 
mm long; margin strongly involute, with spinous teeth above; costa 
extending to the leaf apex, ca. 0.1 mm wide at the base, with several 
teeth at back above. Median laminal cells rectangular, 12-17 x 6.5-8.5 
\(\mu m\), thick-walled, pellucid; lower ones elongate-rectangular or sublinear, 
± sinuose; alar area extending to the costa, the cells very lax, subquad­
rate to rectangular, yellowish-brown to blackish, variable in size, thin­
walled.

Distribution: Endemic to Japan (Hokkaido).

This species grows on logs.

8. Dicranum Polysetum SW. (Fig. 86, B)

Monthl. Rev. 34: 538 (1801).

Plants yellowish-brown above, blackish below, slightly glossy. 
Stems usually ca. 100 mm long, branched at the base, erect or arcuate­
ascending, densely tomentose. Leaves erect or widely spreading, occasi­
onally falcate, slightly altered when dry, somewhat flexuose, lanceolate, 
gradually attenuate, to 10 mm long, keeled and strongly undulate in the 
upper half, slightly undulate below; margin with large teeth in the upper 
half, ± recurved on one side in the lower half; costa narrow, extending 
to almost the leaf apex, with 2 ridges with large teeth at back in the 
upper half. Median laminal cells linear-rhomboidal, 60-80 x 7-13 \(\mu m\), 
 thick-walled, strongly porous; upper cells, 40-60 x 8-10 \(\mu m\), thick-walled,
Figure 85.
A. *Dicranum hamulosum* Mitt.  a. Dry plants, x1.  b. Leaves, x15.  c. Cross-sections of leaf (c1, upper; c2, middle; c3, lower parts), x250.  d. Upper cells of leaf, x200.  e. Median cells of leaf, x200.  f. Cells at leaf base, x200.  g. Alar cells, x140.  h. Perichaetial leaves, x15.  i, j. Capsules, x8.  k. Peristome teeth (with ventral view at right), x135.  l. Calyptra, x8.  m, n. Dwarf males, x34.  o. Inner perigonial leaf, x45.  [a-g, isotype of *D. hamulosum* Mitt.; h-l, Kumamoto Univ. Herb. K25243; m-o, Noguchi 34823]

B. *D. yezomontanum* Nog.  p. Leaves, x25.  q. Cells at leaf apex (dorsal view), x130.  r. Median cells of leaf, x250.  [Holotype of *D. yezomontanum* Nog.]
strongly porous; lower-median cells thin-walled; alar area large, in 2 layers of large (45-70 x 3.0-4.5 µm), hexagonal to subquadratce, thin-walled cells. Seta aggregated, usually 2-5, 30-40 mm long, often flexuose, reddish-brown. Capsules inclined to horizontal, oblong-cylindric, arcuate, asymmetric, 2.5-3.0 x 1.0-1.2 mm. Operculum almost as long as the urn. Peristome teeth lanceolate, ca. 0.6 mm long, evenly deep-brown and longitudinally striolate, the inner surface smooth. Annulus wanting. Stomata several. Spores 20-28 µm. Calyptra ca. 7 mm long.


Distribution: Japan (Hokkaido, Honshu), China, Soviet Far East, Europe, N.America.

This species is easily separated from the other species of Dicranum by the strongly undulate leaves and aggregated setae.

9. Dicranum majus Turn. (Fig. 86, A)

Musc. Hib.: 59 (1804).


Plants yellowish- or dirty brown, glossy, blackish-brown below. Stems arcuate-ascending, with several branches. Leaves secund and ± flexuose when dry, falcate-secund when moist, linear-lanceolate, semi-canaliculate, to 15 mm long; margin incurved, with large teeth in the upper 1/3; costa extending to the leaf apex, the borders between costa and lamina ± obscure in the lower half, prominent and with several rows of large teeth (not forming lamellate ridges) in the upper half. Median laminal cells elongate-rhomboidal, 65-105 x 7-9 µm, rather thick-walled, porous; marginal cells shorter; upper cells ± shorter, elongate rectangular; a few cells with a large mamilla on the upper corner at back forming bistratose intramarginal borders; lower cells similar to the median but distinctly porous; alar cells in 2-4 layers, rectangular to hexagonal, 20-35 x 13-20 µm, brown, thick-walled. Phylloioicous. Sporophytes usually aggregated, 5 or rarely more per perichaetium. Inner perichaetal leaf to 8mm long, convolute-sheathing, long-acuminate. Seta 15-25 mm long, ± flexuose, yellowish-brown. Capsules inclined to horizontal, short-cylindric, 2.5-3.0 x 0.8-0.9 mm, curved. Annulus none. Operculum 3.0-3.5 mm long. Peristome teeth to 0.7 mm long, brown and vertically striolate in the lower half, yellowish and striolate in the upper half, inner surface with high trabeculae; papillose in the upper half, elsewhere smooth. Spores 16-21 µm. Calyptra long, ca. 6 mm long. Dwarf male to 1 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea,
Figure 86.
A. *Dicranum majus* Turn.  
a. Dry plant, xl.  
b, c. Leaves, x10.  
d. Cells at leaf apex (dorsal view), x135.  
e. Upper cells of leaf (dorsal view), x250.  
f, g. Median cells of leaf, x250.  
h. Inner perichaetial leaf, x10.  
i, j. Capsules, x8.  
k. Dwarf male, x20.  

B. *D. polysetum* Sw.  
l. Dry plant, xl.  
m. Leaves, x10.  
n. Upper part of innermost perichaetial leaf, x10.  
o, p. Capsules, x8.  
q. Peristome teeth (with ventral view at right), x135.  
r. Dwarf male, x20.  
s. Inner perigonial leaf, x45.  

* [Noguchi 27648]  
* [Noguchi 23566]
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China, Soviet Far East, Caucasus, Europe, Greenland, N.America.

10. DICRANUM ELATUM LINDB. (Fig. 87, A)


Plants robust in light-brown, dense tufts, slightly glossy. Stems longer than 100 mm. Leaves wide-spreading and circinate when dry, wide-spreading and somewhat arcuate when moist, lanceolate, tapering to an elongate, curved, semicanaliculate subula, to 12 mm in length, undulate at the median part; margin incurved, strongly dentate in the upper half, entire below. Median laminal cells quadrato-irregular-hexagonal or rhomboidal, 7-10 µm, the walls somewhat thick, some cells with a high, acute mammilla; upper cells almost quadrate, similar to the median but mostly with a spine-like mammilla at back; lower cells 85-120 x 8-12 µm, subporous; alar cells rectangular, 40-60 x 20-30 µm. Phyllodioicus. Sporophyte solitary. Inner perichaetial leaf oblong, apex retuse, strongly convolute, to 6 mm long; costa excurrent in awn. Seta 20-25 mm long. Capsules inclined, cylindric, somewhat curved, ca. 3.5 x 1.0 mm. Operculum ca. 3 mm long. Annulus in 2 rows of small cells. Peristome teeth ca. 0.5 mm long. Dwarf male plants ca. 0.8 mm long; inner perigonial leaf ca. 0.5 mm long.

Distribution: Japan (Hokkaido, Honshu), Soviet Far East, Europe.

11. DICRANUM CAESIUM MITT. (Fig. 87, B)


Plants rigid, yellowish-brown and somewhat glossy above, blackish below. Stems arcuate-ascending, longer than 100 mm. Leaves wide-spreading, flexuose at the apex when dry, wide-spreading, incurved at the apex when moist, to 15 mm or more long, linear-lanceolate, tapering to a very long, narrow, semicanaliculate point; margin erect (incurved below), serrate in the upper half; costa broad, occupying 1/5-1/4 the leaf width (ca. 0.25 mm wide at base), excurrent to a long arista, serrate from the apex to near the base. Median laminal cells elongate-rectangular, 20-40 x 5-8 µm, the walls thick but not porous, often prorate; upper cells ± shorter than the median; lower cells 65-95 x 5-8 µm, the walls scarcely porous; alar cells rectangular to hexagonal, 30-50 x 15-25 µm, usually in 4 layers, thick-walled, not porous. Phyllodioicus. Inner perichaetial leaf convolute-sheathing, the lamina widely elliptic, with a very long arista, to 6 mm long; costa weak. Seta 1-3 per perichaetium, 3.0-3.5 mm long, yellowish-brown, flexuose. Capsules slightly inclined, oblong-cylindric, with an indistinct apophysis, often widest near the mouth, asymmetric, 2.5-3.2 x 1.0-1.2 mm, scarcely furrowed when dry. Operculum ca. 2.3 mm long. Annulus in 2 rows of small cells. Stomata several. Peristome teeth to 0.6 mm long, orange and vertically striolate in the
Figure 87.
A. *Dictamon elatum* Lindb.  a. Leaves, x8.  b. Leaf apex (dorsal view), x135.  c. Median cells of leaf (dorsal view), x250.  d. Inner perichaetal leaf, x8.  e. Capsule, x8.  [Herb. Noguchi 13228 from Saghalien]
B. *D. caesium* Mitt.  f. Leaves, x10.  g. Leaf apex, x135.  h. Median cells of leaf (dorsal view), x250.  i. Lower cells of leaf, x250.  j. Inner perichaetal leaf, x10.  k, l Capsules, x8.  m. Peristome teeth (with ventral view at right), x135.  n. Dwarf male, x34.  [Noguchi 48787]
lower half, pale and densely papillose in the upper half. Spores 16–21 μm. Calyptra long, ca. 6 mm long. Dwarf male plant ca. 0.7 mm long, with several leaves.


Distribution: Japan (Honshu, Shikoku, Kyushu), Korea, Taiwan.

This species is remarkable in the large and rigid shoots, bearing long and finely subulate leaves.

12. **DICRANUM MUEHLENBECKII** B.S.G. (Fig. 88, A)


Plants medium-sized, dark-green. Stems to 40 mm long. Leaves appressed and flexuose or ± incurved when dry, erect-spreading when moist, tapering to an elongate, semicanaliculate subula from an ovate-oblong base, to 5 mm long; margin involute, serrate above, elsewhere entire; costa stout, ± dentate at back above. Median laminal cells rounded or ovate, 5-10 μm, thick-walled, not porous, mammillose; upper cells elongate-oblong; lower ones elongate-rectangular or hexagonal, thin-walled, not porous; alar area extending to near the costa, the cells rectangular or hexagonal, deep-brown. Seta 2.0–2.5 mm long. Capsules inclined, oblong-cylindric, ± arcuate, to 3 x 1 mm; annulus present. Operculum ca. 2 mm long.

Distribution: Japan (Honshu). Widely distributed in the N.Hemisphere.

This species is rare in Japan.

13. **DICRANUM NIPPONENSE** BESCH. (Fig. 89)


Plants dark-green, slightly glossy, in dense tufts, soft when moist. Stems usually 20–50 mm long. Leaves appressed or homomalous.
Figure 88.
A. *Dicranum muehlenbeckii* B.S.G.  
a. Leaves, x18.  
b. Cells at leaf apex, x300.  
c. Median cells of leaf, x300.  
d. Alar cells, x162.

B. *D. bonjeanii* De Not.  
e–h. Leaves (*e, h*, ventral, *f, lateral, g*, dorsal view), x12.  
i. Cells at leaf apex, x162.  
j. Median cells of leaf, x300.  
[Noguchi 70848]
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(eespecially in the upper leaves), lanceolate, narrowed to a broad, ± keeled acumen, acute or narrowly acute at the apex; lower leaves ca. 5 mm long, upper to 7 mm; margin strongly dentate in the upper 1/3, the cell of each tooth larger than the surrounding cells, subentire below; costa slender and thin, ca. 0.09 mm thick at the base, extending to near the leaf apex, with 2-3 serrate ridges at back in the upper half. Median laminal cells lax, rectangular, 65-85 x 13-18 µm, thick-walled and distinctly porous; upper cells narrowly rectangular or rhomboidal, ±smaller than the median cells; lower laminal cells, 120-150 x 16-22 µm, rather thin-walled but porous; alar cells brown, rectangular, 45-80 x 25-40 µm, thin-walled, not porous. Dioicus or phyllodioicus. Sporophyte solitary. Inner perichaetial leaves long in proportion to the length of stem leaves, to 7 mm long, strongly convolute-sheathing, acuminate; costa weak but percurrent. Seta 20-40 mm long, ca. 0.35 mm thick. Capsules inclined, cylindric, slightly curved, 3.5-4.8 x 0.8-1.0 mm, brown, scarcely furrowed when dry. Annulus not seen. Stomata few. Operculum 2.5-4.0 mm long. Peristome teeth to 0.7 mm long, evenyl yellowish-brown, vertically striolate in the lower 2/3, papillose above, the inner surface with large, dense trabeculae. Spores 16-21 µm. Calyptra 5.0-6.5 mm long. Normal male plants somewhat more slender than the females; leaves crowded at shoot apex; inner perigonial leaf widely ovate, with a long, subulate, serrate point, ca. 2.5 mm long. Dwarf male plants 0.4-1.5 mm long, with several ovate leaves, acuminate at the apex; antheridia few.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, Taiwan.

This species usually occurs on rotten logs.

This species is variable in size. The larger plants are similar to D. japonicum, but may be distinguished by their leaves appressed when dry, broad leaf acumen, shorter median cells, longer basal cells, and large perichaetial leaves. The capsules are also large in proportion to the size of gametophyte.

14. DICRANUM GROENLANDICUM BRID. (Fig. 90, A)

Mant. Musc. 4: 68 (1819).


Plants in dense, yellowish-brown tufts. Stems longer than 50 mm, branched above; branches erect and straight. Leaves appressed and straight when dry, erect-spreading when moist, linear-lanceolate, tapered to an elongate, straight, canaliculate acumen; margin involute and entire throughout; costa stout, ca. 0.09 mm wide at the base, percurrent, almost smooth throughout. Median laminal cells elongate-rectangular 30-40 x 3-6 µm; marginal cells shorter; upper cells shorter,
Figure 89. *Dicranum nipponense* Besch.  

- a. Dry plant, x1.  
- b. Leaves, x10.  
- c. Leaf apex, x135.  
- d. Median cells of leaf, x250.  
- e. Inner perichaetial leaf, x10.  
- f. Capsule, x8.  
- g. Peristome teeth (with ventral view at right), x135.  
- h. Male plant, x8.  
- i. Dwarf male, x34.  
- j. Inner perigonial leaf, x15. [Noguchi 23450]
rectangular to elongate-rhomboidal, thick-walled, scarcely porous; lower cells elongate-rectangular, 28-45 x 8.5-12.0 µm, thick-walled and porous; alar region comprising a single layer of subquadrate to rectangular cells, 20-35 x 16-22 µm, thin-walled, not porous.

Distribution: Japan (Hokkaido). Widely distributed in the N.Hemisphere.

*D. groenlandicum* seems to be rare in Japan and lacking sporophytes. The specimens from Hokkaido have broader, distinctly porous laminal cells and a stronger costa than European plants.

*D. groenlandicum* is closely related to *D. elongatum*. In the latter the upper cells of leaves are almost quadrate, whereas in *D. groenlandicum* they are elongate.

15. **DICRANUM SETIFOLIUM** CARD. (Fig. 90, B)

*Bull. Herb. Boiss. sér. 2, 7: 714 (1907).*


Plants slender, brown above, blackish below, scarcely glossy. Stems longer than 50 mm. Leaves erect-spreading, scarcely flexuose, occasionally somewhat secund when dry, gradually tapering to a very long, setaceous, semicanaliculate subula from a lanceolate base, to 7 mm long; margin incurved, crenate at the apex, elsewhere entire; costa thin, excurrent, ca. 0.12 mm thick at the base, smooth at back. Median laminal cells elongate-rhomboidal, 18-35 x 3.0-4.5 µm, the walls uniform in thickness, not porous; marginal cells shorter; lower median cells, 35-45 x 4.0-4.5 µm, the walls strongly thickened and porous, sinuose; alar cells subquadrate, hexagonal or rectangular, 20-35 x 15-20 µm, the walls thick, sinuose, the middle lamellae distinct.


Distribution: Endemic to Japan (Hokkaido, Honshu).

16. **DICRANUM UNDULATUM** SCHRAD. EX BRID. (Fig. 91, B)

*J. f. Bot. 1800(2): 294 (1801).*

Plants yellowish-brown, not glossy, in compact tufts. Stems to 100 mm long, densely leaved, with few branches. Leaves appressed, lanceolate, apex finely acuminate, slightly curved, keeled and somewhat undulate and ± rugose above, to 6 mm long; margin erect, slightly undulate, serrate above with large teeth; costa extending to the leaf apex, toothed above, papillose-crenate below. Median laminal cells pellucid, rectangular, rhomboidal or irregular, 12-25 x 5.0-8.5 µm, slightly bulging, the walls with localized thickenings; upper cells somewhat longer, the walls uniformly thickened, mammillose, occasionally papillose; lower cells linear, 70-95 x 4-7 µm thick-walled, subporous; alar cells in 2
Figure 90.
A. *Dicranum groenlandicum* Brid.  a. Leaves, x20.  b. Cells at leaf apex, x250.  c, d Median cells of leaves, x250. e. Alar cells, x180. [Noguchi 41221]
B. *D. setifolium* Card.  f. Leaves, x15.  g. Cells at leaf apex, x250.  h. Median cells of leaf, x250. i. Alar cells, x135. [Isotype of *D. setifolium* Card.]
layers, rectangular, hexagonal or subquadrate, 40-60 x 20-35 µm, orange-brown. Phyllodioicous. Innermost perichaetial leaf convolute-sheathing, apex truncate or retuse; costa slender, excurrent into a long arista. Seta 20-25 mm long, yellowish-brown, slightly flexuose. Capsules horizontal, oblong-cylindrical, curved, ca. 2.3-0.9 mm, furrowed when dry. Annulus present, in 2 rows of small cells. Peristome teeth ca. 0.45 mm long, brown and vertically striolate, the upper part orange and papillose, striate, the inner surface smooth, the trabeculae high and stout. Spores 16-20 µm. Dwarf male plants 0.6-1.7 mm long, often in pairs, with many leaves; innermost leaf cymbiform, ca. 0.3 mm long.

Distribution: Japan (Hokkaido, Honshu), Soviet Far East, Europe, N.America.

This species occurs in open bogs.

**17. DICRANUM FUSCESCENS** TURN. (Fig. 91, A)

Musc. Hib.: 60, 5f. 1 (1804).


Plants in dense, brown to blackish-brown tufts, slightly glossy. Stems usually ca. 50 mm long, arcuate-ascending, branched at the base or simple. Stem leaves homomallous when dry or moist, crisped when dry, linear-lanceolate, tapering to an arcuate and keeled subula, to 6 mm in length; margin bistratose and toothed in the upper leaf; costa stout but narrow, occupying 1/7-1/6 the leaf width (ca. 0.1 mm wide at base) toothed at the back in the upper 2/3. Median laminal cells irregularly rectangular, 12-15 x 5-8 µm, the walls uniformly thick; upper cells similar to the median; lower cells elongate-rectangular, 35-70 x 8-9 µm; alar region bistratose, the cells hexagonal or subquadrate, 30-50 x 15-25 µm, brown, the walls uniformly thin. Dioicous. Inner perichaetial leaf long-subulate, to 5 mm long, the costa weak. Sporophyte solitary. Seta 12-25 mm long, ca. 0.17 mm thick, flexuose, reddish- or yellowish-brown. Capsules horizontal to inclined arcuate-cylindric, with an indistinct crop, 1.5-1.8 x 1.0 mm, sulcate when dry. Operculum almost as long as the urn. Annulus in 2 rows of small cells. Stomata few. Peristome teeth to 0.5 mm long, reddish-brown and densely striolate in most part, yellowish and papillose above. Spores 15-20 µm. Calyptra 3.0-3.5 mm long. Male plants more slender than the females, inner perigonial leaf ca. 1.5 mm long, acuminate; paraphyses and antheridia many.


Distribution: Japan (Hokkaido, Honshu), Korea, China, Soviet Far East, Caucasus, Europe, Greenland, N. and S.America.

This species is distinguished from _D. scoparium_ by the narrower leaves, more crisped when dry. This species is very variable in many
Figure 91.

A. *Dicranum fuscescens* Turn.  
  a. Dry plant, x1.  
  b. Leaves, x10.  
  c. Leaf apex (dorsal view), x180.  
  d. Median cells of leaf, x250.  
  e. Alar cells, x135.  
  f. Inner perichaetial leaf, x10.  
  g. Capsule, x8.  
  h. Inner perigonial leaf, x20.  
  [Hattori s.n.]

B. *D. undulatum* Schrad. ex Brid.  
  i. Dry plant, x1.  
  j. Leaves, x10.  
  k. Leaf apex (dorsal view), x180.  
  l. Median cells of leaf, x250.  
  m. Alar cells, x180.  
  n. Inner perichaetial leaf, x10.  
  o. Capsule, x10.  
  p. Peristome teeth (with ventral view at right), x135.  
  q. Dwarf male, x20.  
  [Noguchi 67954]
respects, and sterile plants are often indistinguishable from *D. hamulosum*.

18. **DICRANUM JAPONICUM** MITT. (Fig. 92, A)

*Trans. Linn. Soc. Bot. ser. 2, 3: 155 (1891).*


Plants yellowish- to pale-green, not glossy. Stems usually to 50 mm long or longer, simple or with few branches, densely tomentose throughout, rather sparsely to densely leaved. Leaves widely spreading and flexuose, occasionally homomallous when dry, falcate-secund when moist, 7-10 mm long, lanceolate, keeled above; margin strongly serrate in the upper half, the teeth composed of a larger cell than the surrounding cells; costa narrow and thin, ca. 0.12 mm thick at the base, percurrent, with two or three ridges with serrate margins at back in the upper half. Median laminal cells elongate-rectangular, 80-100 x 12-14 µm, the walls thick and distinctly porous; upper cells elongate-rhombooidal, 45-80 x 8-10 µm; lower ones elongate-rectangular, 80-120 x 9-13 µm, the walls thinner, porous; alar cells blackish, 40-65 x 20 µm, the walls thinner and not porous. Phyllodioicous. Sporophyte single in each perichaetium. Inner perichaetial leaves to 7 mm long, strongly convolute-sheathing, with a long, flexuose, subulate acumen; costa faint. Seta stout, 30-40 mm long, ± flexuose when moist, yellowish- to reddish-brown. Capsules inclined, cylindric, slightly curved, tapered below, 3-4 x 0.8-1.0 mm, brown, scarcely furrowed. Operculum ca. 5.5 mm long. Annulus not seen. Stomata several. Peristome teeth to 0.7 mm long, narrowly attenuate, orange to brownish-orange, the outer side papillose in the upper half; densely striolate in the lower half; the inner side strongly trabeculate, papillose in the upper half, elsewhere smooth. Spores 14-20 µm. Calyptra 6-7 mm long. Dwarf male plants 1-3 mm long; inner perigonial leaf cymbiform, acuminate, ca. 0.6 mm long; antheridia few.

Exsiccati: *Musci Japonici 19: 911 (1964); 27: 1311 (1976); 33: 1614 (1982).*

Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu), Korea, China, Saghalien.

The present species is closely allied to *D. scoparium* and frequently confused with it. The two species, however, have different habitats: *D. japonicum* usually grows in rather loose tufts in somewhat shady humus in forests, whereas *D. scoparium* occurs in dense, wide tufts in sunny, dry situations, for instance by roads in forests.
Figure 92.
A. *Dicranum japonicum* Mitt.  a. Dry plant, x1. b, c. Leaves (b, ventral, c, dorsal view), x8. d. Cross-sections of leaf (d1, upper, d2, median, d3, lower parts), x150. e. Leaf apex, x55. f. Median cells of leaf (dorsal view), x213. g. Median cells of leaf (dorsal view), x150. h. Upper part of inner perichaetial leaf, x10. i, j. Capsules, x8. k. Dwarf males, x15. l. Inner perigonial leaf, x34. [Noguchi 29144]
B. *D. scoparium* Hedw.  m. Dry plant, x1. n. Leaves, x8. o. Cross-sections of leaf (o1, upper, o2, median, o3, lower parts), x150. p. Leaf apex, x55. q, r. Median cells of leaves, x213. s. Inner perichaetial leaf, x8. t, u. Capsules, x8. [Noguchi 22997]
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19. **DICRANUM SCOPARIUM** HEDW. (Fig. 92, B)

Spec. Musc.: 126 (1801).


Plants in dense tufts, yellowish-brown and scarcely glossy above, blackish-brown below. Stems usually ca. 100 mm long, usually simple. Stem leaves dense, secund, arcuate, scarcely flexuose when dry, lanceolate, tapering to an arcuate, narrow, ± semicanaliculate or keeled subula, usually to 10 mm in length; margin strongly dentate in the upper half, the cell of each tooth as large as the inner cells, incurved and entire below; costa narrow and thin, excurrent or percurrent, ca. 0.25 mm thick at the base, strongly dentate in ca. 3 rows and forming low ridges in the upper half. Median laminal cells elongate-hexagonal to rectangular, 30-50 x 8-10 µm, the walls thick, slightly porous; upper cells similar to the median but shorter, 20-30 µm long; lower cells longer than the median, 85-120 x 8-10 µm, porous; alar cells elongate-rectangular, 42-65 x 16-25 µm, in two layers. Dioicus or phyllodioicus. Sporophyte usually single, rarely aggregated. Inner perichaetial leaves to 8 mm long, shortly subulate; costa weak, percurrent. Seta 20-30 mm long, flexuose, reddish-brown. Capsules inclined, oblong-cylindric, 2.5-3.5 x 0.7-1.0 mm, brown, furrowed when dry. Operculum 2.5-3.0 mm long. Annulus not seen. Stomata several. Peristome teeth ca. 0.5 mm long, reddish-brown and papillose-striolate, strongly papillose and pale brown above. Spores 16-20 µm. Calyptra 3.5-5.0 mm long. Normal male plants more slender than the females; inner perigonial leaf long-subulate, ca. 2.5 mm long. Dwarf male plants ca. 0.8 mm long; inner perigonial leaf shortly acuminate, ca. 0.4 mm long.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Ryukyu). Widely distributed in the N.Hemisphere.

This is a very variable species, but usually characteristic in the secund, long, finely subulate leaves.

20. **DICRANUM BONJEANII** DE NOT. (Fig. 88, B)

In Lisa, Elenco Muschi Torino: 29 (1837).

Plants medium-sized, glossy. Leaves appressed, scarcely falcate when dry, oblong-lanceolate, gradually attenuate, apex narrowly acute, to ca. 6 x 1.5 mm, keeled above, shallowly undulate; upper leaves narrower; margin bluntly serrulate or entire above, entire below; costa
narrow, extending to the leaf apex, almost smooth at back. Median laminal cells elongate-rectangular, 70-85 x 8-9 \( \mu m \), porous; lower cells elongate, 100-125 \( \mu m \); alar area brownish, not extending to the costa, the cells rectangular, 35-45 x 25-35 \( \mu m \), thick-walled, several layers of longer cells along leaf margin. Inner perichaetial leaf to 6 mm long, long-acuminate. Seta solitary, ea. 30 mm long, pale brown. Capsules inclined, oblong-cylindric, arcuate, 3.0-3.5 x 0.8-0.9 mm, without apophysis. Spores 16-20 \( \mu m \), papillose. [Description of sporophytes based on a Canadian specimen].


Distribution: Japan (Hokkaido), China, Siberia, Himalaya, Caucasus, Europe, N. America.

The Japanese plants grow on moors, often forming compact tufts with \textit{Sphagnum} spp., \textit{Calliergonella cuspidata} and \textit{Calliergon stramineum}.

Some authors (Crum and Anderson, 1981, etc.) consider \textit{D. bonjeanii} as conspecific with \textit{D. scoparium}. As mentioned above, Japanese \textit{D. bonjeanii} has wider, less elongate leaves than \textit{D. scoparium}, less dentate leaf margin and a scarcely dentate costa. By these characters, the Japanese populations of \textit{D. bonjeanii} differ from the European and N. American ones and may be recognized as a species distinct from \textit{D. scoparium}.

Species not Available


The type specimens of the above two species are not available.

22. \textbf{DICRANOLOMA} (REN.) REN.

\textbf{DICRANOLOMA CYLINDROTHECIUM} (MITT.) SAK. (Fig. 93)


Plants yellowish-brown, glossy. Stems to 50 mm long, arcuate-ascending, densely leaved, simple or branched. Leaves erect-spreading, often ± homomalous, little altered on drying, linear-lanceolate, tapered to a semicanaliculate, subulate acumen, to 7 mm long; margin involute, entire in the upper half; costa very thin and narrow, occasionally indistinct, extending to the leaf apex, dentate at back in the upper half. Median laminal cells elongate-rectangular, 70–90 x 8.5–12.0 µm, the walls porous; upper cells shorter; median basal cells linear; alar region not extending to the costa, the cells quadrate to hexagonal, thick-walled, 20–30 µm. Dioicus or phyllodioicous. Inner perichaetial leaves strongly convolute-sheathing, retuse at the apex, to 7 mm long; costa extending to a very long arista. Seta slender, flexuose, brown, 12–15 mm long. Capsules erect, cylindric or oblong, attenuate at the base, with an indistinct apophysis, 2.3–3.0 x 0.5–0.6 mm, yellowish-brown, not furrowed when dry. Operculum long-rostrate, 1.7–2.0 mm long. Annulus in one row. Stomata several. Peristome teeth lanceolate, bifid to the middle, orange-brown and faintly striate below, yellowish and papillose above. Spores 14–17 µm, scabrous. Calyptra 4.0–4.7 mm long, extending to near the base of the urn. Normal male plants much smaller than the female plants, to 8 mm long; inner perigonial leaves cymbiform, with a long, subulate acumen, to 2 mm long; antheridia and paraphyses several. Dwarf male plants ca. 1 mm long; inner perigonial leaf ca. 0.5 mm long.

a. VAR. CYLINDROTHECIUM

Capsules cylindric.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu), Korea, Taiwan, Soviet Far East.

b. VAR. BRACHYCARPUM (BROTH.) TAK.


Capsules oblong, not cylindric.

Distribution: Endemic to Japan (Honshu).

23. LEUCOLOMA BRID.

Central strand absent. Leaves tapered to a very long subulate acumen from a lanceolate base; costa narrow, percurrent to long-excurrent in long setaceous point, smooth at back except at the tip;
Figure 93.

*Dicranoloma cylindrothecium* (Mitt.) Sak.  

a. Dry plant, x1.  
b. Leaves, x20.  
c. Cross-sections of leaf (c1, upper, c2, lower parts), x140.  
d. Cells at leaf apex, x140.  
e. Median cells of leaves (dorsal view), x200.  
f. Alar cells, x140.  
g. Inner perichaetial leaf, x10.  
h. Capsules, x10.  
i. Peristome teeth (with ventral view at right), x180.  
j. Male plant, x10.  
k. Dwarf male, x34.  

[a-f, isotype of *D. cylindrothecium* (Mitt.) Sak.; g-h, Noguchi s.n.]
margin entire except at the apex, distinctly bordered by linear, non-papillose, pellucid, thick-walled cells, the borders wider at the leaf base. Laminal cells small, obscure, subquadrar to rectangular, thick-walled, with several papillae over the lumen; alar region not extending to the costa, the cells rectangular to quadrate, the walls thick. Dioicus. Capsules erect, oblong, attenuate at the base, symmetric; annulus in 2 rows; stomata none. Operculum with a long beak. Peristome teeth linear-lanceolate, bifid to near the middle, smooth. Spores scabrous. Calyptra cucullate, long. Male plants slightly smaller than the female plants.

Key to the Species

1. Leaves appressed and ± crisped when dry, not deciduous; marginal border composed of 4-5 rows of linear cells at middle, ca. 10 rows at the base. Median laminal cells 12-18 x 8-10 µm, with large papillae; the area of papillose cells extending to near the leaf base along the costa ......................... 1. L. okamurae

1. Leaves widely spreading and slightly flexuose, not crisped when dry, deciduous; marginal borders composed of 15-20 rows of linear cells at middle, ca. 25 rows at the base. Median laminal cells 5-7 x 3-4 µm, with small papillae; the area of papillose cells ending far above the leaf base ......................... 2. L. molle

1. LEUCOLOMA OKAMURAE BROTH. (Fig. 94, A)

Plants yellowish-green to dirty green. Stems to 20 mm long, simple. Leaves appressed, ± crisped when dry, widely spreading, often homomallous when moist, linear-subulate, to 4 mm long, canalicate; marginal border composed of 1 row of cells at the apex, 4-5 at middle, and about 10 at the base. Costa percurrent. Median laminar cells rectangular, 12-18 x 8-10 µm, with several, large papillae, the walls ± thick and flexuose; upper cells 8-10 x 4-6 µm; lower cells linear, not papillose, pellucid, 15-25 x 4-5 µm, the walls sinuose; lower marginal cells narrower, with gradual transition to the cells of borders; alar cells colorless, rectangular, 20-35 x 15-20 µm, the walls thick. Inner perichaetial leaves convolute-sheathing, with an elongate, subulate acumen, to 3.5 mm long; costa percurrent. Seta 3-5 mm long. Capsules 1.0-1.3 x 0.35-0.50 mm. Operculum 1.0-1.2 mm long. Peristome teeth to 0.25 mm long, orange-brown below, yellowish above. Spores 15-18 µm. Inner perigonia1 leaves widely ovate, acuminate, ca. 1 mm long. Antheridia and paraphyses several.


Distributions: Endemic to Japan (Honshu, Shikoku, Kyushu).

This species grows on decaying logs in the warmer evergreen
Figure 94.
A. *Leucoloma okamurae* Broth.  
a. Dry plants, x1.  
b. Leaves, x24.  
c. Cells at leaf apex, x300.  
d. Median cells of leaf, x300.  
e. Alar cells, x206.  
f. Inner perichaetial leaf, x24.  
g. Capsules, x18.  
h. Peristome teeth (with ventral view at right), x216.  
i. Inner perigonial leaf, x24.  
[No. 38192]
B. *L. molle* (C. Müell.) Mitt.  
j. Leaves, x24.  
k. Cells at leaf apex, x300.  
l. Median cells of leaf, x462.  
[No. 18107]
forests.

2. **LEUCOLOMA MOLLE** (C.MUELL.) MITT. (Fig. 94, B)

*J. Linn. Soc. Bot. suppl. 1: 13 (1859).*

*Dicranum molle* C.Muell., *Syn. 1: 354 (1848).*

Plants pale-green to yellowish-green. Stems usually to 50 mm in length, arcuately ascending. Leaves slightly flexuose, wide- or erect-spreading, often falcate-secund, deciduous; margin involute, the border composed of a single row of cells at the apex, 15-20 rows at middle, and up to 25 rows at the base; costa thin, long excurrent, apex serrate. Median laminal cells subquadrate to rounded-rectangular, 5-7 x 3-4 µm, with several small papillae; lower median cells of similar size, papillose, the extreme basal cells rectangular, 13-20 x 4 µm, smooth, with gradual transition to the cells of border; alar cells quadrate or short-rectangular, 15-25 x 15-20 µm, brown, thick-walled.

*Exsiccati: Musci Japonici 1: 9 (1947); 21: 1028 (1966); 27: 1330 (1976); 34: 1679 (1983).*

*Distribution: Japan (Kyushu, Ryukyu), Taiwan, Indochina, Philippines, Indonesia.*

In Japan this species occurs on tree trunks and the sporophytes are rarely found.

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**LEUCOBRYACEAE**

**LEUCOBRYUM** HAMPE

Plants forming compact, rounded cushions or scattered. Stems dichotomously forked. Leaves thick, narrowed to an elongate, channeled acumen from an oblong or ovate base, contracted at the extreme base, composed mainly of the costa. Costa with several layers of large, hyaline leucocysts, they are rectangular, thin-walled, in surface view; leucocysts enclose a layer of smaller chlorocysts. Unistratose lamina restricted to a narrow band along the lower leaf margin, forming several rows of linear, delicate-walled cells; margin entire or crenulate, often involute above, plane below. Dioicous (often phyllodioicous) or autoicous. Perichaetia terminal; inner leaves acuminate, convolute-sheathing; paraphyses none. Seta elongate, smooth. Capsule usually inclined, oblong or obovoid, usually strumose, sulcate when dry, without stomata. Operculum conic with an elongate, occasionally oblique beak; annulus absent. Peristome teeth 1/2-bifid or more, reddish-brown below, vertically papillose-striolate. Spores usually smooth. Calyptra cucullate, not hairy.

Sometimes leaves of similar structures are found in those of the
genera *Brothera* and *Paraleucobryum*. However, *Leucobryum* does not seem to be closely related to *Brothera* because its peristome teeth are quite different. The nearest genus seems to be *Paraleucobryum* as they have the similar sporophytes, as Cardot (1900) pointed out.

A revision on the Japanese *Leucobryum* was undertaken by Iwatsuki (1977).

**Key to the Species**

1. Leaves scabrous on the dorsal surface, at least near the apex .. 2
1. Leaves smooth on the whole dorsal surface ................. 4

2. Leaves widely spreading, strongly flexuose when dry, lanceolate, attenuate, to 15 mm long, scabrous area of leaf surface restricted to near the leaf apex ................. 6. *L. javense*
2. Leaves ± appressed, and scarcely flexuose when dry, erect-spread when moist, oblong to lanceolate, scabrous area of leaf surface extending over almost the entire surface or restricted to leaf apex ....... ................. 3

3. Leaves oblong to lanceolate, shortly attenuate, to 8 mm long; scabrous area reaching leaf-middle, rarely the leaf base ... 5. *L. scabrum*
3. Leaves lanceolate or gradually narrowed to an elongate acumen from an oblong base, to 6 mm long, scabrous area restricted to leaf apex ................. 4. *L. scaberulum*
4. Cross-section in lower region of costa more or less uniform in thickness, except in the narrow median groove ... 3. *L. glaucum*
4. Cross-section in lower region of costa thicker towards the leaf margin .................... 5
5. Costa with leucocysts usually 2 or 3 layers in the lower region ................. 2. *L. bowringii*
5. Costa with leucocysts up to 7 layers in the lower region ................. 1. *L. neilgherrense*

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1. **LEUCOBRYUM NEILGHERRENSE** C.MUELL. (Fig. 95)


Plants medium-sized, forming compact cushions. Leaves erect-spread, not altered but caducous when dry, lanceolate, subtubular from an oblong base, shortly acuminate or apiculate, 4–5 x 0.7–1.2 mm, smooth at apex; margin erect above, plane below; costa with 6–7 layers of leucocysts in leaf base, and 2 layers at mid-leaf and above; lamina 10–17 cells wide. Dioicous. Inner perichaetial leaf oblong–lanceolate,
shortly attenuate, ca. 6 mm long, involute. Seta 8-10 mm long, ca. 0.15 mm thick. Capsule inclined, oblong, distinctly strumose, 1.0-1.5 x 0.6-0.7 mm, strongly sulcate when dry. Operculum as long as the urn. Peristome teeth bifid beyond middle, occasionally trifid or not cleft, 0.45-0.50 mm long. Spores 10-13 \( \mu m \). Calyptra 2.4-2.6 mm long, blackish above.


Distribution: Japan (Hokkaido, Honshu, Shikoku, Kyushu, Ryukyu, Bonin Isls.), Korea, China, Taiwan, Indochina, Thailand, Burma, Himalaya, India, Sri Lanka, Philippines, Sumatra, Java, Borneo, Celebes.

In Japan this species is common on soil, humus in dry and sunny sites, in semi-shaded earth in open forests and on tree bases, especially coniferous.

A cluster of radicles is often seen at the base or apex of a leaf, and small, juvenile plants sometimes develop on the cluster. A twin seta from a single perichaetium is often observed.

There seems to be a broad gradation in the size of the plants, the largest approaching that of L. glaucum.

2. LEUCOBRYUM BOWRINGII MITT. (Fig. 96, C)


Plants medium-sized, forming loose tufts. Leaves gradually tapering to an elongate, tubular acumen from an oblong base, usually ca. 7.0 x 0.7 mm, smooth at apex; leucocysts in 2 or occasionally 3 layers in leaf base, and 2 layers above; lamina to 10 rows of linear cells. Dioicous. Inner perichaetial leaves long-sheathing, with an elongate, subulate acumen, involute, to 6.5 mm long. Seta 15-20 mm long, ca. 0.18 mm thick. Capsule inclined, oblong, strumose, 1.0-1.2 x 0.65-0.70 mm. Operculum 1.3-1.5 mm long, usually longer than the urn. Peristome teeth to 0.5 mm long, bifid to the middle. Spores 12-16 \( \mu m \), slightly scabrous. Calyptra 2.3-2.5 mm long.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu), China, Taiwan, Indochina, Thailand, Himalaya, India, Sri Lanka, Malay Pen., Philippines, Sumatra, Java, Borneo, Celebes, New Guinea, New Hebrides.

In this species the plants are larger and the leaves are longer than those of L. neilgherrense. Sometimes this species is confused with L. scabrum, but it is distinguished by its smaller, more slender leaves.
Figure 95. *Leucobryum neilgherrense* C.Muell.  
*a, b.* Plants, x1.  
*c.* Leaves, x10.  
*d.* Leaf cells (surface view), x180.  
*e.* Cross-sections of leaf (*e1*, upper, *e2*, median, *e3*, lower parts), x135.  
*f.* Perichaetium with capsule, x8.  
*g.* Inner perichaetal leaf, x10.  
*h.* Capsules, x15.  
*i.* Dry capsule, x15.  
*j.* Peristome teeth (with ventral view at right), x135.  
[a–j, Noguchi 22553]
3. **LEUCOBRYUM GLAUCUM** (HEDW.) AONGSTR. (Fig. 96, A)

   In Fries, Summ. Veg. Scand. 1: 94 (1846).


   Plants medium-sized, forming compact cushions. Leaves erect-spreadling, lanceolate with an attenuate, tubulate acumen from an oblong-ovate base, sheathing portion usually shorter than the tubulate portion, 6-8 x 1.5-2.3 mm, smooth at back; upper margin involute; leucocysts in costa 3-5 layers near leaf base, 2-3 layers along the median line of narrow part, and 2 layers towards the apex; laminae 5-10 cells wide.

   Distribution: Japan (Hokkaido, Honshu), Korea, China, Soviet Far East, Europe, Canary, Madeira, N.America.

   In Japan, this species occurs at relatively high altitudes, and sporophytes are unknown.

4. **LEUCOBRYUM SCABERULUM** CARD. (Fig. 96, B)


   Plants medium-sized, forming loose tufts. Stems to 50 mm long. Leaves erect-spreadling and almost straight when dry, gradually tapering to an elongate, tubular acumen from a narrow-oblong base, usually to 6 mm long, apiculate, scabrous at back above due to inflated cell ends; costa 2 layers throughout; lamina with up to 12 rows of linear cells.

   Distribution: Japan (Ryukyu), Taiwan, Hong Kong.

   This species is related to *L. scabrum* but is distinguished by the leaves being scabrous only in the upper parts. The sporophytes are unknown in Japan.

5. **LEUCOBRYUM SCABRUM** LAC. (Fig. 97)


   Plants large, scattered and ascending or forming loose tufts. Stems usually simple, rather sparsely leaved, sometimes bearing apical clusters of small leaves. Leaves ± appressed when dry, erect-spreadling when moist, oblong to lanceolate, shortly attenuate, the sheathing base indistinct, leaf usually to 7-8 x 1.3-1.5 mm, ± cucullate at apex, scabrous due to projections from the upper ends of cells at back above, or occasionally over the greater part of the leaf; margin incurved above; leucocysts of costa in cross-section usually 5-6 layers near leaf base, 2 layers in mid-leaf; lamina 6-8 rows of cells. Dioicous. Inner perichaetial leaf oblong-lanceolate, acute, ca. 5 mm long. Seta 25-28 mm long, ca. 0.25 mm thick. Capsule inclined, oblong-cylindric, 1.8-2.0 x 1 mm. Operculum as long as the urn. Peristome teeth usually 1/2-bifid, ca. 0.85 mm long.
Figure 96.
A. *Leucobryum glaucum* (Hedw.) Aongstr.  
a. Leaves, x8.  
b. Cross-sections of leaf (*b1*, upper, *b2*, median, *b3*, lower parts), x63. [Hattori s.n.]
B. *L. scaberulum* Card.  
c. Leaves, x10.  
d. Cells at leaf apex (dorsal view), x135.  
e. Cross-sections of leaves (*e1*, upper, *e2*, median, *e3*, lower parts), x135. [Iwatsuki s.n.]
C. *L. bowringii* Mitt.  
f. Leaves, x10.  
g. Cross-sections of leaf (*g1*, upper, *g2*, median, *g3*, lower parts), x135.  
h. Perichaetium with capsule, x8.  
i. Inner perichaetial leaf, x10. [Musci Japonici 26: 1277]
Spores 10–13 μm. Calyptra 3.0–3.5 mm long, blackish above.


Distribution: Japan (Honshu, Shikoku, Kyushu, Ryukyu), China, Taiwan, Philippines, Thailand.

Some members of the genus prefer dry, sunny habitats, but this species grows with in grasses, or associated with other bryophytes, on moist rocks or boulders in forests.

This species is distinct in the field because of its large, silky, glaucous-green texture.

6. **LEUCOBRYUM JAVENSE** (BRID.) MITT. (Fig. 98)


*Sphagnum javense* Brid., Musc. Rec. 2(1): 27, t. 5, f. 3 (1798).

Plants very large. Stems sparingly branched, rather sparsely foliate. Leaves widely spreading, flexuose when dry, lanceolate, attenuate from an indistinct sheathing base, often secund, to 15 mm long, scabrous at tips, elsewhere almost smooth; margin involute; costa in cross-section 2 layers near base, 3–4 layers near margin and 2 layers in the upper portion. Dioicous. Inner perichaetial leaves sheathing, with short acumina, to 4 mm long. Seta 30 mm long, ca. 0.2 mm thick, strongly flexuose. Capsule inclined, strongly sulcate when dry, obovoid, 1.7–2.0 x 1.2–1.5 mm, strumae small. Operculum as long as the urn. Peristome teeth ca. 0.85 mm long. Spores 12–16 μm, slightly scabrous. [Description of sporophytes based on the specimen from Thailand].


Distribution: Japan (Ryukyu), China, Hong Kong, Taiwan, Indochina, Malaya, Thailand, Himalaya, India, Sri Lanka, Philippines, Sumatra, Java, Borneo, Celebes, New Guinea.

In Japan this species is restricted to the Ryukyu Archipelago, where it is not common, and the sporophytes are unknown.
Figure 97.
Figure 98. *Leucobryum javense* (Brid.) Mitt.  

- **a.** Leaves, x8.  
- **b.** Cross-sections of leaf (*b1*, upper, *b2*, median, *b3*, lower parts), x63.  
- **c.** Perichaetium with capsule, x8.  
- **d.** Inner perichaetal leaf, x8.  
- **e.** Capsule, x8.  
- **f.** Dry capsule, x8.  
- **g.** Peristome teeth, x135. 

[a, b, Musci Japonici 27: 1328; c-g, herb. Noguchi 68496 from Thailand]