MANUAL OF HAWAIIAN MOSSES

BY
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INTRODUCTION

SCOPE AND ACKNOWLEDGEMENTS

The literature relative to the Hawaiian mosses is widely scattered. Much of it is difficult of access to any but professional botanists. I have therefore endeavored, by the presentation of descriptions, distributional data, and sketches illustrating the characteristics of the respective species of mosses found in the Hawaiian islands, to embody the available information in a practical manual for the use of students who are or who may be interested in these forms of plant life.

Collections which I made during the early months of 1930, supplemented by a considerable series of unnamed collections made some years ago by Mr. C. N. Forbes and now in the herbarium of Bernice P. Bishop Museum, have formed the groundwork of these studies. Through the courtesy of Dr. Alexander W. Evans of the Osborn Botanical Laboratory it has been possible to examine an approximately complete duplicate series of the collections made by D. D. Baldwin and studied by Dr. V. F. Brotherus for his "Hawaiian mosses." Dr. H. Reimers of the Botanical Garden in Berlin-Dahlem has been most generous in supplying the types of the species described by C. Müller. The types of Sullivant's species have been made available through the kindness of Dr. Carroll W. Dodge of the Farlow Herbarium. I am also grateful to Dr. Hj. Möller of the Naturhistoriska Riksmuseum in Stockholm for the types of Ångström's species, to Dr. Harald Lindberg of the Botaniska Museum in Helsingfors for specimens from the Brotherus Herbarium, to Dr. Karl Keissler of the Naturhistorisches Museum in Vienna for the types of Reichardt's species, and to Mr. R. S. Williams for the privilege of examining the Mitten types in the herbarium of the New York Botanical Garden. As a result of this whole-hearted coöperation it has been possible to study critically most of the original specimens of species concerning the validity of which there was any serious doubt. It has too often been obligatory to base judgment on a fragmentary specimen or on one in poor condition. I have endeavored to make the best of the opportunities, however, and hope that the results may to some extent stimulate an interest in the mosses of one of the most unique phytogeographical areas in the world.

With but few exceptions, the sequence of families and genera is substantially the same as that adopted by Brotherus in the second edition of "Die natürlichen Pflanzenfamilien," Engler and Prantl, but some minor changes have been made in the grouping. The nomenclature conforms to the ruling adopted by the International Congress at Cambridge in 1930 establishing the "Species Muscorum" of Hedwig, 1801, as the starting point.

Although not optimistic enough to believe that the book is lacking in errors of both judgment and commission, I hope that these are neither numerous enough nor flagrant enough to impair seriously the practical value of the work. Any corrections or additions will be heartily welcomed.

The types of the new species have been deposited in the herbarium of Bernice P. Bishop Museum and in the herbarium of the writer.

I am especially indebted to Dr. Herbert E. Gregory, Director, and to the Trustees of Bernice P. Bishop Museum for the coöperation and support which have made the publication of the manual possible.

LIFE HISTORY AND STRUCTURAL FEATURES OF MOSSES

A concise outline of the life history and structural details of mosses should not be without value in a work primarily designed to assist the student in identifying and classifying the mosses of a limited area.

The minute unicellular spore, under favorable conditions, germinates and develops as a slender filament which in most mosses elongates and branches to form a thin chlorophyllose felt or mat termed the protonema. The protonema produces buds and thereafter disappears, though in a few species it persists for a considerable time. The buds develop into moss plants.

The moss plant consists of a stem and leaves but has no true roots. The stem may be either simple or branched, and most stems are provided with radicles, many of which attach themselves to the substratum and function as roots. The leaves have many variations, though all are sessile and none are compound; a few are lobed, many are toothed, and some are laciniate. The simple leaf structure, except for the costa, consists generally of a single layer of cells. Many leaves are differentiated at the margins and at the basal angles. The shape and structure of the leaf cells are important as diagnostic characters.

Reproduction may be sexual, or it may be accomplished by means of specialized bodies termed propagula or gemmae. The sexual organs are of two kinds, the antheridia or male organs and the archegonia or female organs. The relative positions of antheridia and archegonia are important in systematic studies.

After fertilization, the egg develops as the sporophyte and ruptures the archegonium. The outer part of the archegonium is carried upward on

the tip of the capsule as the calyptra. The lower part remains to form the vaginula. The capsule in most mosses is elevated on a straight or curved seta of varying length, and it generally opens by a lid which falls off at maturity. The seta may be either smooth or papillose. The annulus, an elastic ring of specialized cells surrounding the rim, present in most mosses, assists the process of rupture. The spores, which are generally exceedingly numerous, are rounded, smooth or rough, and surround the columella. The peristome, where present, consists either of a single circle of teeth or of two concentric circles. In the single circle the teeth are generally tinged with red. They range in number from 4 to 64, in multiples of 4. In the peristome of two concentric circles the outer teeth are similar to those of the single type of peristome, but the inner peristome is of a more delicate texture and comprises 8 or 16 segments which generally alternate with the teeth, though they may in some species lie opposite them. The segments are either distinct to the base or more or less united below to form a basal membrane of varying height. The membrane in several species is prolonged between the segments into 1 to 3 delicate threadlike cilia.

The two species of the Sphagnales and the single species of the Andreaeales found in Hawaii are all confined to relatively high altitudes. By far the greatest number of Hawaiian mosses are comprised in the Bryales, which, with the exception of the limited tribe, Nematodonteae, are fairly equally divided between the Haplolepideae and the Diplolepideae of the tribe Arthrodonteae.

A detailed discussion with regard to the origin of the Hawaiian moss flora would be superfluous in a work of this character, but it may be remarked in passing that the Hawaiian species are obviously and almost exclusively affiliated with those of the regions to the south and west. Apart from the plants of cosmopolitan distribution, Hawaiian mosses show almost no connection with the mosses of the American continents.

As is naturally to be expected in a diversified insular region, the percentage of endemic Hawaiian species is high. It exceeds 50 per cent. The country up to and including the rain-forest belts has been quite thoroughly explored and it is safe to assume that there the mosses are reasonably well known, though they are by no means exhausted. On the other hand the upper slopes of Haleakala, Mauna Kea, and Mauna Loa, with elevations of more than 6,000 feet, are imperfectly known bryologically and may be expected to yield many species of which we have no knowledge at the present time.

It may be well to remark here that the keys and descriptions in the following pages apply exclusively to the Hawaiian mosses and should not be given a broader application.

KEY TO THE GENERA

1. Leaves in two rows, equitant 2
   Leaves in three or more rows, often complanate, but not equitant 3
2. Leaves costate, with a dorsal lamina ..... **3. Fissidens**
   Leaves ecostate, without a dorsal lamina ..... **69. Orthorrhynchium**
3. Fruit terminal (except *Molendoa* and *Anoectangium*) on erect stems or secondary branches 4
   Fruit lateral on the prostrate stems or erect secondary branches 65
4. Branches in fascicles, leaf cells dimorphous, in one layer, the large hyaline fibrillose cells in the meshes of the network of long narrow chlorophyllose cells ..... **1. Sphagnum**
   Branches not in fascicles, leaf cells without spiral fibers 5
5. Greater part of leaf composed of three or more layers of cells, the outer large, empty, and porose (leucocysts), the inner small, chlorophyllose, in one layer (chlorocysts) 6
   Leaf blade composed of similar cells in 1, or rarely 2 layers 7
6. Capsule erect, chlorocysts in upper part of leaf triangular in cross section ..... **17. Octoblepharum**
   Capsule curved, chlorocysts in cross section quadrangular ..... **18. Leucobryum**
7. Leaves with numerous longitudinal lamellae on the ventral face 8
   Leaves without lamellae 9
8. Leaf margin plane, serrate above ..... **106. Pogonatum**
   Leaf margin inflexed over the lamellae, entire ..... **107. Polytrichum**
9. Capsule opening by vertical slits ..... **2. Andreaea**
   Capsule opening by a lid 10
10. Inner basal cells large, hyaline, sharply differentiated from the small chlorophyllose laminal cells 11
    Inner basal cells not sharply differentiated from the laminal cells 13
11. Leaves bordered with elongated, hyaline cells 12
    Leaves not bordered with hyaline cells ..... **21. Calymperes**
12. Hyaline border narrow, leaf apex not constricted ..... **19. Syrrhopodon**
    Hyaline border very broad below, leaf apex constricted ..... **20. Thyridium**
13. Calyptra large, campanulate 14
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14. Stems creeping, branches erect ..... **57. Macromitrium**
    Stems erect 15
15. Calyptra plicate, leaves serrate above ..... **38. Ptychomitrium**
    Calyptra not plicate, leaves not serrate 16
16. Calyptra not pilose, covering the entire capsule ..... **22. Encalypta**
    Calyptra more or less pilose, not covering the capsule ..... **56. Orthotrichum**
17. Leaf margins involute 18
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18. Leaves narrow, peristome present ..... **25. Weisia**
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19. Peristome wanting 20
    Peristome present 26
20. Fruit lateral on the stems 21
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21. Costa about 100μ wide, smooth, occupying about one-half the leaf base ..... **23. Molendoa**
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22. Capsule barely exserted, seta very short ..... **11. Amphidium**
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23. Mouth of capsule small, strongly puckered....**55. Zygodon**
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24. Leaves broad, spathulate, cells large and lax....**39. Funaria**
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25. Leaf cells papillose, costa denticulate on back....**53. Philonotis**
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26. Peristome teeth spirally twisted....27
Peristome unknown or with straight teeth....30
27. Leaves bordered with elongated cells....**34. Streptopogon**
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28. Leaves broad, obtuse, peristome teeth from a high tessellated tube....**35. Tortula**
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29. Basal cells hyaline, extending obliquely up the margins....**29. Tortella**
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30. Peristome single....31
Peristome double or only inner peristome present....51
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32. Costa very broad, occupying one-third to two-thirds the width of the leaf base....33
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34. Alar cells strongly differentiated, hyaline or brownish....35
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35. Leaves with a hyaline border....**16. Leucoloma**
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42. Leaves strongly crisped when dry....43
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75. Costa faint, ending below mid-leaf, leaves very fragile, appressed when dry..... **82. Haplohymenium**
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113. In dense plumose mats, capsule oblong, leaves with fragile decurrent auricles..... **104. Ctenidium**
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ORDER 1. SPHAGNALES

Typical peat mosses growing in dense tufts or cushions in bogs or on wet mountain tops, whitish green tinged with brown or red. Stems elongate, not radiculose, with a central pith of lax cells inclosed in a wood cylinder which is surrounded by one or several layers of large thin-walled hyaline cells. Branches in fascicles, more densely crowded near the tips of the stems. Branch leaves composed of a single layer of two kinds of cells, a network of linear chlorophyllose cells in the meshes of which are large rhomboidal hyaline cells, porose and with the walls reënforced by spiral fibers. Stem leaves similar in structure but usually less fibrillose and often very different in shape. Capsules dark brown or blackish when mature, subglobose with a convex lid, on a short fleshy stalk or pseudopodium. Spores developed from a distinct layer of cells, the amphithecium, not from the endothecium. Peristome none.

A very distinct order with but one family, Sphagnaceae, and but one genus, *Sphagnum,* of cosmopolitan distribution.

Family SPHAGNACEAE

1. SPHAGNUM Linnaeus, Sp. Pl. p. 1106, 1753.

Leaves rough at the back of the apex, cortical cells of stems and branches fibrillose ..... **1. S. palustre**

Leaves not rough at apex, cortical cells of stems and branches not fibrillose..... **2. S. wheeleri**

1. **Sphagnum palustre** Linnaeus, Sp. Pl., p. 1106, 1753 (fig. 1).
   Sphagnum cymbifolium Ehrhart, Hedwig, Fundam., vol. 2, p. 86, 1782.
   Sphagnum latifolium Hedwig, Sp. Musc., p. 27, 1801.
   ? *Sphagnum lonchocladum* C. Müller, Flora, vol. 82, p. 436, 1896.

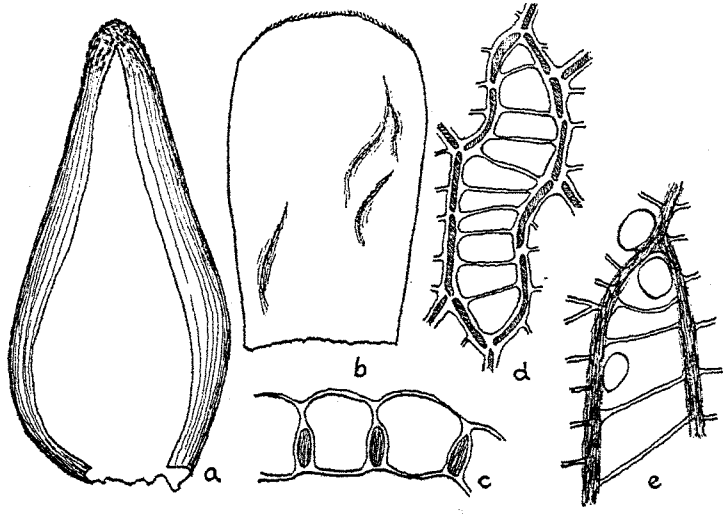


Figure 1. *Sphagnum palustre* Linnaeus: *a*, branch leaf × 25½; *b*, stem leaf ×25½; *c*, cross section of leaf cells × 360; *d*, leaf cells from ventral side × 360; *e*, leaf cells from dorsal side × 360.

Robust plants, pale green tinged with brown. Stems up to 15 cm. or more long. Cortical cells of the stem porose and fibrillose, in three layers; wood cylinder reddish brown. Stem leaves broadly lingulate, rounded at the apex, somewhat fibrillose and porose in the median portion, margins eroded. Branches tumid, in fascicles of 4 or 5, 2 of which are widely spreading, cortical cells fibrillose, in one layer; branch leaves broadly ovate, deeply cymbiform, slightly narrowed to the cucullate apex, very rough on the back above by projecting cells, bordered by a single row of long narrow hyaline cells, denticulate above. Hyaline cells fibrillose, with large pores on the dorsal surface. Chlorophyllose cells in cross-section narrowly elliptic, slightly exposed on both surfaces of the leaf.

Island of Hawaii: Kohala Mountains (Skottsberg).
Cosmopolitan. Type locality, Europe.

The fibrillose cortical cells of the stems and branches, the leaf form, and the scabrous apex will at once distinguish this species from the following. The Hawaiian plants seem to be identical in every essential particular with the widely distributed *S. palustre.*

2. **Sphagnum wheeleri** C. Müller, Flora, vol. 73, p. 416, 1887 (fig. 2).
? Sphagnum vulcanicum Warnstorf, Bot. Centralb., p. 296, 1900.

Robust, pale green tinged with brown. Stems up to 10 cm. or more long. Cortical cells of the stem in 2 or 3 layers, not fibrillose; wood cylinder golden brown. Stem leaves triangular-lingulate, slightly concave, apex obtuse and slightly cucullate, about 1.2 mm. long and 0.7 mm. wide at base, with a small border of narrow cells; hyaline cells slightly fibrillose. Branches dense, divergent; branch leaves up to 3 mm. long, ovate-lanceolate, involute above, truncate and toothed at the apex, bordered with 2 or 3 rows of elongated hyaline cells; margin denticulate. Hyaline cells fibrillose, with numerous rather large pores along the lateral walls. Chlorophyllose cells in cross-section oval, inclosed or barely reaching the dorsal surface.

Mountain bogs. Maui: on and near summit of Mt. Eke (Forbes; Degener and Weibke); Honokohau drainage basin (Forbes).

Endemic. Type locality, Hawaiian islands.

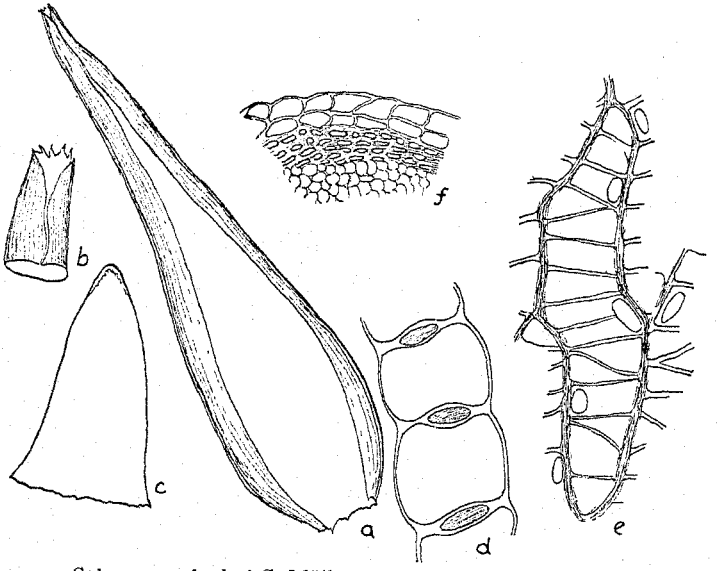


FIGURE 2. *Sphagnum wheeleri* C. Müller: *a,* branch leaf × 25½; *b,* apex of branch leaf × 60; *c,* stem leaf × 25½; *d,* cross section of leaf cells × 360; *e,* leaf cells from dorsal side × 360; *f,* part of cross section of stem × 120.

This species, like the preceding, seems to have a narrowly localized distribution. Both are rare and confined to high mountain bogs. Although I have seen no collections from Kauai, one or both of these species would probably be found in the boggy areas on Waialeale.

ORDER 2. ANDREAEALES

Small reddish brown or blackish plants growing in tufts on rocks at high altitudes, very brittle when dry. Stems slender, radiculose below, erect or decumbent, simple or branched. Leaves crowded, erect-spreading; cells small, incrassate, in one layer, elongate below, rounded and papillose above. Capsules terminal, inclosed in the perichaetium until ripe, then exserted on a short pseudopodium, without lid or peristome, splitting vertically into 4 (6 to 8) valves united at the base and apex; columella persistent; spores smooth or papillose. Spores and columella developed from the endothecium. No air space between the spore sac and capsule wall.

A unique order of mosses comprising but one family, Andreaeaceae, and one widely distributed genus, *Andreaea*.

FAMILY ANDREAEACEAE

2. ANDREAEA Erhart, Hedwig, Sp. Musc., p. 47, 1801.

1. **Andreaea rupestris** Hedwig, Sp. Musc., p. 47, 1801 (fig. 3).
Andreaea petrophila Erhart, Hannov. Mag., p. 140, 1784.
Andreaea perpapillosa Brotherus, B. P. Bishop Mus., Bull. 40, p. 4, 1927.

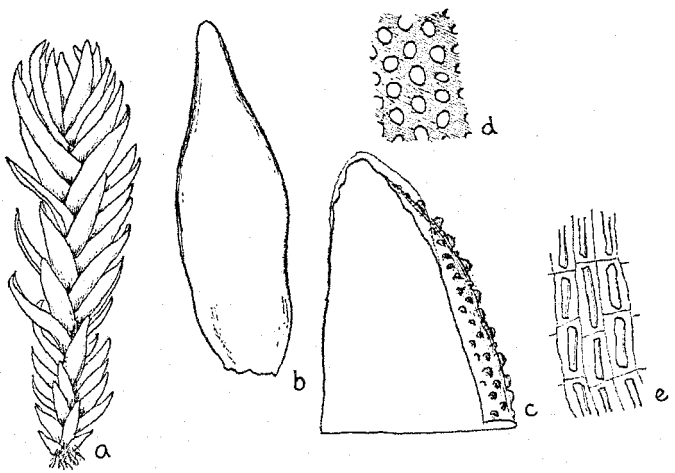


FIGURE 3. *Andreaea rupestris* Hedwig: *a*, moist plant × 18; *b*, upper stem leaf × 60; *c*, apex of stem leaf × 360; *d*, upper leaf cells × 360; *e*, basal leaf cells × 360.

Brittle, dark brown plants in small dense tufts. Stems slender, 3 to 10 mm. high, simple, erect or arcuate. Leaves closely imbricated when dry, erect-spreading with incurved points when moist, ovate or ovate-lanceolate, concave, obtuse or narrowed to a

somewhat acute point, about 0.8 mm. long by 0.3 mm. wide, the lower smaller; margin erect below, incurved above; ecostate; lower leaf cells linear, smooth, sinuose with very incrassate walls, gradually shorter upward, in the upper part of the leaf rounded-quadrate, incrassate, strongly papillose on the back with salient hyaline papillae. Capsules (unknown in Hawaii) about 1 mm. long, finally exserted on a short pseudopodium, vertically split into four thick-walled valves when ripe; spores brown, papillose, 20 to 30μ in diameter.

On rocks. Maui: Haleakala, in crater (Skottsberg).

Distribution: Europe, North America, Tasmania, New Zealand. Type locality, Europe.

There seem to be no tangible characters by which these plants can be separated from *A. rupestris*. The term "obtusely rounded" as applied to the leaf apices by Brotherus is substantially correct, but many of the leaves are narrowed to an acute point and when compared with the leaves of *A. rupestris* are indistinguishable either in size, shape, or areolation. It is not improbable that the plant will be rediscovered on the upper slopes of the higher mountains in Hawaii when these areas are explored bryologically.

ORDER 3. BRYALES

A very large order comprising the majority of mosses. The spores are developed from the endothecium, which is also the source of the columella. The spore sac is separated from the capsule wall by a more or less evident air space. Capsules on a definite seta of varying length, indehiscent or opening by a lid, with or without a peristome.

Peristome teeth, when present, thin, with transverse articulations.....**1. Arthrodonteae**
Peristome teeth thick, solid, not transversely articulated.....**2. Nematodonteae**

Tribe 1. Arthrodonteae

Peristome teeth, when present, relatively thin, with transverse articulations; developed from a single layer of the sporogonium.

Peristome single, outer plates not divided, inner plates with a median line.....
.....**1. Haplolepideae**
Peristome double, outer plates with a median line, inner plates not divided.....
.....**2. Diplolepideae**

Subtribe 1. Haplolepideae

Peristome none or single, the teeth frequently cleft or bifid, composed of two layers of plates below; the outer plates not divided; the inner plates divided by a fine median line. Fruit, with few exceptions, terminal. Stems mostly erect.

Family 1. FISSIDENTACEAE

Small to medium-sized plants with distichous, equitant leaves flattened in one plane, split to the costa on the inner side of the basal part into two blades, clasping the stem. Laminal cells uniform, in one layer, hexagonal or rounded. Costa ending in or below the apex. Seta terminal or lateral. Capsule erect or inclined with a simple peristome of 16 teeth, split to or below the middle into two subulate forks. Spores small.

3. FISSIDENS Hedwig, Sp. Musc., p. 152, 1801.

A natural and distinct group of mosses known at once by the characteristic leaf structure, for which the following terms are used: "duplicate blades," sheathing basal portion facing the stem; "apical blade," portion beyond the duplicate blades on the same side; "dorsal blade," entire lamina on the opposite side of the costa.

1. Leaves bordered with a narrow band of pale, elongated cells.....2
   Leaves not bordered with elongated cells.....4
2. Leaves bordered only on duplicate blades.....**3. F. baldwinii**
   Leaves bordered all around.....3
3. Autoicous, male buds axillary, cells papillose.....**1. F. hawaiicus**
   Synoicous or dioicous, cells smooth.....**2. F. insularis**
4. Leaves obtuse, costa ending well below apex.....**4. F. delicatulus**
   Leaves acute, costa percurrent or nearly so.....5
5. Leaf margin coarsely serrate in upper half.....**5. F. pacificus**
   Leaf margin minutely serrulate.....**6. F. mauiensis**

1. Fissidens hawaiicus, new species (fig. 4).
Fissidens irroratus Bartram, in herbaria.

Autoicous. Caulis procumbens, ad 1.5 cm. altus. Folia 10-15 juga, oblongo-lanceolata, acuminata, ad 2.5 mm. longa; lamina dorsali ad basin folii enata; limbo angusto, hyalino, e 1-2 seriebus cellularum angustarum composito; limbo laminae duplicatae dilatato, e 3-6 seriebus cellularum composito; cellulis hexagonis, minute papillosis. Seta ad 3.5 mm. longa, rubella; capsula sub-erecta, 0.8 mm. longa.

Autoicous; male buds in the axils of the stem leaves. Dark green, densely gregarious plants. Stems procumbent, 1 to 1.5 cm. long with 10 to 15 pairs of leaves, radiculose at the base, about 2.5 mm. wide with leaves. Lower leaves small, composed almost entirely of the duplicate blades, progressively larger upwards, the upper to 2.5 mm. long by 0.4 mm. wide, oblong-lanceolate, acuminate, slightly contorted when dry, duplicate blades ending obliquely about mid-leaf or a little beyond, dorsal blade gradually narrowed to the insertion, border very distinct, composed of several rows of very narrowly linear, pale, incrassate cells ending just below the apex; margin obscurely denticulate at the apex, otherwise entire; costa pale, percurrent; leaf cells chlorophyllose, hexagonal, thin-walled, minutely papillose, 6 to 7 μ in diameter. Seta terminal, reddish, 3.5 mm. long; capsule erect or inclined, ovoid-cylindric, greenish brown, constricted under the mouth when dry, urn 0.8 mm. long; peristome teeth dark red, strongly incurved when moist, the divisions spirally thickened; lid conic-rostrate, erect or oblique, 0.4 mm. long; calyptra cucullate, extending below the rim of the capsule; spores smooth, yellowish, 6 to 7 μ in diameter.

Damp shaded rocks. Oahu: Waikane-Schofield trail, Koolau Range, altitude 800 feet (Bartram). Maui: bank, Iao Valley (Bartram); Honokohau ditch trail, altitude 1,000 feet (Bartram). Kauai: vicinity of Kokee, common (Bartram); rocks near Power Plant (Bartram).

Type: damp shaded rocks, vicinity of Kokee, Kauai, altitude 4,000 feet, February 20, 1930, E. B. Bartram, number 605.

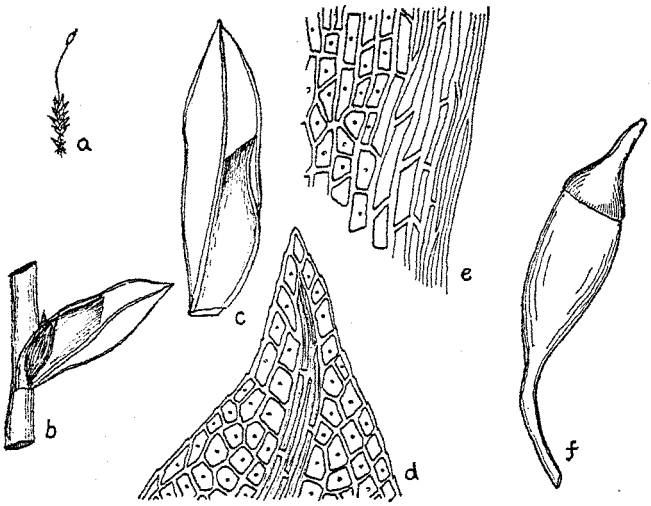


FIGURE 4. *Fissidens hawaiicus* Bartram: *a*, plant × 1½; *b*, axillary male bud × 25½; *c*, stem leaf × 25½; *d*, apex of leaf × 360; *e*, basal margin of duplicate blade × 360; *f*, capsule × 10½.

The axillary male buds are quite conspicuous in this species and may be easily seen through the translucent leaves when the plant is mounted entire under a cover glass. It resembles *F. bryoides* Hedwig in a general way but will be readily distinguished by the more sharply acuminate leaves and the papillose cells.

2. **Fissidens insularis,** new species (fig. 5).

Synoicous et dioicous. Caulis procumbens, ad 2-3 mm. altus. Folia sicca crispata, ovato-oblonga, 1.8 mm. longa, lamina dorsali ad basin folii enata; limbo angusto, hyalino, e 1-2 seriebus cellularum angustarum composito, limbo laminae duplicatae dilatato, e 5-6 seriebus cellularum composito, cellulis quadrato-hexagonis, laevis. Seta ad 3 mm. longa, geniculata, rubella; capsula erecta, sub-cylindrica; operculum rostratum.

Synoicous and dioicous. Small, densely gregarious plants, yellowish green. Stems procumbent, 2 to 3 mm. long, simple, 2 to 2.5 mm. wide with leaves when moist, densely radiculose at base. Leaves strongly twisted and contorted when dry, widely spreading when moist, the lower abruptly smaller, ovate-oblong, acute, up to 1.8 mm. long by 0.5 mm. wide; duplicate blades extending beyond mid-leaf, unequal at the top, dorsal blade

tapering gradually to the base and ending at the leaf insertion; border distinct, composed of pale, linear, incrassate cells, 5 to 6 rows wide at base of duplicate blades and frequently intra-marginal, narrowing upward, ending just below the minutely denticulate apex; costa pale, percurrent; leaf cells chlorophyllose, smooth, quadrate-hexagonal, thin-walled, 6 to 8 μ in diameter. Seta terminal, reddish, 3 mm. long, geniculate at base; capsule (immature) sub-cylindric, urn 0.6 mm. long; lid erect, rostrate; calyptra narrowly conical, nearly entire at base.

Damp rocks. Oahu: ledges, Nuuanu Pali (Bartram). Maui: damp rocks back of Lahainaluna School (Bartram). Hawaii: damp ledge, Bird Park (Bartram).

Type: shaded rock along road to Bird Park, Kilauea, Hawaii, altitude 4,200 feet, January 26, 1930, E. B. Bartram, number 276.

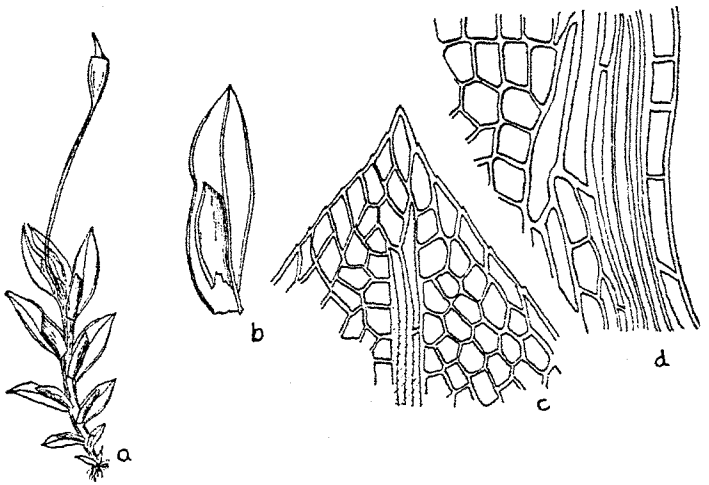


FIGURE 5. *Fissidens insularis* Bartram: *a*, plant × 9; *b*, stem leaf × 25½; *c*, apex of leaf × 360; *d*, basal margin of duplicate blade × 360.

Apart from the inflorescence this species is distinguished from *F. hawaiicus* by the shorter more broadly pointed leaves and the smooth leaf cells. It seems to be constantly smaller than the preceding species, with the leaves more strongly contorted and crisped when dry.

3. **Fissidens baldwinii** Brotherus, B. P. Bishop Mus., Bull. 40, p. 4, 1927 (fig. 6).

Dioicous; male plant about 1.5 mm. high with 5 or 6 pairs of leaves, antheridia terminal, inclosed by 4 or 5 perigonial leaves with deeply sheathing bases, notched at the top of the duplicate blades. Plants small, growing in extensive, dense mats, deep green tinged with brown. Stems procumbent, up to 3.4 mm. long, with 5 to 12 pairs of leaves, radiculose at base, 1 to 1.5 mm. wide with leaves. Lower leaves minute, progressively larger upward, the upper about 1.5 mm. long by 0.25 mm. wide, lanceolate-ligulate,

acute, slightly contorted and decurved when dry, duplicate blades ending about mid-leaf, very unequal at the top, dorsal blade ending abruptly at the insertion, duplicate blades bordered with pale, linear, incrassate cells, 4 or 5 rows wide at the insertion, narrowing upward, apical and dorsal blades not bordered, serrulate on the margins; costa pale, ending just below the apex; leaf cells hexagonal with firm walls, 5 to 6 μ in diameter, minutely papillose; perichaetial pair of leaves slightly longer with a broadly vaginate base. Seta terminal, pale, erect from an abruptly geniculate base, up to 2 mm. long, becoming reddish with age; capsule erect when young, inclined to horizontal when older, ovoid-cylindric, urn 0.5 to 0.6 mm. long; peristome teeth reddish, the divisions papillose and spirally thickened; lid conic-rostrate, erect or oblique, about as long as the urn, calyptra cucullate; spores pale, smooth, 10 to 12 μ in diameter.

Damp stones and bases of trees, in shady places. Oahu: east side of Manoa Valley (Bartram); Pupukea-Kahuku trail (Bartram); Waikane-Schofield trail, Koolau Range (Bartram); upper slopes of Tantalus (Bartram). Maui: along water courses of western Maui (Baldwin, type); damp rocks near Kailua (Bartram). Kauai: Haena caves (Bartram).

Endemic. Type locality, eastern Maui.

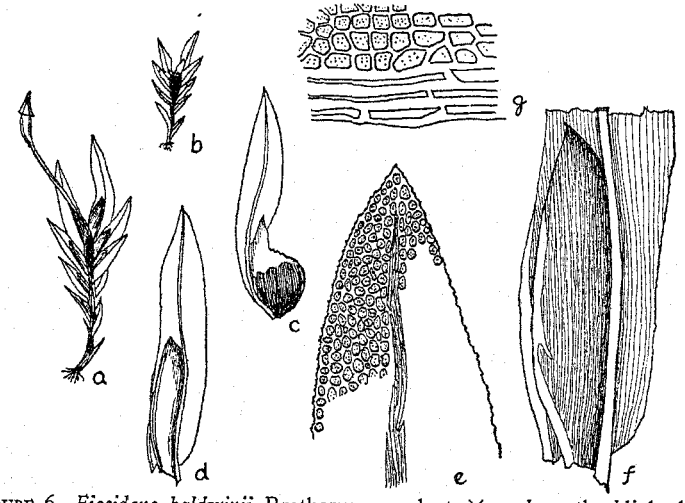


FIGURE 6. *Fissidens baldwinii* Brotherus: *a*, plant × 9; *b*, antheridial plant × 9; *c*, perigonial leaf × 25½; *d*, stem leaf × 25½; *e*, apex of leaf × 360; *f*, lower half of leaf × 60; *g*, basal margin of duplicate blade × 360.

Rather variable in size and number of leaves but easily recognizable by the bordered duplicate blades and the unbordered apical and dorsal blades.

4 **Fissidens delicatulus** Ångström, Öfv. K. Vet. Akad. Förh., no. 4, p. 20, 1872 (fig. 7).

Autoicous, male buds in the axils of the stem leaves. Gregarious, rather rigid plants, yellowish green above, brown below. Stems simple or branched, erect or ascending, radiculose at base, up to 12 or 14 mm. high, with 12 to 20 pairs of leaves, about 3 mm. wide with leaves. Leaves crowded, overlapping, regularly arched with decurved

points giving the plants a fanlike aspect when dry, more rigidly erect-spreading when moist, rapidly decreasing in size toward the base, ligulate, obtuse, not bordered, up to 3 mm. long by 0.4 mm. wide, duplicate blades extending beyond mid-leaf, dorsal blades ending abruptly just above the leaf insertion, margin minutely serrulate; costa pale, ending 10 or 12 cells below the apex; leaf cells incrassate, rounded-hexagonal, about 5 μ in diameter, smaller toward the margins and larger next to the costa, perichaetial leaves not differentiated. Seta terminal, erect, pale, about 3 mm. long; capsule erect, oblong, urn 1 mm. long; peristome bright red, divisions papillose and spirally thickened; lid rostrate, erect, as long as the urn or longer; calyptra mitriform, slightly scabrous, lacerate at the base; spores pale, smooth, 12 μ in diameter.

Wet, shaded vertical rock faces. Oahu: Waikane-Schofield trail, Koolau Range, altitude 1,500 feet (Bartram); Pupukea-Kahuku trail, altitude 1,000 feet (Bartram). Maui: Iao Valley, altitude 1,200 feet (Bartram); Honokohau ditch trail, western part of island (Bartram). Lanai: (Forbes).

Endemic. Type locality, Hawaii.

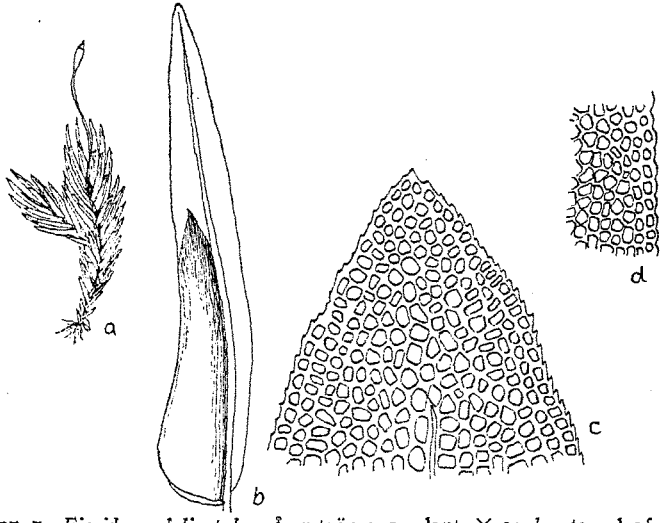


FIGURE 7. *Fissidens delicatulus* Ångström: *a*, plant × 3; *b*, stem leaf × 25½; *c*, apex of leaf × 360; *d*, basal margin of duplicate blade × 360.

Very distinct in the narrow, unbordered leaves with the costa ending well below the rounded apex. The fanlike habit with the arched, overlapping leaves gives the plants a neat and unmistakably characteristic appearance.

The species was described from a sterile collection. The sporophyte characters are described here for the first time.

5. Fissidens pacificus Ångström, Öfv. K. Vet. Akad. Förh., no. 4, p. 21, 1872 (fig. 8).

More robust than *F. mauiensis*, yellowish green above, brown below. Stems simple, up to 6 cm. long, about 5 mm. wide with leaves. Leaves crowded, frequently more or

less falcate or with the tips curved when dry, erect-spreading when moist, oblong-lingulate, 3.5 mm. long and 0.6 to 0.7 mm. wide, acute, duplicate blades extending beyond mid-leaf, dorsal blade tapering slightly downward, broad at the leaf insertion and slightly decurrent; costa strong, brownish, a little flexuose above, ending just below the apex; margins irregularly serrate toward the apex, serrulate or crenulate below; cells of the apical and dorsal blades irregularly hexagonal, incrassate, slightly tumid, 7 to 10 μ in diameter, 5 or 6 rows at the edges paler and slightly larger forming an indistinct pellucid marginal band; cells of the duplicate blade similar but flat and sharply defined, somewhat larger and more pellucid toward the edges. Fruit and inflorescence unknown.

Oahu: Honolulu (Andersson, type); (Baldwin, number 210); Nuuanu Pali (Degener). Maui: valleys in western part, altitude 800 feet (Baldwin).

Endemic. Type locality, Honolulu.

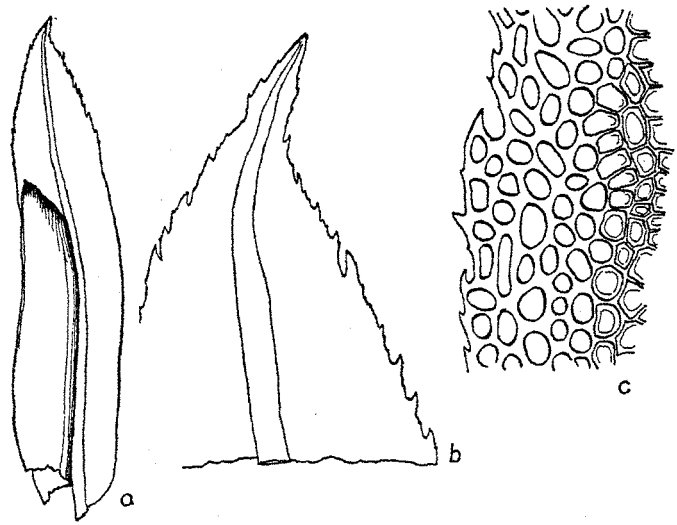


FIGURE 8. *Fissidens pacificus* Ångström: *a*, stem leaf × 18; *b*, apex of leaf × 120; *c*, upper leaf cells and margin × 360.

This species is very close to *F. cristatus* Wilson, a widely distributed moss, and may eventually have to be subordinated to it. The irregularly serrated apical margins will distinguish *F. pacificus* from *F. mauiensis*. Both species are imperfectly known and will remain open to question until the fruiting characters are available.

6. **Fissidens mauiensis** C. Müller, Flora, vol. 82, p. 435, 1896 (fig. 9).
Fissidens alto-gracilis C. Müller, Bull. Herb. Boiss., vol. 5, p. 850, 1897.

Relatively robust plants, yellowish green, scarcely glossy. Stems simple, erect or ascending, up to 2.5 cm. long, radiculose below, 3 to 4 mm. wide with leaves. Leaves well spaced, erect-spreading, crisped and curled at the tips when dry, oblong-lanceolate, acute or short acuminate, 2.5 mm. long by 0.6 mm. wide, duplicate blades barely extending to mid-leaf, dorsal blade ending abruptly in a rounded lobe at or just above the leaf

insertion; costa pale, percurrent, slightly flexuose above; cells of the apical and dorsal blades tumid, rounded-hexagonal, incrassate, 8 to 10 μ in diameter, 3 or 4 rows at the edges paler and pellucid, forming a rather indistinct marginal band; cells of the duplicate blades similar but flat and more distinct, smaller toward the edges; margins serrulate all around. Fruit and inflorescence unknown.

Maui: rocks in ravines, Haleakala, altitude 8,000 feet (Baldwin). Endemic. Type locality, Haleakala.

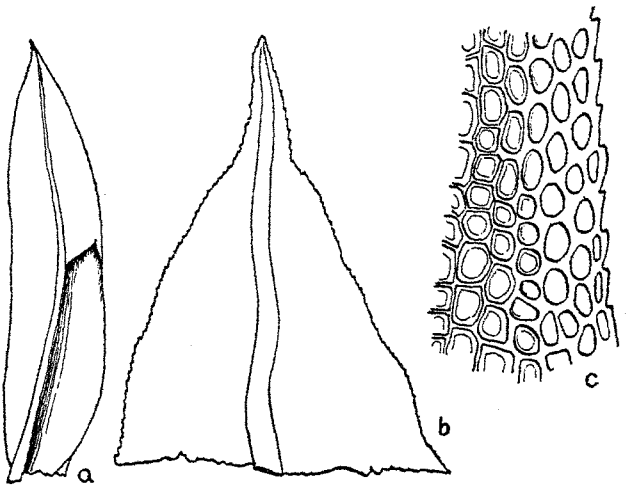


FIGURE 9. *Fissidens mauiensis* C. Müller: *a*, leaf × 18; *b*, apex of leaf × 120; *c*, upper leaf cells and margin × 360.

The robust habit and the leaves bordered with a paler band of short cells will immediately separate this and the preceding species from the other Hawaiian species. The few plants from the type collection of *F. alto-gracilis* which I have seen are inseparable from *F. mauiensis*.

FAMILY 2. DITRICHACEAE

Small plants in rather dense tufts or patches. Stems erect, branched. Leaves small, crowded, lanceolate; margin slightly revolute below, toothed toward the apex; costa percurrent or excurrent; cells smooth, rectangular toward the base, alar cells not differentiated, sub-quadrate above. Seta erect, reddish; capsule erect or inclined, often furrowed when dry; peristome simple, reddish, of 16 teeth from a short basal membrane, bifid nearly to the base; lid conic; annulus large; spores small.

Leaves glaucous, with a granular, waxy bloom, teeth irregularly split.....**5. Saelania**
Leaves not glaucous, teeth regularly bifid.....**4. Ceratodon**

4. CERATODON Bridel, Bryol. Univ., vol. 1, p. 480, 1826.

Plants caespitose, dull green, not glossy. Stems erect, not branched, radiculose below. Leaves small, crowded, ovate-lanceolate, acuminate; costa strong, percurrent or excurrent; cells smooth. Capsule exserted on a slender seta, inclined or horizontal, slightly strumose at base, sulcate when dry; peristome single, from a short basal membrane, teeth 16, bifid nearly to the base, nodose, bordered below by the wider and paler inner plates.

1. **Ceratodon purpureus** Bridel, Bryol. Univ., vol. 1, p. 480, 1826 (fig. 10).
Mnium purpureum Linnaeus, Sp. Pl. p. 1111, 1753.
Ceratodon microcarpus C. Müller, Flora, vol. 82, p. 449, 1896.

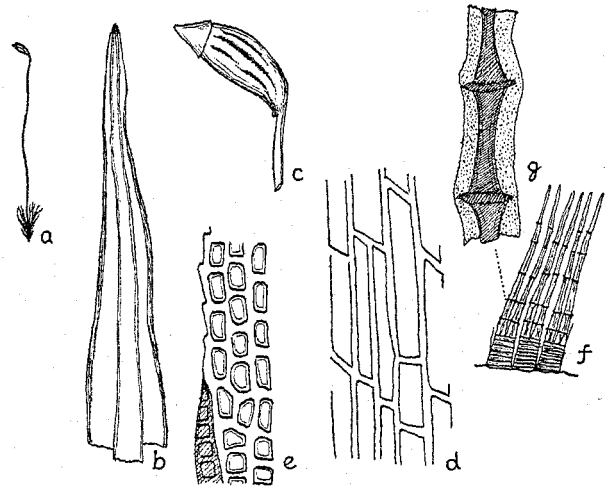


FIGURE 10. *Ceratodon purpureus* Bridel: *a*, plant × 1½; *b*, leaf × 25½; *c*, capsule × 9; *d*, basal cells × 360; *e*, leaf cells and margin near apex × 360; *f*, part of peristome × 120; *g*, part of peristome tooth from dorsal side × 360.

Dioicous. Small plants in dense or lax dull fulvous green patches. Stems erect, branched, usually 5 to 10 mm. high but frequently higher, radiculose below. Leaves rather crowded, appressed and slightly curved and twisted when dry, erect-spreading when moist, ovate to linear-lanceolate, concave, 1 to 1.5 mm. long; margin plane and denticulate for a short distance below the apex, then revolute to the base; costa percurrent or slightly excurrent; upper leaf cells rounded-quadrate, incrassate, distinct, toward the base rectangular, more elongated near the costa and shorter toward the margins; perichaetial leaves sheathing, longer than the stem leaves. Seta purplish, or more rarely yellowish, erect, 10 to 15 mm. long; capsule inclined, ovoid, glossy, reddish brown, about 1.5 mm. long, when dry and empty curved, cylindric, sulcate, minutely strumose at base; peristome teeth reddish, papillose, incurved when dry, cleft nearly to the base into two equal, filiform forks bordered below by the projecting plates of the inner surface; annulus large; lid conic, about 0.5 mm. long.

Shaded rocks and peaty banks. Maui: rocks below Rest House, Haleakala (St. John); Ukulele, Haleakala (Forbes). Island of Hawaii: military reservation, Kilauea (Bartram); Bird Park, Kilauea (Bartram); lava ledges, Kipuka Neenee (Bartram).

Cosmopolitan. Type locality, Europe.

Easily recognized when in fruit by the curved, glossy brown, sulcate capsules. The sub-quadrate pellucid leaf cells and the revolute margins becoming plane and denticulate just below the apex are constant and familiar characters which, in spite of considerable variation in habit and color, will serve to identify the species without any difficulty. In the Hawaiian islands *C. purpureus* appears to be confined to the more temperate mountain regions of Maui and Hawaii at elevations of more than 4,000 feet.

5. SAELANIA Lindberg, Utkast, p. 35, 1878.

Small plants with branched stems. Leaves linear-lanceolate, glaucous on the back with a granular, waxy bloom; costa percurrent or excurrent. Capsule oblong-cylindric, erect, slightly furrowed when dry; peristome teeth 16, irregularly split to the base into two narrow papillose divisions, united here and there above.

1. **Saelania glaucescens** (Hedwig) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 300, 1901 (fig. 11).
   Trichostomum glaucescens Hedwig, Sp. Musc., p. 112, 1801.
   Byrum glaucescens Dickson, Crypt., fasc. 4, p. 10, 1801.
   Leptotrichum subglaucescens C. Müller, Flora, vol. 82, p. 445, 1896.

Autoicous. Small, densely tufted plants of a glaucous blue-green color due to a granular bloom on the back of the leaves. Stems erect, branched, up to 1.5 cm. high. Lower leaves small, the upper larger, crowded in a comal tuft, appressed and slightly twisted when dry, erect-spreading when moist, linear-lanceolate from an oblong base, up to 2 mm. long by 0.35 mm. wide below, carinate; margin erect or narrowly recurved near mid-leaf, entire below, bluntly serrate above, the teeth frequently in pairs; costa yellowish, percurrent or slightly excurrent; leaf cells rectangular, smooth, the upper about 7 μ wide and 1.5 to 3 times as long, gradually longer toward the base, in the lower leaves shorter and sub-quadrate throughout. Seta erect, 6 to 9 mm. long; capsule erect, oblong-cylindric, brown, slightly sulcate when dry and empty, urn 1.5 mm. long; peristome teeth purplish, split to the base into two slender, more or less united forks, densely papillose; annulus wide, persistent; lid conic, 0.6 mm. long.

On earth in rock crevices. Maui: ravines, eastern part, altitude 8,500 feet (Baldwin); crater of Haleakala (Degener).

Distribution: Europe, Asia, North America, South Africa, New Zealand. Type locality, Europe.

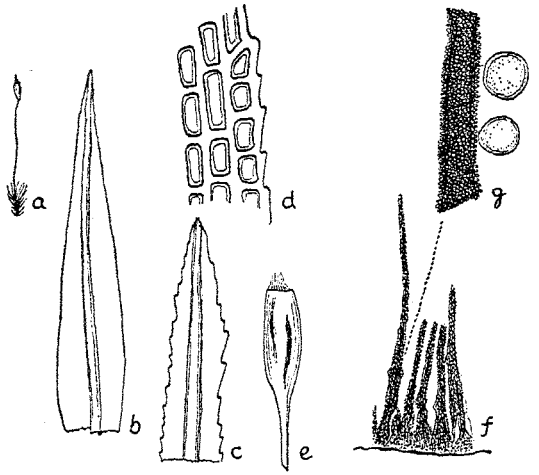


FIGURE 11. *Saelania glaucescens* (Hedwig) Brotherus: *a*, plant × 1½; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 9; *f*, part of peristome × 120; *g*, part of peristome tooth × 360.

The evanescent granular bloom gives this species a peculiar bluish-green color that is at once distinctive. It is apparently a rare moss in Hawaii, as elsewhere, and confined to rock crevices around the rim and within the crater of Haleakala.

FAMILY 3. DICRANACEAE

Large to small plants with dichotomously branched stems. Leaves usually long acuminate, linear-lanceolate to broadly lanceolate, erect, secund or crispate; costa usually stout and percurrent or excurrent; basal cells rectangular, often pitted, alar group frequently strongly differentiated, upper cells small, sub-quadrate or rarely linear. Seta elongate (except *Amphidium*), straight or cygneous; capsule oval or cylindrical, furrowed or smooth, sometimes strumose, erect, or curved and asymmetrical; peristome single, of 16 reddish teeth, divided to the middle or below into two lanceolate or subulate forks, usually vertically and obliquely striate below on the outer surface, papillose at the tips, strongly trabeculate on the inner surface.

1. Seta very short, capsule barely exserted above the tips of the perichaetial leaves ..... **11. Amphidium**
   Seta elongate, capsule long exserted 2
2. Alar cells strongly differentiated 3
   Alar cells not or scarcely differentiated 8
3. Costa broad, seta cygneous or geniculate when moist 4
   Costa narrow, seta erect or flexuose 5

4. Cells of the upper lamina narrowly linear, 8 to 12 times as long as wide..... **10. Dicranodontium**
   Cells of the upper lamina oval and rhomboidal, shorter..... **9. Campylopus**
5. Leaves with a hyaline border of linear cells..... **16. Leucoloma**
   Leaves without a hyaline border..... 6
6. Slender plants, stems neither tomentose nor radiculose..... **15. Dicranoloma**
   Coarser plants with densely tomentose stems..... 7
7. Peristome teeth papillose, perichaetial leaves with long setaceous points..... **13. Holomitrium**
   Peristome teeth striate, perichaetial leaves with shorter points..... **14. Dicranum**
8. Seta stout, cygneous when moist..... **8. Campylopodium**
   Seta slender, erect..... 9
9. Capsule with a long tapering neck twice as long as the urn..... **6. Trematodon**
   Capsule without a long neck..... 10
10. Leaves very crispate when dry..... **12. Dicranoweisia**
    Leaves erect or secund, not crispate..... **7. Dicranella**

6. TREMATODON Michaux, Fl. Bor. Am., vol. 2, p. 289, 1803.

Small gregarious plants. Leaves abruptly narrowed from an ovate, concave base to a slender, flexuose point; costa ending just below the blunt toothed apex; cells smooth, rectangular at the base, sub-quadrate above. Seta elongate, slender, flexuose; capsule curved, with a long slender neck about twice as long as the urn; peristome single, of 16 long, irregularly perforated teeth, vertically striate below on the outer surface, papillose on the edges, the inner surface and at the tips. Spores large.

1. **Trematodon latinervis** C. Müller, Flora, vol. 82, p. 445, 1896 (fig. 12).
   Trematodon squarrulosus C. Müller, Flora, vol. 82, p. 478, 1896.

Autoicous. Small, gregarious plants, pale yellowish green. Stems of the fertile plants 2 to 3 mm. high. Leaves variously flexuose-spreading, from an ovate or oblong-ovate, concave base abruptly narrowed to a linear, channeled, flexuose point about 1.5 times as long as the basal portion, obtuse, 1.2 mm. long by 0.4 mm. wide; margins entire except at the toothed apex, erect below, irregularly recurved above; costa broad and not sharply defined in the leaf base, up to 90 μ wide, ending just below the blunt, toothed apex; lower cells narrowly rectangular with firm, pellucid walls, 10 to 12 μ wide and 5 to 8 times as long, upper cells quadrate or short rectangular, 5 to 7 μ wide and 6 to 15 μ long. Perichaetial leaves 2 to 3 mm. long with a longer sheathing base; seta yellowish becoming reddish with age, flexuose, about 15 mm. long; capsule, including the neck, 5 to 6 mm. long, horizontal, urn about 2 mm. long, oblong-cylindric, brown, neck 4 mm. long, yellowish, tapering to the seta, with a distinct struma at the base; peristome from a low, slightly exserted basal membrane, the teeth up to 450 μ high, irregularly perforated with long, narrow apertures extending nearly to the base, with 8 to 10 coarse, reddish brown, vertical striae below, coarsely papillose on the margins, paler and papillose at the tips; annulus large; calyptra slightly scabrous at the tip, entire at base; lid conic-rostrate, 1 mm. long; spores coarsely papillose, 20 to 22 μ in diameter.

Shaded banks. Oahu: Waikane-Schofield trail, Koolau Range, altitude 1,500 feet (Bartram); Manoa trail, Tantalus (Forbes). Molokai: Deer trail, Waikapu (Forbes). Island of Hawaii: shaded banks and edges of

steam fissures, vicinity of Kilauea (Bartram; Skottsberg). Kauai: Hii Mountains (Forbes).

Endemic. Type locality, Hawaii.

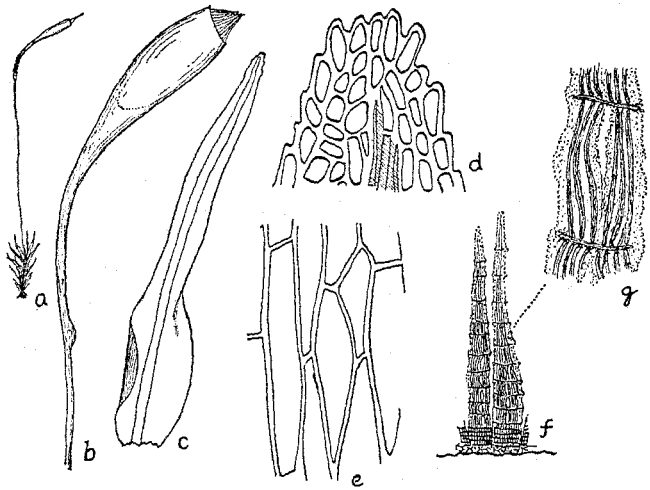


FIGURE 12. *Trematodon latinervis* C. Müller: *a*, plant × 1½; *b*, capsule × 9; *c*, leaf × 25½; *d*, apex of leaf × 360; *e*, basal leaf cells × 360; *f*, part of peristome × 60; *g*, part of peristome tooth, × 360.

Admitting a certain amount of variation in the position of the leaves, which is a rather unstable character in this group, I cannot see how *T. squarrulosus* can be satisfactorily separated from this species.

The peculiar long, spongy neck of the capsule is a salient character and serves as a ready mark of identification, as the fruit is produced abundantly.

7. DICRANELLA Schimper, Coroll. Bryol. Eur., p. 13, 1855.

Small plants in dense tufts or mats. Stems erect, simple or branched. Leaves abruptly narrowed from an ovate, concave base to a linear or subulate point; costa stout, percurrent or excurrent; cells smooth, more or less incrassate, narrowly rectangular at base, sub-quadrate above. Seta erect, slender, flexuose; capsule erect or nearly so; peristome single, of 16 reddish teeth, divided to about the middle into papillose forks, or irregularly cleft, papillose-striate or merely papillose on the outer surface.

1. Peristome teeth coarsely papillose, not striate.....**5. D. integrifolia**
   Peristome teeth vertically papillose-striate.....2
2. Leaves erect and rigid.....**4. D. rigidula**
   Leaves with flexuose-spreading or falcate-secund points.....3
3. Peristome teeth less than 200 μ high.....**3. D. hillebrandi**
   Peristome teeth 250 μ or more high.....4

4. Stems 3 to 4 cm. high, leaves 4 to 5 mm. long, widely spreading.....1. **D. hawaiica**
   Stems about 1 cm. high, leaves up to 2.5 mm. long, falcate-secund..2. **D. hochreutineri**

1. **Dicranella hawaiica** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 310, 1901 (fig. 13).
   Ångströmia hawaiica C. Müller, Flora, vol. 82, p. 446, 1896.

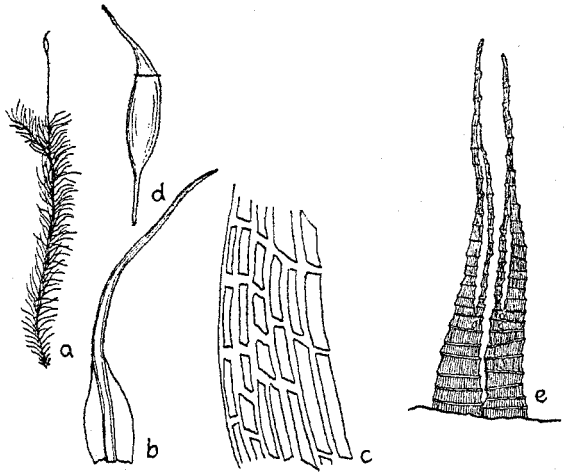


FIGURE 13. *Dicranella hawaiica* (C. Müller) Brotherus: *a*, plant × 1½; *b*, stem leaf × 13½; *c*, cells and margin at leaf shoulder × 360; *d*, capsule × 9; *e*, 2 peristome teeth × 120.

Dioicous, male flower terminal, often appearing lateral by an innovation from just below the perigonium; archegonia numerous with abundant filiform paraphyses, inclosed by 6 to 8 bracts, deeply concave-clasping at the base, abruptly contracted to long, flexuose, entire, subulate points. Slender, densely tufted plants, olive-green above, brown below, slightly glossy. Stems simple or with few innovations, erect, flexuose, up to 3 cm. high, radiculose near the base but readily separating. Leaves up to 5 mm. long but frequently shorter, distant, widely spreading or more or less secund, from a short, erect, oblong, sub-clasping base abruptly narrowed to a long, widely spreading, flexuose, subulate point composed almost entirely of the excurrent costa; margin plane, entire; costa yellowish, strong, up to 130 μ wide near the base, excurrent in a long fleuxuose or decurved point, the lamina decurrent upward for a short distance above the leaf shoulders; cells of the leaf base narrowly rectangular and linear, smooth, very incrassate, shorter and sub-rectangular at the margin near the leaf shoulder and in the upwardly decurrent lamina. Perichaetial leaves more sheathing at the base; seta slender, erect, slightly flexuose, pale yellow, 6 to 8 mm. long, capsule erect or very slightly inclined, cylindric, brown, urn 1 to 1.5 mm. long, stomata none; peristome teeth pale red, 250 to 350 μ high, vertically papillose-striate on the outer surface, cleft to about the middle into two sub-equal forks with pale tips; lid oblique, long rostrate from a conic base, about 1 mm. long; annulus large; calyptra cucullate, extending about halfway down the urn; spores minutely papillose, 18 to 24 μ in diameter.

Damp banks. Molokai: Papaali Pali (Degener and Weibke). Maui: ravines, western part (Baldwin); trail to Nakalalua, western part of island

(Bartram); Ditch trail northeast of Olinda (Degener and Weibke); near Kailua (Bartram).

Endemic. Type locality, Hawaii.

Most likely to be confused with *Campylopodium euphorocladum,* to which it bears a close resemblance in vegetative features. When in fruit the slender, erect seta of *D. hawaiica* will establish its identity at once. Sterile plants are more difficult to separate from *C. euphorocladum* but may usually be recognized by the very strong, clearly defined costa and the relatively shorter areolation of the leaf base.

Dicranella hawaiica variety **tomentella,** new variety.

Caespites compacti, caules parallelo-appressi, dense fusco-tomentosi, arcte adherentes.

Plants with the characters of the species but in very dense, compact tufts, very tomentose below, matted together for the greater part of their length.

Oahu: east rim, Nuuanu Valley (Degener); Castle trail, Pauoa Flats to Konahuanui (Forbes). Maui: wet vertical bank near Huelo, eastern part of island (Bartram, type); Ukulele, Haleakala (Forbes).

The variety *tomentella* is a well-marked form growing on very wet, dripping banks, with the stems closely matted together with reddish brown tomentum.

2. **Dicranella hochreutineri** Cardot, Ann. Conserv. Jard. Bot. Genève, vol. 15, p. 158, 1912 (fig. 14).

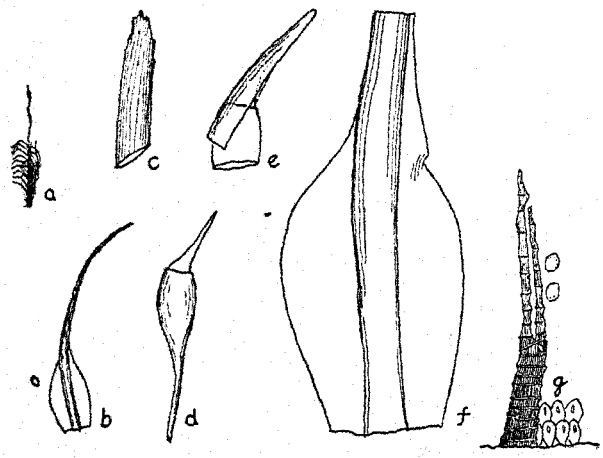


FIGURE 14. *Dicranella hochreutineri* Cardot: *a*, plant × 1½; *b*, leaf × 13½; *c*, apex of leaf × 120; *d*, capsule × 9; *e*, calyptra × 13½; *f*, leaf base × 60; *g*, peristome tooth × 120.

Dioicous. Usually in dense tufts, bright green or yellowish green above, brown below. Stems erect, simple or branched, up to 1 cm. high, radiculose below. Leaves rather crowded, erect, flexuose, usually falcate-secund, from an ovate, concave base abruptly narrowed to a flexuose, grooved point, 2 to 3 times as long as the basal portion, sub-obtuse and bluntly denticulate at the apex, up to 2.5 mm. long by 0.4 mm. wide; margin erect, entire below the denticulate point; costa strong, yellowish, up to 120 μ wide near the leaf shoulder, excurrent, occupying nearly all of the leaf point; basal cells narrowly rectangular with firm, pellucid walls, linear at the margins, becoming short-linear and strongly incrassate upwards, in the narrow lamina above the leaf shoulders quadrate or short-rectangular. Perichaetial leaves from a sheathing, laxly areolate base abruptly contracted to a long, flexuose, subulate point, entire except for a few blunt teeth at the extreme apex, costa narrower than in the stem leaves; seta yellowish, 5 to 7 mm. long; capsule erect, oblong-cylindric, brown when young, becoming blackish with age, urn about 1.25 mm. long; peristome teeth up to 350 μ long, usually split to about the middle into two more or less connected forks, reddish below, paler at the tips, vertically papillose-striate on the outer surface; lid conic-rostrate, as long as the urn; annulus broad, usually of two rows of cells; calyptra extending about halfway down the urn; spores papillose, 20 to 24 μ in diameter.

Damp banks and wet rocks. Common on all the larger islands.

Endemic. Type locality, Kauai.

The shorter stems, smaller, more crowded, and less widely spreading leaves are, in reality, all that distinguish this species from *D. hawaiica*. Intermediate forms of varying degrees of luxuriance are not uncommon and in the absence of any clear structural differences it is often difficult to decide where one species ends and the other begins. The extreme forms of both species differ so widely in size and habit, however, that it seems the better plan to keep them separate, for the present, at least.

3. **Dicranella hillebrandi** (C. Müller) Brotherus, Soc. Bot. Ital. Bull., p. 16, 1904 (fig. 15).

Ångströmia Hillebrandi C. Müller, Flora, vol. 82, p. 446, 1896.

Dioicous. Low, inconspicuous plants in dense tufts, dull yellowish green above, dark brown below. Stems 10 to 12 mm. high, erect, rather rigid, simple or with few innovations. Leaves erect-spreading with rather flexuose points, 1.5 to 2 mm. long, from a short, oblong, partly sheathing base, rather gradually narrowed to a more or less flexuose, subulate point; margin plane, entire; costa strong, about 90μ wide below, excurrent in a flexuose, entire point with the lamina decurrent upward for some distance above the leaf shoulders; cells of the leaf base linear and linear-rhomboidal, incrassate, becoming shorter at the margins toward the leaf shoulders and in the upwardly decurrent lamina. Perichaetial leaves up to 2.5 mm. long, with longer, more gradually narrowed and more flexuose points than the stem leaves. Seta slender, yellowish, erect, about 5 mm. long; capsule narrowly cylindric, erect, about 1 mm. long, brown becoming black with age; peristome teeth about 150 μ high, reddish brown, irregularly cleft to below the middle into two united, coarsely papillose forks, vertically papillose-striate below on the outer surface; lid oblique, conic-rostrate; annulus large; calyptra extending halfway down the urn; spores brown, papillose, 20 to 24 μ in diameter.

Damp banks. Molokai; settlement trail (Forbes); deer trail, Waikapu (Forbes).

Endemic. Type locality, Hawaii.

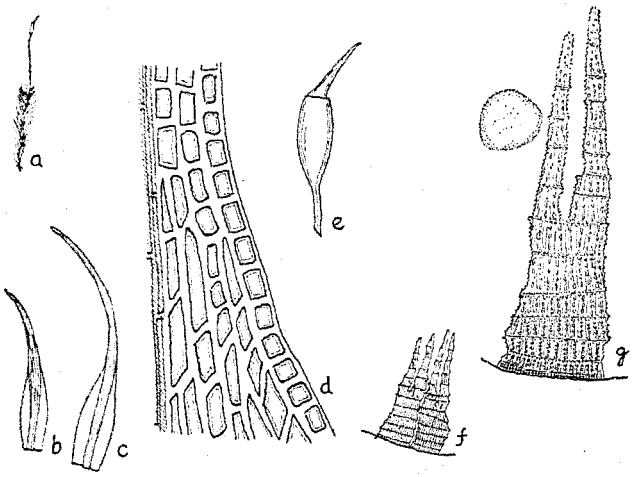


FIGURE 15. *Dicranella hillebrandi* (C. Müller) Brotherus: *a*, plant × 1½; *b*, lower stem leaf × 13½; *c*, upper stem leaf × 13½; *d*, cells and margin near leaf shoulder × 360; *e*, capsule × 9; *f*, part of peristome × 120; *g*, peristome tooth × 360.

A rather puzzling species differing from *D. hochreutineri* in the shorter, irregularly cleft peristome teeth and from *D. rigidula* in the more flexuose-spreading leaf points.

4. Dicranella rigidula, new species (fig. 16).

Dicranella rigida Bartram, in herbaria.

Tenellus, rigidus, caespites densi, fuscenti-viridi. Caulis simplex, erectus, ad 5 mm. longus, haud radiculosus. Folia adpressa, rigida, ovato-lanceolata, ad 1.5 mm. longa, sensim in subulam brevissime attenuata; nervo lato, subulam superiorem ex toto occupante; cellulis superioribus rectangularibus dein sensim longioribus. Seta ad 3 mm. alta, erecta, minuta, peristomii dentibus fuscis, papilloso-striatis; operculum oblique rostratum. Sporae papillosi, 20-23 μ.

Dioicous; male inflorescence unknown. Short, strict, slender plants in rather dense tufts, dull olive-green above, brown below. Stems erect, simple, about 5 mm. high, hardly radiculose. Leaves erect, rigid, appressed, rather crowded, the upper about 1.5 mm. long, smaller below, ovate-lanceolate, slightly concave at base, narrowed to a short straight point with the lamina extending nearly to the apex; margin plane and entire; costa strong, yellowish, about 75 μ wide near the base, short excurrent in the lower leaves, rather long excurrent in the larger upper leaves, denticulate at the extreme point; upper leaf cells in longitudinal rows, rectangular with rounded ends, slightly incrassate, about 5 μ wide and 2 to 4 times as long, basal cells narrowly rectangular and linear, pellucid, yellowish toward the insertion. Perichaetial leaves not differentiated. Seta yellowish, 3 mm. long, erect; capsule erect, short ovoid, urn 0.8 mm. long, brown, becoming darker and more cylindric with age; peristome teeth about 120 μ high, light

brown, irregularly cleft, coarsely papillose on the inner surface, faintly vertically papillose-striate on the outer surface; annulus large; lid rostrate, oblique, nearly or quite as long as the urn; calyptra extending fully halfway down the urn; spores yellowish, coarsely papillose, 20 to 23 μ in diameter.

Oahu: Nuuanu Pali (Degener and Shear); central ridge of Niu Valley (Forbes); east side of Manoa Valley (Bartram).

Type: wet rocks, Haena caves, Kauai, altitude 100 feet, February 21, 1930, E. B. Bartram, number 618-a.

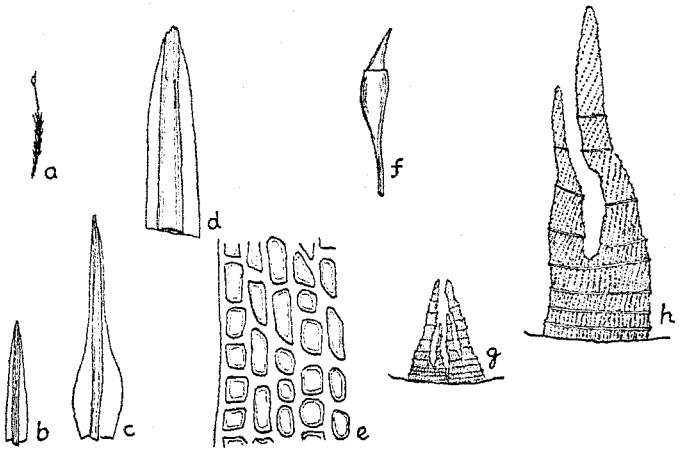


FIGURE 16. *Dicranella rigidula* Bartram: *a*, plant × 1½; *b*, lower leaf × 13½; *c*, upper leaf × 13½; *d*, apex of leaf × 120; *e*, upper leaf cells × 360; *f*, capsule × 9; *g*, part of peristome × 120; *h*, peristome tooth × 360.

The smallest of all the Hawaiian Dicranellas and distinguished by the combination of rigid, erect, appressed leaves and the short, irregularly cleft peristome teeth, striate on the outer surface. *D. integrifolia* also has erect-appressed leaves, but its peristome teeth are coarsely papillose on both surfaces without any vertical striae.

5. Dicranella integrifolia (Brotherus), new combination (fig. 17).
Microdus integrifolius Brotherus, in herbaria.
? *Dicranella integrifolia* Brotherus, Bull. Soc. Bot. Ital., p. 16, 1904.

Dioicous. Slender plants in dense tufts, olive-green or brownish green above, brown below. Stems erect, 5 to 25 mm. high, usually simple, radiculose at base. Leaves erect, slightly flexuose when dry, erect-spreading when moist, from a short, broadly ovate or obovate base abruptly narrowed to a linear, subulate point about 1.5 times as long as the basal portion, apex obtuse with a few short, blunt teeth; margin erect, entire except at the extreme apex; costa up to 90 μ wide below, percurrent, bordered above by the narrow lamina which extends nearly or quite to the apex; basal cells linear near the costa, becoming rectangular toward the margins, incrassate, rather pellucid, gradually

shorter upward, upper laminal cells rectangular, 5 to 7 μ wide, and 4 to 6 times as long. Seta erect, yellowish, 6 to 8 mm. long; capsule erect, ovoid-cylindric, bright brown, urn up to 1.5 mm. long; peristome teeth up to 125 μ high, yellowish, irregularly cleft above, coarsely papillose, not striate; annulus very broad, nearly half the height of the teeth; lid conic-rostrate, slightly oblique, 1 mm. long; calyptra cucullate, extending halfway down the urn; spores papillose, 16 to 20 μ in diameter.

Dry banks. Maui: western part of island, on ground, altitude 3,500 feet (Baldwin, type). Molokai: west of Pepeopae (Degener); south of Kaulahuki (Degener). Island of Hawaii: rock crevices along Wailuku River near Hilo (Bartram); vicinity of Kilauea, frequent (Degener; Bartram).

Endemic. Type locality, western Maui.

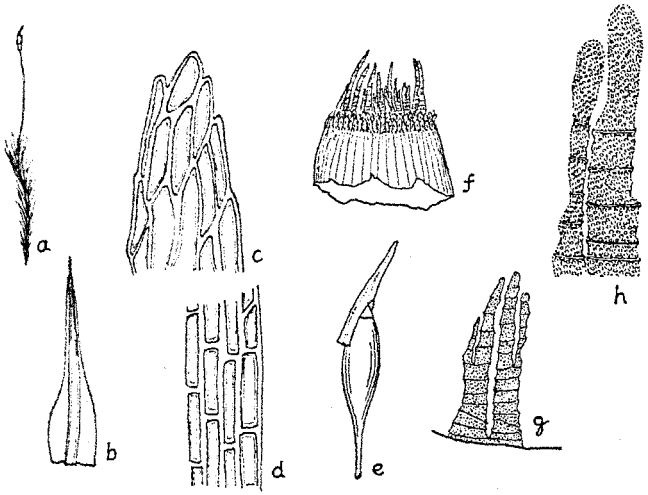


FIGURE 17. *Dicranella integrifolia* (Brotherus) Bartram: *a*, plant × 1½; *b*, leaf × 13½; *c*, apex of leaf × 360; *d*, upper leaf cells × 360; *e*, capsule and calyptra × 9; *f*, mouth of capsule × 52½; *g*, part of peristome × 120; *h*, upper part of peristome tooth × 360.

This species will be known at once by the short, irregularly cleft peristome teeth with the papillae scattered over the surface, not arranged in rows forming vertical striae as in the other local species. It is apparently more common on the island of Hawaii than elsewhere and so far has not been found on either Oahu or Kauai.

8. CAMPYLOPODIUM (C. Müller) Bescherelle, Ann. Sci. Bot. Nat. V., vol. 18, p. 189, 1873.

Ängströmia, section *Campylopodium* C. Müller, Syn., vol. 1, p. 429, 1848.

Small plants growing on wet rocks. Stems laxly erect, radiculose below. Leaves from an oblong, clasping base abruptly narrowed to a long, flexuose,

subulate point; costa long excurrent; cells smooth, linear at base without any distinct alar group, rectangular above. Seta stout, sinuose when dry, cygneous when moist; capsule ovoid, ribbed when dry, minutely strumose; peristome teeth reddish, striate below, cleft to the middle into 2 or 3 pale, papillose forks; lid conic-rostrate.

1. **Campylopodium euphorocladum** (C. Müller) Bescherelle, Fl. Bryol. Nouvelle Caledonie, 5th ser., vol. 18, p. 189, 1873 (fig. 18).
Ångströmia euphoroclada C. Müller, Syn., vol. 1, p. 429, 1849.
Ångströmia microcampylopus C. Müller, Flora, vol. 82, p. 447, 1896.

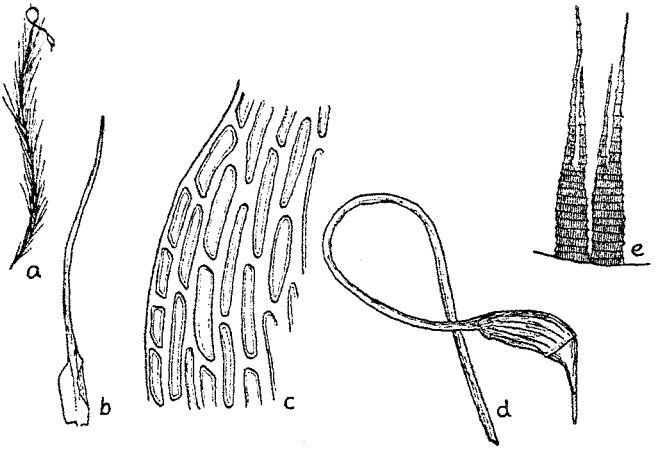


FIGURE 18. *Campylopodium euphorocladum* (C. Müller) Bescherelle: *a*, plant × 1½; *b*, leaf × 13½; *c*, cells and margin near leaf shoulder × 360; *d*, capsule × 9; *e*, part of peristome × 60.

Dioicous; male plants similar to and mixed with the fruiting plants, antheridial flowers terminal, gemmiform. In dense, fulvous green tufts, rather glossy, dark brown below, matted together with red radicles in the older parts. Stems erect or ascending, simple or dichotomously branched, up to 4 or 5 cm. long but often shorter. Leaves from an erect, oblong, clasping base suddenly contracted to a long linear-setaceous point composed almost entirely of the excurrent costa, widely flexuose-spreading when dry, more rigid and erect-spreading when moist, up to 7 mm. long at the tips of the branches, shorter below; margin of the leaf base erect, entire below, irregularly sinuate at the shoulders; costa rather ill-defined, excurrent from just above the leaf shoulder in a long setaceous point, entire or denticulate at the extreme apex; cells of the leaf base linear with thick, yellowish, pellucid walls, shorter and irregular toward the margins at the shoulders. Seta rather thick, about 1 cm. long, very sinuouse when dry, strongly cygneous when moist; capsule ovoid, about 1.4 mm. long, slightly gibbous on the upper side, when dry distinctly ribbed, constricted below the mouth, minutely strumose at base; peristome teeth reddish, vertically striate, cleft to about the middle into 2 or 3 filiform forks with hyaline, papillose tips; lid conic-rostrate, 1 mm. long; calyptra cuculate, not fringed; spores smooth, 12 to 15 μ in diameter.

On wet rocks in mountains. Oahu: Waikane-Schofield trail, Koolau Range (Bartram). Molokai: Waikapu (Forbes). Maui: Honokohau ditch trail, western part of island (Bartram); Kula pipe line trail, eastern part of island (Bartram). Island of Hawaii: without locality (Forbes).

Distribution: East Africa, East Indies, Pacific islands. Type locality, Java.

This moss has the vegetative characters of *Dicranella* with the cygneous seta of *Campylopus*. The narrow costa will at once distinguish it from *Campylopus*, and as the fruit is usually produced in abundance there is ordinarily little difficulty in recognizing it. Barren plants closely resemble *Dicranella hawaiica*. For distinctions between these species refer to the notes under the latter plant.

9. CAMPYLOPUS Bridel, Musc. Recent. Suppl., vol. 4, p. 71, 1819.

Plants variable in size, dioicous, growing in compact tufts. Stems tomentose or radiculose. Leaves crowded, sub-erect with flexuose or secund points; costa broad below, percurrent or excurrent, often ridged or lamellose on the back; basal cells rectangular to linear, often pitted; alar cells usually hyaline or reddish and inflated, forming distinct auricles; upper cells rhomboidal. Seta arcuate or cygneous when moist; capsule small, ovoid, furrowed when dry; peristome teeth divided to or below the middle, vertically striate on the outer surface; annulus large; lid conic-rostrate; calyptra cucullate, often fringed at the base.

1. Upper leaves with distinct hyaline tips.....2
   Upper leaves without hyaline tips.....5
2. Costa smooth or only faintly ribbed on the back.....3
   Costa with serrate lamellae on the back.....4
3. Costa in cross-section with bands of stereid cells on both sides of the median guide row.....**7. C. wheeleri**
   Costa in cross-section with stereid band on the dorsal side only, ventral cells large.....**1. C. skottsbergii**
4. Costa in cross-section with both dorsal and ventral stereid bands, capsule rough at base.....**9. C. umbellatus**
   Costa in cross-section with dorsal stereid band only, capsule not rough at base.....**3. C. introflexus**
5. Leaf base distinctly bordered with a narrow hyaline band of elongated cells.....6
   Leaf base not bordered.....8
6. Leaves about 4 mm. long, not setaceous pointed, costa percurrent.....**4. C. densifolius**
   Leaves 5 to 7 mm. long, setaceous pointed, costa excurrent.....7
7. Leaves crowded, widely spreading.....**5. C. hawaiico-flexuosus**
   Leaves not crowded except in the comose tufts.....**6. C. purpureo-flavescens**
8. Leaves obtuse, often emarginate and erose at the tips.....**10. C. exasperatus**
   Leaves with subulate-acuminate points.....9
9. Costa in cross-section with stereid band on dorsal side only, ventral cells large.....**2. C. fumarioli**
   Costa in cross-section with both dorsal and ventral stereid bands.....**8. C. boswelli**

1. **Campylopus skottsbergii** Brotherus, B. P. Bishop Mus., Bull. 40, p. 6, 1927 (fig. 19).

Autoicous; male flowers unknown. Plants growing in dense deep tufts, yellowish and somewhat glossy above, bright reddish brown below. Stems variable, in the bog forms slender and strict, up to 12 cm. high, in drier locations shorter and more flexuose, simple or with slender strict branches or innovations, reddish tomentose, radiculose below. Leaves rigid, straight, appressed when dry, erect-spreading when moist, 6 to 8 mm. long, lanceolate-subulate, concave, gradually narrowed to a slender, channeled point, often in comose tufts; margin essentially entire; costa up to 330 μ wide below, about two-thirds the width of the leaf base, short excurrent in a smooth or denticulate hyaline point, smooth on the back, in cross-section near mid-leaf showing a layer of large empty cells on the ventral side of the median row, on the dorsal side a stereid band with larger differentiated cells on the outer surface. Basal cells rectangular, up to 15 μ wide toward the costa, gradually becoming linear toward the margins, thin-walled, hyaline or pellucid, obliquely prolonged upward for some distance along the margins of the leaf base, changing rather abruptly to the smaller irregular, rhomboidal, incrassate cells of the upper lamina which is continued along the costa as a very narrow border almost to the base of the short hyaline point; alar cells rather indistinct, hardly forming inflated auricles, pale or hyaline in the younger leaves, brownish with age. Fruit unknown.

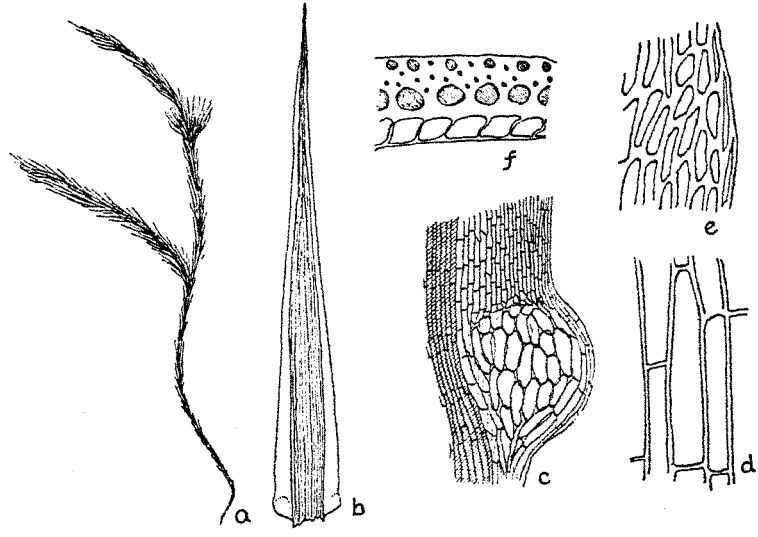


FIGURE 19. *Campylopus skottsbergii* Brotherus: *a*, plant × ¾; *b*, leaf × 9; *c*, one side of leaf base × 60; *d*, basal cells near costa × 360; *e*, upper leaf cells × 360; *f*, part of cross section of costa × 360.

Bogs and damp humus. Oahu: Kipapa, Koolau Range, backbone (Oswald). Maui: top of Puu Kukui, western part of island (Skottsberg, type; St. John); Honokohau drainage basin (Forbes); Ukulele, Haleakala (Forbes).

Endemic. Type locality, summit of Puu Kukui, Maui.

The bog form, from which this species was described, is much more slender and strict than the plants from Ukulele, eastern Maui, but I can find no

structural differences between them. Evidently the bog plants of western Maui have acquired the strict, slender habit from the prevalent excess of moisture as have *C. fumarioli* and the varieties of *Leucobryum hawaiiense* around the edges of steam fissures near Kilauea. The collections from the eastern part of Maui look totally different on account of the shorter stems with darker, more widely spreading leaves.

2. **Campylopus fumarioli** C. Müller, Abh. Nat. Ver. Brem., vol. 16, p. 496, 1900 (fig. 20).

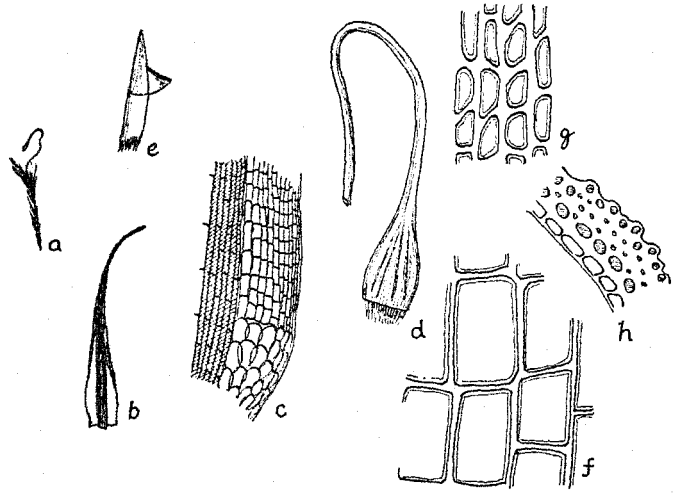


FIGURE 20. *Campylopus fumarioli* C. Müller: *a*, plant × ¾; *b*, leaf × 9; *c*, one side of leaf base × 60; *d*, capsule × 9; *e*, calpytra and lid × 9; *f*, basal cells near costa × 360; *g*, upper leaf cells × 360; *h*, part of cross section of costa × 360.

Dioicous. Slender plants growing in compact tufts or cushions, yellowish above, light brown below. Stems simple, rigid, erect, up to 5 cm. high, red tomentose above, sparingly radiculose below. Upper leaves in dense comose tufts, stem leaves not crowded, erect, rigid, 4 to 6 mm. long, from an ovate-lanceolate, concave base rather quickly narrowed to a long channeled or sub-tubulose, setaceous point; margin denticulate toward the apex, entire below; costa up to 225 μ wide below, occupying about one-third the width of the leaf base, long excurrent in a denticulate, concolorous point, in cross-section showing a row of large empty cells on the ventral surface, a median row of similar but somewhat smaller cells with a band of stereid cells on the dorsal side, the outer layer of which shows larger, differentiated cells. Cells of the leaf base short rectangular with firm, pellucid walls, up to 20 μ wide toward the costa, smaller toward the margins and upward, upper cells narrowly rhomboidal, about 5 μ wide and 3 to 4 times as long, alar cells inflated, forming conspicuous hyaline or reddish brown auricles. Seta flexuose and erect when dry, cygneous when moist; capsule dark brown, symmetrical, sulcate, about 1 mm. long.

Damp banks and around steam fissures. Molokai: mountain ridges, on ground (Baldwin); Pepeopae, on ground in bog (Degener); Deer trail, Waikapu (Forbes). Maui: trail to Nakalalua, on bank (Bartram). Island of Hawaii: vicinity of Kilauea (Bartram); along Wailuku River, Hilo (Bartram).

Endemic. Type locality, Kilauea, island of Hawaii, edge of steam fissure.

This species was described from a sterile collection made in the vicinity of Kilauea, Hawaii, but subsequent specimens, some in fruit, from Hawaii and Molokai indicate that the plant is not uncommon on these islands. The stems, like those of many mosses found around steam vents where there is a continual excess of moisture, tend to elongate and form deep compact tufts of slender, strict, uniformly leaved plants. Under more normal growing conditions the tufts are more dense and the upper leaves crowded in comal tufts; along the stems the leaves are slightly longer and less rigidly erect. The leaves without hyaline hair points, as well as the structure of the costa in cross-section, can be relied upon to separate this species from all but *C. boswelli,* which has long narrow basal leaf cells without any clearly defined auricles.

3. **Campylopus introflexus** (Hedwig) Bridel, Bryol. Univ., vol. 1, p. 472, 1826 (fig. 21).

Dicranum introflexum Hedwig, Sp. Musc., p. 147, 1801.

Campylopus polytrichoides De-Notaris, Syll. Musc., p. 222, 1838.

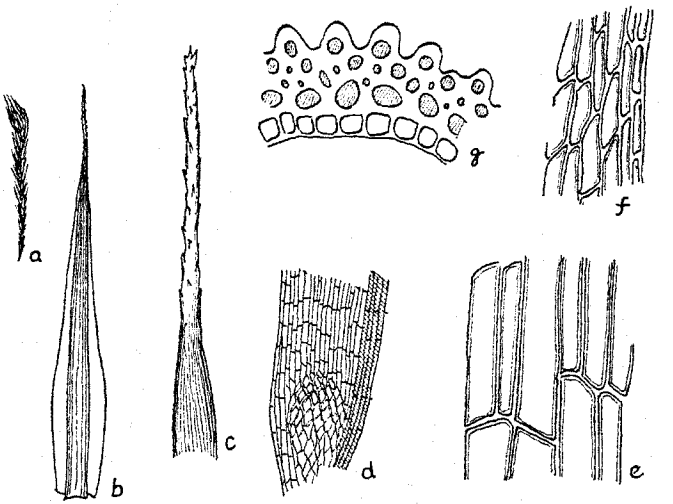


FIGURE 21. *Campylopus introflexus* (Hedwig) Bridel: *a,* plant × ¾; *b,* leaf × 9; *c,* apex of leaf × 60; *d,* one side of leaf base × 60; *e,* basal cells near costa × 360; *f,* upper cells and margin × 360; *g,* part of cross section of costa × 360.

Dioicous. In compact tufts, golden green above, dark brown below. Stems 3 cm. or more high, erect, rigid. Leaves crowded, erect, strict, with slightly flexuose points, 4 to 5 mm. long, from an oblong, concave base gradually lanceolate-subulate, channeled above; margin incurved and obscurely denticulate toward the apex, plane and entire below; costa up to 300 μ wide below, about two-thirds the width of the leaf base, excurrent in a hyaline denticulate point, with numerous parallel ridges 1 or 2 cells high on the back, in cross-section near the middle showing a layer of large empty cells on the ventral surface and a stereid band mixed with larger differentiated cells on the dorsal side of the median row; cells of the leaf base rectangular, thin-walled, narrower toward the margins, changing abruptly in an oblique line to the oblique, oval-rhomboidal cells of the upper lamina, alar cells inconspicuous, not inflated, hyaline or pale brown; setae aggregated; capsule oval, slightly rugose at base, furrowed when dry; calyptra fringed at the base.

On dry peaty banks and ledges. Island of Hawaii: koa forest above Kilauea (Skottsberg); dry bank, military reservation, Kilauea (Bartram); Mount Hualalai, northern Kona (Miss Reed).

Distribution: Europe, North America, South America, New Zealand, Pacific islands. Type locality, New Zealand.

This widely distributed moss is not likely to be confused with any other local species except *C. skottsbergii,* which is a much more robust plant with longer, less conspicuously hyaline-pointed leaves, lacking the alternate furrows and ridges on the back of the costa. Apparently *C. introflexus* is rather rare in the Hawaiian islands. It has not yet been found there in fruit, as far as I know. The costal ridges viewed laterally in profile are frequently serrate on the edges but are best observed in cross-section, where they appear as a series of knob-like elevations, 1 or 2 cells high, across the dorsal surface.

4. **Campylopus densifolius** Ångström, Öfv. K. Vet. Akad. Förh., no. 4, p. 18, 1872 (fig. 22).

Campylopus wawraeanus Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 565, 1877.

Campylopus densiretis Brotherus, Bull. Soc. Bot. Ital., p. 15, 1904.

Dioicous. A variable, rather robust species growing in large, dense cushions, pale or yellowish green above, light brown below. Stems lightly matted together with reddish radicles in the older parts, red tomentose above, erect or ascending, branched, slightly flexuose at the tips, up to 3 or 4 cm. high but frequently shorter. Leaves very crowded, erect-appressed with flexuose points, usually falcate-secund toward the ends when dry, more rigidly erect-spreading when moist, linear-lanceolate, gradually acuminate, channeled above, 4 to 4.5 mm. long by 0.5 mm. wide at base; margin plane, denticulate for a short distance below the apex, entire below; costa about one-half the width of the leaf base, up to 200 μ wide, short excurrent, lightly ridged on the back above and denticulate near the point, in cross-section near mid-leaf showing a median row of about 12 large cells with bands of thick-walled stereid cells on both the dorsal and ventral sides, the outer layer on the dorsal surface differentiated. Leaf cells incrassate, the upper rounded-quadrate or transversely oval, 8 to 10 μ in diameter, alar cells reddish or hyaline, inflated, forming conspicuous auricles extending to the costa, supra-alar cells rectangular, up to 15 μ wide toward the costa, becoming narrower upward, toward the

basal margins very long and narrow forming a distinct hyaline band, 2 or 3 rows wide, extending up the margin almost to mid-leaf. Seta solitary, about 6 mm. long; capsule symmetrical, deeply furrowed when dry, urn 1 mm. long; calyptra fringed at the base with a few short fragile teeth.

Trees and humus in wooded districts. Very common.
Endemic. Type locality, Honolulu.

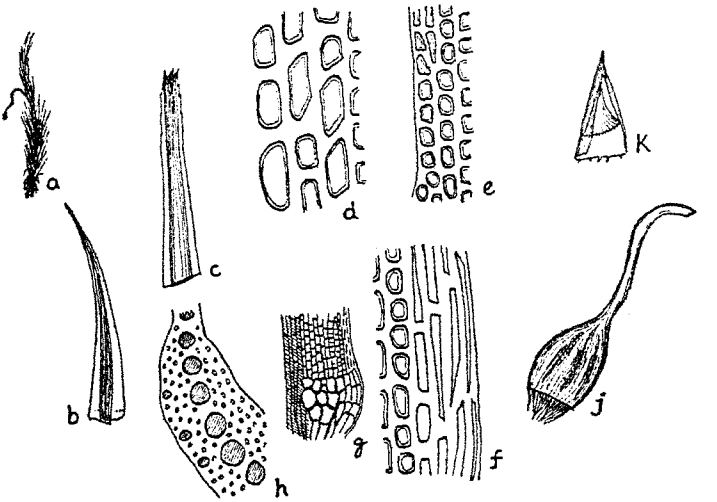


FIGURE 22. *Campylopus densifolius* Ångström: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, basal leaf cells near costa, × 360; *e*, upper leaf cells and margin × 360; *f*, basal cells and margin × 360; *g*, one side of leaf base × 60; *h*, part of cross section of costa × 360; *j*, capsule × 9; *k*, lid and calyptra × 9.

Probably one of the commonest mosses in Hawaii but extremely variable and shading by imperceptible degrees into *C. hawaiico-flexuosus* and *C. purpureo-flavescens*. I have been unable to segregate the form described as variety *falcatus* by Brotherus and believe these larger plants with longer, more setaceous-pointed leaves can safely be combined with *C. hawaiico-flexuosus*. In spite of its variability this species is readily recognized by the dense, rigid, erect leaves with flexuose or subsecund points. In its typical form the leaves are shorter than either of the allies and less regularly falcate-secund.

As noted by Brotherus(2)* these three species form a small but distinct group characterized by the thick-walled rectangular basal leaf cells bordered with a narrow hyaline band of elongated cells extending well up the margin of the leaf. One of the intermediate forms, *C. wawraeanus*, seems to approach *C. densifolius* more closely than *C. hawaiico-flexuosus*.

* Numbers in parentheses refer to Literature Cited, page 263.

5. **Campylopus hawaiico-flexuosus** (C. Müller) Paris, Index Bryol. Suppl., p. 92, 1900 (fig. 23).
Dicranum hawaiico-flexuosum C. Müller, Flora, vol. 82, p. 443, 1896.
Campylopus perangustifolius C. Müller, Flora, vol. 82, p. 479, 1896.

Similar in structural details to *C. densifolius* but more robust, with longer, more flexuosely spreading or falcate-secund leaves. Stems 3 cm. or more high, bright green above, reddish brown below. Leaves crowded, flexuose or falcate-secund, with setaceous points, usually slightly crispate at the tips of the branches, often with capillary, concolorous, or hyaline hair points.

Logs, trees, and turfy banks in damp forests, frequent.
Endemic. Type locality, Hawaii.

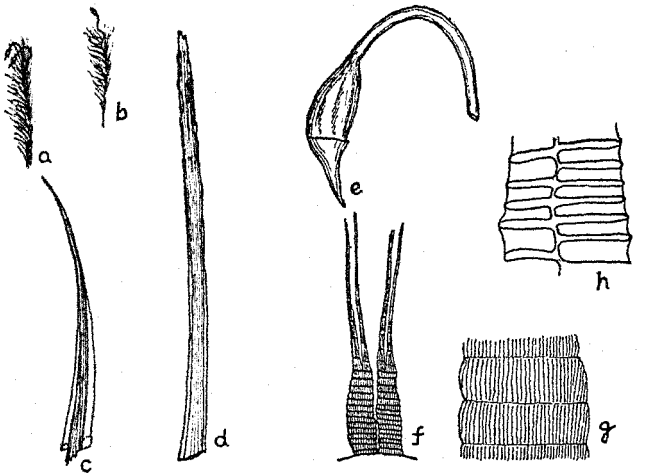


FIGURE 23. *Campylopus hawaiico-flexuosus* (C. Müller) Paris: *a*, moist plant × ¾; *b*, dry plant × ¾; *c*, stem leaf × 9; *d*, apex of leaf × 60; *e*, capsule × 9; *f*, peristome teeth × 60; *g*, part of peristome tooth from dorsal side × 360; *h*, part of peristome tooth from ventral side × 360.

The longer capillary-pointed leaves give this species a rather silky or shaggy appearance that is not shared by typical *C. densifolius*. Furthermore, the leaves are more widely spreading and flexuose when dry, which in connection with the more robust habit gives a certain general appearance that is quite characteristic in the extreme forms.

6. **Campylopus purpureo-flavescens** Hampe, in herbaria (fig. 24).
Dicranum purpureo-flavescens C. Müller, Flora, vol. 82, p. 442, 1896.
? *Dicranum hawaiicum* C. Müller, Flora, vol. 82, p. 441, 1896.

Stems more slender and more elongate than in either of the two preceding species. The leaves are longer and more slenderly pointed than in *C. densifolius*, and less crowded

along the stem but more conspicuously comose than in *C. hawaiico-flexuosus*. The differences between all three species are of degree rather than kind, and there is some evidence that the variations may be due to varying environmental conditions. At any rate, I have found it extremely difficult to separate the forms with any great degree of satisfaction and am tempted to believe that in being accorded specific rank this and the preceding species have been rather generously treated.

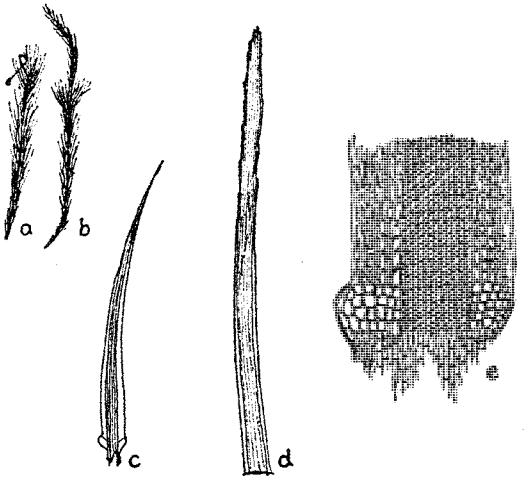


FIGURE 24. *Campylopus purpureo-flavescens* Hampe: *a*, fruiting plant × ¾; *b*, sterile plant × ¾; *c*, stem leaf × 9; *d*, apex of leaf × 60; *e*, leaf base × 60.

7. **Campylopus wheeleri** Hampe, in herbaria (fig. 25).

Dicranum wheeleri C. Müller, Flora, vol. 82, p. 441, 1896.

Dioicous. Slender plants in deep, rather loose tufts, yellowish green above, brown below. Fertile stems flexuose, ascending, with elongate, caudate innovations from just below the comal tufts; sterile stems more slender and uniformly foliose, densely tomentose above, radiculose below. Stem leaves erect-appressed and rather rigid when dry, erect-spreading when moist, 5 to 6 mm. long, linear-lanceolate, finely acuminate, channeled above, slightly hyaline at the tips; comal leaves up to 7 or 8 mm. long with longer, more setaceous hyaline hair points; margin plane, minutely denticulate for a short distance below the apex, entire below; costa broader in proportion to the leaf width than in the three preceding species, up to 300 μ wide below, occupying more than half of the width of the leaf base, percurrent in the stem leaves with the lamina extending nearly or quite to the point, in the comal leaves long excurrent in a smooth or faintly denticulate hyaline hair point, in cross-section with bands of stereid cells on both sides of the median guide row, the surface layer on both the dorsal and ventral sides with larger, differentiated cells. Cells of the leaf base rectangular with thickened pellucid walls, up to 15 μ wide near the costa, much narrower at the margins but not forming a hyaline border; alar cells inflated, hyaline or reddish, forming conspicuous auricles; upper leaf cells rhomboidal, about 6 μ wide. Setae aggregated, erect and flexuose when dry, cygneous when moist; capsule symmetrical or slightly gibbous on the upper side, ovoid-cylindric, 1.5 mm. long, furrowed; calyptra fringed at base.

Trees and peaty banks in wet forests. Maui: mountain ridges, western part of island (Baldwin; Bartram); Honokohau drainage basin (Forbes); Haleakala, along trail below Rest House (St. John); Kula pipe line trail, on log (Bartram). Kauai: Waineke swamp (Degener and Weibke); vicinity of Kokee, wooded bank (Bartram).

Endemic. Type locality, Hawaii.

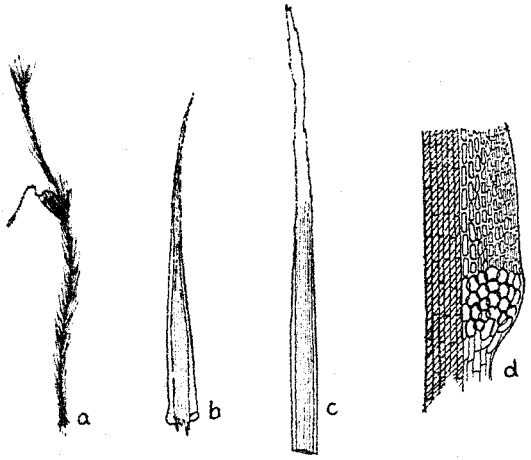


FIGURE 25. *Campylopus wheeleri* Hampe: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, one side of leaf base × 60.

Although this species is closely allied to the *C. densifolius* group, the distinguishing characters comprised by the sub-comal innovations, by the hyaline hair-pointed leaves, and especially by the absence of a hyaline border to the leaf base, establish its identity without much question.

8. Campylopus boswelli Hampe, in herbaria (fig. 26).

Dicranum Boswelli C. Müller, Flora, vol. 82, p. 442, 1896.

Dioicous; male flowers gemmiform, terminal on short, slender, simple stems; antheridia numerous with abundant pale filiform paraphyses, inclosed by 5 or 6 perigonial leaves which are abruptly setaceous-pointed from a broadly obovate, concave, clasping, chestnut-brown base. Slender plants in rather dense tufts, dull, sordid green tinged with brown. Stems erect, up to 4 cm. high, simple, numerous flexuose, uniformly leaved sterile plants mixed with the more rigid fruiting ones, which are comose at the tips, slightly tomentose, but not radiculose. Upper leaves of the fertile plants crowded in dense comal tufts, ending in long denticulate, setaceous points, not or scarcely hyaline at the tips; stem leaves and leaves of the sterile plants erect and appressed with rigid, slightly spreading points, 6 to 7 mm. long, from an oblong, slightly concave base gradually narrowed to a channeled, setaceous, concolorous point; margin plane, denticulate at the extreme apex, entire below; costa up to 300 μ wide below, occupying about one-half of the width of the leaf base, excurrent, denticulate on the back at the point, slightly ridged on the back, in cross-section near the base showing a distinct stereid band on the dorsal side of the

median guide row with the outer layer of cells scarcely differentiated, on the ventral side a thin stereid band covered with a surface layer of much larger, empty cells, larger even than the median row, in the upper part of the leaf showing thick stereid bands on both sides of the median row slightly differentiated by a mixture of somewhat larger, opaque cells on both surfaces. Cells of the leaf base rectangular, lax, with thin delicate walls, up to 20 μ wide toward the costa, much narrower at the margins but not forming a border; alar cells pale and fragile, indistinct or wanting, rarely well marked; upper cells oval-rhomboidal, oblique, incrassate. Setae aggregated, very flexuose and cygneous both wet and dry; capsule brown, symmetrical or slightly gibbous on the upper side, about 1 mm. long, lightly furrowed; lid rostrate, oblique, reddish; calyptra brownish, strongly fringed at base.

Wet turfy banks. Molokai: along Paapala Pali, on ground (Degener and Weibke). Maui: Kula pipe line trail, wet bank (Bartram); northeast of Olinda (Degener and Weibke).

Endemic. Type locality, Hawaii.

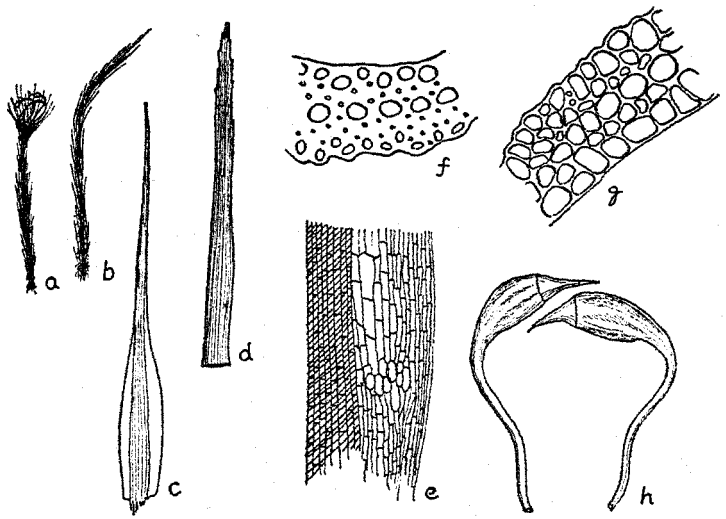


FIGURE 26. *Campylopus boswelli* Hampe: *a*, fertile plant × ¾; *b*, sterile plant × ¾; *c*, leaf × 9; *d*, apex of leaf × 60; *e*, leaf base × 60; *f*, cross section of costa from upper half of leaf × 360; *g*, cross section of costa from lower half of leaf × 360; *h*, 2 dry capsules × 9.

Resembling *C. wheeleri* in gross appearance but quite distinct in the concolorous leaf points and the more delicate, thin-walled areolation of the leaf base, without distinct auricles. The alar cells are frequently missing entirely and when present are pale, fugacious, and not at all conspicuous. I have not seen the type material of this species, but the characters separating it from *C. wheeleri* agree exactly with Müller's description (16) and I am strongly inclined to think it is a distinct species.

9. Campylopus umbellatus (Walker Arnott), new combination (fig. 27).

Thysanomitrium umbellatum Walker Arnott, Disp., p. 34, 1826.

Trichostomum Blumii Dozy and Molkenboer, Ann. Sci. Nat., p. 316, 1844

? *Dicranum Didrichseni* C. Müller, Bot. Zeit., p. 329, 1862.

Campylopus geniculatus Ångström, Öfv. K. Vet. Akad. Förh., no. 4, p. 18, 1872.

Thysanomitrium Hawaiicum C. Müller, Flora, vol. 82, p. 440, 1896.

? *Dicranum pertriste* C. Müller, Flora, vol. 82, p. 444, 1896.

Dioicous. Very variable in size and habit but usually growing in large tufts, yellowish green and glossy above, brown or black below. Stems 2 to 12 cm. or more long, erect or decumbent, innovating from the flower clusters, reddish tomentose in the lower parts. Stem leaves laxly erect with flexuose tips when dry, more rigidly erect-spreading when moist, oblong-lanceolate from a slightly narrower, auriculate base, shortly acuminate or blunt, up to 4.5 or 5 mm. long by nearly 1 mm. wide, concave or sub-tubulose above by the inflexed margins, with or without serrulate hyaline points; margin entire below, minutely denticulate above; costa about 300 μ wide, occupying about one-half of the leaf base, in cross-section with stereid bands on both sides of the median guide row, with variable serrate lamellae on the back in the upper half; alar cells distinct, brownish or hyaline, in two layers, often forming well-developed auricles extending to the costa; supra-alar cells rectangular, incrassate, slightly pitted, becoming linear at the margins, quickly becoming narrower and obliquely oval and rhomboidal upward, cells of the upper lamina obliquely oval and short linear, 20 to 25 μ long. Leaves of the comose flower clusters longer with the costa less clearly defined, ending in serrulate, hyaline hair points. Setae 5 to 6 mm. long, flexuose and cygneous, papillose at the base of the capsule; capsule symmetric, elliptic, dark brown, urn about 1.5 mm. long, rough at base, furrowed in upper part when dry; peristome teeth up to 0.6 mm. long, brownish, vertically striate below, usually split to below the middle into two filiform papillose forks; annulus large; lid conic-rostrate, 0.8 mm. long; calyptra cucullate, fimbriate at base; spores pale, smooth, up to 10 μ in diameter.

Dry banks and rocks. Common on all the larger islands.

Distribution: Indo-Malayan regions and through the Pacific islands to Hawaii. Type locality, Hawaii.

I am thoroughly in accord with Dixon (9) as far as *C. umbellatus* is concerned, but I cannot convince myself that this species and *Thysanomitrium Richardi* (Bridel), of tropical America, are clearly conspecific. In all the American plants that I have seen the leaves are more slenderly pointed and the costa lightly ribbed but not lamellose on the back, whereas in *C. umbellatus* the stem leaves are short, acuminate, rather blunt, the costa nearly always provided with distinct serrate lamellae on the back in the upper half. Occasional forms of *C. umbellatus* may show intermediate characters, but I do not think this fact should obscure the more obvious distinctions which are certainly well maintained in the scores of Hawaiian collections that have been examined.

The coarser habit, more laxly imbricated leaves, the hyaline hair points of the comal leaves, and the pointed apices of the stem leaves of the fertile

plants will serve to distinguish this plant from *C. exasperatus* without much trouble.

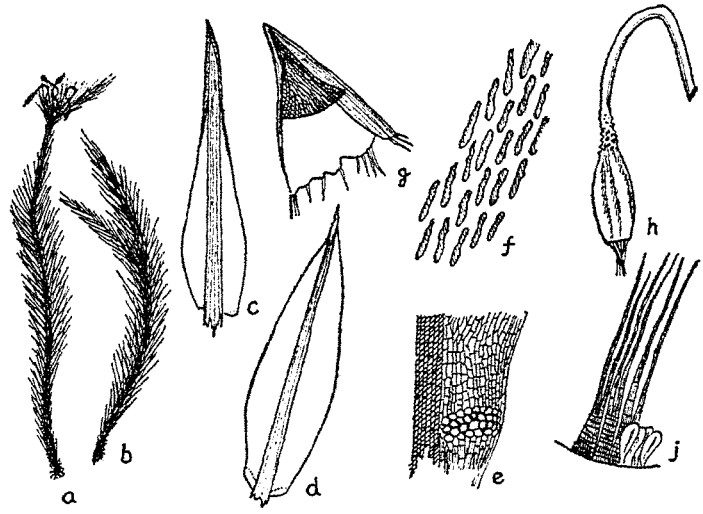


FIGURE 27. *Campylopus umbellatus* (Walker Arnott) Bartram: *a*, fertile plant × ¾; *b*, sterile plant × ¾; *c*, stem leaf × 9; *d*, comal leaf × 9; *e*, part of leaf base × 60; *f*, upper leaf cells × 360; *g*, calyptra and lid × 25½; *h*, capsule × 9; *j*, part of peristome × 60.

Both this and the following species are customarily included in the genus *Thysanomitrium*, but as the generic distinctions are by no means sharp it seems advisable to combine them with *Campylopus* in a local treatment of this kind.

Dicranum Didrichseni and *D. pertriste* are tentatively included in the synonymy of this species. I have not seen the type collections and have found it impossible to determine from the descriptions whether the plants belong here or to *C. introflexus*.

10. Campylopus exasperatus Bridel, Bryol. Univ., vol. 1, p. 473, 1826 (fig. 28).

Dicranum praemorsum C. Müller, Bot. Zeit., p. 337, 1862.

Dicranum microcephalus C. Müller, Flora, vol. 82, p. 443, 1896.

Dioicous. Usually in large, rather dense tufts, pale golden green and glossy at the tips, dark brown or blackish below. Stems erect, 2.5 to 6 cm. high, loosely matted together with reddish brown tomentum in the lower parts, usually branched near the base. Upper leaves of the fertile stems in dense comal tufts, without hyaline hair points, stem leaves below the comal tufts closely appressed, emarginate and erose-denticulate at the apex, lower stem leaves erect-spreading, rigid, deeply concave, slightly cucullate at the blunt apex, leaves of the sterile stems similar to the lower stem leaves of the fertile

plants but often larger, closely imbricated in a sharp cuspidate tip at the ends; margin erect below, incurved above; costa about one-half the width of the leaf base, lightly ridged and serrulate on the back but not lamellose, ending in the apex, often with curved, forward-pointing hyaline teeth on the back near the tip. Upper leaf cells obliquely oval, pitted, linear at the margins, basal cells rectangular, gradually becoming obliquely rhomboidal upward, at the basal angles rounded, brownish, in two layers forming a small, well-differentiated alar group extending nearly or quite to the costa. Sporophyte similar to *C. umbellatus* but with the calyptra only slightly or not at all fringed at the base.

Dry banks and ledges. Maui: top of western part of island. Island of Hawaii: common in vicinity of Kilauea (Bartram); dry rocks near Hookena, southern Kona (Bartram); Pahoehoe, near Hiulani forest, common (Skottsberg); vicinity of Hilo, frequent (Bartram).

Distribution: Ceylon, Java, Borneo, Celebes. Type locality, Java.

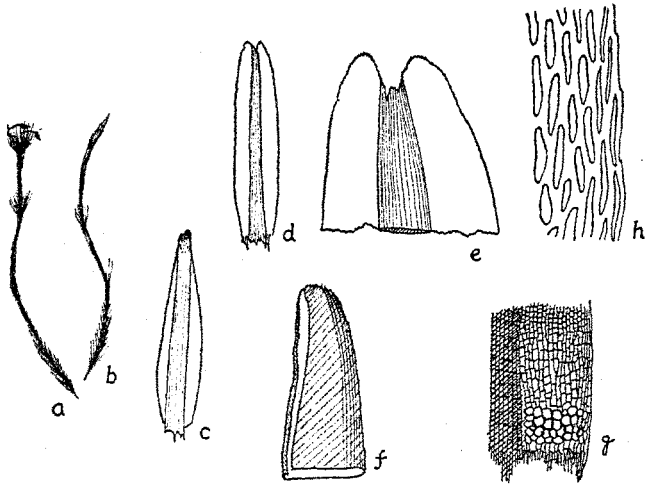


FIGURE 28. *Campylopus exasperatus* Bridel: *a*, fertile plant × ¾; *b*, sterile plant × ¾; *c*, lower stem leaf × 9; *d*, upper stem leaf × 9; *e*, apex of upper stem leaf × 60; *f*, apex of lower stem leaf × 60; *g*, one side of leaf base × 60; *h*, upper leaf cells and margin × 360.

Dicranum praemorsum and *D. microcephalus* seem to be nothing more than forms of this species, which though variable in size is readily distinguishable from *C. umbellatus* by the concolorous leaf tips and the closely clasping leaves of the fertile stems, which are erose and notched at the tips. The species is much more common on the island of Hawaii than elsewhere and does not seem to have been collected yet on Oahu.

A very slender, compactly tufted form with stems up to 10 or 12 cm. long grows around the edges of steam fissures near Kilauea. The structural details differ in no way from the species, and the unusual habit is probably due to the excess of heat and moisture in the environmental conditions.

10. DICRANODONTIUM Bruch and Schimper, Bryol. Eur., fasc. 41, 1847.

Densely tufted plants with elongate, tomentose stems. Leaves falcate-secund with long setaceous points. Costa thin and broad below, long excurrent; alar cells hyaline or reddish, fragile; cells of the leaf base large and broad toward the costa, narrower toward the margins and upward, porose. Seta curved when moist; capsule symmetrical; peristome teeth divided nearly or quite to the base (fruit unknown in Hawaii).

1. **Dicranodontium falcatum** Brotherus, B. P. Bishop Mus., Bull. 40, p. 7, 1927 (fig. 29).
   Dicranodontium hawaiicum Brotherus, B. P. Bishop Mus., Bull. 40, p. 8, 1927.

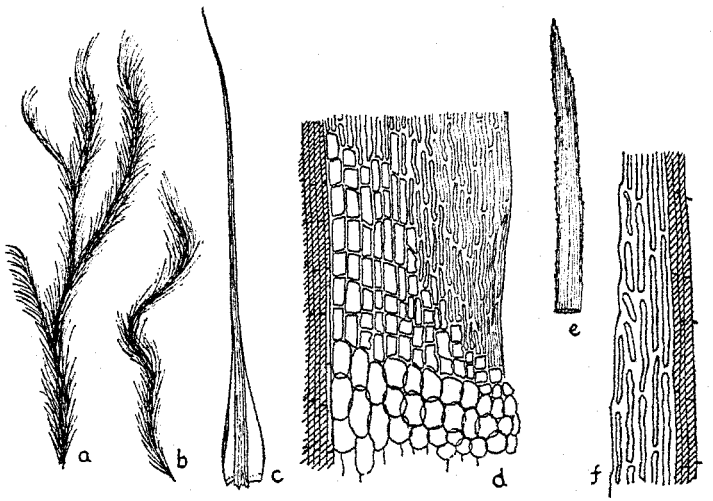


FIGURE 29. *Dicranodontium falcatum* Brotherus: *a, b,* plants × ¾; *c,* stem leaf × 9; *d,* one side of leaf base × 120; *e,* apex of leaf × 120; *f,* upper leaf cells and margin × 300.

Dioicous. Tall, robust plants, growing in dense, deep tufts, pale golden green above, brown below. Stems up to 8 cm. long, simple or sparingly branched, ascending, densely reddish tomentose. Leaves up to 9 mm. long, crowded, falcate-secund or flexuose-spreading, from a concave, sub-clasping base rather quickly narrowed to a long, denticulate, setaceous, grooved point; margin involute toward the base, not quite entire, plane and denticulate above; costa rather indistinct, 150 to 175 μ wide below, occupying about one-third of the leaf base, excurrent in a long, denticulate, concolorous point, minutely toothed on the back above, in cross-section showing bands of stereid cells on both sides of the median guide row with the outer layers slightly differentiated; alar cells hyaline or reddish, fragile, extending nearly or quite to the costa but not forming distinct auricles, just above the alar cells a sharply defined group of large, rectanglar, pellucid cells, up to 34 μ wide, changing abruptly toward the margins and obliquely upward to the narrow, strongly pitted areolation of the leaf base, 8 to 10 rows at the

margins very narrow with only slightly sinuose walls but not forming a distinct border; upper cells linear, incrassate, 2 to 4 μ wide and 10 to 15 times as long, the marginal rows frequently shorter. Fruit unknown.

Trees and wet peaty banks. Maui: western part of island (Baldwin, type); trail to Nakalalua, western part of island (Bartram); Kula pipe line trail, eastern part of island, frequent (Bartram). Island of Hawaii: Kilauea (Lieut. Hinds). Kauai: Waimea drainage basin (Forbes).

Endemic. Type locality, western Maui.

A robust species with a silky appearance due to the long setaceous leaf points. The structure of the costa in cross-section is similar to that in some of the species of *Campylopus* but will readily be distinguished from any of that group by the linear cells of the upper leaf blade.

In no structural particular does *D. hawaiicum* differ, so far as I can see. It seems to be only a trivial form of a rather variable species. Both slender and robust plants are found in the same tuft, and leaves on the same plant will vary from flexuose-spreading to falcate-secund.

Dicranodontium falcatum variety **atrovirens** (Brotherus) new combination.

Dicranodontium hawaiicum Brotherus, variety *atrovirens* Brotherus, B. P. Bishop Mus., Bull. 40, p. 8, 1927.

Dark, sordid green, in very large, deep tufts.

Maui: bog on top of Puu Kukui (St. John). Island of Hawaii: Kohala (Skottsberg); Kilauea (Lieut. Hinds).

This form seems to be fairly well marked by the dark green color and the much coarser habit.

11. AMPHIDIUM (Nees) Schimper, amended in Bryol. Eur. Consp., 1855.

Small plants in compact tufts or cushions. Leaves linear-lanceolate, acute, curled and twisted when dry; costa ending just below the apex; upper cells rounded-quadrate, densely papillose, basal cells rectangular, smooth at the insertion. Seta short; capsule erect, barely exserted, wide-mouthed, eight-striate when dry; peristome none; spores small.

1. **Amphidium cyathicarpum** (Montagne) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 460, 1902 (fig. 30).

Zygodon cyathicarpus Montagne, Ann. Sci. Nat., p. 106, 1845.

Zygodon anoectangioides C. Müller, Flora, vol. 82, p. 449, 1896.

Autoicous; male flowers in a terminal cluster on short, lateral branches or short-stalked and axillary just below the perichaetium, antheridia few with a few short paraphyses, inclosed by 6 to 8 acute or obtuse costate bracts. Plants small, compactly tufted, olive green at the tips, dark brown or blackish below. Stems up to 10 or 15 mm. high, dichotomously branched, densely radiculose below. Leaves spreading, flexuose, curled and contorted when dry, erect-flexuose when moist, linear-lanceolate, acute, carinate, 2 to 3.5 mm. long by about 0.3 mm. wide; margin plane or lightly reflexed on one side in the middle, minutely crenulate with papillae, entire or sometimes indistinctly notched with

distant, irregular teeth; costa about 75 μ wide at base, prominent at back, ending just below the apex; upper leaf cells rounded-quadrate or transversely oval, indistinct, densely papillose, 10 to 12 μ in diameter, becoming longer toward the base, basal cells rectangular, pellucid or hyaline; perichaetial leaves erect, sheathing, with elongate, smooth cells, margin irregularly sinuate above. Seta 1.5 to 2 mm. long, erect; capsule erect, barely exserted above the tips of the perichaetial leaves, oval, gradually contracted to a distinct neck, 1 to 1.5 mm. high by 1 mm. wide, greenish brown, when dry reddish brown, urceolate, strongly eight-striate; peristome none; annulus none; spores pale, 8 to 12 μ in diameter.

Rock crevices. Maui: Waikamoi, Haleakala (Forbes); Haleakala, below Rest House (St. John).

Distribution: western South America, Australia, New Zealand, Africa. Type locality, Chile.

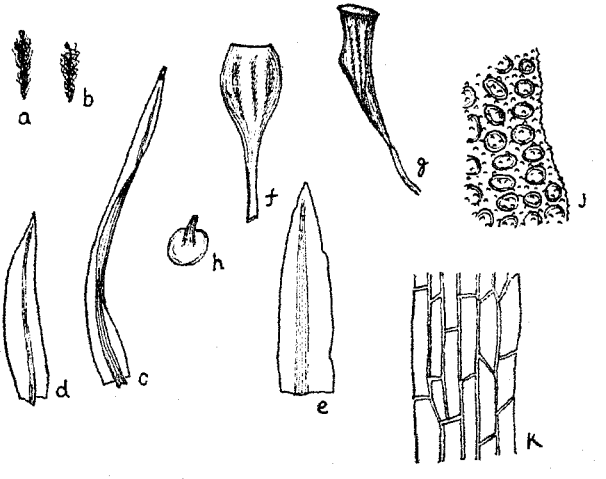


FIGURE 30. *Amphidium cyathicarpum* (Montagne) Brotherus: *a*, moist plant × ¾; *b*, dry plant × ¾; *c*, stem leaf × 12; *d*, perichaetial leaf × 12; *e*, apex of stem leaf × 60; *f*, moist capsule × 12; *g*, dry capsule × 12; *h*, lid × 12; *j*, upper leaf cells and margin × 300; *k*, basal leaf cells × 300.

The St. John collection is abundantly fruited. The inflorescence is clearly autoicous, and this character in connection with the indistinctly sinuate-dentate leaf margins identifies the plant, without much question, with *A. cyathicarpum*, a species of rather wide distribution in the Southern Hemisphere. The leaf margins are usually quite entire, but a careful examination of the leaves of almost any plant will reveal a few showing the irregularly notched edge. *Zygodon anoectangioides* was described from plants lacking fruit, and though the references to small perichaetial leaves and long exserted, curved setae are somewhat anomalous, it seems probable that Müller's species should be referred here. The capsules and setae become progressively darker with age and are usually curved to one side when old.

The dense olive-green cushions with strongly crisped leaves give these plants a characteristic appearance shared by no other local species. When in fruit the strongly ribbed, wide-mouthed capsules are unmistakable. *Trichostomum mauiense* is a more robust plant with broader leaves, less crispate when dry and with smaller leaf cells. *Amphidium cyathicarpum* seems to be confined to the rim of Haleakala, but it should be looked for on the upper slopes of both Mauna Kea and Mauna Loa in Hawaii.

12. DICRANOWEISIA Lindberg, Öfv. Sv. Vet. Akad. Förh., vol. 21, p. 230, 1864.

Rather small, densely tufted plants with erect stems, radiculose only at the base. Leaves linear-lanceolate, crispate when dry; costa percurrent; cells smooth, sub-quadrate above, rectangular at the base. Seta solitary, erect; capsule erect, sub-cylindric; annulus broad; peristome teeth 16, reddish, inserted below the rim, entire, papillose on the outer surface.

1. **Dicranoweisia cirrata** (Hedwig) Lindberg, Öfv. Sv. Vet. Akad. Förh., vol. 21, p. 230, 1864 (fig. 31).

   Weisia cirrata Hedwig, Sp. Musc., p. 69, 1801.

   Symblepharis Hillebrandii C. Müller, Bull. Herb. Boiss., vol. 5, p. 850, 1897.

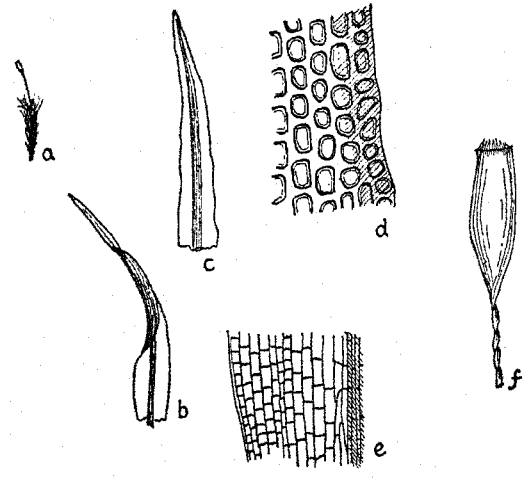


FIGURE 31. *Dicranoweisia cirrata* (Hedwig) Lindberg: *a*, plant × ¾; *b*, stem leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 120; *f*, capsule × 12.

Autoicous. In rather dense tufts, dull yellowish green above, dark brown below. Stems about 1 cm. high, simple or sparingly branched. Leaves erect-spreading, curled and crisped when dry, flexuose when moist, linear-lanceolate from a narrow base, gradu-

ally acuminate, 3 to 3.5 mm. long by a scant 0.5 mm. wide, carinate; margin slightly sinuate in the upper half, recurved on one or both sides near the middle of the leaf; costa about 60 μ wide below, percurrent; upper cells quadrate and short rectangular, smooth, 8 to 10 μ wide, several rows at the margins frequently in two layers, gradually becoming larger, rectangular and pellucid toward the base. Inner perichaetial leaves slightly sheathing in the lower half; seta erect, yellow, 6 to 7 mm. long; capsule erect, cylindric, pale brown, with a red mouth, smooth, about 1.6 mm. long; peristome teeth reddish at the base, paler above, papillose, undivided, deeply inserted; annulus broad; spores papillose, 15 to 18 μ in diameter.

Distribution: Europe, Asia, Africa, North America. Type locality, Europe.

This species is known in Hawaii only from the single collection by Hillebrand in 1870, without definite locality, described by Müller under the name of *Symblepharis Hillebrandii.* These plants agree in every essential particular with specimens of *D. cirrata* from Europe and North America, and it is probable that they came from the upper slopes of Haleakala. It is apparently a rare species and should be looked for around the rim of Haleakala and on the high peaks of Hawaii.

13. HOLOMITRIUM Bridel, Bryol. Univ., vol. 1, p. 226, 1826.

Plants of medium size, growing in dense tufts, often with terminal clusters of short, microphyllous branches. Stems branched, tomentose. Leaves from a short, erect base narrowed to a lanceolate point, crispate when dry; costa percurrent; basal cells linear, usually pitted; alar cells very distinct, upper cells rounded, incrassate, bistratose at the margins. Inner perichaetial leaves convolute-sheathing, erect, with long setaceous points frequently overtopping the capsule; seta erect; capsule erect, cylindric; peristome teeth 16, dark red, inserted below the rim, coarsely papillose, usually split along the median line; lid conic-rostrate.

Leaves spreading when moist, crenulate or entire at apex.....1. **H. seticalycinum**
Leaves squarrose-recurved when moist, toothed at apex.....2. **H. squarrifolium**

1. **Holomitrium seticalycinum** C. Müller, Flora, vol. 82, p. 445, 1896 (fig. 32).
Holomitrium brevicalycinum C. Müller, Flora, vol. 82, p. 446, 1896.

Pseudoautoicous; male plants minute, attached to the tomentum on the lower parts of the fertile plants. Growing in dense, extensive mats, yellow above, brown below. Stems 1 to 1.5 cm. high, simple or branched, densely reddish tomentose; leaves crowded, twisted and curled when dry, widely spreading when moist, linear-lanceolate from a short, erect, oblong or slightly obovate, concave base, carinate above, 3 to 3.5 mm. long, sharply pointed; margin erect, minutely crenulate at the extreme apex, otherwise entire; costa about 90 μ wide at base, percurrent; basal leaf cells linear, incrassate, slightly sinuose, alar cells conspicuous, golden brown, forming a rectangular group about 150 μ long by 75 μ wide bordered on the inside by a group of delicate hyaline cells extending to the costa, cells at the leaf shoulders oval-rhomboidal and transversely oval, upper

cells rounded, 5 to 7 μ in diameter, very incrassate, in two layers at the margins and here and there through the lamina. Perichaetial leaves conspicuous, the inner erect, convolute-sheathing, up to 15 to 18 mm. long, with long flexuose setaceous points, usually exceeding the capsule but occasionally shorter, areolation linear, incrassate; seta erect, pale at base, brownish above, 10 to 20 mm. long; capsule cylindric, erect, reddish brown, 2.5 mm. high; peristome teeth dark red with pale tips, coarsely papillose, more or less split along the median line nearly to the base, inserted below the rim; lid conic-rostrate; spores pale, papillose, 12 to 15 μ in diameter.

Trunks and branches of trees in rain-forests. Oahu: Puu Kaala, east ridge (St. John); Lanihuli trail (Forbes). Molokai: west of Pepeopae (Degener and Weibke). Maui: trail to Nakalalua, western part of island, frequent (Bartram); Puu Kukui, forest (Skottsberg); Olowalu Valley (Forbes). Island of Hawaii: vicinity of Kilauea, frequent (Bartram); Makahanaloa, Puu Kauku (Skottsberg); Waimea drainage basin (Forbes).

Endemic. Type locality, western Maui.

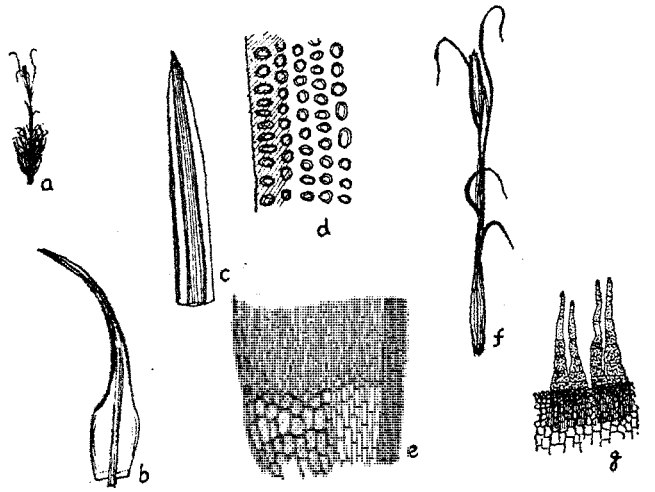


FIGURE 32. *Holomitrium seticalycinum* C. Müller: *a*, moist plant × ¾; *b*, stem leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 120; *f*, capsule and perichaetial leaves × 3¾; *g*, 2 peristome teeth × 120.

This species fruits abundantly and may usually be recognized at sight by the long, pale setaceous-pointed perichaetial leaves. *H. brevicalycinum* is distinguished by the author through the relatively longer seta so that the capsule exceeds the tips of the perichaetium. In reality this character is very unstable. Both extremes with numerous intergrades are frequently found in the same colony, and I have been utterly unable to segregate the form described as *H. brevicalycinum* with any degree of satisfaction.

2. **Holomitrium squarrifolium,** new species (fig. 33).

Dense caespitosum. Caulis 3-4 cm. longus, flexuosis, dense rubro-tomentosus. Folia sicca incurvato-circinnata, humida squarrosa et recurvata, e basi vaginantia, obovata, oblongo-lanceolata, acuta, carinato-concava, 2.5-3 mm. longa; marginibus erectis, apice denticulatis, inferne integris; costa basi 100 μ, percurrente; cellulis basilaribus linearibus, incrassatis, sinuosis, superioribus rotundatis, incrassatis, 5 to 7 μ, marginalibus 2-stratosis; cellulis alaribus numerosis, lutescentibus, ad costa hyalinis. Caetera ignota.

Slender plants growing in deep, dense mats. Stems ascending, 3 to 4 cm. long, simple or sparingly branched, flexuose, densely reddish tomentose; leaves erect, appressed, with circinnate-incurved tips when dry, squarrose-spreading to recurved when moist, oblong-lanceolate from a short, erect, slightly obovate, clasping base, carinate above, acute, 2.5 to 3 mm. long; margin erect, denticulate at apex, entire below; costa about 100 μ wide at base, percurrent, pale and glossy on the back when dry; basal cells linear, incrassate, sinuose, gradually becoming shorter, rounded and transversely oval toward the leaf shoulders, the upper cells rounded, very incrassate, 5 to 7 μ in diameter, about two rows at the margins in two layers forming a rather conspicuous thickened border; alar cells numerous, golden brown, becoming hyaline toward the costa. Fruit unknown.

Type: on damp rocks and trees, south of Pahoehoe, Kau, Hawaii, E. B. Bartram, number 341-a.

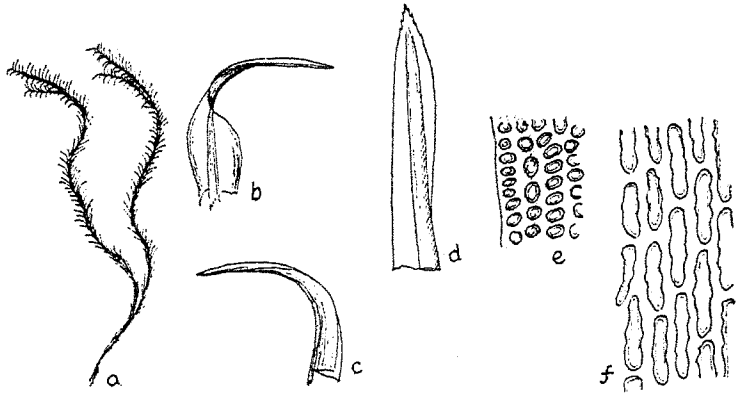


FIGURE 33. *Holomitrium squarrifolium* Bartram: *a*, moist plant × 1; *b*, *c*, stem leaves × 12; *d*, apex of leaf × 60; *e*, upper leaf cells and margin × 300; *f*, basal leaf cells × 300.

The slender elongated stems and squarrose leaves, when moist, will at once distinguish this species from *H. seticalycinum*. The leaves are also shorter than in the preceding species, broader in the limb, and sharply toothed at the apex. Unfortunately, because the type collection is sterile, the systematic position of the species must remain uncertain.

14. DICRANUM Hedwig, Sp. Musc., p. 126, 1801.

Robust plants in large, deep tufts. Stems branched, very tomentose. Leaves large, ovate-lanceolate, entire or serrate above; costa narrow, ending below the apex, with serrate lamellae or wings on the dorsal side. Leaf cells linear, smooth, incrassate, very porose; alar cells brown, forming a distinct group. Seta solitary, reddish, smooth; capsule large, cylindric; peristome teeth red, split to below the middle into 2 or 3 more or less united forks, striate on the outer surface; annulus none; lid conic-rostrate; spores large, papillose.

1. **Dicranum speirophyllum** Montagne, Voy. Bonite, Crypt., p. 275, 1846 (fig. 34).
   Dicranum sandwicense Sullivant, U. S. Expl. Exped., Musci., p. 4, 1859.
   Dicranum praemorsum Sullivant, Bull. Torr. Bot. Club, vol. 5, p. 10, 1878.

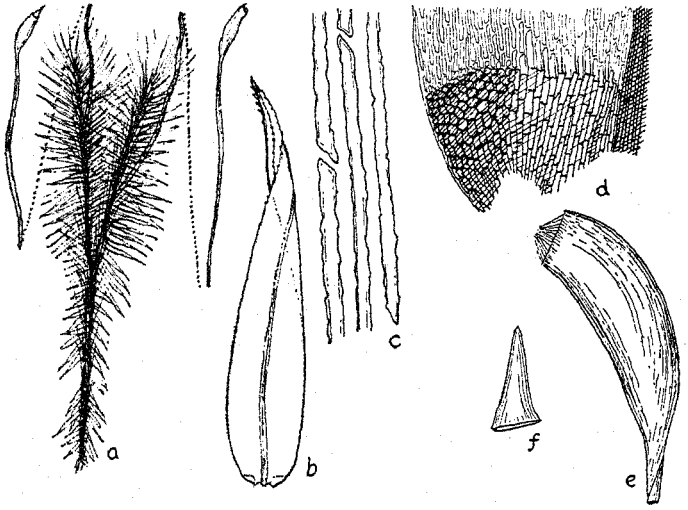


FIGURE 34. *Dicranum speirophyllum* Montagne: *a*, plant × ¾; *b*, leaf × 9; *c*, upper leaf cells × 300; *d*, one side of leaf base × 60; *e*, moist capsule × 9; *f*, lid × 9.

Pseudoautoicous. Male plants minute, 1 mm., or less, high, attached to the tomentum of the stems of the fertile plants. Variable but usually tall and robust, in large, deep tufts, yellowish green or golden brown, glossy. Stems usually decumbent at the base, 5 to 30 cm. long, densely tomentose. Leaves of the elongated stems laxly imbricated, more crowded in the shorter plants, widely spreading or deflexed, erect at the tips of the stems forming cuspidate tufts, when dry with spirally twisted points, scarcely undulate, ovate-lanceolate, 8 to 10 mm. long, broadly pointed; margin plane, entire or coarsely serrate toward the apex; costa faint, with two serrated wings or lamellae on the back above, indistinct in the upper half, ending below the apex; alar cells numerous,

brown, forming a large conspicuous group extending about halfway to the costa, the interior cells usually paler; cells of the lamina linear, incrassate, very porose. Inner perichaetial leaves 10 to 12 mm. long, convolute-sheathing, abruptly contracted to a short, erect, serrulate, linear point; seta solitary, reddish, about 5 cm. long; capsule curved, cylindric, slightly gibbous, brown, smooth, about 4 mm. long without the lid; peristome teeth bright red with paler tips, split more than two-thirds of the way down into three slender forks, joined together by numerous cross articulations extending nearly or quite to the tips, vertically or obliquely striate on the outer surface; annulus none; lid erect or slightly oblique, rostrate from a conic base, 3 mm. long; spores papillose, 20 to 25 μ in diameter.

Damp banks on humus and bases of trees in wet forests, frequent.

Endemic. Type locality, Hawaii.

A fine, handsome moss, readily known by its robust habit and lustrous leaves with a very faint narrow costa winged on the back with serrate lamellae. The fruit is not rare and is often produced in abundance. Although there is a wide variation in size, color, and the degree to which the leaf points are spiraled when dry, every conceivable intergrade will be found. I am thoroughly convinced that all these variations may properly be included in the form circle of one specific type.

Dicranum speirophyllum variety **breviflagellare** (C. Müller), new combination.

Dicranum breviflagellare C. Müller, Flora, vol. 82, p. 444, 1896.

Rather shorter, usually less than 5 cm. high; sterile stems with apical clusters of short, rigid, microphyllous branches.

Frequent near the top of Puu Kaala, Waianae Mountains, Oahu.

15. DICRANOLOMA Renauld, Rev. Bryol., vol. 28, p. 85, 1901.

Resembling *Dicranum* but more slender. Stems neither radiculose nor tomentose. Leaves slightly secund, with long subulate points; costa excurrent; cells uniform, narrowly linear, incrassate; alar cells reddish, extending nearly to costa. Fruit unknown in Hawaii.

1. Dicranoloma gracile Brotherus, in herbaria (fig. 35).

Dioicous (?). Slender plants, pale yellowish green above, brown below. Stems dark reddish brown, without central strand, simple or with few branches, about 6 cm. long, denuded of leaves below, neither radiculose nor tomentose. Leaves rather distant, flexuose-spreading, somewhat secund, from an oblong-ovate base quickly narrowed to a long subulate, faintly denticulate point composed entirely of the excurrent costa, 3 to 3.2 mm. long by 0.5 mm. wide at base; margin entire, usually slightly involute; costa slender, 45 to 60 μ wide toward the base, long excurrent, in cross section slightly convex, showing 3 or 4 layers of stereid cells almost homogeneous in structure; alar cells deep reddish brown, forming very conspicuous auricles, extending almost to the costa, supra-alar cells few, oval or rounded; cells of the lamina uniform, linear, 2 to 4 μ wide and 10 to 20 times as long, with very thick yellowish pellucid walls. Fruit unknown.

Endemic. Type locality, Maui.
Maui: Haleakala, altitude 8,000 feet (Baldwin, type).

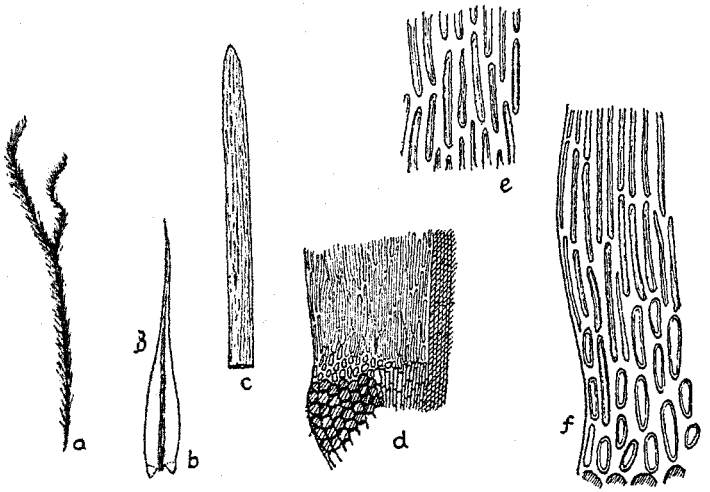


FIGURE 35. *Dicranoloma gracile* Brotherus: *a*, plant × ¼; *b*, stem leaf × 12; *c*, apex of leaf × 120; *d*, one side of leaf base × 120; *e*, upper leaf cells × 300; *f*, basal leaf cells and margin × 300.

The exact systematic position of this interesting plant will be open to question until more abundant and better material is available. *Dicranodontium falcatum* and *Dicranum speirophyllum* are both coarser species with tomentose stems, longer leaves, and quite different cells.

16. LEUCOLOMA Bridel, Bryol. Univ., vol. 2, p. 218, 1827.

Rather large plants growing in soft, loose tufts. Stems branched, neither radiculose nor tomentose, frequently naked below. Leaves flexuose or curved, with long setaceous points; costa pale and narrow, excurrent; chlorophyllose cells small, papillose, in a broad median band extending to the insertion, bordered on both sides by a broad band of narrow, elongated colorless cells; alar cells large, brown or hyaline, very conspicuous. Seta erect; capsule erect, cylindric; peristome teeth bifid to the middle or below.

1. Leucoloma molle (C. Müller) Mitten, Musc. Ind. Orient, p. 13, 1859 (fig. 36).

Dicranum molle C. Müller, Syn., vol. 1, p. 354, 1849.

Leucoloma hawaiiense Brotherus, B. P. Bishop Mus., Bull. 40, p. 9, 1929.

Dioicous. Robust, densely tufted plants, pale green above, brown below, glossy. Stems up to 5 cm. long, ascending, usually naked in the lower parts, simple or branched;

upper leaves crowded, striate when dry, erect-spreading or subfalcate with long flexuose setaceous points, more rigid when moist, from an oblong-ligulate base gradually narrowed to a long, fine point, carinate-concave, about 5 mm. long by 0.5 mm. wide; margin erect, entire; costa pale, thin, long excurrent in a fine, concolorous, minutely denticulate point; chlorophyllose leaf cells oval-oblong, papillose, the upper 5 μ wide and 10 to 20 μ long, the lower elongate and sinuose, in a broad median band extending to the insertion, bordered on both sides by smooth, colorless, narrowly linear cells forming a broad band at the base, gradually decreasing in width upward, and continuous to the top of the lamina; alar cells numerous, conspicuous, quadrate and sub-rectangular, irregular, very incrassate, pale brown and hyaline, extending to the costa; supra-alar cells numerous, rounded and oval-rhomboidal. Seta short, erect; capsule erect, oval; peristome teeth split nearly to the base into two filiform, papillose forks; lid conic-rostrate.

Trees in rain-forest. Oahu: altitude 2,500 feet (Baldwin); Pupukea-Kahuku trail, altitude 1,000 feet (Bartram); Koolau Range, Kawaiiki ditch trail (Skottsberg). Maui: trail to Nakalalua, western part of island (Bartram).

Distribution: Society Islands to New Guinea, Luzon, Hongkong, Formosa, and Japan. Type locality, Java.

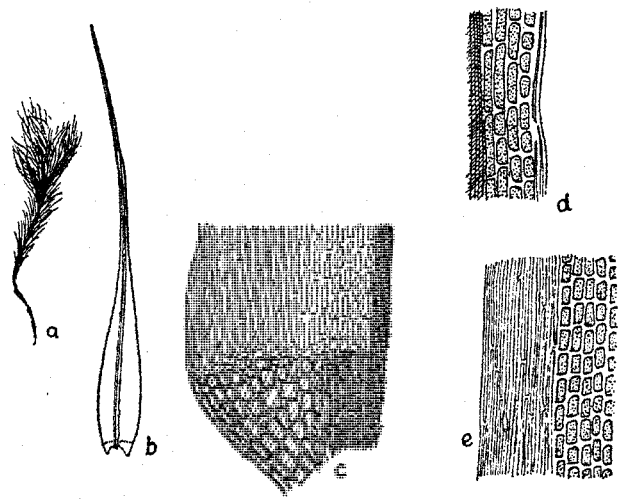


FIGURE 36. *Leucoloma molle* (C. Müller) Mitten: *a*, plant × ¾; *b*, leaf × 9; *c*, one side of leaf base × 120; *d*, upper leaf cells and margin × 300; *e*, median leaf cells and margin × 300.

A pretty, rather silky moss often associated with and closely resembling *Campylopus hawaiico-flexuosus* to the naked eye. The unique cell structure of the leaves at once establishes its identity under the microscope.

Brotherus distinguishes *L. hawaiiense* from *L. molle* through the more robust habit and falcate leaves but I doubt if there is any clear line of demarcation. The leaves of the Hawaiian plants are frequently falcate, but this character is by no means constant and does not seem to be definitely cor-

related with the more robust forms in any of the collections I have seen. Fruit has not yet been found in Hawaii.

Family 4. LEUCOBRYACEAE

Small or medium-sized plants growing in compact tufts, pale green or whitish green tinged with brown. Stems branched, radiculose below. Leaves fragile, crowded, straight or curved, composed almost entirely of the broad costa, which in cross-section shows a central row of small chlorophyllose cells covered on both sides by one or more layers of large hyaline cells, porose on the inner walls. Seta solitary, reddish; capsule erect or inclined; peristome single, of 8 or 16 teeth; lid rostrate; calyptra cucullate.

Capsule erect, peristome teeth 8.....**17. Octoblepharum**
Capsule inclined, curved, peristome teeth 16.....**18. Leucobryum**

17. OCTOBLEPHARUM Hedwig, Sp. Musc., p. 50, 1801.

Plants in compact tufts, whitish green tinged with brown. Leaves fragile, crowded, consisting chiefly of the broad, thick ligulate costa bordered below by the small hyaline cells of the rudimentary lamina. Seta erect; capsule erect and symmetrical; peristome teeth eight (in reality eight pairs), inserted below the rim, faintly striate, often perforate along the median line.

1. **Octoblepharum albidum** Hedwig, Sp. Musc., p. 50, 1801 (fig. 37).
Bryum albidum Linnaeus, Sp. Pl., 2d ed., p. 1583, 1763.

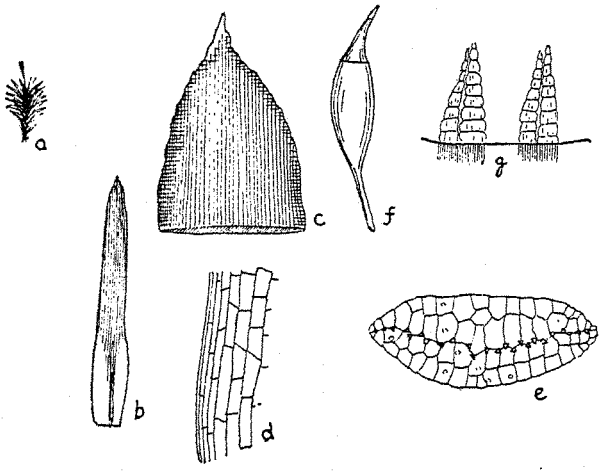


Figure 37. *Octoblepharum albidum* Hedwig: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, hyaline laminal cells near base × 120; *e*, cross section of leaf near apex × 120; *f*, capsule × 9; *g*, 2 pairs of peristome teeth × 120.

Autoicous; male buds minute, in the axils of the upper stem leaves. Fragile plants in dense whitish green or brownish cushions. Stems simple or branched, up to 3 cm. high. Leaves crowded, spreading or recurved, ligulate from a slightly obovate, concave, hyaline base, rounded and apiculate at the apex, up to 6 mm. or more long by 0.4 mm. wide; margin serrulate at the apex, entire below; costa broad and thick, occupying about one-half of the leaf base and forming the entire ligulate blade of the leaf, in cross-section near the middle showing a median row of triangular chlorocysts with 3 or 4 layers of porose leucocysts on both the dorsal and ventral sides; hyaline cells of the lamina in one layer, long rhomboidal and rectangular; perichaetial leaves shorter and narrower. Seta erect, about 5 mm. long; capsule oblong-ovoid, greenish brown, urn 1 to 1.5 mm. long; peristome teeth in eight pairs, yellow, well-spaced; lid rostrate, oblique, up to 1 mm. long; spores papillose, up to 22 μ in diameter.

On trees. Oahu: on *Eucalyptus* trees, southwest of Nuuanu Pali, along road (Bartram). Maui: valleys, western part of island, altitude 800 feet (Baldwin).

Cosmopolitan in tropical regions. Type locality, Bahama Islands.

Readily identified by the pale whitish color and the fleshy, strap-shaped leaves composed almost entirely of the broad, thick costa. Although this species is common throughout tropical regions generally, it appears to be rather rare locally and to be confined to low altitudes.

18. LEUCOBRYUM Hampe, Flora, vol. 20, p. 282, 1837.

Small to medium-sized plants in compact cushions or tufts, pale or glaucous green tinged with yellowish brown. Stems branched, radiculose below. Leaves crowded, straight or curved, from a narrowly ovate base contracted to a sub-tubulose point; costa very broad, constituting all of the upper part of the leaf, rough on the back near the apex, composed of several layers of large hyaline cells inclosing a median row of small four-sided chlorophyllose cells. Seta erect, flexuose; capsule inclined, furrowed when dry; peristome teeth 16, red, divided to about the middle into two papillose forks, striate below.

1. Leaves 4 to 6 mm. long, small plants ..... **1. L. gracile**
   Leaves 7 to 12 mm. long, more robust 2
2. Leaves with rigid, appressed points, hyaline border continuous to apex ..... **3. L. pachyphyllum**
   Leaves with flexuose points, hyaline border ending about two-thirds up ..... **2. L. hawaiiense**

1. Leucobryum gracile Sullivant, Bull. Torr. Bot. Club, vol. 5, p. 10, 1878 (fig. 38).

Leucobryum nano-crispulum C. Müller, Flora, vol. 82, p. 436, 1896.

Leucobryum Baldwini C. Müller, Flora, vol. 82, p. 436, 1896.

Leucobryum falcarium C. Müller, Abh. Nat. Ver. Bremen, vol. 16, p. 498, 1900.

Dioicous (?). Male flowers not seen. Small, fragile plants growing in very dense, soft tufts, whitish or glaucous green above, pale brown slightly tinged with red below. Stems branched, matted together with reddish radicles in the older parts, up to 1 cm. long. Leaves crowded, more or less falcate-secund, ovate-lanceolate below from a narrow insertion, concave, tubulose above, apiculate, up to 4 or 5 mm. long and 0.5 to 0.7 mm. wide; margin entire, incurved above, erect below; costa very broad, occupying all of the upper part of the leaf, more or less undulate and scabrous on the back above; in cross-section near the base showing 2 or 3 layers of large hyaline cells on both sides of the central row of chlorophyllose cells in the thicker parts of the leaf, with a thinner median furrow, 6 to 8 cells wide, composed of one layer of hyaline cells on each side of the chlorophyllose row; laminal cells reduced to a hyaline border, 8 to 10 cells wide in the broadest part, linear toward the margins, abruptly larger and rhomboidal next to the costa, the inner row about 20 μ wide. Inner perichaetial leaves erect, subulate-acuminate from a linear-oblong, clasping base, up to 6 mm. long; seta about 2 cm. long, bright red, flexuose; capsule short oblong, inclined, strumose, urn about 1.2 mm. long, brown, arcuate and striate when dry; peristome teeth dark red, split to about the middle into two equal forks; annulus none; lid red, long rostrate from a conic base, 1.8 mm. long; calyptra cucullate.

Bases of trees, logs, damp turfy banks, in woods, common.
Endemic. Type locality, Oahu.

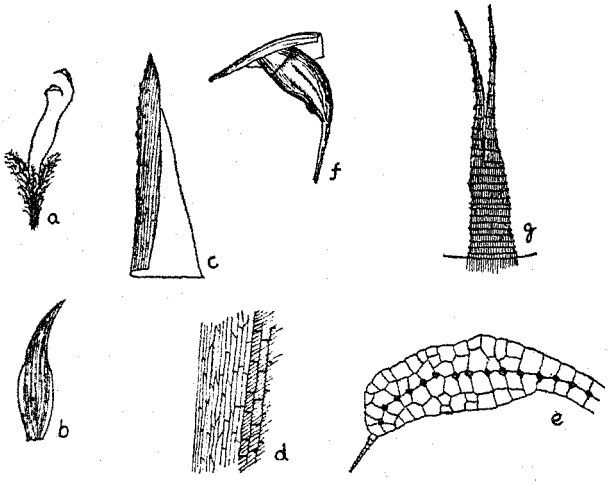


FIGURE 38. *Leucobryum gracile* Sullivant: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, hyaline laminal cells about 1/3 up × 120; *e*, part of cross section of leaf near base × 120; *f*, capsule with calyptra × 9; *g*, peristome tooth × 60.

A variable species as far as size and the direction of the leaves are concerned. The smaller forms with leaves only 2 or 3 mm. long seem to be specifically distinct from the robust plants with leaves 10 mm. or more long which have been referred to *L. hawaiiense*, yet the structural features of the leaves are very similar throughout all the Hawaiian species, and numerous intergrading forms of different degrees of robustness are frequently

encountered which are difficult to place satisfactorily. The differences between this species and the following are, however, too radical to be ignored, and better judgment suggests that they should be kept separate.

Leucobryum gracile variety **hamatum,** new variety.

Caulis longioribus, ad 4 cm. longus, folia circa 5 mm. longa, hamata, saepe spiraliter seriata.

Stems longer, up to 4 cm. high; leaves about 5 mm. long, strongly and regularly hamate and somewhat spirally seriate.

Oahu: east side of Manoa Valley, grassy slope (Bartram); on tree, Nuuanu Pali (Bartram). Molokai: Kalaupapa, bank (Degener and Weibke). Maui: grassy bank, vicinity of Oopula (Bartram, type). Kauai: Halemanu, Kokee (Degener and Weibke).

A very neat and pretty form on account of the longer stems and regularly hooked leaves.

2. **Leucobryum hawaiiense** (Reichardt), new combination (fig. 39).

Leucobryum falcatum C. Müller variety *Haviensis* Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 567, 1877.

Leucobryum pachybasis Cardot, in herbaria.

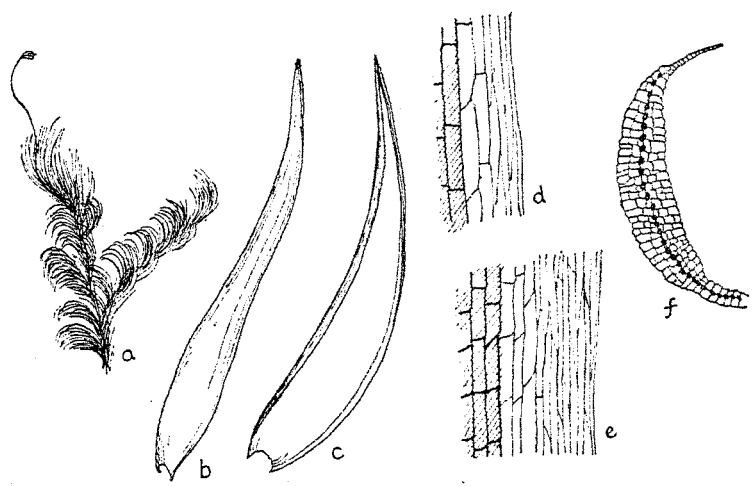


FIGURE 39. *Leucobryum hawaiiense* (Reichardt) Bartram: *a*, plant × ¾; *b*, leaf from dorsal side × 9; *c*, leaf from ventral side × 9; *d*, hyaline laminal cells about 2/3 up × 120; *e*, hyaline laminal cells near base × 120; *f*, part of cross section of leaf near base × 60.

Dioicous. Robust plants in dense, soft tufts, glaucous green frequently tinged with yellow, paler in the older parts. Stems branched, up to 5 or 6 cm. long, sparingly radiculose below, easily separating. Leaves crowded, falcate-secund or flexuose-spreading, lanceolate from a long, deeply channeled, narrowly ovate base, contracted at the inser-

tion, tubulose above, apiculate, 7 to 10 mm. long by about 1.5 mm. wide, slightly undulate and scabrous on the back near the apex; in cross-section near the base showing a single layer of large hyaline cells on either side of the chlorophyllose row along the median furrow and 2 to 3 (rarely 4) layers on either side of the chlorocysts in the thicker parts of the leaf; hyaline laminal cells forming a border 8 to 12 rows wide, oblong and rhomboidal toward the costa, 20 to 25 μ wide, gradually becoming linear toward the margins. Sporophyte as in *L. gracile.*

Bases of trees and peaty banks in woods, common.

Endemic. Type locality, Hawaii.

A much larger species than the preceding, with longer and relatively narrower leaves. The broad border of hyaline cells, 7 to 12 rows wide, representing the true lamina, is constantly wider in all the Hawaiian species than in *L. javense* and seems to distinguish these insular forms specifically from any of their allies. The leaves are always scabrous on the back near the apex, thus precluding both *L. nielgherrense* and *L. hollianum.* In *L. hawaiiense* the hyaline laminal cells seem to be shorter and broader than in *L. gracile,* which shows only the innermost row enlarged, but I am not sure that this character is constant enough to be of diagnostic value.

Leucobryum hawaiiense variety **fumarioli** (C. Müller), new combination.

Leucobryum fumarioli C. Müller, Abh. Nat. Ver. Bremen, vol. 16, p. 498, 1900.

Stems 6 to 7 cm. high, pale yellow, soft and very fragile; leaves shorter, more erect, very slightly secund, broader at the base, broadly grooved rather than tubulose in the point.

Hawaii: damp banks and edges of steam fissures, vicinity of Kilauea, frequent (Bartram).

This form is nearly as robust as *L. pachyphyllum,* but the leaves are more deeply channeled and more flexuose in the points, and the hyaline border of laminal cells extends only about two-thirds of the way up the leaf.

Leucobryum hawaiiense variety **solfatarae** (C. Müller), new combination.

Leucobryum solfatarae C. Müller, Abh. Nat. Ver. Bremen, vol. 16, p. 500, 1900.

Stems 5 to 6 cm. high, strict, leaves erect, rather rigid, about 5 mm. long, tubulose in the point.

Hawaii: edges of steam fissures, vicinity of Kilauea (Bartram). Kauai: wet logs, altitude 1,800 feet (Miss Reed); Alakai swamp (Skottsberg).

A slender form with shorter leaves, verging toward *L. gracile.*

3. **Leucobryum pachyphyllum** C. Müller, Flora, vol. 82, p. 435, 1896 (fig. 40).

More robust than any of the preceding species, glaucous green tinged with brown above, paler below. Stems up to 9 cm. long, dichotomously branched, flexuose, ascend-

ing, scarcely or not at all radiculose. Leaves densely imbricated, rigid, erect to slightly spreading, scarcely secund, oblong-lanceolate from a narrow insertion, acuminate, broadly concave below, deeply channeled in the point, undulate and scabrous on the back near the apex, 7 to 8 mm. long by 2 mm. wide; costa in cross-section showing a narrow median furrow with a single layer of large hyaline cells on either side of the chlorocysts; in the thicker part of the leaf, which is relatively much broader than in any of the other species, with 2 or 3 layers of hyaline cells on the dorsal side and two layers on the ventral side of the chlorocysts; hyaline laminal cells extending to the leaf apex, 6 to 8 rows wide in the broadest part, linear at the edges, becoming rectangular and rhomboidal and much broader toward the costa. Fruit unknown.

Wet banks at high altitudes. Oahu: Waikane-Schofield trail, summit of Koolau Range (Bartram). Maui: bog near top of Puu Kukui, western part of island (St. John); western part of island, on ground (Baldwin); Honokohau drainage basin, western part of island (Forbes).

Type locality, Lanai.

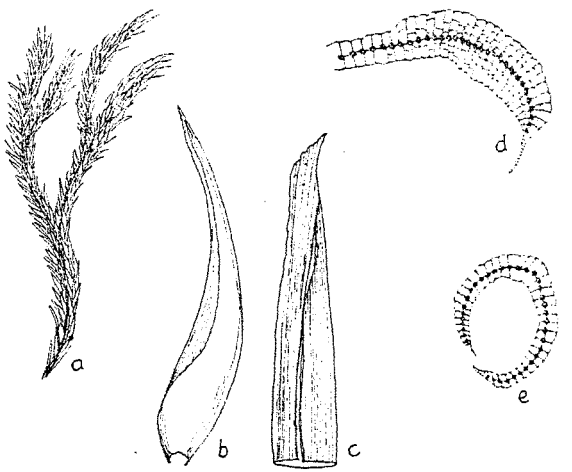


FIGURE 40. *Leucobryum pachyphyllum* C. Müller: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, part of cross section of leaf near base × 60; *e*, cross section of leaf near apex × 60.

The closely imbricated, nearly erect leaves with broad, flat bases and straight, rigid points give this plant a characteristic appearance when compared with the other local species. Furthermore, the broad, thickened parts of the leaf on either side of the median furrow and the continuous border of hyaline laminal cells extending to the apex seem amply to distinguish this plant from its congeners. I am inclined to think it is a perfectly valid species.

Family 5. CALYMPERACEAE

Plants of varying size growing in dense tufts or compact cushions. Stems branched, radiculose below. Leaves crowded, more or less sheathing at the pale base, usually with either a hyaline or thickened border; costa ending in or near the apex, or excurrent, smooth, papillose, or spinose on the back, often with clusters of spindle-shaped propagula near the apex; upper leaf cells small, chlorophyllose, usually papillose; inner basal cells large and clearly defined, sub-rectangular, hyaline (cancellinae), passing abruptly to the small cells of the leaf blade. Seta erect; capsule erect; peristome none or of 16 brownish, papillose teeth; lid conic or rostrate.

The plants of this family are usually sparse fruiters. The diagnostic characters are principally in the vegetative parts.

1. Leaves with a hyaline border of elongated cells.....2
   Leaves without a hyaline border.....**21. Calymperes**
2. Stems erect, hyaline leaf border narrow.....**19. Syrrhopodon**
   Stems creeping with erect branches, hyaline leaf border broad.....**20. Thyridium**

19. SYRRHOPODON Schwaegrichen, Suppl. 2, pt. 2, p. 110, 1824

Rather small plants, either tufted or in dense cushions. Leaves crowded, erect or crispate, from an erect, whitish, clasping base, narrowed to a linear, grooved point, with a hyaline border of elongated cells; costa percurrent or ending just below the apex; upper cells small, papillose, changing abruptly to the large hyaline cells (cancellinae) of the leaf base.

1. Margin of the leaf base long ciliate.....**1. S. oahuensis**
   Margin of the leaf base entire.....2
2. Leaves crispate when dry, costa spinose on the back above.....**2. S. hawaiicus**
   Leaves erect-spreading when dry, costa papillose on the back.....**3. S. kilaueae**

1. **Syrrhopodon oahuensis** Brotherus, B. P. Bishop Mus., Bull. 40, p. 11, 1927 (fig. 41).

Slender plants in dense, compact cushions, yellowish green at the tips, bright reddish brown below. Stems erect, compactly matted together with reddish brown radicles, up to 3 cm. high, fastigiately branched. Leaves crowded, crispate with incurved points when dry, rigidly erect-spreading when moist, up to 2 mm. long by 0.4 mm. wide, from an oblong, clasping base narrowed to an oblong-linear tubulose point slightly longer than the basal portion, obtuse; margin erect, spinose-ciliate with long, irregular, more or less recurved teeth in the upper half of the leaf base, sinuate and denticulate in the tubulose blade, spinose-serrate at the apex, bordered with a narrow band of elongated hyaline cells for a short distance above the top of the leaf base; costa yellowish, percurrent or ending just below the blunt or minutely apiculate apex, in cross-section showing bands of stereid cells on both sides of the median row of guide cells, spinose on both sides with prickles of irregular length to about the middle of the leaf base, smooth below; cells of the leaf blade rounded-quadrate, rather irregular, mamillate on the inner surface and on the back near the costa, becoming strongly spinose-papillose on the roll of the leaf; cancellinae occupying most of the leaf base, extending obliquely upward along the costa to just above the leaf shoulders. Sporophyte unknown.

On trees. Oahu: Koolau Range back of Tantalus, altitude 1,900 feet (Skottsberg, type); upper slopes of Tantalus (Bartram).

Endemic. Type locality, Koolau Range, Oahu.

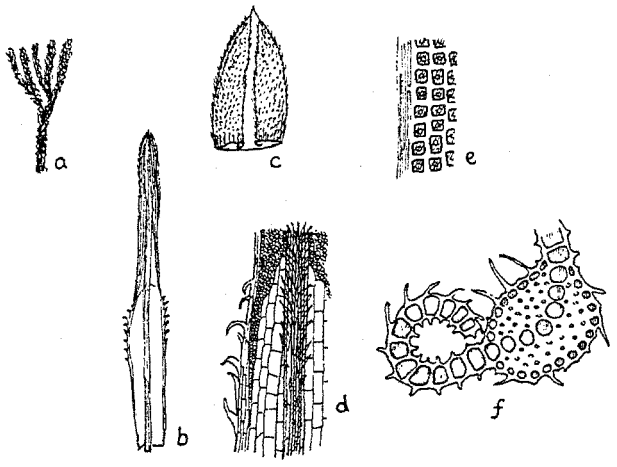


FIGURE 41. *Syrrhopodon oahuensis* Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 120; *d*, part of leaf base × 60; *e*, upper leaf cells and margin × 300; *f*, part of cross section of leaf × 300.

A species with many unique characters, among which the spinose-ciliate margins of the leaf base will immediately separate it from any of its local congeners. It seems to be restricted to the Tantalus region but should be looked for elsewhere.

2. Syrrhopodon hawaiicus C. Müller, Flora, vol. 82, p. 437, 1896 (fig. 42).

In large dense cushions, pale, whitish green above, light brown below. Stems up to 3 cm. long, laxly erect, usually dichotomously branched, radiculose below. Leaves closely imbricated, erect with strongly crisped points when dry, erect-spreading with incurved points when moist, 3.5 to 4 mm. long by 0.5 mm. wide below, from an oblong or slightly obovate base, quickly narrowed to a linear, grooved point from 1 to 2 times as long as the basal portion, apex obtuse, minutely apiculate, often deformed and bearing small clusters of cylindrical, septate gemmae, bordered all around with a narrow hyaline band of elongated cells; margin erect, coarsely dentate at the extreme apex and then minutely denticulate for a short distance, entire below; costa pale, ending just below the apex, denticulate on the back above, spinose at the extreme point, smooth below; cells of the leaf blade obscure, rounded, densely papillose on both sides, 6 to 8 μ in diameter; cancellinae rounded above, occupying most of the leaf base. Sporophyte unknown.

On trees. Oahu: Manoa Valley (Skottsberg). Maui: ravines, western part of island, altitude 4,000 feet (Baldwin); trail from Haelaau to Nakalalua, western part of island, common (Bartram). Island of Hawaii: trail from Makaopuhi to Napau (Bartram).

Endemic. Type locality, Hawaii.

This species is decidedly more abundant and more widely distributed than any of the others. It is a more robust plant than *S. oahuensis,* growing in looser tufts. Under a microscope it will be distinguished readily by the entire leaf base and nearly smooth costa.

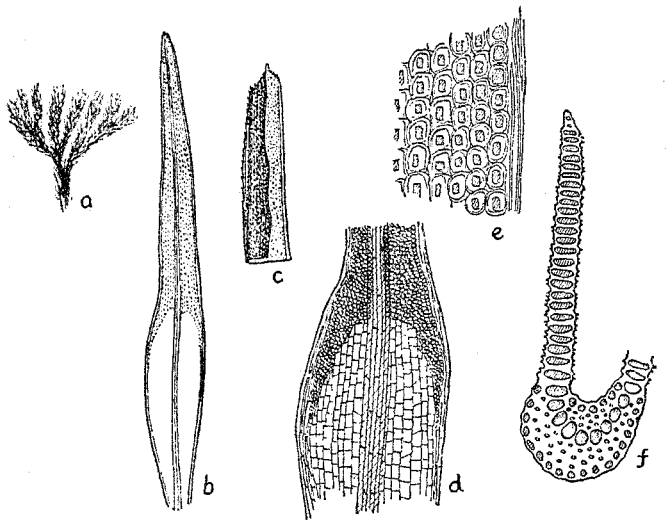


FIGURE 42. *Syrrhopodon hawaiicus* C. Müller: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, leaf base × 60; *e*, upper leaf cells and margin × 300; *f*, part of cross section from upper half of leaf × 300.

3. **Syrrhopodon kilaueae** C. Müller, Abh. Nat. Ver. Bremen, vol. 16, p. 500, 1900 (fig. 43).

Syrrhopodon pellucidus Brotherus, B. P. Bishop Mus., Bull. 40, p. 10, 1927.

In small, laxly cohering tufts, pale green. Stems up to 2 cm. high, erect, simple or branched, slightly radiculose at the base. Leaves erect-spreading and slightly flexuose both wet and dry, up to 5.5 mm. long by 0.3 mm. wide below, from a narrow, oblong base narrowed to a long, slender, slightly grooved, linear point 2.5 to 3 times as long as the basal portion, apex bluntly acute or obtuse, the narrow hyaline border of elongated cells extending from just below the apex to the base; margin erect, serrulate at the extreme apex, otherwise entire; costa stout, brownish, about 60 μ wide in the blade, ending just below the point, frequently with a few cylindrical septate gemmae on the ventral side near the apex, papillose on the back to about the middle of the leaf base, smooth below. Cells of the leaf blade rounded-hexagonal, about 6 μ in diameter, papillose on both sides; cancellinae slightly rounded or ending in rather acute angles above, occupying nearly all of the leaf base. Sporophyte unknown.

On trees. Oahu: ravine along Pupukea-Kahuku trail, altitude 800 feet (Bartram). Island of Hawaii: Hiulani forest, altitude 1,600 feet (Skottsberg); Makahanaloa, Kauku (Skottsberg).

Endemic. Type locality, Kilauea, island of Hawaii.

The longer, erect-spreading, rather strict leaf points of this species are in marked contrast to the strongly crisped leaves of both *S. oahuensis* and *S. hawaiicus*. Plants from the type collection of *S. pellucidus*, which I have seen, agree in every particular with the species.

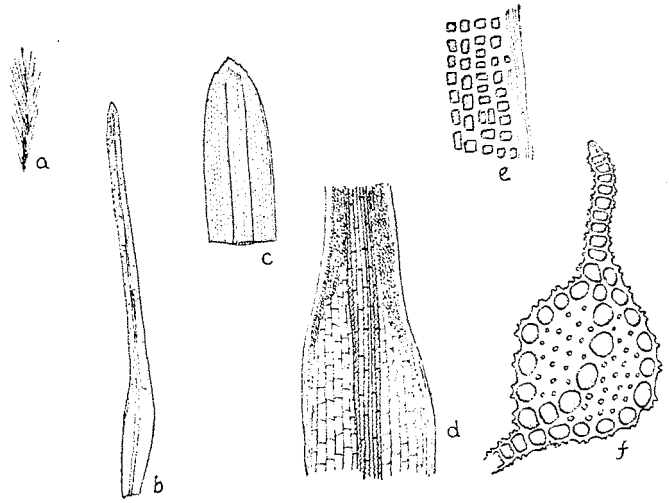


FIGURE 43. *Syrrhopodon kilaueae* C. Müller: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, leaf base × 60; *e*, upper leaf cells and margin × 300; *f*, part of cross section of leaf × 300.

20. THYRIDIUM Mitten, Jour. Linn. Soc., p. 188, 1868; amended by Fleischer, in Laubm. Java, vol. 1, p. 223, 1900-1902.

Slender plants. Primary stems prostrate with erect branches. Leaves crowded, crispate when dry, oblong-ovate from an erect, sheathing, hyaline base, broadly bordered below with a hyaline band of elongated cells; upper cells small, incrassate, papillose, changing abruptly to the cancellinae group of the leaf base. Sporophyte unknown in Hawaii.

1. Thyridium constrictum (Sullivant) Mitten, Jour. Linn. Soc., vol. 10, p. 188, 1868 (fig. 44).

Calymperes constrictum Sullivant, U. S. Expl. Exped., Musci, p. 6. 1859.

Dioicous (?). Relatively slender plants in dense, intricate mats, pale green or yellow above, brownish below, slightly glossy. Stems elongate, prostrate, up to 6 or 7 cm. long, irregularly branched, the branches laxly erect or ascending. Leaves crowded, laxly appressed with crisped points when dry, erect-spreading and distinctly spirally three-ranked when moist, 3 to 3.5 mm. long, broadly ovate-oblong from a clasping, hyaline base, deeply carinate above with the margins broadly and irregularly inflexed,

constricted just below the apex into a narrow, flaring throat, frequently with clusters of reddish brown radicles on the back just below the apex, bordered below with a very wide band of elongated hyaline cells which decreases rapidly in width upward and disappears near the throat; margin erect, minutely denticulate; costa ending in the throat below the broadly rounded apex; cancellinae filling about half the leaf base, broadly rounded above; laminal cells hexagonal, slightly incrassate, densely papillose with numerous small sharp papillae. Sporophyate unknown.

Distribution: Sumatra, Great Natuna Island, Borneo to Hawaii. Type locality, Hawaii.

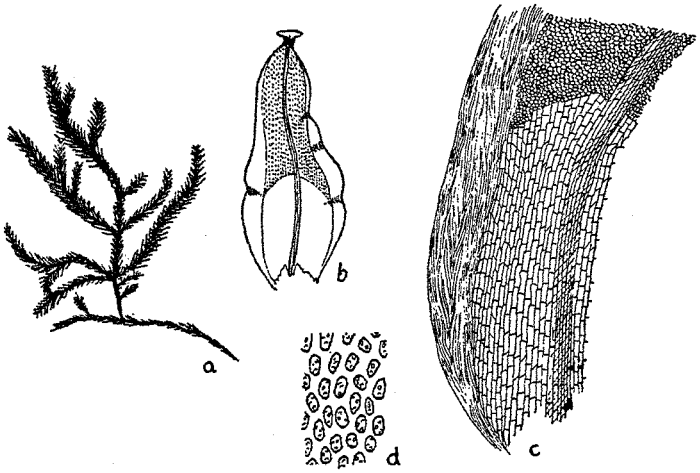


FIGURE 44. *Thyridium constrictum* (Sullivant) Mitten: *a*, plant × ¾; *b*, leaf × 12; *c*, one side of leaf base × 52½; *d*, upper leaf cells × 300.

A unique species that will be recognized at sight by the peculiar constricted, flaring throat below the leaf apex and the wide border of narrow hyaline cells. Apparently the Wilkes Expedition collection, a scrap of which I have seen, is the only record of the species in Hawaii. In the Society Islands, where this species is abundant, it is a plant of comparatively low altitudes. The Hawaiian specimen, presumably, came from a like region.

21. CALYMPERES Swartz, in Schwaegrichen, Suppl. 1, pt. 2, p. 333, 1816.

Plants of variable size growing in tufts or compact cushions. Leaves crispate when dry, lanceolate or ligulate from a broader, pale base; costa stout, percurrent or excurrent in a thick point with clusters of propagula at the apex; upper leaf cells small, rounded, papillose, changing abruptly to the cancellinae cells of the leaf base. Seta erect; capsule erect; peristome none; calyptra campanulate. Fruit unknown in Hawaii.

Small plants, leaves not bordered.....1. **C. tenerum**
Robust plants, leaves with a thickened, serrate border.....2. **C. hawaiiense**

1. Calymperes tenerum C. Müller, Linnaea, p. 144, 1871-1873 (fig. 45).

In dense, soft, extensive mats, dull green above, brown below. Stems simple, erect, about 1 cm. high, sparingly radiculose at the base. Leaves crisped and curled when dry, erect-spreading when moist, mostly abnormal, up to 3 mm. long by 0.75 mm. wide, slightly contracted above the short, broad, lightly clasping base to a broad lingulate point 2 mm. or less long; margin entire, plane or slightly inflexed; costa strong, not tapering upward, about 90 μ wide, convex and very prominent on the back, excurrent into a thick, blunt, scabrous point bearing numerous cylindrical, septate propagula; normal leaves with the costa only percurrent and without propagula are rarely found; basal leaf cells toward the margins in 6 or 7 rows, small, pellucid, short rectangular at the extreme base, gradually becoming quadrate or transversely elongate upward and merging with the dense areolation of the lamina, which is composed of rounded-quadrate thin-walled cells about 7 μ wide, in one layer, lightly papillose on both sides; cancellinae large, short rectangular, about 25 μ wide, thin-walled and hyaline, forming a sharply differentiated group ending abruptly below the top of the leaf base and occupying about two-thirds of its width.

On trees. Kauai: Hanalei beach, on coconut trunks, abundant (Bartram); Haena caves (Bartram).

Distribution: India, Sumatra, Java, Fiji, New Caledonia, Society Islands. Type locality, Calcutta, India.

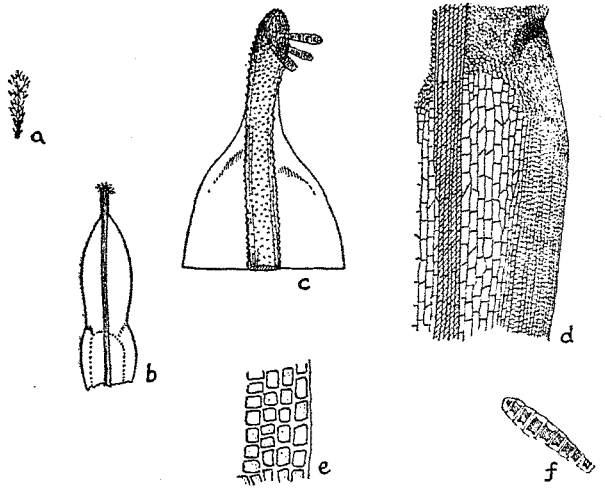


FIGURE 45. *Calymperes tenerum* C. Müller: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, one side of leaf base × 60; *e*, upper leaf cells × 300; *f*, propogulum × 120.

The leaves of this species are almost entirely of the abnormal type in our region. The few normal leaves found after careful search prove to be identical with those from plants from other countries.

2. Calymperes hawaiiense, new species (fig. 46).

C. tahitensi (Sullivant) Mitten affine sed teniola indistincta, ad medium basin folii evanida; cellulae marginales ad basin 2-4-seriatae dentiformes.

Robust plants in large tufts, dark, vivid green above, brown or black below. Stems up to 3 or 4 cm. long, decumbent, sparingly radiculose below, usually branched. Leaves crowded, appressed, with flexuose or crispate points when dry, erect-spreading when moist, the lower much eroded, from a narrow ovate or obovate base gradually narrowed to a linear-lanceolate, grooved point about three times as long as the basal portion, up to 7 mm. long by 0.6 mm. wide below; margin of the leaf blade thickened, distantly serrate with the teeth occasionally in pairs, basal margin erect, not thickened, minutely denticulate by projecting cells; costa stout, 120 μ wide below, percurrent or excurrent in a stout point with clusters of propagula at the apex, smooth on both sides, in cross-section very convex on the dorsal side, with a median row of about eight large guide cells, stereid bands above and below with the outer cells clearly differentiated. Cells of the leaf blade distinct, rounded, incrassate, 5 to 8 μ in diameter, nearly smooth on the dorsal side, mamillose on the ventral side, the marginal rows in several layers forming a thick border, triangular in cross-section; teniolae reduced to a short band in the lower half of the leaf base; cancellinae extending a little beyond the leaf shoulders, rounded or acutely angled above; marginal cells of the leaf base short, lax, irregularly rhomboidal, hyaline, in 2 to 4 rows below, changing abruptly on the inner side toward the lower half of the leaf base to a band of elongated cells, 4 or 5 rows wide, extending from the insertion about halfway up the leaf base between the cancellinae and the short marginal cells. Sporophyte unknown.

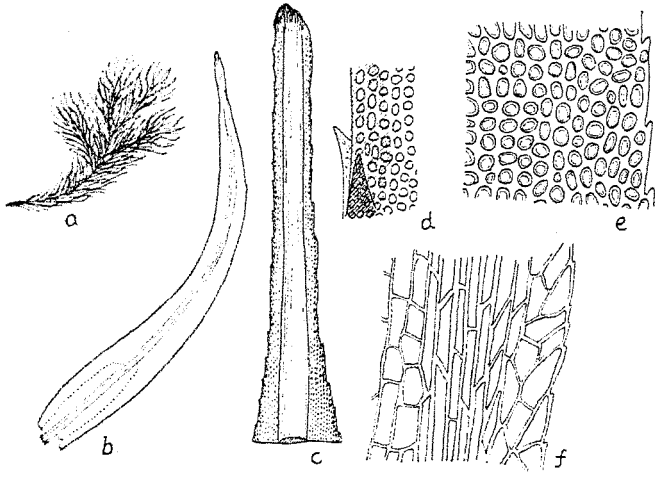


FIGURE 46. *Calymperes hawaiiense* Bartram: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, cells and margin at leaf shoulder × 300; *f*, cells and margin near base × 300.

Type: on wet rocks, Waikane-Schofield trail, Koolau Range, Oahu, altitude about 1,900 feet, January 19, 1930, E. B. Bartram, number 145.

This species shares many of the characters of *C. tahitense* (Sullivant) Mitten, but is distinguished at once by the lack of taeniolae in the upper part

of the leaf base. The intra-marginal bands of elongated cells above the leaf insertion probably represent the remains of teniolae which, in *C. tahitense,* are very distinct and merge with the thickened border of the blade above the shoulders of the leaf.

Family 6. ENCALYPTACEAE

Robust plants growing in dense tufts. Stems erect, branched, radiculose below. Leaves oblong-ligulate, obtuse or apiculate, crispate when dry; margin plane or slightly recurved; costa ending below the apex or excurrent; upper cells hexagonal, densely papillose, basal cells rectangular, hyaline, fragile. Capsule erect, cylindric, on an erect seta; peristome none or single and of 16 reddish teeth; lid subulate-rostrate; calyptra very large and conspicuous, campanulate, straw-colored, fringed or entire at base; spores large.

22. ENCALYPTA Schreber, Hedwig, Sp. Musc., p. 60, 1801.

Encalypta Schreber, Gen. 2, no. 1643, p. 759, 1791.

A single genus with the characters of the family.

Peristome none, leaves obtuse, calyptra not fringed.....1. **E. sandwicensis**
Peristome present, leaves apiculate, calyptra fringed at base.....2. **E. scabrata**

1. **Encalypta sandwicensis** Sullivant, U. S. Expl. Exped., Musci, p. 6, 1859 (fig. 47).

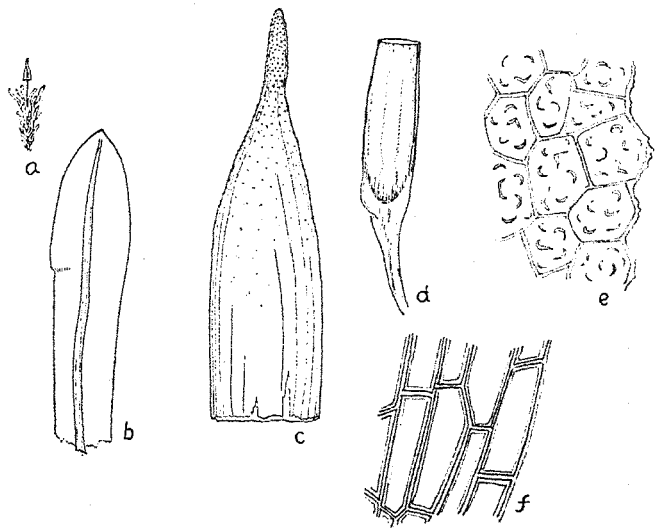


Figure 47. *Encalypta sandwicensis* Sullivant: *a,* plant × ¾; *b,* leaf × 12; *c,* calyptra × 12; *d,* capsule × 12; *e,* upper leaf cells and margin × 300; *f,* basal leaf cells and margin × 300.

Autoicous (?). Dull brownish green plants in dense tufts. Stems about 1 cm. high, branched. Leaves spreading, strongly contorted and crisped when dry, 3 to 4 mm. long, oblong-ligulate, obtuse or rounded at the apex; margin plane, entire near the base, rough with projecting papillae above; costa brownish, ending below the apex; upper leaf cells hexagonal-quadrate, 25 to 35 μ in diameter, with several large multifid or crescent-shaped papillae over the lumen, basal cells hyaline, rectangular. Seta short, reddish, about 4 mm. long; capsule erect, bright brown, cylindric, urn about 2 mm. long, plicate when dry; peristome none; lid long subulate from a short conic base, 1.5 mm. long; calyptra very large, inclosing the whole capsule, about 5 mm. long by 1.5 mm. broad, scabrous about halfway down, straw-colored with a brown tip, nearly entire at the base; spores papillose, 22 to 26 μ in diameter.

Endemic. Type locality, Hawaii.

The obtuse leaves with much larger leaf cells, the striate capsules without any peristome, and the calyptra not fringed at the base will separate this species at once from *E. scabrata.* The only plants I have seen are from the original collection by the Wilkes Expedition.

2. Encalypta scabrata, new species (fig. 48).

Autoicum. Robustiusculum, caespitosum, caespitibus densiusculis, viridibus. Caulis ad 3 cm. longus, inferne dense radiculosis. Folia sicca incurva, contorta, humida patentia, elliptico-oblongo, apiculata, ad 5 mm. longa et 1.5 mm. lata, marginibus inferne anguste recurvis, ad apicem planis, papillosis; nervo lutescente, breviter excedente; cellulis superioribus hexagonis, obscuris, dense papillosis, basilaribus rectangularibus, hyalinis. Seta ad 12 mm. alta; capsula erecta, cylindrica. Calyptra laciniata, superne scaberrima. Spori fusci, papillosi, 30 μ.

Autoicous. Robust plants 2 to 3 cm. high, in dense tufts, bright green above, brown below. Stems branched, densely matted together with radicles in the lower parts. Leaves crowded, 4 to 5 mm. long by 1.5 mm. wide, elliptic-oblong, obtuse or rarely acute, apiculate, strongly undulate-crisped with incurved, twisted points when dry, spreading when moist; margin narrowly recurved to above the middle, plane above and rough with papillae; costa yellowish, glossy on the back when dry, excurrent in a yellowish, not quite entire, apiculate point up to 0.5 mm. long; upper leaf cells hexagonal, 13 to 18 μ in diameter, dense, obscure, very papillose; basal cells rectangular, hyaline, narrower toward the margins, the inner cells tinged with reddish brown, especially on the thickened end walls. Seta 10 to 12 mm. long, yellow when young, becoming reddish with age; capsule erect, cylindric, bright brown, smooth or very slightly striate when dry, urn 3 to 3.5 mm. long; peristome teeth erect when dry, inflexed when moist, red, up to 225 μ long, with 6 to 8 articulations, without a median line; calyptra very large, straw-colored, 5 to 7 mm. long by 1.5 mm. broad, extending below the base of the capsule, fringed at the base with numerous pale brown laciniae about 0.5 mm. long, very scabrous in the upper half and frequently nearly to the base; spores brownish, papillose, 30 μ in diameter.

Maui: within Haleakala crater, rock crevices (Degener); brink of Haleakala, altitude 10,000 feet (Baldwin). Island of Hawaii: Mauna Kea (Wilkes Expedition).

Type: rock crevices below Rest House, Haleakala, Maui, altitude 8,800 feet, February 14-15, 1930, St. John, number 580-a.

Readily identified by the fringed calyptra, excurrent costa, recurved leaf margins, and the presence of a peristome. Sullivant listed this plant as *E. ciliata* among the mosses collected by the Wilkes Expedition, but as Müller suspected, it proves to be a distinct endemic species differing from *E. ciliata* principally in the very scabrous calyptra but also in the longer leaf apiculus.

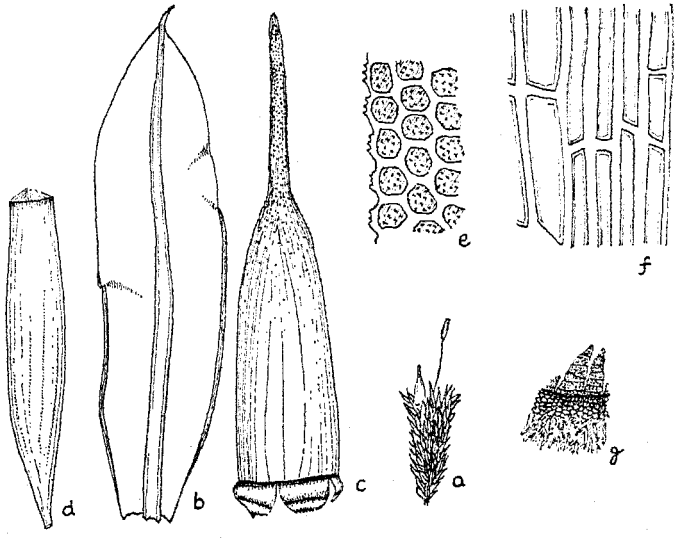


FIGURE 48. *Encalypta scabrata* Bartram: *a*, plant × ¾; *b*, leaf × 12; *c*, calyptra × 12; *d*, capsule × 12; *e*, upper leaf cells and margin × 300; *f*, basal leaf cells and margin × 300; *g*, 2 peristome teeth × 30.

FAMILY 7. POTTIACEAE

Small or medium-sized tufted plants. Stems erect, branched. Leaves crowded, more or less crispate when dry; costa usually strong and excurrent or ending near the apex; upper cells usually small, more or less obscure and papillose; basal cells larger, usually hyaline. Seta elongate, smooth; capsule erect, sub-cylindric, symmetrical; peristome wanting or of 16 straight or spirally twisted teeth, entire or divided into filiform, papillose forks; spores usually small.

1. Leaf margins involute, at least when dry 2
   Leaf margins plane or revolute 3
2. Leaves narrow, peristome present ..... **25. Weisia**
   Leaves broad, peristome none ..... **31. Hyophila**
3. Fruit lateral 4
   Fruit terminal 5

4. Costa smooth, broad below, occupying about one-half of the leaf base..... **23. Molendoa**
   Costa papillose on the back, less than one-half the width of the leaf base..... **24. Anoectangium**
5. Leaf cells smooth, leaves not crispate..... **26. Hymenostylium**
   Leaf cells papillose, leaves crispate..... 6
6. Peristome teeth spirally twisted..... 7
   Peristome teeth straight..... 10
7. Leaves with a border of elongated cells..... **34. Streptopogon**
   Leaves not bordered..... 8
8. Leaves broad, obtuse, 1 to 1.5 mm. wide..... **35. Tortula**
   Leaves narrow, acute or acuminate, 0.5 mm. or less wide..... 9
9. Basal cells hyaline, extending obliquely up the margin..... **29. Tortella**
   Basal cells not hyaline..... **33. Barbula**
10. Upper leaf margin coarsely dentate..... **30. Leptodontium**
    Leaf margin not dentate..... 11
11. Leaf margins recurved..... **32. Didymodon**
    Leaf margins plane..... 12
12. Leaves obtuse, up to 3 mm. long..... **27. Trichostomum**
    Leaves long acuminate, up to 12 mm. long..... **28. Pseudosymblepharis**

23. MOLENDOA Lindberg, Utkast, p. 29, 1878.

Robust, densely tufted plants with simple or branched stems, radiculose below. Leaves crispate when dry, linear-lanceolate, acute; costa stout, ending just below the apex; basal cells rectangular, smooth; upper cells subquadrate, incrassate, papillose, obscure. Seta lateral; capsule erect; peristome none. (Fruit not known in Hawaii.)

1. **Molendoa crassinervis** Brotherus, B. P. Bishop Mus., Bull. 40, p. 11, 1927 (fig. 49).

Robust plants growing in dense, deep tufts, deep green or glaucous green above, brown below. Stems up to 3 cm. high, without a distinct central strand, simple or dichotomously branched, densely reddish tomentose, lightly matted together below, fragile. Leaves crisped with incurved points when dry, erect-spreading when moist, linear-lanceolate, acute, carinate-concave, up to 2 mm. long by 0.25 mm. wide; margin erect or slightly recurved on one side toward the base, entire; costa very strong, brown, about 100 μ wide below, occupying about one-half the width of the leaf base, prominent at the back, ending just below the apex, in cross-section showing a median row of 5 or 6 large guide cells with thick bands of stereid cells on both sides, the surface layers larger and well differentiated; upper cells angular, quadrate or hexagonal, incrassate, papillose, at the extreme base short rectangular, smooth. Sporophyte unknown.

Damp rock crevices. Oahu: Nuuanu Pali (Bartram). Maui: Iao Valley (Bartram); Honokohau ditch trail, western part of island (Bartram).

Endemic. Type locality, Hawaii.

The distinguishing mark of this species is the very stout brown costa which is about twice as wide as in the local species of *Anoectangium* and *Hymenostylium*.

Molendoa is distinguished from *Anoectangium* by the presence of a large central strand in the stem and a median row of numerous guide cells in the costa. With respect to this interpretation *M. crassinervis* is irrelevant, as the stems show no central strand. The costa, however, is provided with a

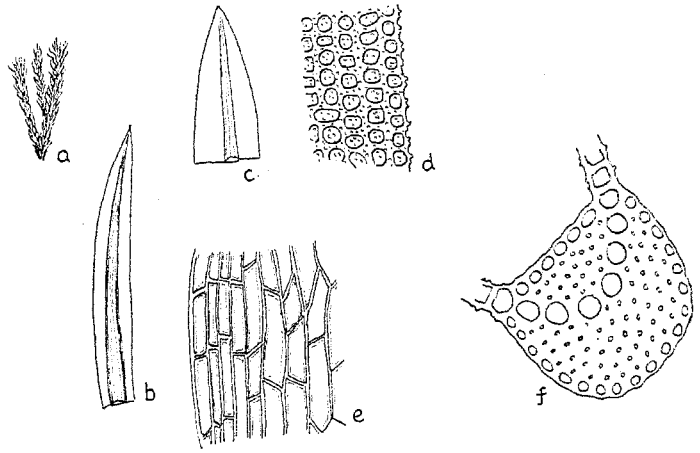


FIGURE 49. *Molendoa crassinervis* Brotherus: *a*, plant × ¾; *b*, leaf 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300; *f*, cross section of costa × 300.

distinct median row of guide cells which, in connection with the more robust habit, will identify the species without much trouble irrespective of its generic affiliations.

24. ANOECTANGIUM (Hedwig) Bruch and Schimper, Bryol. Eur., fasc. 29-30, 1846.

Rather small, rupestrine plants, in dense mats. Leaves linear or ligulate; costa percurrent or nearly so; cells small, obscure, papillose. Seta lateral, slender, elongate; capsule small, erect; peristome none; calyptra cucullate.

Leaves obtuse, mucronate, areolation opaque.....1. **A. euchloron**
Leaves acute, areolation pellucid.....2. **A. haleakalae**

1. **Anoectangium euchloron** (Schwaegrichen) Mitten, Jour. Linn. Soc., vol. 12, p. 176, 1869 (fig. 50).

   Gymnostomum euchloron Schwaegrichen, Suppl. 2, pt. 2, p. 83, 1826.

   Anoectangium skottsbergii Brotherus, B. P. Bishop Mus., Bull. 40, p. 11, 1927.

Dioicous. Plants growing in dense extensive mats, yellowish green above, brown below. Stems erect, flexuose, densely radiculose below, simple or sparingly branched, up to 2.5 cm. high. Leaves erect, flexuose with incurved points, crisped and spirally

contorted when dry, rather widely spreading when moist, oblong-ligulate, carinate, obtuse, mucronate, about 1.25 mm. long by 0.25 mm. wide; margin plane, slightly sinuate, minutely crenulate with papillae; costa prominent at back and scabrous almost to the base, about 40 μ wide below, percurrent or ending just below the apex; areolation very opaque, leaf cells obscure, incrassate, densely papillose, at the base short rectangular toward the margins, a few juxta-costal cells elongate, pellucid, quickly becoming smaller and irregularly transversely rectangular upward, the upper cells very obscure, quadrate-hexagonal, about 5 μ in diameter. Perichaetial leaves acute; seta lateral, yellowish, 6 mm. long; capsule erect, oblong-cylindric, urn 0.8 mm. long; peristome none; annulus none; lid subulate-rostrate, as long as the urn; calyptra cucullate; spores papillose, 10 to 12 μ in diameter.

Damp ledges and banks. Maui: Iao Valley, western part of island (Bartram); pipe line back of Lahainaluna School (Bartram); Honokohau ditch trail, western part of island (Bartram). Lanai: (Forbes). Island of Hawaii: vicinity of Kilauea, frequent (Bartram); Wailuku River, Hilo (Bartram).

Distribution: tropical America, Java, Philippines, Africa. Type locality, Guadeloupe, West Indies.

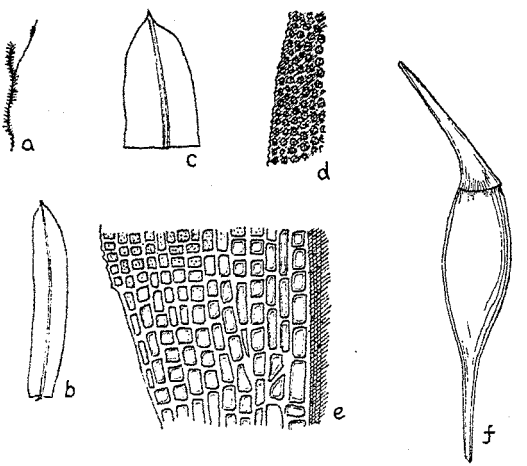


FIGURE 50. *Anoectangium euchloron* (Schwaegrichen) Mitten: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 300; *f*, capsule × 25½.

The obtuse, mucronate leaves, narrower nerve, and very opaque, obscure areolation will separate this species from *A. haleakalae*. The distinctions between *A. skottsbergii* and *A. euchloron*, a common tropical species of wide distribution, are, however, not so clear. The salient characters of *A. skottsbergii* are exactly those of *A. euchloron* and I do not see how our plants can be separated from this species.

2. **Anoectangium haleakalae** (C. Müller) Paris, Ind. Bryol., Suppl., p. 12, 1900 (fig. 51).

Zygodon haleakalae C. Müller, Flora, vol. 82, p. 450, 1896.

Dioicous (?). Male flowers unknown. Plants growing in dense, extensive mats or tufts, yellowish-green above, brown below. Stems simple or branched, erect or ascending, slightly flexuose, matted together in the lower parts with radicles, up to 2.5 or 3 cm. long. Leaves densely imbricated, erect, flexuose with incurved points when dry, erect-spreading when moist, linear, carinate, acute or short acuminate, about 1.5 mm. long by 0.2 to 0.25 mm. wide; margin plane, slightly sinuate, minutely crenulate with papillae; costa strong, yellow, about 60 μ wide at base, ending just below the apex or percurrent; aerolation incrassate, pellucid, narrowly rectangular and almost smooth at the extreme base, quickly becoming shorter upward, the upper cells quadrate-hexagonal or transversely oval, 5 to 8 μ in diameter, densely papillose, rather obscure, but not as opaque as in the previous species. Perichaetial leaves shorter than the stem leaves, erect, sheathing, acuminate, areolation more elongate and smooth; seta lateral, slender, yellowish, about 8 mm. long; capsule erect or slightly inclined, ovoid-cylindric, tapering to a short neck, about 1.25 mm. high by 0.6 mm. wide, greenish brown with a shining, reddish-brown mouth, exothecial cells rectangular, thin-walled, several rows around the rim small, with thickened, colored walls; peristome none; annulus none; spores nearly smooth, 8 to 12 μ in diameter.

Maui: Puu Nianiau, Haleakala (Forbes); Ukulele, Haleakala (Forbes). Endemic. Type locality, Halekala, Maui.

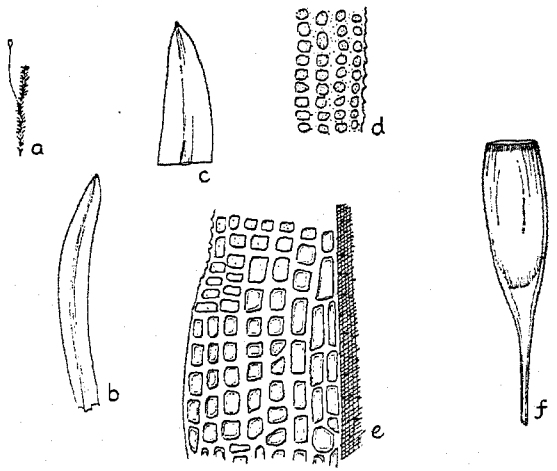


FIGURE 51. *Anoectangium haleakalae* (C. Müller) Paris: a, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 300; *f*, capsule × 25½.

Anoectangium haleakalae variety **laxulum**, new variety.

Caulis longioribus, flexuosis; folia caulina laxiuscula imbricata e cellulis majoribus; nervo pallido, gracilioribus.

Usually more robust than the species, stems longer, more flexuose and laxly

spreading; leaves rather loosely imbricated, more flexuose, relatively wider, areolation larger and more pellucid, upper leaf cells up to 8 μ in diameter; costa relatively narrower and paler.

Oahu: Waikane-Schofield trail, Koolau Range, altitude about 1,200 feet (Bartram). Maui: east of Ukulele, Haleakala (Forbes). Island of Hawaii: vicinity of Kilauea, dripping ledges (Bartram, type).

This form may usually be distinguished from the species by the more robust, laxer habit and when well-developed has a very close superficial resemblance to *Zygodon tetragonostomus*. It seems to show a preference for very wet habitats, and though intergrades are not infrequent the distinctions are marked enough to merit segregation.

25. WEISIA Hedwig, Sp. Musc., p. 64, 1801.

Small plants in rather dense tufts. Leaves linear-lanceolate with involute margins, crispate when dry; basal cells rectangular, hyaline; upper cells small, papillose, obscure. Seta terminal, erect, elongate; capsule small, erect; peristome of 16 more or less rudimentary, papillose teeth; lid conic-rostrate; calyptra cucullate.

Peristome teeth well developed, up to 200 μ high.....1. **W. viridula**
Peristome teeth very rudimentary, from a low basal membrane.....2. **W. ovalis**

1. **Weisia viridula** Hedwig, Sp. Musc., p. 68, 1801 (fig. 52).
Bryum viridulum Linnaeus, Sp. Pl., vol. 2, p. 1119, 1753.

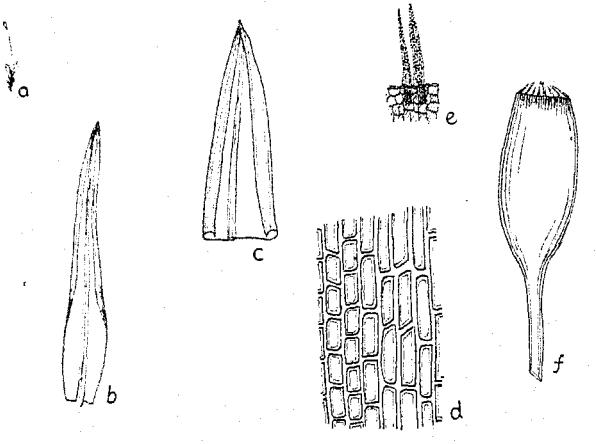


FIGURE 52. *Weisia viridula* Hedwig: *a*, plant × 3/4; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, basal leaf cells × 300; *e*, 2 peristome teeth × 60; *f*, capsule × 25½.

Autoicous. Small, bright green plants in dense tufts or cushions. Stems erect, up to 5 mm. high. Leaves strongly crisped when dry, erect-spreading when moist, linear-

lanceolate from a short, pale base, mucronate, about 2 mm. long; margin erect below, narrowly involute above; costa yellowish, 45 to 60 μ wide below, excurrent in a short mucro; basal cells rectangular, hyaline; upper cells rounded, 7 to 8 μ in diameter, obscure, papillose. Seta 4 to 8 mm. long, yellow; capsule oval, urn about 0.8 mm. long, brown; peristome teeth up to 200 μ long, inserted below the rim, brownish, papillose; spores brown, papillose, 15 to 18 μ in diameter.

Banks and thin soil. Oahu: east side of Manoa Valley (Bartram). Island of Hawaii: frequent on banks and in lava seams, vicinity of Kilauea (Bartram). Kauai: near power plant, on ground (Bartram).

Cosmopolitan. Type locality, Europe.

It is not surprising to find this well-known cosmopolitan species in Hawaii, although it does not seem to have been previously credited to the local flora.

2. **Weisia ovalis** (R. S. Williams), new combination (fig. 53).
Hymenostomum ovale R. S. Williams, Bull. Torr. Bot. Club, vol. 42, p. 576, 1915.

Dioicous (?). Male flower terminal. In rather dense, bright green tufts. Stems simple or branched from the extreme base, erect, 2 to 4 mm. high, radiculose below. Lower leaves small, rapidly enlarging upward, the upper leaves crowded, very crispate when dry, erect-spreading when moist, linear or linear-lanceolate from a short, pale base, acute, mucronate, up to 2.5 mm. long by 0.4 mm. wide; margin erect below, rather broadly involute above; costa up to 60 μ wide toward the base, excurrent in a short upturned mucro; upper leaf cells chlorophyllose and papillose, obscure, quadrate-hexagonal, 8 to 10 μ in diameter, basal cells rectangular, with firm walls, hyaline or pellucid. Perichaetial leaves slightly longer than the stem leaves, with a longer subclasping base; seta yellow, 4-8 mm. long; capsule oval, urn about 1 mm. long, brown, glossy, with a reddish mouth, exothecial cells rectangular and hexagonal, thin-walled, several rows around the mouth much smaller with thickened, reddish brown walls; peristome of 16 rudimentary, blunt teeth, pale and papillose, up to 10 or 12 μ long from the edge of a narrow basal membrane inserted below the rim; annulus none; lid conic-rostrate, slightly oblique, nearly as long as the urn; calyptra pale, cucullate, extending below the middle of the urn; spores brown, papillose, 15 to 24 μ in diameter.

Banks, rocks, and ledges. Oahu: Honolulu (Leiberg, type); Nuuanu Pali (Heller; Degener; Forbes; Bartram); Makiki (Heller). Molokai: near Waiahewahewa (Degener); along Hanakea trail (Degener). Maui: pipe line, Lahainaluna School (Bartram). Lanai: (Forbes). Island of Hawaii: Niulii, Kohala, near sea level (Degener); edge of Kilauea crater (Bartram). Kauai: between Hanapepe and Wahiawa rivers (Heller); rocks near Haena caves (Bartram).

Endemic. Type locality, Honolulu, Oahu.

Very similar to *W. viridula* in general appearance but with somewhat wider leaves and more broadly incurved margins. Williams described this species as having no peristome, but plants from the original collection and supplementary gatherings in perfect fruiting condition show the peristome as

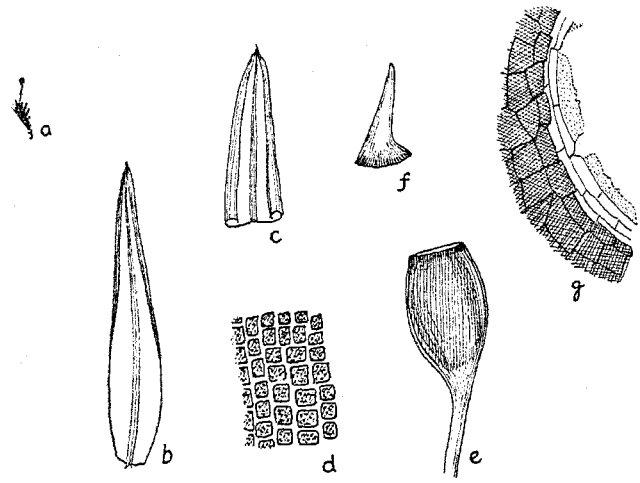


FIGURE 53. *Weisia ovalis* (R. S. Williams) Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells × 300; *e*, capsule × 25½; *f*, lid × 25½; *g*, part of peristome and rim from above × 300.

described above. It may be viewed best microscopically by cutting off the top of the capsule just below the rim and looking down on the ring which corresponds to the mouth of the capsule. The very rudimentary teeth, which do not project above the rim, are readily seen in this way.

26. HYMENOSTYLIUM Bridel, Bryol. Univ., vol. 2, p. 81, 1827; amended by Lindberg, Trichost., p. 230, 1864.

Slender, compactly tufted plants. Leaves crowded, linear-lanceolate, slightly flexuose but not crisped when dry; costa percurrent or nearly so; cells narrowly rectangular, papillose or smooth. Seta slender, elongate; capsule erect; peristome none.

1. **Hymenostylium firmum** (C. Müller) Brotherus, in herbaria (fig. 54). *Zygodon firmus* C. Müller, Flora, vol. 82, p. 450, 1896.

Dioicous. Slender, fragile plants in deep, compact, brownish tufts. Stems smooth, up to 1 to 1.5 cm. long, erect, tomentose, but readily separating, simple or dichotomously branched, branches erect; leaves crowded, erect, a little flexuose when dry, rigidly erect-spreading when moist, linear-lanceolate, gradually tapering to an acuminate point, carinate, 1.8 mm. long by 0.3 mm. wide; margin entire, usually recurved on one side below; costa yellowish, smooth, about 50 μ wide at base, percurrent; lower leaf cells long rectangular and linear, incrassate, pellucid, the upper very distinct, irregular, long rectangular toward the costa with thick sinuose walls, up to 5 μ wide by 3 to 4 times as long, shorter and sub-quadrate in several rows at the margins, essentially smooth. Fruit unknown.

Damp rocks. Maui: near Rest House, Haleakala (St. John).

Endemic. Type locality, Hawaii.

These plants differ but slightly from *Hymenostylium curvirostre* variety *commutata* and may have to be united with this widely distributed species when additional and better collections are available for comparative study.

Distinct from the local species of both *Anoectangium* and *Amphidium* in the smaller, more rigid leaves and the smooth, pellucid areolation.

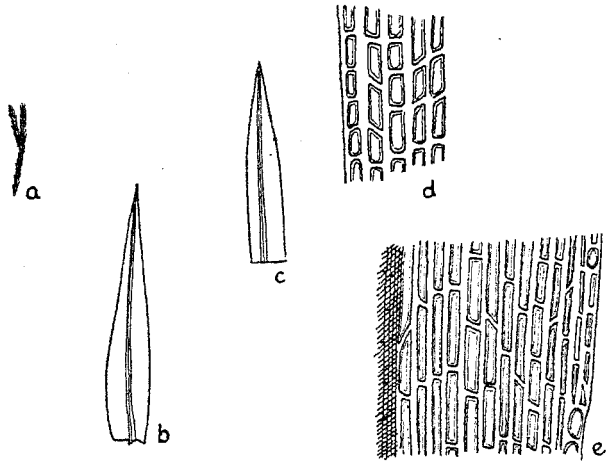


FIGURE 54. *Hymenostylium firmum* (C. Müller) Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 300.

27. TRICHOSTOMUM Hedwig, Sp. Musc., p. 107, 1801.

Medium-sized plants in dense tufts. Leaves crispate when dry, more or less fragile, usually narrow and elongate, mucronate; costa stout, short excurrent; basal cells rectangular, pellucid or hyaline; upper cells small, papillose and very obscure. Capsule sub-cylindric on an elongate, erect seta; peristome teeth 16, divided almost to the base into 32 erect, filiform, papillose, slightly united forks.

Leaves linear-lanceolate, fragile ..... **1. T. mauiense**
Leaves oblong-lanceolate, not fragile ..... **2. T. oblongifolium**

1. **Trichostomum mauiense** Brotherus, B. P. Bishop Mus., Bull. 40, p. 12, 1927 (fig. 55).

Dioicous. In dense tufts, yellowish green tinged with brown above, dark brown below. Stems erect, up to 1.5 cm. high, usually dichotomously branched, radiculose below. Leaves crowded, fragile, circinate-incurved when dry, erect-spreading when moist, linear-lanceolate from a short concave hyaline base, carinate-concave, acute or

obtuse, mucronate, up to 4 mm. long by 0.4 mm. wide; margin erect, entire at the base, papillose-crenulate and slightly sinuate and undulate above; costa yellowish, smooth, about 75 μ wide below, excurrent in a very short mucro; upper leaf cells rounded-quadrate, obscure, densely papillose, 8 to 10 μ in diameter; basal cells rectangular, hyaline, smooth, 10 to 12 μ wide by 4 to 6 times as long, not or very little higher at the margins than toward the costa. Sporophyte unknown.

Rocks. Maui: near Rest House, Haleakala (Skottsberg, type; St. John); valleys, western part of island (Baldwin). Island of Hawaii: ledges, Bird Park, Kilauea (Bartram); roadside rocks, vicinity of Kilauea (Bartram). Kauai: Waimea drainage basin, western side (Forbes).

Endemic. Type locality, Haleakala, Maui.

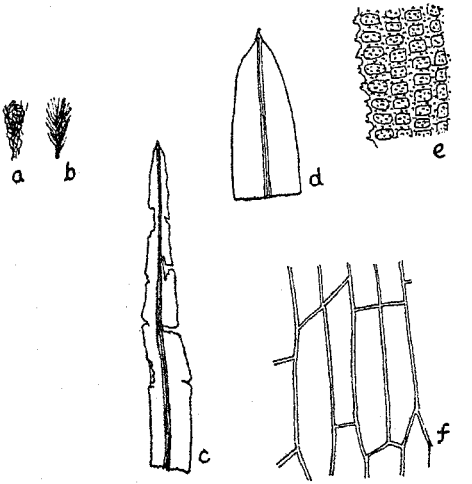


FIGURE 55. *Trichostomum mauiense* Brotherus: *a*, dry plant × ¾; *b*, moist plant × ¾; *c*, leaf × 12; *d*, apex of leaf × 60; *e*, upper leaf cells and margin × 300; *f*, basal leaf cells × 300.

Until fruit is available the exact status of this and the following species cannot be satisfactorily settled, as the peristome plays an important role in the specific determinations. The shape of the leaf tip varies from acute to broadly rounded. As far as the sterile plants are concerned, it is hard to see how they can be separated from *T. stenophyllum* (Mitten) of Java and India.

Brotherus (4, p. 260) seems to have inadvertently given *Barbula mauiensis* C. Müller as a name-bringing synonym for this species and has still further confused the synonymy by publishing *Pseudosymblepharis mauiensis* (C. Müller under *Trichostomum*) (2, p. 12) when the proper name-bringing synonym of this species is *Barbula mauiensis* C. Müller (2, p. 36). *Pseudosymblepharis mauiensis* (C. Müller) is a very different plant with greatly

elongated stems and long, slender, acuminate leaf points. The confusion can only be accounted for by the identity of the specific names.

2. **Trichostomum oblongifolium,** new species (fig. 56).

Caulis ad 2.5 cm. altus, simplex vel dichotome ramosus. Folia haud fragilia, sicca incurva, humida patentia, oblongo-lanceolata, carinato-concavo, ad 3 mm. longa et 0.7 mm. lata, mucronata; marginibus erectis vel ad apicem incurvis, nervo breviter excedente, dorso papilloso; cellulis basilaribus rectangularibus, pellucidis, laminalibus quadratis, obscuris, dense papillosis, incrassatis, 5-6 μ. Caetera ignota.

Dioicous. Tufts dense, bright yellowish green above, brown below. Stems up to 2.5 cm. high, simple or dichotomously branched, radiculose below. Leaves erect with incurved points when dry, widely spreading when moist, not fragile, oblong-lanceolate from a short, scarcely differentiated base, carinate-concave, obtuse, mucronate, up to 3 mm. long by 0.7 mm. wide; margin erect, narrowly incurved just below the apex, but not forming a cucullate point, entire at base, papillose-crenulate above; costa very strong, brownish, up to 110 μ wide below, excurrent in a short mucro, minutely papillose on the back above; basal leaf cells rectangular with firm pellucid walls, not hyaline, gradually becoming smaller and quadrate or transversely rectangular upward, with incrassate walls; upper cells quadrate, very obscure, incrassate, densely papillose, 5 to 6 μ in diameter. Sporophyte unknown.

Maui: Iao Valley, western part of island (Bartram); Honokohau ditch trail, ledges, western part of island (Bartram).

Type: roadside rocks south of Pahoehoe, Kau, island of Hawaii, altitude about 400 feet, January 30, 1930, E. B. Bartram, number 336.

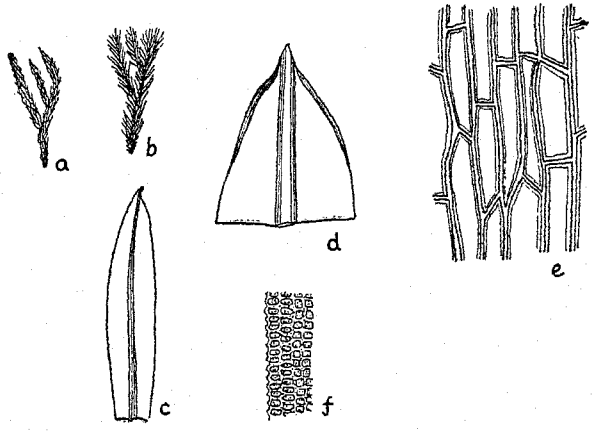


FIGURE 56. *Trichostomum oblongifolium* Bartram: *a*, dry plant × ¾; *b*, moist plant × ¾; *c*, leaf × 12; *d*, apex of leaf × 60; *e*, basal leaf cells × 300; *f*, upper leaf cells and margin × 300.

Distinct from *T. mauiense* in the broader, less fragile leaves and different basal areolation. Resembling *T. brachydontium* Bruch, but an uncertain species until the peristome characters are known.

28. PSEUDOSYMBLEPHARIS Brotherus, Engler and Prantl, Pflanzenf., 2d ed., vol. 10, p. 261, 1924.

Slender plants with elongated flexuose stems growing in large masses. Leaves fragile, crispate when dry, abruptly narrowed from the short, erect base to a long, slender, flexuose, entire point; costa excurrent; basal cells rectangular, thin-walled; upper cells small, densely papillose, obscure. Fruit unknown in Hawaii.

1. **Pseudosymblepharis mauiensis** (C. Müller) Brotherus, B. P. Bishop Mus., Bull. 40, p. 12, 1927 (fig. 57).
Barbula mauiensis C. Müller, Flora, vol. 82, p. 449, 1896.
Tortella dilatata Brotherus, Bull. Soc. Bot. Ital., p. 24, 1904.

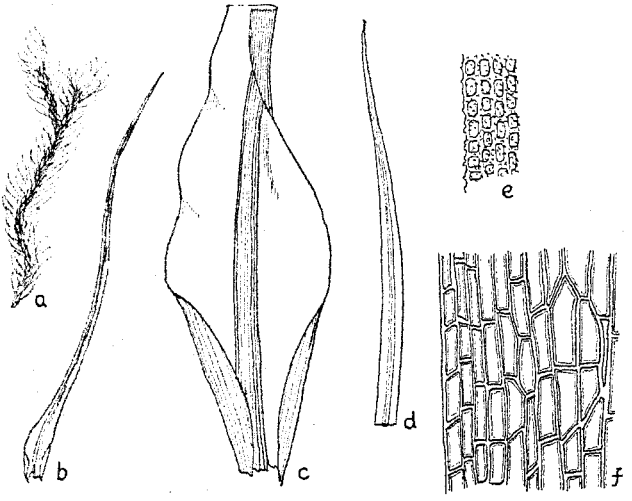


FIGURE 57. *Pseudosymblepharis mauiensis* (C. Müller) Brotherus: *a*, plant × ¾; *b*, leaf × 9; *c*, leaf base × 60; *d*, apex of leaf × 60; *e*, upper leaf cells and margin × 300; *f*, basal leaf cells and margin × 300.

Dioicous (?). Male flowers not seen. Slender feathery plants growing in deep loose tufts, yellowish green above, brown below, scarcely glossy, stems up to 5 cm. or more long, flexuose, simple or dichotomously branched, sparsely radiculose below. Leaves long, erect-spreading with strongly twisted and contorted points when dry, fragile, widely flexuose-spreading when moist, up to 12 mm. long, from a short, erect oblong or obovate, clasping base, 1 to 1.5 mm. long, abruptly narrowed to a grooved, linear-lanceolate blade, very gradually narrowed to a slender, sharp point formed by the excurrent costa; margin erect, minutely papillose-crenulate; costa strong, yellow, 150 μ wide near the base, smooth on the back, excurrent; upper leaf cells rounded-quadrate, thin-walled, obscure, densely papillose; more elongate, slightly sinuose and incrassate with yellowish pellucid walls toward the leaf shoulders; lower cells narrowly oblong with thin, delicate walls, almost hyaline, extending about halfway up the leaf

base, but not appreciably higher at the margins than toward the costa. Sporophyte unknown.

Damp, shaded rock ledges. Oahu: Waikane-Schofield trail, Koolau Range, altitude 1,500 feet (Bartram); Makeleha Valley, Waianae Mountains (Skottsberg). Maui: valleys in western part of island, altitude 3,500 feet (Baldwin, type); Haleakala, eastern part of island (Baldwin); Iao Valley, western part of island, altitude 1,200 feet (Bartram).

Endemic. Type locality, western Maui.

The elongated stems and long, slenderly pointed leaves, abruptly narrowed above the short erect base, make the identification of this plant a simple matter, but since no fruit has been found its systematic position must, unfortunately, remain uncertain. The plant is certainly very distinct from either of our local species of *Trichostomum* and seems to fit very well in *Pseudosymblepharis* as far as the vegetative structure is concerned.

29. TORTELLA (C. Müller) Limpricht, Laubm., vol. 1, p. 599, 1888.

Barbula section *Tortella* C. Müller, Syn., vol. 1, p. 599, 1849.

Medium-sized terrestrial, tufted plants. Leaves spirally twisted with incurved points when dry, oblong-lanceolate, mucronate; costa excurrent; basal cells rectangular, hyaline, extending obliquely up the margins, sharply differentiated from the small, papillose, obscure upper cells. Capsule erect on an elongate seta; peristome teeth 16, from a low basal membrane, divided to the base into 32 filiform, papillose branches, spirally twisted; lid rostrate.

1. **Tortella caespitosa** (Schwaegrichen) Limpricht, Laubm., vol. 1, p. 600, 1888 (fig. 58).

Barbula caespitosa Schwaegrichen, Suppl. 1, pt. 1, p. 120, 1811.

Autoicous. Male flower on a short stalk just below the perichaetium. In small tufts, bright green or yellowish green above, brownish below. Stems up to 6 or 8 mm. high, radiculose below. Leaves crowded, spirally contorted with incurved points when dry, erect-spreading when moist, oblong-lanceolate, bluntly acute, mucronate, concave, about 4 mm. long by 0.5 mm. wide; margin erect, often broadly inflexed, crenulate-papillose above, entire below; costa excurrent in a short mucro; basal cells rectangular, thin-walled, hyaline, extending obliquely up the margins much higher than toward the costa; upper cells obscure, rounded-hexagonal, densely papillose, 6 to 8 μ in diameter. Seta yellow, becoming reddish with age; capsule erect, ovoid-cylindric, urn 2.5 mm. long; peristome teeth long, spirally twisted; lid rostrate, 1.5 mm. long.

Damp shaded rocks. Maui: along pipe line back of Lahainaluna School (Bartram). Island of Hawaii: vicinity of Pahoehoe and Kealakekua, southern Kona (Bartram); near Hookena, Kau (Bartram); Kipuka Neenee (Bartram).

Distribution: Europe, North America, northern Africa, Asia. Type locality, Pennsylvania.

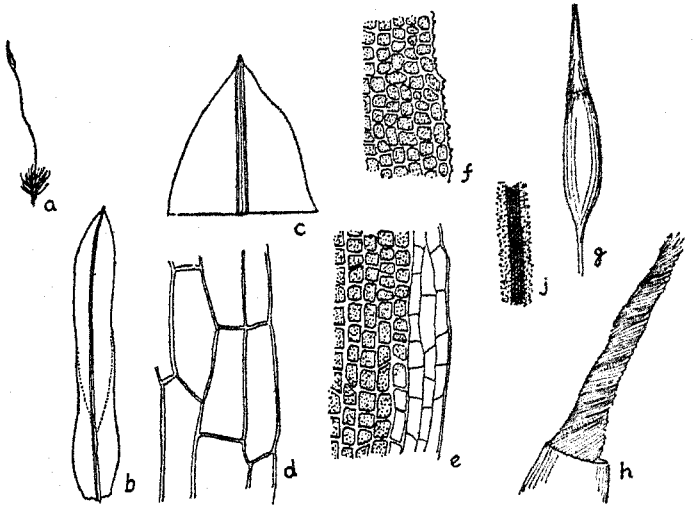


FIGURE 58. *Tortella caespitosa* (Schwaegrichen) Limpricht: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, basal leaf cells and margin × 300; *e*, leaf cells and margin about 1/3 up × 300; *f*, upper leaf cells and margin × 300; *g*, capsule × 9; *h*, peristome × 25½; *j*, part of peristome tooth × 300.

Although this well-known species has not been credited to Hawaii, I found it fairly common in the south and west portions of the island of Hawaii. It will be easily recognized by the long twisted peristome and the hyaline cells of the leaf base ending in a V above, as contrasted with the local species of *Trichostomum* in which the cells of the leaf base are no higher toward the margins than near the costa.

30. LEPTODONTIUM Hampe, Linnaea, vol. 20, p. 70, 1847.

Small, densely tufted plants with oblong-ligulate leaves, coarsely serrate in the upper third, crispate when dry; costa strong, ending just below the apex; basal cells linear or rectangular, pellucid, quickly changing to the small rounded, papillose, obscure upper cells. Capsule erect on an elongate seta; peristome teeth smooth or faintly papillose, divided nearly to the base into two more or less united forks. Fruit unknown in Hawaii.

1. Leptodontium brevicaule, new species (fig. 59).

Caespites densi, flavescentes. Caulis erectus, ad 5-6 mm. longus; folia sicca crispata, humida erecto-patentia, oblongo-ligulata, acuta, ad 2 mm. longa, caniculato-concava; marginibus recurvis, superne grosse serratis; costa basi 90-100 μ lata, dorso papillosa,

sub apice evanida; cellulis rotundato-quadratis, 6-8 μ, dense papillosis, obscuris, basilaribus juxta costatis linearibus, ad margines rectangularibus et quadratis, laevibus. Caetera ignota.

Dioicous (?). Small plants growing in dense tufts, yellow above, dark brown or blackish below. Stems short, up to 5 or 6 mm. high, erect, usually branched above, radiculose below. Leaves crowded, crisped and contorted when dry, erect-spreading when moist, oblong-ligulate, acute, carinate-concave, 1.5 to 2 mm. long by 0.5 mm. wide; margin recurved about two-thirds of the way up, erect and coarsely serrate above; costa strong, yellowish, 90 to 100 μ wide at base, ending just below the apex, papillose on the back; upper leaf cells rounded-quadrate, densely papillose, obscure, 6 to 8 μ in diameter, at the extreme base smooth and pellucid, linear near the costa, becoming short rectangular and quadrate toward the margins. Fruit unknown.

Type: on rock, Bird Park, Kilauea, Hawaii, altitude 4,200 feet, January 26, 1930, E. B. Bartram, number 273.

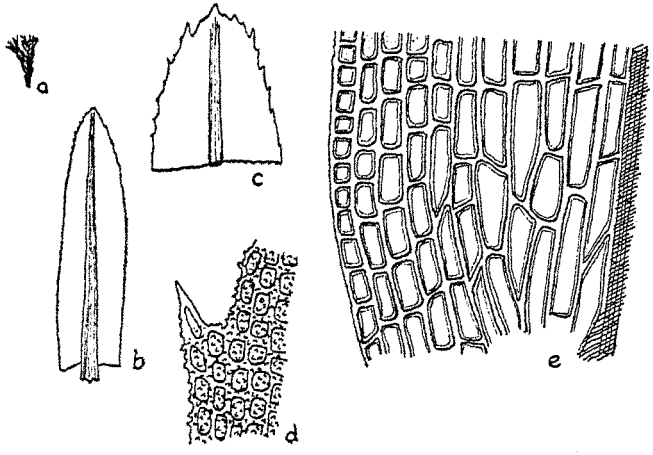


FIGURE 59. *Leptodontium brevicaule* Bartram: *a*, plant ×¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 300.

A unique local species somewhat resembling *Anoectangium euchloron* but easily known by the coarsely serrate leaves.

The Hawaiian plant is close to *L. warnstorfii* Fleischer, of Java, but is, I think, quite distinct in the more broadly pointed and more coarsely serrate leaves.

31. HYOPHILA Bridel, Bryol. Univ., vol. 1, p. 760, 1826.

Medium-sized, dark green plants, growing in dense tufts on damp rocks. Leaves crispate when dry, with strongly involute margins, oblong-ligulate, obtuse, usually toothed near the apex; costa excurrent in a short mucro, rough on the back; basal cells rectangular, pellucid; upper cells small, incrassate, papillose. Capsule cylindric, exserted on a long seta; peristome none. Fruit unknown in Hawaii.

1. **Hyophila dozy-molkenboeri** Fleischer, Laubm. Java, vol. 1, p. 328, 1900-1902 (fig. 60).

Dioicous. Dark green, scarcely glossy plants in dense cushions, brown in the lower parts. Stems erect or reclining, 1 to 1.5 cm. high, slightly radiculose below; leaves crowded, not in comal tufts, variously twisted and contorted with incurved points and strongly involute margins when dry, widely spreading when moist, oblong-ligulate, slightly concave, obtuse, about 3 mm. long by 1 mm. wide, frequently broadly inflexed on one side at the short sub-clasping base; margin erect, entire below, denticulate above; costa yellowish brown, up to 120 μ wide below, scabrous on the back above, excurrent in a short, sharp mucro; upper leaf cells dense, incrassate, rounded-quadrate, 7 to 10 μ in diameter, slightly papillose, toward the base rectangular with thickened, yellowish, pellucid walls.

Wet rocks at low altitudes. Oahu: Nuuanu Pali (Bartram); Waikane-Schofield trail, Koolau Range (Bartram). Maui: near Waikamoi, eastern part of island (Bartram); pipe line back of Lahainaluna School (Bartram). Island of Hawaii: vicinity of Hilo, frequent (Bartram); Waiohinu, Kau (Bartram). Kauai: power plant (Bartram).

Distribution: Sumatra, Java, Amboina. Type locality, Amboina.

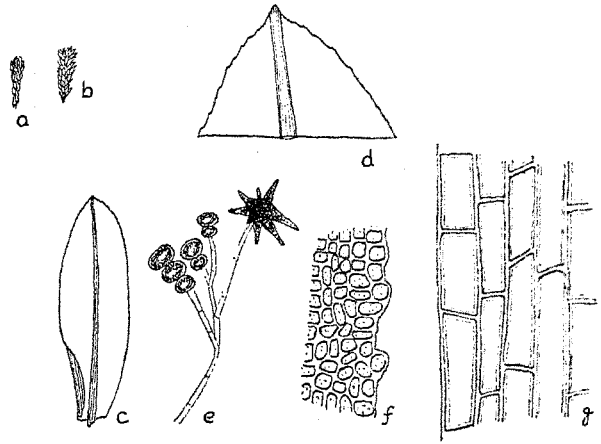


FIGURE 60. *Hyophila dozy-molkenboeri* Fleischer: *a*, dry plant × ¾; *b*, moist plant × ¾; *c*, leaf × 12; *d*, apex of leaf × 60; *e*, axillary propagula × 300; *f*, upper leaf cells and margin × 300; *g*, basal leaf cells and margin × 300.

The broad, obtuse, widely spreading leaves distinguish this species at once, even to the naked eye, when moist. It is also well characterized when dry by the strongly involute leaf margins and curled leaves.

As the Hawaiian plants seem to be uniformly sterile it is difficult to place them definitely, but the vegetative characters agree so closely with those of *H. dozy-molkenboeri* that I have little hesitation in referring them here, especially as there is nothing to be gained by adding a new name to an already long list of very dubious species described from sterile collections. It is

strange that this moss has not appeared in any of the previous Hawaiian collections. I found it rather widely distributed over the larger islands and certainly far from rare.

32. DIDYMODON Hedwig, Sp. Musc., p. 104, 1801.

Slender, branched plants in dense tufts, bright reddish brown in the lower parts, radiculose. Leaves crispate when dry, linear-lanceolate from an erect base; margins revolute; costa percurrent or excurrent; basal cells rectangular, hyaline; upper cells small and papillose. Seta elongate, erect; capsule cylindric, erect; peristome teeth 16, erect, from a low basal membrane, faintly papillose, irregularly cleft above; lid conic-rostrate.

1. **Didymodon recurvirostre** (Dickson) Jennings, Man. Mosses W. Pa., p. 97, 1913 (fig. 61).
Bryum recurvirostrum Dickson, Pl. Crypt., fasc. 2, no. 7, 1801.
Bryum rubellum Hoffman, Deutchl. Fl., vol. 2, p. 33, 1796.
Didymodon rubellus (Hoffman) Bry. Eur., fasc. 29-30, 1846.

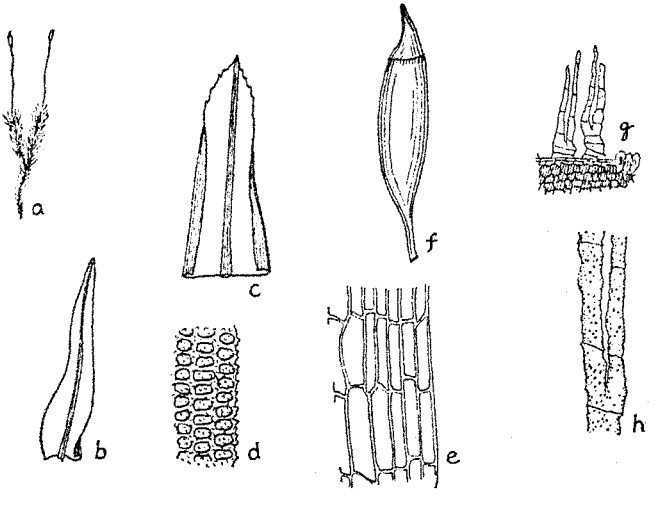


FIGURE 61. *Didymodon recurvirostre* (Dickson) Jennings: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells × 300; *f*, capsule × 12; *g*, part of peristome × 120; *h*, part of peristome tooth × 300.

Synoicous or paroicous. In deep tufts, vivid green above, bright reddish brown below, scarcely glossy. Stems up to 2.5 cm. or more high, branched, rather slender, sparingly radiculose below. Leaves curled and twisted when dry, widely spreading or recurved when moist, linear-lanceolate from an erect, pale, concave base, acute or apiculate, 2 to 3 mm. long; margin broadly recurved from just below the apex to the top of the leaf base, plane below, irregularly denticulate near the point; costa reddish, ending in the point or excurrent as a small apiculus; cells of the leaf base rectangular, pellucid or

hyaline; upper cells dense, rounded-quadrate, papillose, 7 to 9 μ in diameter. Perichaetial leaves with a longer, sheathing base; seta 10 to 12 mm. long, bright red; capsule erect, cylindric, brownish green becoming bright brown with age, urn about 2 mm. long; peristome teeth erect from a narrow basal membrane, pale, faintly papillose, usually irregularly cleft above; annulus large; lid erect, conic-rostrate, pale brown, 0.75 mm. long; spores pale brown, minutely papillose, 13 to 17 μ in diameter.

Maui: rock crevices, rim of Haleakala, eastern part of island (St. John).

Distribution: Europe, North America, Africa, Asia, Tasmania, New Zealand. Type locality, Europe.

This cosmopolitan species is well marked, as a rule, by the bright rufous color of the lower leaves. The St. John collection from near the Rest House on the rim of Haleakala is in perfect fruiting condition. The species may prove to be not uncommon in the higher regions. The irregularly toothed leaf apices, usually ending in a distinct apiculus, may be relied upon to distinguish this plant without any particular difficulty.

33. BARBULA Hedwig, Sp. Musc., p. 115, 1801, reduced in part by Venturi in Comm. Fauna, Flora, no. 3, Venezia, 1868.

Small, slender, tufted plants with linear-lanceolate, acuminate leaves, more or less twisted and curled when dry; costa percurrent; basal cells short rectangular; upper cells smaller, rounded, papillose. Capsule cylindric, erect, exserted on a slender seta; peristome teeth 16, from a short basal membrane, divided to the base into 32 filiform, papillose branches, spirally twisted; lid conic-rostrate; calyptra cucullate; spores small.

1. **Barbula vinealis** Bridel, variety **cylindrica** (Taylor) Boulay, Musc. France, p. 430, 1884 (fig. 62).
Zygotricha cylindrica Taylor, Mack. Fl. Hib., vol. 2, p. 26, 1836.

Dioicous. Plants growing in rather dense tufts, fulvous green at the tips, reddish brown below. Stems short, 3 to 5 mm. high. Leaves crowded, progressively larger upward, spirally curled and twisted when dry, somewhat flexuose and erect-spreading when moist, linear-lanceolate, gradually tapering from the oblong-ovate base, up to 4 mm. long by 0.6 to 0.7 mm. wide in the comal tufts, smaller below, acute or blunt at the apex; margin entire and recurved toward the base, usually flat above and faintly denticulate and sinuate toward the apex; costa yellow or brown, about 75 μ wide at base, ending in the apex; leaf cells small, the upper irregular, rounded-quadrate to transversely oval, obscure, papillose, 5 to 8 μ in diameter, toward the base short rectangular, more elongate near the costa, shorter at the margins. Seta erect, flexuose, reddish, 7 to 8 mm. long; capsule erect, oblong-cylindric, dark brown, 1.5 to 1.8 mm. long by 0.5 mm. wide; lid rostrate, about 1 mm. long; peristome pale red, 0.5 mm. long, of 16 spirally twisted teeth from a very short basal membrane, divided to the base into 32 filiform, papillose branches.

Rocks. Maui: rim of Haleakala (Degener).

Distribution: Europe, northern Africa, Asia, North America. Type locality, Ireland.

Known only from a few plants, including several in good fruit, collected by Degener on Haleakala. It should be looked for on the upper slopes of Mauna Kea and Mauna Loa.

This species is distingiushed from *Didymodon recurvirostre,* which also occurs on Haleakala, by the dioicous inflorescence, twisted peristome, and shorter basal leaf cells.

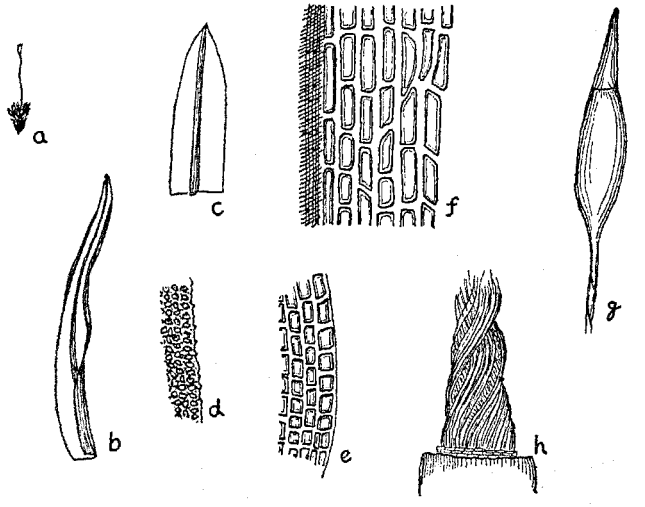


FIGURE 62. *Barbula vinealis* Bridel variety *cylindrica* (Taylor) Boulay: *a,* plant × ¾; *b,* leaf × 12; *c,* apex of leaf × 60; *d,* upper leaf cells and margin × 300; *e,* basal leaf cells and margin × 300; *f,* juxta-costal basal cells × 300; *g,* capsule × 12; *h,* peristome × 60.

34. STREPTOPOGON Wilson; Mitten, in Hooker, Jour. Bot., vol. 3, p. 51, 1851.

Medium-sized plants with a rufous tinge. Stems branched, radiculose below. Leaves spirally twisted when dry, lanceolate from an oblong, subclasping base, distinctly bordered with a narrow band of elongated cells; costa excurrent; basal cells rectangular, thin-walled; upper cells oval-hexagonal, smooth. Seta short, erect; capsule erect; peristome of 32 filiform, papillose, spirally twisted teeth from a short basal membrane.

1. **Streptopogon erythrodontus** (Taylor) Wilson, Lond. Jour. Bot., vol. 3, p. 51, 1851 (fig. 63).
Barbula erythrodonta Taylor, Lond. Jour. Bot., vol. 5, p. 50, 1846.

Autoicous. In rather lax tufts, pale olive green with a rufous tinge. Stems 1.5 to 2 cm. high, erect, dichotomously branched above, radiculose below. Leaves crowded,

erect-spreading, flexuose and spirally contorted when dry, lanceolate from an oval-oblong, subclasping base, acuminate, carinate, 5 to 6 mm. long; margin recurved in the lower half, erect and denticulate above; costa reddish, excurrent in a denticulate arista; upper leaf cells oval-hexagonal with firm yellowish, pellucid walls, 10 to 14 μ wide by 30 to 50 μ long, more elongate and lax toward the base, the lower cells narrowly rectangular with thin, delicate walls, bordered from the base to just below the apex with a narrow yellowish band of linear cells clearly differentiated from the cells within. Seta about 4 mm. long, erect; capsule erect, oblong-cylindric, urn 2 mm. long by 0.8 mm. wide, pale brown when mature; peristome teeth reddish, from a short basal membrane, twisted; lid rostrate, up to 1.1 mm. long; calyptra extending a little below the mouth of the capsule, mitriform, hispid above; spores smooth, 15 to 25 μ in diameter.

Maui: north bank of crater, Haleakala (Wilkes Expedition).

Distribution: Ecuador, Colombia, Peru, Bolivia, Madagascar. Type locality, Andes of Quito, Ecuador.

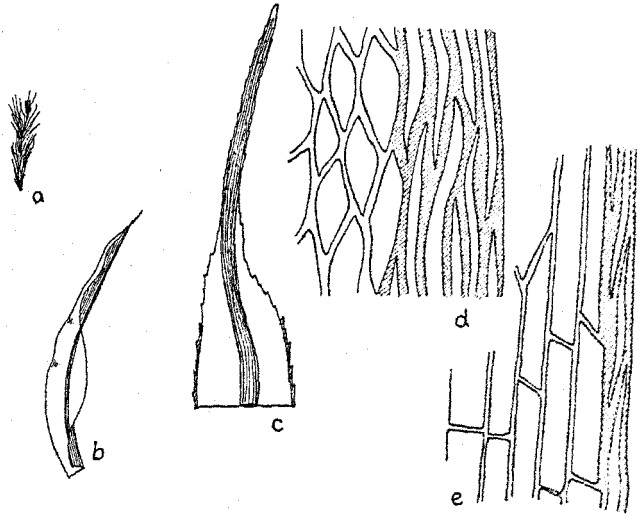


FIGURE 63. *Streptopogon erythrodontus* (Taylor) Wilson: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300.

The only Hawaiian plants of this species that I have seen are from number 33 of the Wilkes Expedition, reported by Sullivant. The crowded, rather narrow, erect-flexuose leaves and firm upper leaf cells seem to swing this plant nearer to the South American forms than to the variety *Rutenbergii* from Madagascar, in accordance with the critical study of this group by Salmon (19), who unfortunately was unable to examine the Hawaiian specimen.

It is earnestly hoped that additional collections of this most interesting link in the geographical distribution of the species will, eventually, be made.

35. TORTULA Hedwig, Sp. Musc., p. 122, 1801, in part.

Robust, tufted plants with branched stems, radiculose below. Leaves broad, oblong, obtuse; costa excurrent in a long, hyaline, denticulate hair-point; basal cells rectangular, hyaline; upper cells hexagonal, papillose, rather obscure; capsule cylindric, erect, on an elongate seta; peristome of 32 filiform, papillose, spirally twisted teeth, united below in a high basal tube or cylinder.

1. **Tortula princeps** DeNotaris, Syll. Musc. Ital., p. 170, 1838 (fig. 64).

Synoicous. Robust plants in rather dense cushions or tufts, green above, bright ruddy brown below. Stems up to 3 cm. high, branched, lightly matted together in the lower parts with brown radicles. Leaves crowded, appressed, more or less spirally twisted when dry, erect-spreading when moist, elliptic-oblong, obtuse or rounded at the apex, carinate, up to 4 mm. long by 1.5 mm. wide; margin revolute to about the middle, plane and crenulate-papillose toward the apex; costa stout, reddish brown, denticulate on the back, excurrent in a long, hyaline, denticulate hair-point, reddish at the base; inner basal cells rectangular, thin-walled, hyaline or brownish, shorter and more colored toward the margins; upper cells rounded-hexagonal, densely papillose with crescent-shaped papillae, obscure, 12 to 18 μ in diameter. Seta 1 cm. or more long, reddish; capsule erect or slightly curved, narrowly cylindric, urn about 4 mm. long; peristome teeth long, spirally twisted, united below in a high, spirally tessellated cylinder; lid about half as long as the urn.

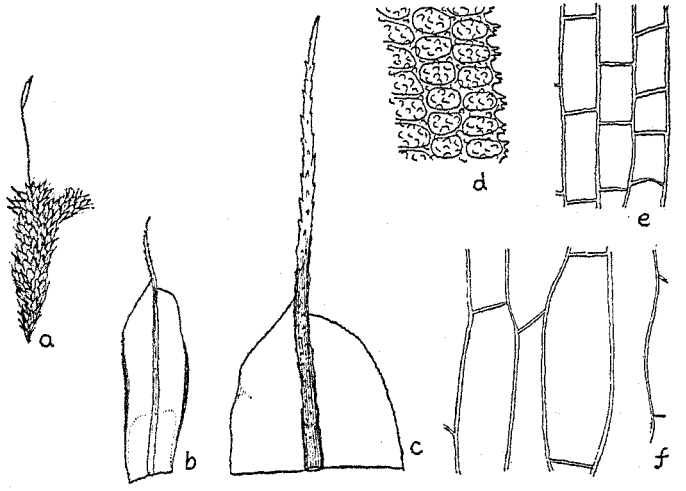


FIGURE 64. *Tortula princeps* De Notaris: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 25½; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300; *f*, inner basal cells × 300.

Rocks. Maui: near Rest House, rim of Haleakala (St. John).

Distribution: Europe, Asia, western North America, South America, New Zealand. Type locality, Sardinia.

This striking, almost cosmopolitan, species has been collected in Hawaii but once, although it may eventually prove to be not uncommon at high altitudes. It will be known at once by the long hyaline hair-points of the leaves and the bright ruddy color.

Family 8. GRIMMIACEAE

Mostly rupestrine plants in dense tufts or cushions. Leaves usually very hygroscopic, frequently with hyaline hair-points, ovate-lanceolate; upper cells small, often in two or more layers; basal cells rectangular, more or less sinuose. Seta erect or arcuate; capsule erect, immersed or exserted; peristome single, of 16 papillose teeth.

1. Calyptra plicate ..... **38. Ptychomitrium**
   Calyptra not plicate 2
2. Leaf cells short, faintly sinuose, peristome teeth entire or cleft above ..... **36. Grimmia**
   Leaf cells elongate, very sinuose or nodulose, peristome teeth bifid. **37. Rhacomitrium**

36. GRIMMIA Ehrhart, Hedwig, Sp. Musc., p. 75, 1801.

Small or medium-sized plants in dense tufts. Stems branched, radiculose below. Leaves crowded, usually with hyaline hair-points; margin often thickened; cells short except at the base, more or less sinuose, obscure above. Seta erect or curved; capsule oval; peristome teeth 16, entire or cleft above.

1. Leaves without hair-points, capsule immersed ..... **1. G. scabrifolia**
   Leaves with hair-points, capsule exserted 2
2. Seta erect, upper leaf cells in two layers ..... **2. G. haleakalae**
   Seta cygneous, upper leaf cells in one layer except at margins ..... **3. G. trichophylla**

1. Grimmia scabrifolia Brotherus, B. P. Bishop Mus., Bull. 40, p. 12, 1927 (fig. 65).

Slender plants, ruddy brown at the tips, darker brown below. Stems procumbent, up to 6 or 7 cm. long, nearly naked in the older parts, much-branched, branches flexuose, blunt at the tips. Upper leaves closely imbricated, erect, appressed when dry, squarrose-spreading when first moistened, then erect-spreading, ovate-lanceolate, obtuse, carinate-concave, slightly decurrent, 2 to 3 mm. long by 0.7 mm. wide, without hair-points; margin rather broadly revolute from the base nearly to the apex, plane, thickened and remotely denticulate with blunt teeth above; costa strong, brownish, ending just below the apex, scabrous on the back above; upper leaf cells rounded, very incrassate, more or less sinuose, 5 to 7 μ in diameter, becoming short rectangular and very sinuose toward the base, the lowermost cells near the costa linear with nearly straight lateral walls, pellucid, shorter and sinuose toward the margins. Perichaetial leaves 3 to 4 mm. long, short lanceolate from an oblong, clasping base, obtuse; capsule immersed on a short seta; calyptra mitriform, lobed at base.

Maui: Haleakala, on gound, 8,000 feet (Baldwin, type).
Endemic. Type locality, easten Maui.

This species obviously belongs in the section *Schistidium* near *G. alpicola* Swartz, but in the absence of mature fruit its systematic position cannot be definitely determined. The incomplete sporophyte characters in the above description are taken from a very immature capsule found on a plant in the type collection.

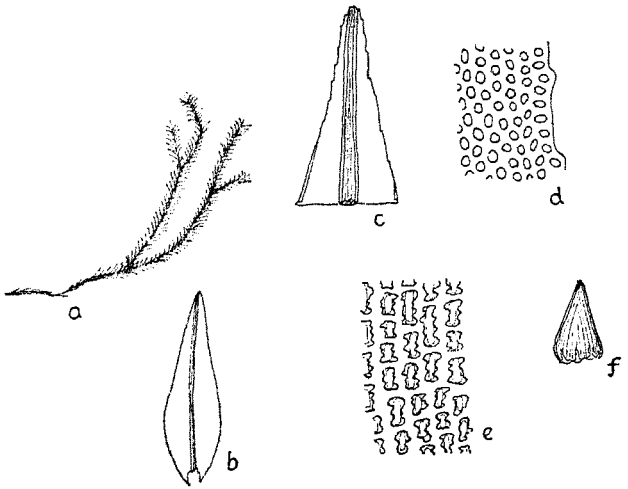


FIGURE 65. *Grimmia scabrifolia* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells × 300; *f*, calyptra × 25½.

2. **Grimmia haleakalae** Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 567, 1877 (fig. 66).

Grimmia Hawaiica C. Müller, Flora, vol. 82, p. 454, 1896.

Dioicous. Growing in small dense cushions, dark olive-green above, slightly hoary with the hyaline leaf points, brown or black below. Stems up to 1 cm. high, radiculose below but easily separating; leaves rigidly erect-spreading, up to 3 mm. long by 0.5 mm. wide, lanceolate from an oblong-ovate, deeply concave base, ending in a minutely denticulate, hyaline hair-point up to one-third the length of the leaf in the upper leaves; margin slightly recurved on one side, otherwise plane; costa narrow and flat below, prominent at the back but obscure above; lower leaf cells toward the costa linear, 10 to 15 times as long as wide, with strongly sinuose, incrassate lateral walls, gradually shorter toward the edges, 3 or 4 rows at the margins pellucid, short rectangular, with straight walls, quickly decreasing in size upward and becoming oval and rectangular with strongly sinuose walls, the upper cells in two layers, rounded, incrassate, 7 to 10 μ in diameter, lower leaves much smaller, muticous. Seta erect, yellowish, slightly exceeding the tips of the perichaetial leaves, straight; capsule erect, ovoid, urn 1.4 mm. long by 0.6 mm. wide, greenish brown, smooth; lid conic, blunt, 0.4 mm. long; annulus broad; calyptra mitriform, lobed at base.

Rock clefts. Maui: upper slopes of Haleakala, frequent (Forbes; Baldwin; St. John).

Endemic. Type locality, Haleakala, Maui.

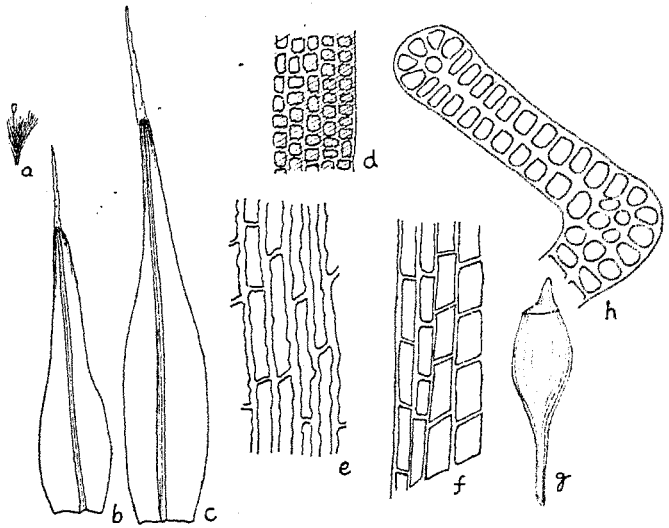


FIGURE 66. *Grimmia haleakalae* Reichardt *a*, plant × ¾; *b*, stem leaf × 25½; *c*, perichaetial leaf × 25½; *d*, upper leaf cells and margin × 300; *e*, inner basal cells × 300; *f*, basal leaf cells and margin × 300; *g*, capsule × 12; *h*, cross section from upper part of leaf × 300.

The straight seta and bistratose leaf cells will at once distinguish this species from *G. trichophylla,* which is also a larger plant with more flexuose, yellowish leaves and longer hair-points. *G. haleakalae* is closely related to the dioicous form of *G. ovata* Weber and Mohr and may eventually prove to be inseparable from this variable and widely distributed species.

3. **Grimmia trichophylla** Greville, Fl. Edin., p. 235, 1824 (fig. 67).

Dioicous. Robust plants in deep, dense tufts, yellowish at the tips and hoary with the long hyaline leaf points, brown or blackish below. Stems 3 to 4 cm. high, radiculose in the lower parts, but easily separating, leaves narrowly ovate-lanceolate, carinate, about 2.5 mm. long by 0.4 mm. wide, gradually tapering and ending in a long, smooth or faintly denticulate, hyaline hair-point about half as long as the leaf, erect, twisted and flexuose when dry, erect-spreading when moist, the lower smaller with shorter hair-points; margin slightly recurved below on one or both sides, erect above; costa distinct, very prominent at the back; basal leaf cells long and narrow toward the costa, 10 to 20 times as long as broad, with incrassate, slightly sinuose walls, quickly becoming shorter and broader outward, 3 or 4 rows at the margins pellucid, rectangular or linear with straight walls, all rapidly shortening upward and becoming sinuosely rectangular, the upper cells distinct, 5 to 7 μ wide by 10 to 18 μ long, very sinuose with thick pellucid walls, in one layer except 2 or 3 marginal rows which are bistratose. Seta cygneous both moist and dry, yellow, 3 to 4 mm. long; capsule plicate, yellowish when young, becoming light brown with age, oval-oblong, 1.3 mm. long by 0.6 mm. wide;

peristome teeth pale red, papillose, irregularly 2-cleft to 3-cleft; annulus broad; lid red, 0.4 mm. long, conic-rostrate, slightly oblique; calyptra mitriform; spores smooth, pale yellow, 8 to 10 μ in diameter.

Rocks. Maui: near Rest House, Haleakala (St. John); crater of Haleakala (Degener). Island of Hawaii: summit of Hualalai (Skottsberg).

Distribution: Europe, North Africa, Asia Minor, North America, New Zealand. Type locality, Europe.

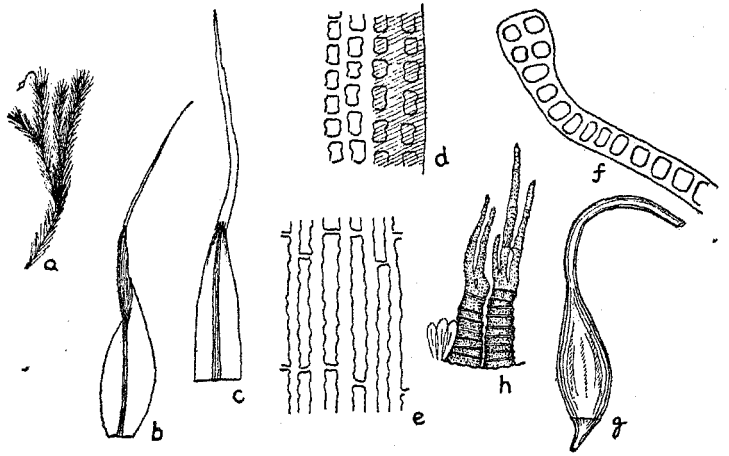


FIGURE 67. *Grimmia trichophylla* Greville: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 25½; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells × 300; *f*, part of cross section of leaf × 300; *g*, capsule × 12; *h*, 2 peristome teeth × 120.

It seems strange that this species has not been recognized before in Hawaii, as it is apparently as common as *G. haleakalae* and often mixed with it. The plants referred here are rather variable in size but share in common the distinct upper cells in one layer, except at the margins, the tawny color, and flexuose leaves with long hyaline points. When in fruit the curved seta is, of course, unmistakable.

37. RHACOMITRIUM Bridel, Mant., p. 78, 1819.

Stems often elongate, branched, frequently with numerous short lateral branchlets. Leaves with or without hyaline points; costa narrow, indistinct above, not excurrent; lower cells linear and very nodulose, larger and pellucid at the basal angles; upper cells more or less elongate with strongly sinuose walls. Seta erect; capsule cylindric; peristome usually divided to the base into two filiform, papillose branches. Fruit unknown in Hawaii.

1. Leaves without hyaline points.....1. **R. fasciculare**
   Leaves with hyaline points.....2
2. Hyaline leaf points papillose and erose.....3. **R. lanuginosum**
   Hyaline leaf points not papillose, denticulate on the margins.....2. **R. crispulum**

1. **Rhacomitrium fasciculare** (Schrader) Bridel variety **erosum** Brotherus, B. P. Bishop Mus., Bull. 40, p. 13, 1927 (fig. 68).
   Rhacomitrium erosum Brotherus, Bull. Soc. Bot. Ital., p. 22, 1904.
   Rhacomitrium perrobustum Brotherus, Bull. Soc. Bot. Ital., p. 22, 1904.

Dioicous. Robust plants up to 5 cm. high with numerous short lateral branches, yellowish at the tips, bark brown below. Leaves crowded, erect-spreading when dry, widely spreading or slightly recurved when moist, oblong-lanceolate, carinate, gradually tapering to a rather broad, grooved, blunt point, up to 4 mm. long by 1.2 mm. wide below, erose-denticulate at the apex, without any hyaline point; margin narrowly recurved below; costa yellowish, 50 μ wide below, indistinct above, ending below the apex; leaf cells linear with thick, very nodulose lateral walls, slightly papillose, the upper 3 to 4 times as long as wide, longer toward the base, the marginal row at the basal angles, short rectangular and pellucid. Sporophyte unknown.

Maui: rocks in ravines, western part of island, altitude 3,500 feet (Baldwin).

Endemic. Type locality, Maui.

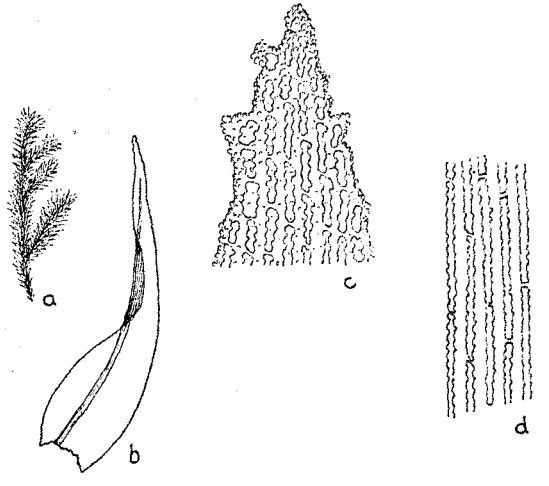


FIGURE 68. *Rhacomitrium fasiculare* (Schrader) Bridel variety *erosum* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 300; *d*, basal leaf cells × 300.

A rather unsatisfactory plant, the exact status of which must remain uncertain until better and more ample collections are available, but amply distinguished from the other Hawaiian species by the blunt leaf apices without any trace of hyaline points. The structural details of the leaf

agree very well with those of the familiar *R. fasciculare* of Europe and North America, but, as Brotherus has observed, the erose-denticulate point is rather an anomalous feature. As the degree to which the apex is narrowed varies to some extent, even on leaves of the same plant, I think the variety *perrobustum* can be merged with the variety *erosum,* especially as the characteristic denticulate leaf point is common to both forms.

2. **Rhacomitrium crispulum** (Hooker, J. D., and Wilson) Hooker, J. D., and Wilson, Fl. Tasm., p. 181, 1867 (fig. 69).
Dryptodon crispulum Hooker, J. D., and Wilson, Fl. Antarct., vol 1, p. 57, 1843.

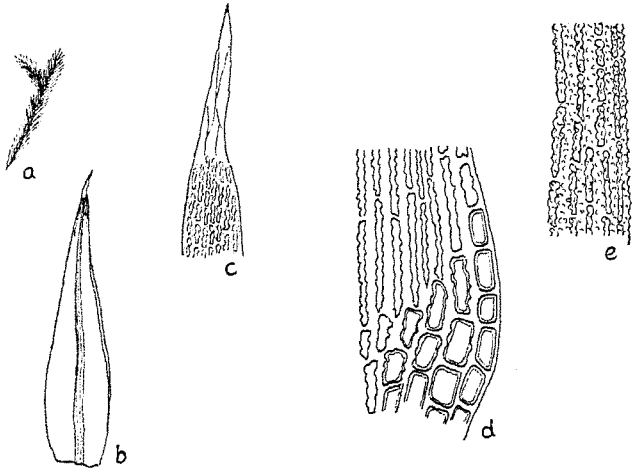


FIGURE 69. *Rhacomitrium crispulum* (Hooker, J. D., and Wilson) Hooker, J. D., and Wilson: *a,* plant × ¾; *b,* leaf × 25½; *c,* apex of leaf × 120; *d,* basal angle of leaf × 300; *e,* upper leaf cells and margin × 300.

Dioicous; male buds gemmiform, terminal at the tips of the stem and on short lateral branches. Plants densely tufted, yellowish at the tips, dark brown or black below. Stems up to 3 cm. long, ascending, dichotomously branched, rarely with few short lateral branchlets. Leaves crowded, nearly erect, with slightly spreading points when dry, more erect-spreading when moist, ovate-lanceolate, carinate, gradually tapering to the point, tipped with a short, slightly denticulate, hyaline hair-point, up to 2.5 mm. long by 0.6 mm. wide; margin recurved on one side to above the middle, usually plane on the other side; costa yellowish, about 50 μ wide below, becoming indistinct in the point and apparently ending below the hyaline tip; lower leaf cells linear with very thick, strongly nodulose lateral walls, at the basal angles a marginal row of about five much-enlarged, hyaline or pellucid, short rectangular cells, not at all sinuose; upper cells elongate, very nodulose, 3 to 6 times as long as wide, apparently slightly papillose on the lateral walls. Sporophyte unknown locally.

Rocks at high elevations. Maui: east of Ukulele, Haleakala (Forbes). Island of Hawaii: vicinity of Kilauea (Lieut. Hinds).

Distribution: Tierra del Fuego, Kerguelen Island, New Zealand, Tasmania, Africa. Type locality, Tasmania.

The Hawaiian collections, though meager, seem to be identical with the New Zealand plant. I have but little hesitation in referring them to this variable species of austral distribution.

3. **Rhacomitrium lanuginosum** (Hedwig) Bridel variety **pruinosum** Hooker, J. D., and Wilson, Fl. New Zealand, vol. 2, p. 76, 1855 (fig. 70).
Rhacomitrium lanuginosum variety *sandvicensis* Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 568, 1877.
Grimmia rigidissima C. Müller, Flora, vol. 82, p. 455, 1896.

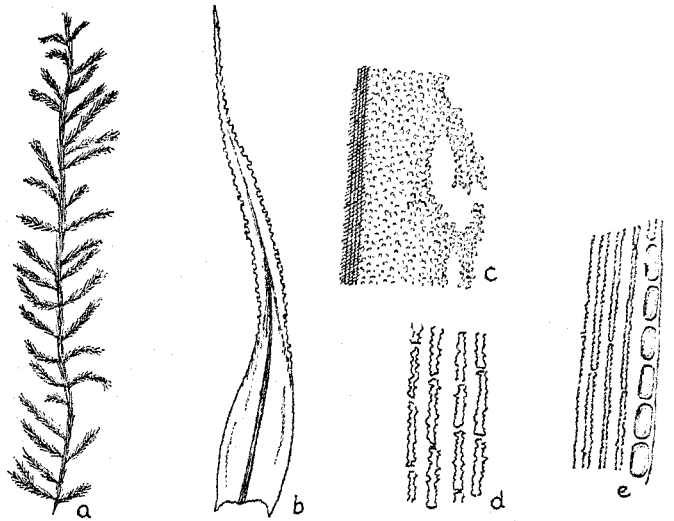


FIGURE 70. *Rhacomitrium lanuginosum* (Hedwig) Bridel variety *pruinosum* Hooker, J. D., and Wilson: *a*, upper part of plant × 1; *b*, leaf × 25½; *c*, part of hyaline leaf tip and margin × 300; *d*, upper leaf cells × 300; *e*, basal leaf cells and margin × 300.

Dioicous. Growing in large dense mats, dull brownish or yellowish green, very hoary. Stems slender, laxly procumbent, up to 15 cm. or more long, very fragile and brittle when dry, with numerous widely spreading lateral branches from 1 to 2 cm. long. Leaves appressed with flexuose, crispate tips when dry, erect-spreading and slightly secund at the ends of the branches when moist, gradually narrowed from a concave, slightly plicate, ovate base to a long tapering point which consists almost entirely of a broad, flat, hyaline, densely papillose tip, long decurrent along the edges of the leaf and spinulose-dentate on the margins, with broad irregular teeth; margin recurved below; costa about 150 μ wide below, extending well into the hyaline point and ending below the apex; lower leaf cells linear with thick, nodulose lateral walls, the marginal row at the basal angles subrectangular, pellucid, not or very slightly sinuose; upper cells shorter, 2 to 4 times as long as wide at the base of the hyaline tip, smooth. Sporophyte unknown locally.

Rocks, banks, and bogs. Molokai: Pepeopae, bog (Degener). Maui: crater of Haleakala (Degener); bog near top of Puu Kukui (Bartram). Island of Hawaii: vicinity of Kilauea, common (Bartram); summit of Hualalai, altitude 8,000 feet (Miss Reed); summit of Mauna Loa, altitude 13,600 feet (Brummagin). Kauai: Alakai swamp (Skottsberg).

Distribution: New Zealand, Tasmania, Africa. Type locality, New Zealand.

The Hawaiian plants are all referable to the austral variety *pruinosum,* which is distinguished from the typical form of the Northern Hemisphere by the longer hyaline points with more coarsely spinulose-dentate margins. It is common in exposed, barren places at high elevations, especially in the vicinity of Kilauea, Hawaii. The collections from the summit of Mauna Loa by Mr. Brummagin probably represent the highest elevation known for any insular moss in the world.

Under a microscope the diaphanous leaf point is a beautiful object. It is conspicuous even to the naked eye, and in this austral form gives the plant a peculiar greyish, hoary appearance that is shared by no other local species.

38. PTYCHOMITRIUM (Bruch) Fürnrohr, Flora, Erg. 2, p. 19, 1829.

Robust, densely tufted plants. Leaves crispate when dry, more or less plicate at the base, serrate above; upper cells rounded, incrassate; basal cells elongate, sinuose. Capsule erect; peristome single, of 16 teeth, split into two filiform, papillose branches; clayptra campanulate, plicate, not hairy.

1. **Ptychomitrium mauiense** Brotherus, B. P. Bishop Mus., Bull. 40, p. 18, 1927 (fig. 71).
Glyphomitrium sandwicense Brotherus, Bull. Soc. Bot. Ital., p. 18, 1904.

Autoicous; male flower gemmiform on a short stalk just below the perichaetium. Robust plants growing in dense tufts, yellowish above, dark brown or black below. Stems erect, up to 2.5 cm. long, simple or with several short branches, radiculose below. Leaves crowded, erect with incurved, crisped points when dry, erect-spreading when moist, linear-lanceolate from an ovate, plicate base, caniculate-concave, acute, up to 4.5 mm. long by 1.2 mm. wide below; margin erect, remotely and bluntly serrate in the upper half, entire below; costa yellowish, 180 μ wide near the base, ending just below the apex; upper leaf cells rounded-quadrate, very incrassate, 6 to 8 μ in diameter, two rows at the margins in two layers forming an indistinct border, the outer row transversely oval; basal cells toward the costa linear with thickened, slightly sinuose walls, gradually shorter outward, 8 to 10 rows at the margins rectangular and subquadrate, at the basal angles and across the width of the insertion laxly rectangular, brownish. Setae solitary or two from the same perichaetium, reddish yellow, flexuose, up to 10 mm. long; capsule erect, ovoid-cylindric, urn 1.8 mm. long, pale brown with a bright red mouth; peristome teeth 16, erect, reddish brown, 0.5 mm. long, split nearly to the base into two slender, filiform, densely papillose branches; annulus narrow; lid erect,

long rostrate from a conic base, about 1.4 mm. long; calyptra campanulate, strongly plicate, lobed at the base, slightly scabrous on the plaits near the apex; spores pale yellow, faintly papillose, about 12 μ in diameter.

Maui: eastern part of island, on ground, 8,000 feet (Baldwin, type). Endemic. Type locality, eastern Maui.

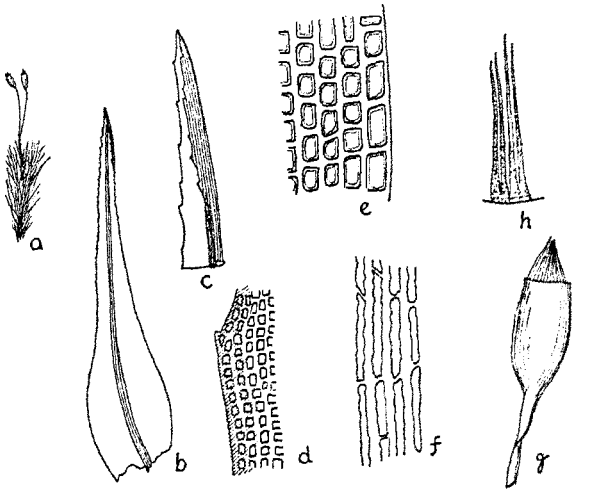


FIGURE 71. *Ptychomitrium mauiense* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300; *f*, inner basal cells × 300; *g*, capsule × 12; *h*, 2 peristome teeth × 60.

A unique species which is confined to the upper slopes of Haleakala, as far as known. In addition to Baldwin's specimens there is a collection in Bernice P. Bishop Museum from eastern Maui, number 28, lacking the name of the collector, which provided the additional sporophyte characters that were lacking in the type collection.

SUBTRIBE 2. DIPLOLEPIDEAE

Peristome when present normally double, the teeth mostly entire, composed of two layers of plates; the outer plates divided by a fine zigzag median line or with a median furrow; the inner plates not divided. Inner peristome, when present, pale and membranous; consisting of a more or less highly developed basal membrane, normally bearing 16 keeled segments alternating with the teeth, with or without intermediate cilia. Sporophyte terminal or lateral. Stems usually more or less prostrate, less frequently erect.

FAMILY 9. FUNARIACEAE

Small terrestrial plants with broad, soft, laxly areolate leaves. Costa slender, usually ending below the apex. Capsule erect or curved and asymmetrical, smooth or furrowed, exserted on a long seta; peristome none or double with the segments of the inner peristome opposite the oblique teeth. Lid plano-convex. Calyptra cucullate, inflated at the base, long-beaked, smooth.

39. FUNARIA Schreber, Hedwig, Sp. Musc., p. 173, 1801.

Small short-stemmed plants with the characters of the family.

Capsule erect, peristome none ..... 1. **F. subintegra**
Capsule curved, peristome double ..... 2. **F. hygrometrica**

1. Funaria subintegra Brotherus, B. P. Bishop Mus., Bull. 40, p. 13, 1927 (fig. 72).

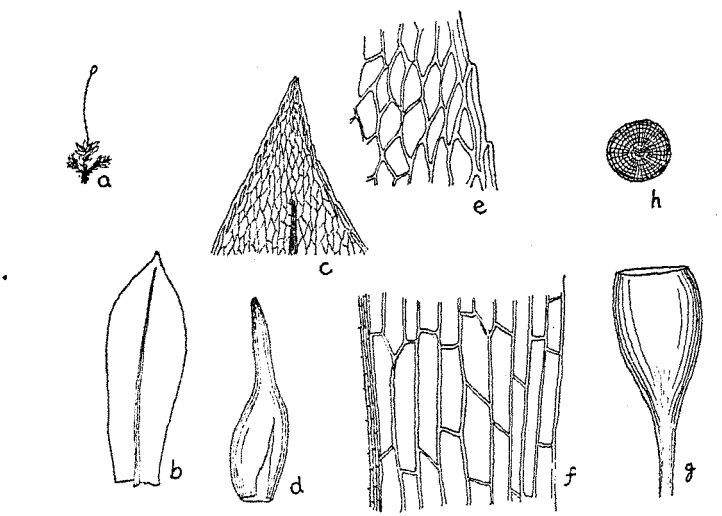


FIGURE 72. *Funaria subintegra* Brotherus: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, calyptra × 12; *e*, upper leaf cells and margin × 120; *f*, one side of leaf base × 120; *g*, capsule × 12; *h*, lid × 12.

Small, rather densely gregarious plants, pale or yellowish green. Stems erect, 5 to 8 mm. high, radiculose below. Lower leaves minute, the upper much larger, crowded in a comal tuft, shrunken and contorted when dry, flexuose-spreading when moist, oblong-spathulate or obovate, acute, 2.5 to 4 mm. long and 1 to 1.5 mm. wide; margin erect or broadly inflexed and entire below, flat and denticulate above; costa pale or brownish, ending considerably below the apex; upper leaf cells oval-hexagonal, up to 25 μ wide, more elongate below, the basal cells long rectangular, 100 to 150 μ long, bordered all around with a single row of linear, yellowish, pellucid cells. Seta erect, slightly flexuose, reddish, about 12 mm. long; capsule erect or inclined, reddish brown, pyriform, smooth,

about 2 mm. long by 1 mm. wide, strongly contracted under the mouth when dry and empty; peristome none; annulus none; lid nearly flat; calyptra subcucullate, 2.5 mm. long, inflated below, deeply split on one side; spores brown, papillose, 30 to 38 μ in diameter.

Wet banks. Oahu: Manoa Valley (Skottsberg, type); summit of Konahuanui (Forbes); Cooke trail, east side of Nuuanu Valley (Forbes); Waikane-Schofield trail, Koolau Range (Bartram); above Manoa (Heller). Maui: mountain ridges, western part of island (Baldwin); east of Ukulele, Haleakala (Forbes); Puu Nianiau, Haleakala (Forbes); Honokohau drainage basin (Forbes); Kula pipe line trail, northeast of Olinda (Bartram).

Endemic. Type locality, Manoa Valley, Oahu.

A rather common species on Oahu and Maui; easily recognized by the suberect capsules without any peristome and the broad leaves with large lax cells.

2. **Funaria hygrometrica** Hedwig, Sp. Musc., p. 172, 1801 (fig. 73).
Mnium hygrometricum Linnaeus, Sp. Pl., p. 1110, 1753.

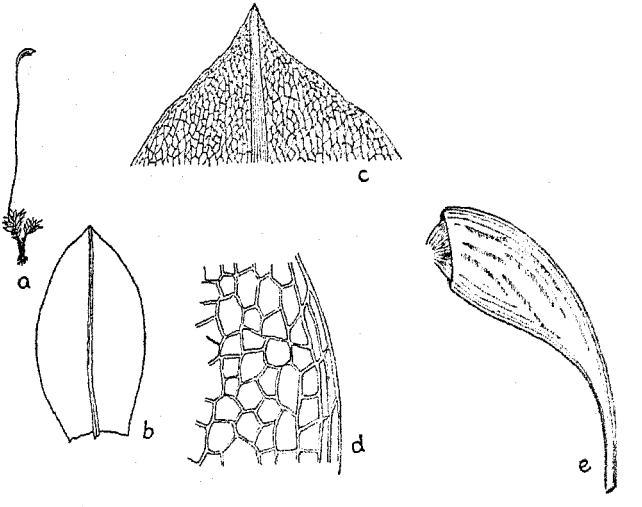


FIGURE 73. *Funaria hygrometrica* Hedwig: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 120; *e*, capsule × 12.

Autoicous; male flowers discoid on a short basal branch. Gregarious, growing in large patches, pale yellowish green. Stems short, less than 1 cm. high, erect. Upper leaves erect, concave, oblong-ovate, short-pointed, closely imbricated in a comal tuft, contorted when dry; margin plane below, slightly inflexed above, essentially entire; costa ending just below the apex or percurrent; leaf cells lax, rectangular or hexagonal, narrower toward the margin. Seta up to 4 cm. long, reddish when old, flexuose, capsules reddish brown with age, pyriform, curved and rounded on the back, asymmetrical,

sulcate, the mouth oblique; peristome double, the teeth oblique, united at the top, segments of the inner peristome shorter than and opposite the teeth; annulus very broad; lid convex; spores 12 to 15 μ in diameter.

Burned ground and waste places. Island of Hawaii: Halemaumau trail, Kilauea (Bartram); Glenwood, clay roadside (Degener); opposite road to Milolii (Degener and Iwasaki).

Cosmopolitan. Type locality, Europe.

This common moss will usually be recognized at sight. Most of the Hawaiian collections that I have seen are referable to *F. calvescens* Schwaegrichen, but plants with the shorter, more incurved, and more deeply sulcate capsules typical of *F. hygrometrica* have been collected, especially at higher altitudes. At best, *F. calvescens* is only a rather luxuriant form of the species, with the leaves more flexuose when dry, longer setae, and longer, more erect capsules.

Family 10. SPLACHNACEAE

Medium-sized plants with broad leaves similar in structure to *Funaria*; costa excurrent. Capsule cylindric, erect, with a distinct apophysis. Seta stout. Peristome single. Calyptra scabrous above.

40. TAYLORIA Hooker, in Jour. Sci. Arts, vol. 3, p. 144, 1816; amended by Mitten in Musc. Ind. Orient., p. 57, 1859.

Erect plants with simple stems and broad, flaccid, laxly areolate leaves; costa excurrent. Seta elongate; capsule erect with a narrow apophysis; peristome teeth in eight pairs.

1. **Tayloria sandwicensis** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 503, 1903 (fig. 74).
Dissodon sandwicensis C. Müller, Flora, vol. 82, p. 436, 1896.

Dioicous. Robust plants, dull olive-green. Stems erect, up to 3 cm. high, simple, purplish radiculose in the lower parts. Lower leaves small and distant, the upper larger, not crowded, widely spreading to somewhat recurved, ovate-lingulate, acute, aristate by the excurrent costa, slightly carinate-concave, up to 4 mm. long by 1 mm. wide; margin narrowly recurved in the lower half, plane and sharply serrate above with coarse teeth; costa yellowish, excurrent in a long, nearly smooth arista; leaf cells very lax and thin-walled, smooth, the upper hexagonal-rhomboidal, about 30 μ wide by 75 to 90 μ long, becoming rectangular toward the base. Seta stout, reddish brown, about 8 mm. long; capsule erect, brown, oblong-cylindric, wide-mouthed; urn 2 mm. long, apophysis much narrower than the urn and half as long; peristome teeth 16, yellowish, in pairs, erect when dry; lid not seen; calyptra verrucose-papillose above; spores irregular in shape, up to 25 μ in diameter.

Endemic. Type locality, western Maui.

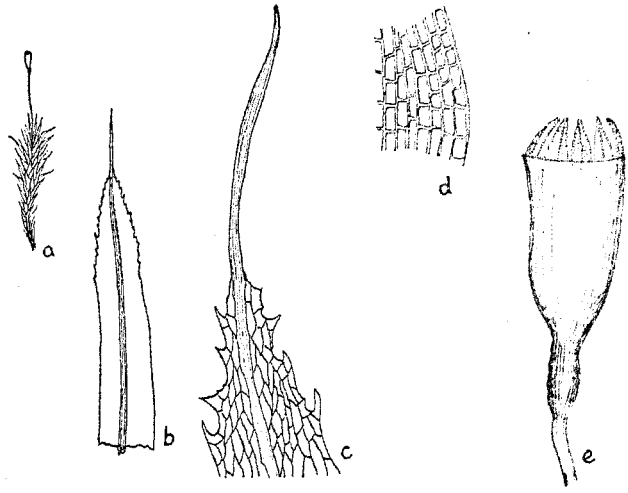


FIGURE 74. *Tayloria sandwicensis* (C. Müller) Brotherus: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, basal leaf cells and margin × 60; *e*, capsule × 12.

The only plants I have seen are from the type collection by Baldwin from mountain ridges, on ground, western Maui, altitude 5,500 feet, although the Wilkes Expedition collection, recorded by Sullivant as *Orthodon serratus,* is, in all probability, the same thing. The large, lax leaf cells in connection with the coarsely serrate upper margins and long excurrent costa will identify it at once.

FAMILY 11. BRYACEAE

Plants of variable size, usually tufted. Stems radiculose below, often with numerous subfloral or basal innovations. Lower leaves small, the upper larger and lanceolate; costa percurrent or excurrent; cells smooth, prosenchymatous, linear to rhomboidal, thin-walled, often narrower in several rows at the margins. Seta elongate; capsule inclined or pendulous, usually tapering to a distinct neck; lid convex and apiculate, not rostrate; peristome usually double, the outer composed of 16 lanceolate, entire teeth with numerous articulations; the inner pale and delicate, of 16 keeled segments alternating with the teeth, intermediate cilia present or none, from a basal membrane usually about half as high as the teeth.

1. Outer peristome wanting.....**41. Mielichhoferia**
   Outer peristome present.....2
2. Stems julaceous, leaves erect imbricated.....**44. Anomobryum**
   Stems not julaceous, leaves spreading.....3

3. Segments of inner peristome rudimentary or wanting, capsules erect ..... **43. Brachymenium**
   Segments of inner peristome present, capsules horizontal 4
4. Leaves large, upper cells 20 μ or more wide ..... **47. Rhodobryum**
   Leaves smaller, upper cells narrower 5
5. Leaves linear, setaceous ..... **45. Leptobryum**
   Leaves broader, lanceolate 6
6. Cilia nodose, not appendiculate ..... **42. Webera**
   Cilia appendiculate ..... **46. Bryum**

41. MIELICHHOFERIA Hornschuch, Bryol. Germ. 2, vol. 2, p. 179, 1831.

Small, densely tufted plants with narrow leaves. Sporophyte lateral; seta slender, elongate; capsule inclined; outer peristome wanting; segments of inner peristome linear and appendiculate.

1. **Mielichhoferia pulvinata** C. Müller, Flora, vol. 82, p. 439, 1896 (fig. 75).
   Bryum plumaefolium C. Müller, Flora, vol. 82, p. 440, 1896.

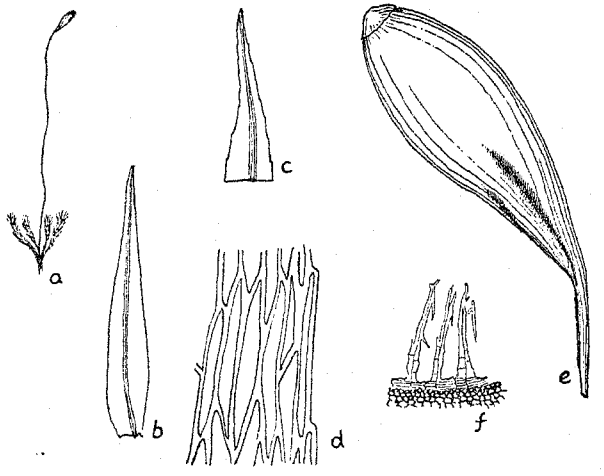


FIGURE 75. *Mielichhoferia pulvinata* C. Müller: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 12; *f*, part of peristome × 60.

Synoicous; perichaetia lateral, radiculose. Growing in large dense cushions, pale yellowish or brownish green, glossy. Stems short, radiculose, with numerous simple, erect, flexuose branches up to 2 cm. long, branches naked or with a few scattered, minute leaves below, gradually becoming more densely leaved above; upper leaves crowded, erect-spreading with slightly flexuose points, narrowly lanceolate, slenderly acuminate, carinate-concave, 1.5 mm. long by 0.3 mm. wide below; margin erect or very slightly reflexed toward the base, denticulate toward the apex, entire below; costa yellowish, 45 μ wide at base, percurrent or short excurrent. Leaf cells linear, 7 to 8 μ wide by 10 to 14 times as long, several rows at the extreme base shorter and rectangular. Peri-

chaetial leaves smaller, about 1 mm. long, golden brown at base; seta slender, flexuose, up to 5 cm. long, reddish below, paler above; capsule inclined, 5 mm. long, small-mouthed, brown, oblong-cylindric with a tapering neck about as long as the urn; outer peristome wanting, inner consisting of a low basal membrane extending about 35 μ above the rim with 16 linear segments, 250 to 270 μ long, entire or narrowly split along the median line, with numerous irregular appendages; annulus narrow; lid convex, minutely apiculate; spores brown, papillose, 16 to 20 μ in diameter.

Maui: Puu Nianiau, Haleakala (Forbes); Haleakala (Baldwin).

Endemic. Type locality, Hawaii.

In spite of the fact that Müller describes this species as dioicous and gymnostomous, an examination of part of the type collection shows the inflorescence clearly synoicous and fragments of an inner peristome on the only old capsule available. Forbes' specimens are in good fruit and agree perfectly with the plants I have seen from the type collection. The only conclusion I can form is that Müller's description relating to the inflorescence and peristome is in error.

Judging from the few plants of *Bryum plumaefolium* that I have seen, this species is identical with *M. pulvinata*. The leaf structure and visible sporophyte characters agree in every particular, but as the peristome of *B. plumaefolium* is unknown the matter is still more or less of an open question.

42. WEBERA Hedwig, Sp. Musc., p. 168, 1801.

Slender, tufted plants. Lower leaves small, gradually enlarged upward, the upper lanceolate; costa percurrent or ending below the apex; cells linear, smooth. Capsule horizontal or pendulous; peristome double, cilia nodose but not appendiculate.

1. Sterile stems without propagulae, leaf cells 4 to 5 μ wide, incrassate.....2
   Sterile stems with axillary propagulae, leaf cells 7 to 12 μ wide, not incrassate.....3
2. Paroicous .....1. **W. baldwinii**
   Dioicous .....2. **W. mauiensis**
3. Propagulae filiform, pale.....3. **W. gracilescens**
   Propagulae obovoid, brown.....4. **W. leucostomoides**

1. **Webera baldwinii** Brotherus, Bull. Soc. Bot. Ital., p. 25, 1904 (fig. 76).

Paroicous; antheridia naked in the axils of the upper stem leaves. Slender, loosely tufted plants, yellowish green. Stems red, up to 1 cm. high, usually simple. Lower leaves small, gradually enlarged upward, the upper in a crowded comal tuft, erect, slightly flexuose, lanceolate, up to 4 mm. long by 0.5 mm. wide; margin narrowly recurved below, plane above, sharply serrulate toward the apex; costa strong, brownish, percurrent. Leaf cells linear, incrassate, 5 μ wide and 12 to 15 times as long, at the base broader and shorter, rectangular. Seta 2 to 3 cm. long, reddish; capsule about 4 mm. long, reddish brown, horizontal or pendulous, urn ovate-oblong, 2 mm. long, exothecial cells with straight, very incrassate walls, neck as long as the urn; peristome teeth brownish; inner peristome pale, cilia two, about half the length of the segments;

annulus large; lid conic, 0.5 mm. long; spores minutely papillose, up to 18 μ in diameter.

Maui: eastern part of island, on ground in ravines, altitude 8,000 feet (Baldwin, type).

Endemic. Type locality, eastern Maui.

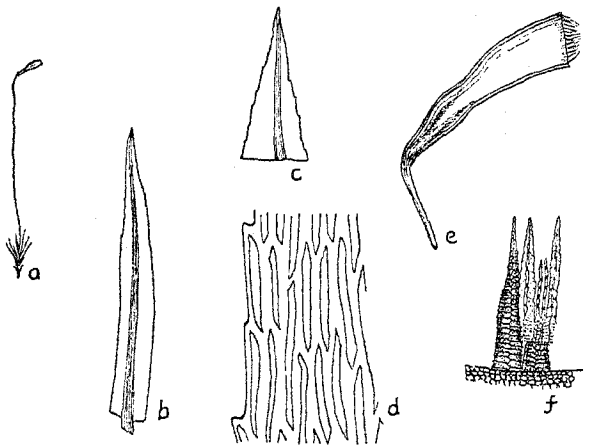


FIGURE 76. *Webera baldwinii* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 9; *f*, part of peristome × 60.

Until this species and *W. mauiensis* are better known through further and more abundant collections their relation to each other and to some of the closely allied plants of the East Indies must remain rather obscure.

2. **Webera mauiensis** Brotherus, Bull. Soc. Bot. Ital., p. 25, 1904.

Maui: Haleakala, in little ravines on ground, altitude 8,000 feet (Baldwin, type).

Endemic. Type locality, Haleakala, Maui.

The only apparent difference between this species and *W. baldwinii* is in the dioicous inflorescence. I have dissected several young sporophyte-bearing plants without finding any trace of antheridia, and although the male flowers have not been seen it seems safe to assume that the inflorescence is dioicous. The costa averages a little broader than in *W. baldwinii,* up to 150 μ wide below, but I doubt if this is a very constant character.

3. **Webera gracilescens,** new species (fig. 77).

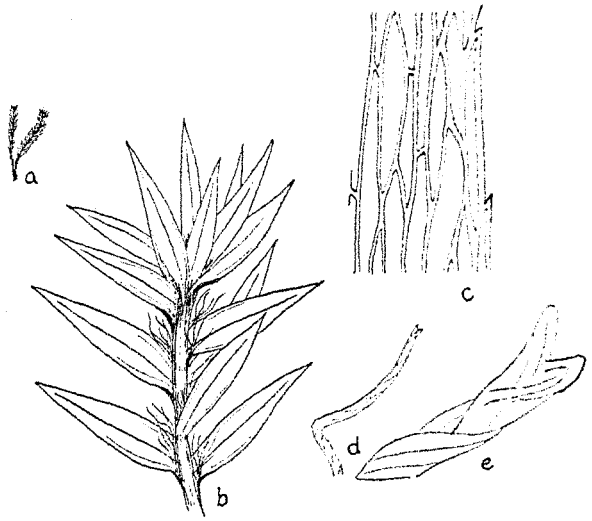
Webera leucostomoides affinis sed propagulis pallidis, flexuosis, filiformibus, ad 400 μ longus.

Dioicous (?). Sporophyte-bearing plants unknown. Sterile stems very similar to those of *W. leucostomoides,* but more slender, pale green, in lax tufts. Propagulae filiform, pale, flexuose, 350 to 400 μ long, numerous in the axils of the upper leaves.

Type: shaded rock face, Halemaumau trail, Kilauea, Hawaii, altitude 4,000 feet, January 24, 1930, E. B. Bartram, number 217.

Maui: Puu Nianiau, Haleakala (Forbes).

The leaves of this species are not distinctive as compared with those of *W. leucostomoides,* but the propagula are so unmistakably different that the two species can never be confused when these bodies are present. The cells composing these propagula seem to twist in spirals so as to give a peculiar braided appearance to the transparent structure when viewed under a fairly high magnification.



FIGUBE 77. *Webera gracilescens* Bartram: *a,* sterile stems × ¾; *b,* tip of stem × 25½; *c,* upper leaf cells and margin × 300; *d,* propagulum × 60; *e,* tip of propagulum × 300.

4. Webera leucostomoides Brotherus, B. P. Bishop Mus., Bull. 40, p. 14, 1927 (fig. 78).

Dioicous; male flowers gemmiform, terminal on a slender plant about 5 mm. high. Slender plants in dense to rather lax tufts, yellowish or brownish green. Fertile stems erect, about 1 cm. high, with innovations 5 to 6 mm. long; sterile stems laxly ascending, up to 2 cm. long, simple, bearing numerous obovoid, brown, multicellular propagula about 18 μ long in the axils of the upper leaves. Stem leaves not crowded, laxly spreading and more or less flexuose when dry, more erect-spreading when moist, carinate-concave, long and narrowly decurrent at the basal angles, lanceolate, gradually narrowed to a short acuminate point, up to 1.5 mm. long by 0.4 mm. wide; comal leaves of the fertile stems longer and narrower with more or less revolute margins. Leaf cells linear, 8 to 12 μ wide and 7 to 10 times as long, walls firm but hardly incrassate; extreme basal cells shorter, rectangular, more lax; leaves of the innovations similar but smaller. Seta 2.5 to 4 cm. long, slender, reddish; capsule horizontal, brown, oval, with a very short, hardly apparent neck, 3.5 mm. long by 2 mm. wide; exothecial cells rounded-hexagonal,

incrassate, not collenchymatous; peristome teeth pale, blunt, about 150 μ high, papillose-striate; inner peristome pale, papillose, basal membrane more than half the height of the teeth, segments nearly as long as the teeth, poorly developed, cilia two, short and rudimentary; annulus narrow; lid conic; 0.6 mm. long; spores papillose, 15 to 18 μ in diameter.

Damp banks. Oahu: east side of Manoa Valley (Bartram). Maui: mountain ravines, on ground, western part of island, altitude 4,500 feet (Baldwin, type). Molokai: Deer trail, Waikapu (Forbes); Waikapu to Kamoku (Forbes). Kauai: vicinity of Kokee, bank, altitude 4,000 feet (Bartram).

Endemic. Type locality, western Maui.

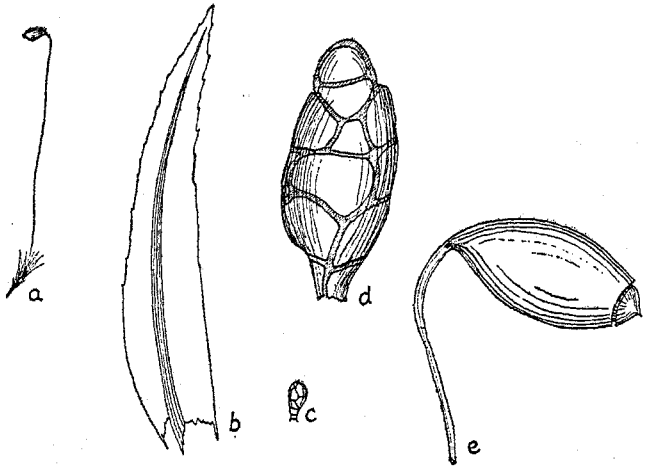


FIGURE 78. *Webera leucostomoides* Brotherus: *a*, plant × ¾; *b*, leaf × 60; *c*, propagulum × 60; *d*, propagulum × 300; *e*, capsule × 9.

When in fruit this species will be recognized by the turgid, oval capsule with a short, almost obsolete neck. Sterile plants will be known by the abundant, obovoid, brown propagula in the upper leaf axils.

43. BRACHYMENIUM Schwaegrichen, Suppl. 2, pt. 1, p. 131, 1823.

Small plants growing in dense tufts with numerous erect, slender branches. Leaves minute, ovate; costa strong, excurrent; cells rhomboidal, smooth. Capsule sub-erect on a long seta; peristome double; the teeth papillose; segments of the inner peristome very short and rudimentary; cilia none.

1. **Brachymenium exile** (Dozy and Molkenboer) Bryol. Jav., vol. 1, p. 139, 1860 (fig. 79).

   Bryum exile Dozy and Molkenboer, Ann. Sci. Nat., p. 300, 1840.

Dioicous. Plants in low dense tufts, bright green and rather glossy above, brown below. Stems very short with numerous erect, short, slender subjulaceous innovations, very sparingly radiculose at the base. Leaves minute, closely appressed, ovate, slightly concave, acute, about 0.6 mm. long by 0.35 mm. wide; margin plane, entire; costa strong, yellowish, excurrent into a short, stiff, cuspidate point. Leaf cells hexagonal-rhomboidal, smooth, not incrassate, up to 35 μ long by 10 μ wide, several rows at the margins longer and narrower, but not forming a distinct border; a few rows near the base short rectangular and more lax. Sessile, ovate bulbils about 150 μ long are often found in some abundance in the leaf axils of the sterile branches. Perichaetial leaves slightly larger than the stem leaves, margin narrowly reflexed nearly to the apex, basal areolation more lax and reddish at the insertion. Seta slender, erect, reddish below, pale yellow above, 12 to 14 mm. long, smooth; capsule erect or slightly inclined, ovoid-cylindric, 2 mm. long by 0.8 mm. wide, strongly corrugated in the lower half, especially when immature, pale brown; peristome teeth linear-lanceolate, pale brown below, hyaline above, finely papillose; basal membrane of inner peristome a little more than half as long as the teeth, pale, finely papillose, segments very rudimentary, cilia none; annulus large and compound, about one-third the height of the teeth; lid short conic, 0.3 mm. long; calyptra cucullate, 1 mm. long, pale and somewhat ragged at the base, reddish brown toward the tip, slightly rugose above; spores pale, smooth, 8 to 10 μ in diameter.

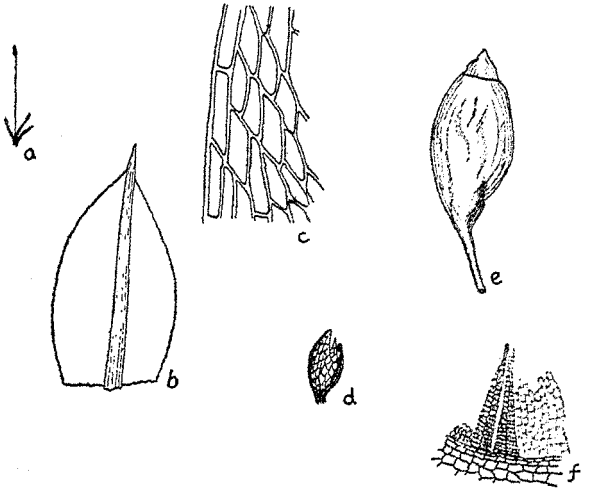


FIGURE 79. *Brachymenium exile* (Dozy and Molkenboer) Bryol. Jav.: *a*, plant × ¾; *b*, leaf × 60; *c*, upper leaf cells and margin × 300; *d*, propagulum × 60; *e*, capsule × 12; *f*, part of peristome × 60.

On shaded, rather dry banks. Oahu: Nuuanu Pali (Bartram); Tantalus, upper slopes, on coral rock walls (Bartram). Maui: Honokohau ditch trail (Bartram). Hawaii: vicinity of Kilauea, lava pockets (Bartram); Kealakekua, Kona (Bartram); Paauilo (Bartram); Rainbow Falls near Hilo (Bartram). Kauai: vicinity of Kokee (Bartram).

Distribution: Ceylon, Java, Sumatra. Type locality, Java.

Although not a conspicuous species, this moss may be recognized by the slender, compactly tufted stems with closely appressed leaves. It usually fruits abundantly and then the small sub-erect capsules, roughened or warty in the lower half, are quite characteristic. Under a microscope the broadly ovate, sharply cuspidate leaves with bryoid areolation and the usually abundant bulbils in the leaf axis of the sterile stems are good diagnostic characters.

Brachymenium indicum (Dozy and Molkenboer) has been recorded from Hawaii by Sullivant (21). Although the few plants from this collection that I have seen seem to be correctly named, there is no further evidence to substantiate the occurrence of this species in Hawaii. I have therefore omitted it from the list. The synoicous inflorescence and more cylindrical capsules will distinguish it from *B. exile*. It may prove to be *B. melanothecium* (C. Müller) Jaeger, a species of Polynesian distribution.

44. ANOMOBRYUM Schimper, Syn., 1st ed., p. 382, 1860.

Slender plants with julaceous stems. Leaves closely appressed, ovate, obtuse; costa ending above mid-leaf; upper cells linear, vermicular, shorter and broader below. Sporophyte as in *Bryum*.

1. **Anomobryum angustirete** Brotherus, B. P. Bishop Mus., Bull. 40, p. 14, 1927 (fig. 80).

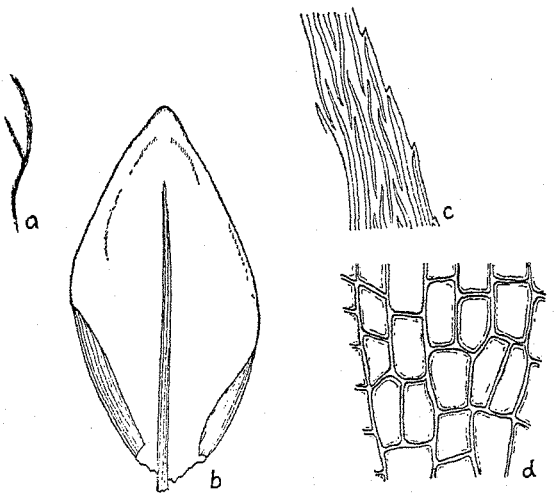


FIGURE 80. *Anomobryum angustirete* Brotherus: *a*, plant × ¾; b, leaf × 60; *c*, upper leaf cells and margin × 300; *d*, basal leaf cells × 300.

Dioicous (?). Male flowers unknown. Plants slender, densely tufted, pale yellow, glossy. Stems erect, julaceous, up to 4 cm. long, radiculose in the lower parts, simple or sparingly branched. Leaves closely imbricated, appressed, concave, ovate, obtuse, 1 to 1.5

mm. long by 0.5 mm. wide; margin minutely serrulate in the upper half, entire below, narrowly recurved toward the base; costa slender, pale, ending above mid-leaf; upper cells incrassate, vermicular, narrowly linear, 3 μ wide by about 70 μ or more long, smooth or very minutely papillose on the back by the projecting ends; towards the base conspicuously shorter and broader, rhomboidal or broadly rectangular, lax with pellucid, hardly incrassate walls. Fruit unknown.

Maui: valleys in western part of island, on ground, altitude 800 feet (Baldwin, type).

Endemic. Type locality, western Maui.

In the absence of fruit the exact status of this species must remain uncertain. It is at present known only from the type collection. The vegetative characters of the plants are very similar to those of *A. cymbifolium* (Lindberg) Brotherus from India and Java. It seems inadvisable, however, to reduce the plant to synonymy without knowledge of the sporophyte characters.

45. LEPTOBRYUM (Bryologia Europaea) Wilson, Byrol. Brit., p. 219, 1855.
Bryum subgenus *Leptobryum,* Bryol. Eur., fasc. 46-47, and Consp. to vol. 4, 1851.

Small, slender plants with narrow setaceous leaves and linear cells. Capsules very glossy, pendulous, pyriform with a distinct neck; peristome as in *Bryum.*

1. Leptobryum pyriforme (Hedwig) Wilson, Bryol. Brit., p. 219, 1855 (fig. 81).
Mnium pyriforme Linnaeus, Sp. Pl., p. 112, 1753.
Webera pyriformis Hedwig, Sp. Musc., p. 169, 1801.

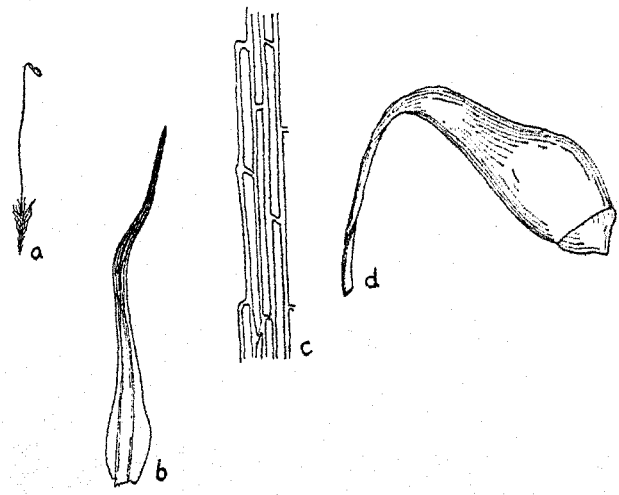


FIGURE 81. *Leptobryum pyriforme* (Hedwig) Wilson: *a*, plant × ¾; *b*, upper leaf × 12; *c*, upper leaf cells and margin × 300; *d*, capsule × 12.

Synoicous or dioicous. Slender, silky plants in pale green tufts, glossy. Leaves erect-spreading, flexuose when dry, linear-setaceous, tapering to a long, slender point, the upper up to 4.5 mm. long by 0.4 mm. wide; margin plane, slightly denticulate above; costa rather broad and thin, not well-defined, excurrent; leaf cells linear, smooth, long and narrow. Seta elongate, reddish, flexuose; capsule inclined or pendulous, pyriform with a long tapering neck, bright brown, very glossy; peristome teeth yellowish; cilia of the inner peristome appendiculate; lid convex, apiculate; spores 14 to 18 μ in diameter.

Distribution: nearly cosmopolitan. Type locality, Europe.

I have seen no plants from Hawaii that could definitely be referred to this species, although *L. pyriforme* has been recorded from the vicinity of Kilauea by Brotherus on the basis of a collection by Skottsberg. Such a widely distributed and familiar species may well prove to have a place in the local flora. When in fruit the handsome, pale brown capsules are not likely to escape notice.

46. BRYUM (Hedwig) Schimper, Syn., 1st ed., 1860.

Small to medium-sized tufted plants. Stems innovating below the flowers, radiculose below. Lower leaves usually small and distant, the upper larger, ovate, often in crowded terminal tufts; cells smooth, narrowly rhomboidal, often linear in several rows at the margins forming a more or less distinct border; costa usually percurrent or excurrent. Seta terminal, elongate; capsule usually pendulous, pyriform or clavate with a tapering neck; peristome double, the outer of 16 lanceolate, entire teeth, the inner pale with a basal membrane about half as high as the teeth, bearing 16 lanceolate, keeled segments alternating with the teeth, more or less perforate along the median line and 1 to 3 intermediate cilia opposite the teeth, usually with short transverse appendages; lid convex, apiculate; calyptra small, fugacious.

1. Leaves spirally twisted when dry ..... **1. B. vino-viride**
   Leaves not spirally twisted 2
2. Robust plants, leaves 3 mm. or more long 3
   Slender plants, leaves 2.5 mm. or less long 4
3. Leaves spreading, the uppermost in comose, rosulate tufts ..... **7. B. decaisnei**
   Leaves erect, not comose ..... **8. B. baldwinii**
4. Costa ending about two-thirds up, upper cells colorless ..... **9. B. argenteum**
   Costa excurrent 5
5. Costa long excurrent ..... **5. B. caespiticum**
   Costa short excurrent 6
6. Leaves about 2.5 mm. long, capsule constricted under the mouth when dry ..... **2. B. megalostegium**
   Leaves about 1.5 mm. long 7
7. Leaves flaccid, seta 1.5 cm. long ..... **6. B. mauiense**
   Leaves firm, seta 2.5 cm. or more long 8
8. Leaves bordered with 2 to 3 rows of narrow cells ..... **3. B. crassicostatum**
   Leaves not bordered ..... **4. B. erythrocarpum**

1. Bryum vino-viride, new species (fig. 82).

Dioicum; caespitosum, caespitibus laxis, viridibus, saepe rubicundulus, nitidis. Folia sicca spiraliter contorta, spathulata, acuminata, nervo crasso subcontinuo vel brevissime excedente; marginibus inferne revolutis; cellulis rhombeis et hexagonis, marginalibus angustis, limbum pauciseriatum sed distinctum efformantibus. Seta ad 2.5 cm. longa; theca nutans, cylindrica, 3 mm. longa.

Dioicous; male plants short, 6 to 8 mm. high, mixed with the fruiting plants, antheridia numerous, 0.4 mm. long, with abundant brown filiform paraphyses, in a terminal cluster, perigonial leaves about 1 mm. long, short acuminate, concave, costate to the apex, the inner tinged with golden brown. Plants loosely tufted, deep green tinged above with vinous red, glossy, dark brown below. Stems erect with numerous ascending, flexuose branches, 1.5 to 2 cm. high, very radiculose in the lower parts. Leaves rather distant, uniformly spaced, not comose at the tips of the branches, loosely spreading, spirally twisted and shrunken when dry, rather widely spreading when moist, broadly ovate or obovate-spathulate, 2 to 2.5 mm. long by 1 mm. wide, flat or slightly concave, very shortly acuminate; margin narrowly reflexed in the lower half, plane and remotely denticulate above; costa usually reddish, broad at the base, percurrent or slightly excurrent in a short cuspidate point; leaf cells hexagonal-rhomboidal, thin-walled, very chlorophyllose, 16 to 18 μ wide and 3 to 4 times as long, 3 or 4 rows at the margins very long and narrow with thickened yellowish walls, forming a narrow but distinct border; becoming rectangular toward the base. Seta 2 to 2.5 cm. long, reddish at the base, paler above; capsule 3 mm. or more long, narrowly cylindric with a long tapering neck, horizontal or sub-pendulous, reddish brown when mature, barely constricted under the mouth; peristome teeth light orange, paler at the tips, inner peristome pale, basal membrane slightly more than half the height of the teeth, segments widely split along the median line, cilia two, appendiculate; lid conic, apiculate; spores yellowish, smooth, 12 to 15 μ in diameter.

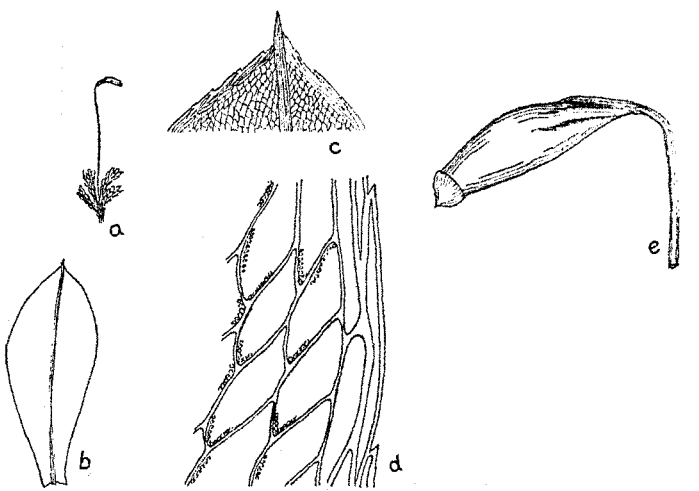


FIGURE 82. *Bryum vino-viride* Bartram: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 9.

Type: shaded rocky bank, vicinity of Kokee, Kauai, altitude 4,000 feet, February 21, 1930, E. B. Bartram, number 596.

A handsome moss easily recognized by the flexuose, twisted, and contorted leaves when dry and the long cylindric capsules. Although evidently allied to the cosmopolitan *B. capillare* Linnaeus, it seems to be quite distinct in the very shortly pointed leaves with a barely excurrent costa. I found it rather abundant on the steep sides of shaded ravines near Kokee, Kauai, and it may be expected from other elevated sections where the conditions are suitable.

2. **Bryum megalostegium** Sullivant, U. S. Expl. Exped., Musci., p. 9, 1859 (fig. 83).

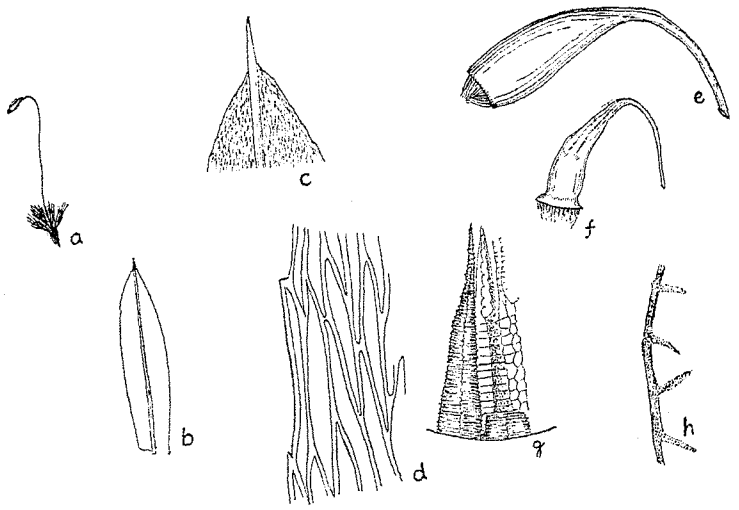


FIGURE 83. *Bryum megalostegium* Sullivant: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, moist capsule × 9; *f*, dry capsule × 9; *g*, part of peristome × 60; *h*, part of appendiculate cilium × 300.

Dioicous. Slender plants in dense tufts or cushions, pale green above, light brown below, glossy. Stems erect or ascending, up to 1 cm. high with innovations, sparingly radiculose in the older parts. Leaves rather crowded, erect with flexuose tips when dry, erect-spreading when moist, concave, oblong-lanceolate, cuspidate, 2.5 to 2.8 mm. long by 0.75 mm. wide; margin plane or broadly inflexed toward the apex, entire to minutely denticulate above; costa slender, excurrent in a short yellowish, cuspidate point. Leaf cells linear or linear-rhomboidal, slightly chlorophyllose, about 10 μ wide and 8 to 12 times as long, walls delicate, yellowish, not at all incrassate, gradually narrower toward the margins, but without a differentiated border, larger and rectangular at the base and usually reddish. Seta slender, reddish, about 1.5 cm. long, broadly arcuate at the top; capsule horizontal or subpendulous, up to 3 mm. long by 1 mm. wide, strongly contracted under the mouth when dry, oblong-cylindric, bright reddish brown, contracted to a long, sulcate neck as long as or longer than the urn; peristome teeth orange-brown, reddish at base; inner peristome pale yellow, basal membrane about two-thirds the height of the teeth, segments keeled and widely split along the median line, cilia appendiculate; lid red, conic, apiculate, 0.75 mm. long; spores pale, smooth, 10 to 12 μ in diameter.

Damp rocks and banks. Oahu: Waikane-Schofield trail, Koolau Range (Bartram); Nuuanu Pali (Bartram); east side of Manoa Valley (Bartram). Maui: Honokohau ditch trail (Bartram); Haleakala, lower ditch trail (Skottsberg); Oopula (Bartram). Island of Hawaii: Hilo, along Wailuku River (Bartram); Rainbow Falls near Hilo (Bartram); Pahoehoe, southern Kona (Bartram); Paauilo (Bartram); Niulii, Kohala (Degener and Iwasaki). Kauai: power plant (Bartram).

Endemic. Type locality, Hawaii.

A very pretty species easily recognized by the glossy green cushions and the large, bright brown capsules which are usually produced in abundance. In a general way the plant is strongly suggestive of a *Webera.* The resemblance is borne out by the elongated leaf areolation, but the excurrent costa and appendiculate cilia confirm its true relationship without question. The capsules are more strongly constricted under the mouth, both before and after the fall of the lid, than in any of the other local species. This character as well as the larger leaves will help to distinguish the species from *B. erythrocarpum.*

3. **Bryum crassicostatum** Brotherus, B. P. Bishop Mus., Bull. 40, p. 15, 1927 (fig. 84).

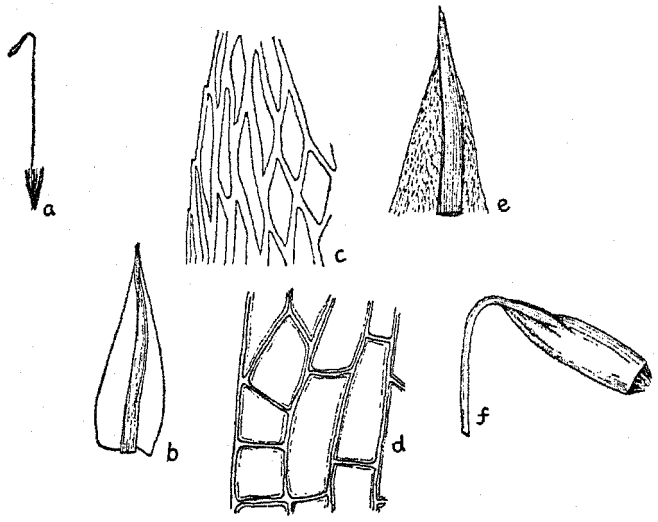


FIGURE 84. *Bryum crassicostatum* Brotherus: *a*, plant × ¾; *b*, leaf × 25½; c, upper leaf cells and margin × 300; *d*, basal leaf cells × 300; *e*, apex of leaf × 60; *f*, moist capsule × 9.

Dioicous; male flowers unknown. Slender, densely tufted plants, yellowish above, brown below, slightly glossy. Stems erect with slender, erect innovations, up to 1 cm. high, matted together with radicles in the lower parts. Leaves crowded, erect to slightly spreading wet and dry, carinate-concave, ovate-lanceolate, cuspidate, 1.5 to 2 mm. long

and 0.4 to 0.5 mm. wide; margin more or less revolute above, usually plane below, denticulate toward the apex; costa very strong, reddish at the insertion, brown above, 75 μ wide at the base, excurrent in a short, stout, smooth or minutely denticulate point. Upper leaf cells linear-rhomboidal with firm, pellucid walls, up to 10 μ wide and 35 to 50 μ long, 2 or 3 rows at the margins linear, incrassate but hardly forming a distinct border; toward the base larger, more lax, subrectangular, usually tinged with red at the insertion. Seta slender, brown, 2.5 to 3 cm. long; capsule horizontal or slightly pendulous, brown, oblong, a scant 3 mm. long by 1.5 mm. wide, contracted to a distinct neck about 1 mm. long; peristome teeth 0.5 mm. long, lanceolate, deep yellow with hyaline tips; basal membrane of inner peristome more than half the height of the teeth, cilia appendiculate; lid unknown; spores pale, smooth, 12 to 15 μ in diameter.

Maui: brink of Haleakala, on ground, altitude 10,000 feet (Baldwin, type). Island of Hawaii: bank, vicinity of Kilauea (Bartram).

Endemic. Type locality, Haleakala, Maui.

A rather inconspicuous plant to the naked eye, but under the microscope easily recognized by the small concave, cuspidate, indistinctly bordered leaves and especially by the stout, reddish brown costa, which is relatively wider and thicker than in any of the other local species of this genus.

4. **Bryum erythrocarpum** Schwaegrichen, Suppl. 1, pt. 2, p. 100, 1816 (fig. 85).

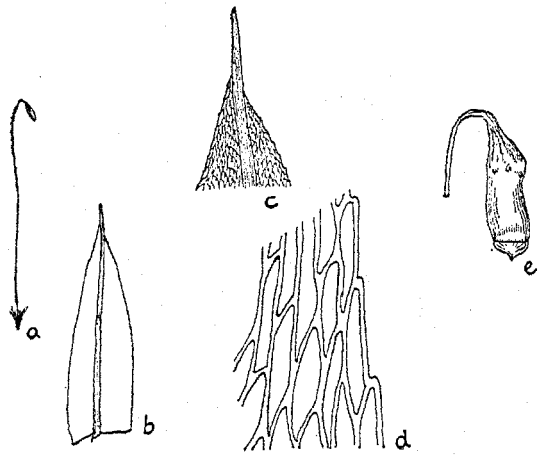


FIGURE 85. *Bryum erythrocarpum* Schwaegrichen: *a*, plant × ¾; *b*, leaf × 27; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, dry capsule × 9.

Dioicous. Small, short, loosely tufted plants, usually tinged with red. Stems short, up to 5 or 6 mm. high, radiculose below. Leaves small, rather crowded, rigid, erect when dry, slightly spreading when moist, ovate-lanceolate to lanceolate, 1.5 mm. long and 0.4 to 0.5 mm. wide, carinate-concave, cuspidate; margin slightly revolute, denticulate toward the apex; costa reddish at the insertion, yellowish above, up to 60 μ wide at the base, excurrent in a short, stout, yellowish, more or less denticulate point. Leaf cells narrowly rhomboidal, about 10 μ wide by 4 to 5 times as long, slightly narrower

toward the margins, but not forming a distinct border. Seta slender, reddish, 3.5 to 4 cm. long; capsule pendulous, oblong-cylindric, 3 to 4 mm. long by 1.2 mm. wide, tapering gradually to a sulcate neck; lid conic, apiculate.

Oahu: central ridge of Niu Valley (Forbes). Island of Hawaii: bank near Kilauea Iki (Bartram).

Distribution: Europe, northern Africa, North America. Type locality, Europe.

The status of this species in Hawaii is not as clear as it might be. The few collections I have seen are all immature and fail to show the characteristic crimson or purplish capsules, although the vegetative characters are identical with those of typical plants of Europe and North America. The looser tufts and longer setae may help to separate this plant from *B. crassicostatum* in the field. The less distinctly bordered leaves and narrower costa seem to be distinctive microscopic characters.

5. **Bryum caespiticum** Hedwig, Sp. Musc., p. 180, 1801 (fig. 86).
Bryum caespiticum Linnaeus, Sp. Pl., p. 1121, 1753.

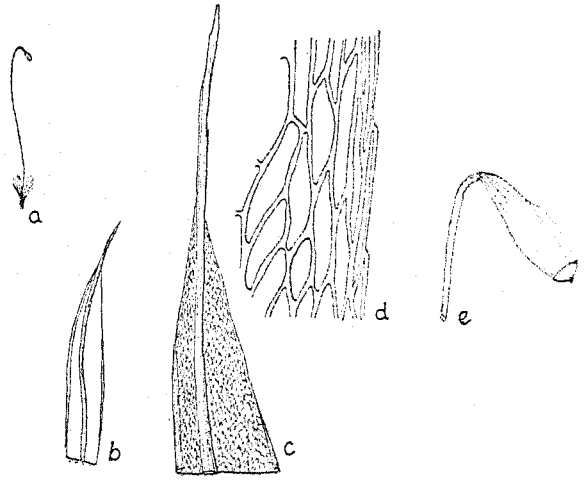


FIGURE 86. *Bryum caespiticum* Hedwig: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 9.

Dioicous; male plants about 3 mm. high mixed with the sporophyte-bearing plants, antheridia numerous with abundant paraphyses. In rather loose, pale green tufts. Stems 1 to 1.5 cm. long, radiculose below, usually with numerous slender innovations. Upper leaves crowded in a comal tuft, narrowly lanceolate, slenderly acuminate, slightly twisted and flexuose when dry, 2 to 2.5 mm. long by 0.4 mm. wide; margin plane and slightly denticulate toward the apex, narrowly revolute below; costa excurrent in a long, denticulate, yellowish arista; leaf cells with firm walls, narrowly rhomboidal, about 10 μ wide and 4 to 6 times as long, toward the margins long and narrow, but not forming a well-defined border, basal cells all narrowly oblong to linear. Seta 2 to 3 cm. long, sometimes longer, hooked at the apex; capsule pendent or horizontal, sub-

cylindric, 3 to 4 mm. long, brown, with a sulcate neck about half as long as the urn; peristome teeth pale yellow, cilia of the inner peristome strongly appendiculate; annulus present; lid conic, apiculate, reddish brown, glossy; spores 10 to 14 μ in diameter.

Maui: dry rock crevices, crater of Haleakala (Degener).

Distribution: Europe, Asia, North America, Japan, New Zealand. Type locality, Europe.

This well-known moss seems to be rare locally. It should be easily recognized by the narrow leaves and long excurrent costa.

6. **Bryum mauiense** Brotherus, B. P. Bishop Mus., Bull. 40, p. 14, 1927 (fig. 87).

Dioicous. Growing in dense tufts, pale green tinged with red above, slightly glossy, brown below. Stems erect, 1 to 2 cm. high with innovations, radiculose at the base. Leaves rather soft and flaccid, crowded, erect-spreading, carinate, concave, oblong-ovate, acute or very short acuminate, 1.5 mm. long by 0.5 mm. wide; margin plane, entire; costa slender, reddish, percurrent; leaf cells lax, with thin, delicate walls, narrowly rhomboidal, acute, 10 to 12 μ wide and 6 to 8 times as long, more elongated toward the margin but without a distinct border, toward the base short rectangular to subquadrate, reddish. Seta short, up to 15 mm. long, reddish brown; capsule inclined, ovoid, brown, wide-mouthed, up to 2.5 mm. long; peristome unknown; lid obtusely conic

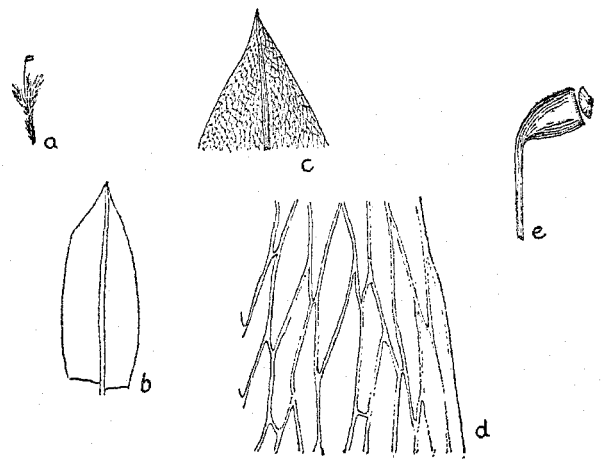


FIGURE 87. *Bryum mauiense* Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 9.

Maui: western part of island, in valleys, altitude 700 feet (Baldwin, type). Endemic. Type locality, western Maui.

The short setae and soft leaves with delicate, thin-walled cells will serve to identify this plant, but in reality our knowledge is limited to the one collection, of which I have seen only a few plants. It remains to be seen how stable the distinctive characters are and to what extent they will establish the species.

7. **Bryum decaisnei** Dozy and Molkenboer, Musci Frond. ined. Archip. Ind., p. 19, 1845 (fig. 88).
? *Bryum limbato-marginatum* C. Müller, Flora, vol. 82, p. 440, 1896.

Dioicous. Plants rather robust in dense, deep tufts or mats, pale or yellowish green at the tips, brown below. Stems 2 to 3 cm. high with numerous flagellaceous innovations from the comal tufts, loosely erect or ascending, radiculose below. Stem leaves crowded in dense terminal rosettes, more or less shrunken and flexuose when dry, widely spreading when moist, slightly carinate, oblong-spathulate, cuspidate by the excurrent costa, about 5 mm. long by 2 mm. wide at the broadest part; margin narrowly reflexed and entire in the lower half, plane and serrulate above; lower leaves of the innovations distant, the upper crowded in a comal tuft similar to the stem leaves but smaller. Leaf cells rhomboidal-hexagonal with firm pellucid walls, about 10μ wide and 40 to 60 μ long, gradually larger toward the base, the 6 to 8 marginal rows linear, very incrassate, forming a distinct, yellowish border. Seta 2 to 4 cm. long; capsule pendulous, cylindric, up to 6 mm. long, dark brown.

Maui: western part of island, mountain ridges (Baldwin).
Distribution: Java. Type locality, Java.

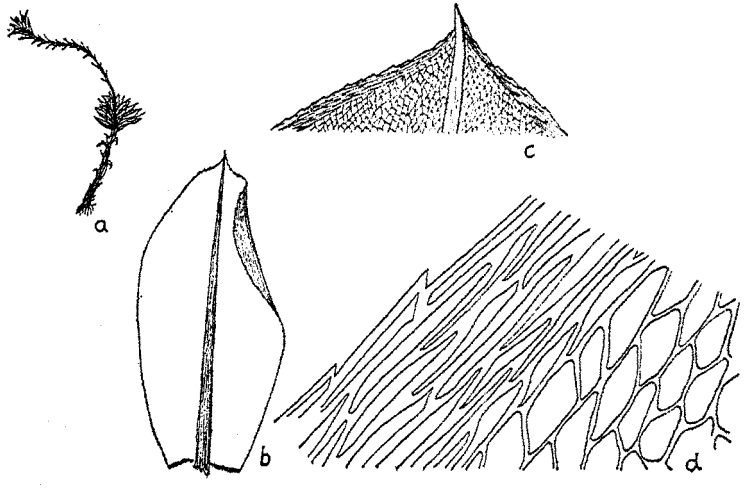


FIGURE 88. *Bryum decaisnei* Dozy and Molkenboer: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300.

This is evidently a rare species in Hawaii and, as far as known, confined to the mountains of western Maui. The large, spreading leaves crowded in conspicuous terminal rosettes preclude confusion with any other local species but *Rhodobryum giganteum,* which has even larger leaves. The fruit is rare and so far has not been found in Hawaii.

8. **Bryum baldwinii** Brotherus, B. P. Bishop Mus., Bull. 40, p. 15, 1927 (fig. 89).

Dioicous. Plants robust, densely tufted, yellowish green, slightly glossy, brown below. Stems erect from an ascending base, up to 4 cm. high, 3 to 4 mm. wide with leaves, simple or with few short, erect branches, radiculose at the base. Leaves crowded, erect when dry, slightly spreading when moist, indistinctly plicate, slightly carinate-concave, oblong-ovate, short acuminate or acute, about 3 mm. long by 1 mm. wide; margin narrowly revolute almost to the point, denticulate for a short distance below the apex, entire below; costa strong, yellowish, 120 μ wide at base, tapering upward, percurrent or excurrent in a short, yellowish, denticulate mucro. Leaf cells narrowly hexagonal-rhomboidal with rather thick, yellowish, pellucid walls, 4 to 6 rows at the margins linear forming a rather distinct yellowish border, toward the base shorter and broader, more lax, often tinged with brown at the insertion. Fruit unknown.

Maui: western part of island, mountain ravine, altitude 3,000 feet (Baldwin, type).

Endemic. Type locality, western Maui.

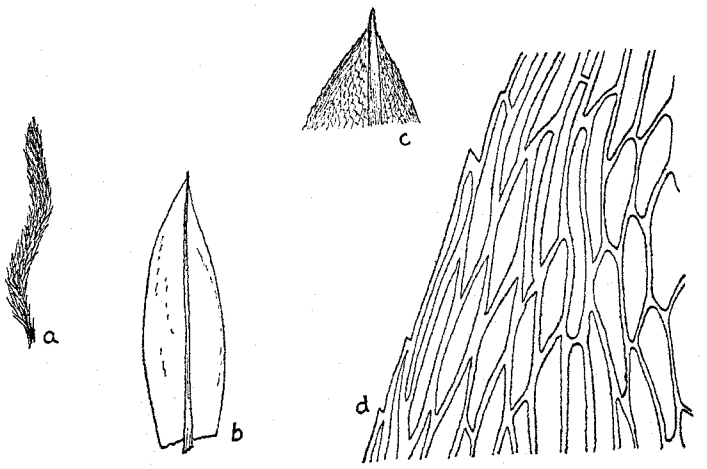


FIGURE 89. *Bryum baldwinii* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300.

A rather unsatisfactory species known only from two sterile collections by Baldwin in the mountains of western Maui. When fruit is available the status and relationship of the species may be more accurately determined. The robust habit and large leaves separate it from all but *B. decaisnei*, in which the leaves are flexuose and shrunken when dry and in rosulate, comal tufts.

9. Bryum argenteum Hedwig, Sp. Musc., p. 181, 1801 (fig. 90).
Bryum argenteum Linnaeus, Sp. Pl., p. 1120, 1753.

Dioicous. Plants small, in dense cushions or small tufts, pale green or silvery white, glossy and papery when dry. Stems up to 1.5 cm. or more long but usually shorter, with julaceous branches. Leaves crowded, broadly ovate or obovate, acute or short acuminate, concave, erect, appressed, about 1 mm. long by 0.5 mm. wide; costa slender, ending about two-thirds up; margin plane and entire; upper leaf cells linear-rhomboidal, about 12 μ wide and 80 to 100 μ long, slightly vermicular, colorless, toward the base shorter, rhomboidal and oblong, chlorophyllose. Seta 1 cm. or less long, reddish below, paler above, arcuate at the top; capsule short oblong, up to 1.5 mm. long by 0.5 mm. wide, abruptly contracted at the base, reddish brown; lid convex, apiculate.

Banks. Island of Hawaii: summit of Mount Hualalai (Miss Reed). Kauai: near Kalihiwai (Bartram).

Cosmopolitan. Type locality, Europe.

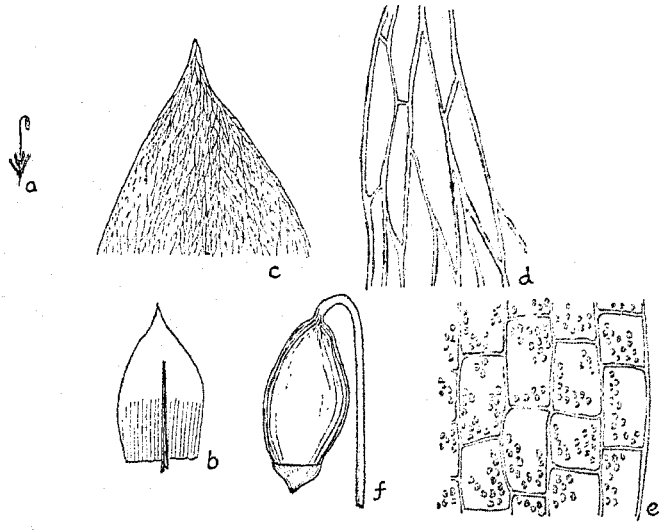


FIGURE 90. *Bryum argenteum* Hedwig: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300; *f*, moist capsule × 12.

The thin silvery leaves lend a characteristic tint that makes identification of this species a simple matter. The variety *lanatum* is a fairly well-marked xerophytic form in which the costa, instead of ending well below the apex as in the type, is percurrent or even excurrent. Most Hawaiian plants are referable to this form.

Bryum argenteum variety **lanatum** (Palisot de Beauvois) Bryol. Eur., fasc. 6-9, p. 79, 1839.

Mnium lanatum Palisot de Beauvois, Prodrome, p. 75, 1805.

Leaves longer acuminate; costa extending into the apex or excurrent.

Maui: Honokohau ditch trail (Bartram); near Rest House, Haleakala (St. John). Island of Hawaii: stone wall, Hilo (Bartram); vicinity of Kilauea, lava pockets (Bartram); near Kealakekua (Bartram).

47. RHODOBRYUM (Schimper) Limpricht, Laubm., vol. 2, p. 444, 1892.

Bryum subgenus 3, *Rhodobryum* Schimper, Syn., 1st ed., p. 381, 1860.

Large stoloniferous plants growing in large, loose mats. Stems erect from subterraneous stolons, naked below or with small, appressed leaves, upper leaves abruptly much larger, forming a large terminal rosette, long spathulate, serrate above; costa broad below, nearly percurrent; leaf cells elongate-hexagonal. Setae often clustered, elongate; capsule large, pendulous.

1. **Rhodobryum giganteum** (Hooker) Schimper, Syn., 2d ed., p. 464, 1876 (fig. 91).

Bryum giganteum Hooker, Schwaegrichen, Suppl. 2, pt. 2, fasc. 1, p. 20, 1824-1826.

Bryum pseudo-giganteum C. Müller, Flora, vol. 82, p. 439, 1896.

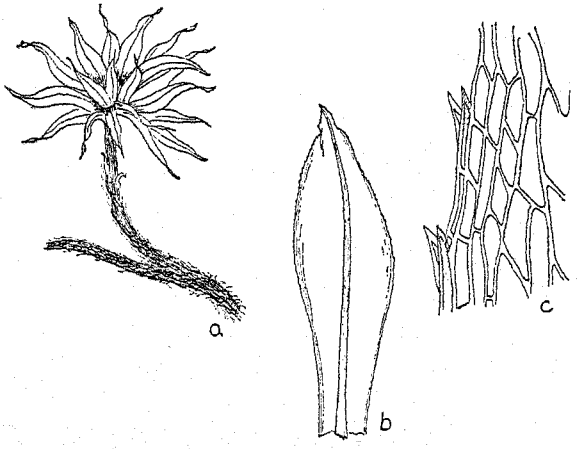


FIGURE 91. *Rhodobryum giganteum* (Hooker) Schimper: *a*, plant × ¾; *b*, leaf × 3; *c*, upper leaf cells and margin × 120.

Synoicous and dioicous. Gregarious, robust plants, deep green, growing in loose tufts or mats. Stems erect, simple or branched, stoloniferous, naked or with small, appressed leaves below, densely radiculose at the base, up to 6 cm. high; upper leaves very large, forming a broad terminal rosette, widely spreading, slightly flexuose when dry, long spathulate, acute, up to 15 mm. long by 4 mm. wide; margin narrowly recurved and entire in the lower half, plane and spinose-serrate above with the teeth usually in pairs; costa broad below, tapering upward and ending just below the apex. Upper leaf cells long-hexagonal, up to 25 μ wide by 125 μ long, becoming rectangular toward the base, the marginal rows more elongate but not forming a distinct border. Setae 1 to 3 from a single perichaetium, up to 8 cm. long; capsules large, pendulous, up to 9 mm. long, cylindric; lid conic, short apiculate.

Damp, shaded banks. Oahu: Puu Kaala. Maui: east of Ukulele, Haleakala (Forbes); pipe line trail, northeast of Olinda (Degener); western part of island, altitude 5,500 feet (Baldwin). Kauai: (Hillebrand).

Distribution: Indo-Malayan regions, Africa, Borneo, China, Japan. Type locality, Nepal.

A beautiful moss that will be known at sight by the broad terminal rosettes of large leaves. Although no fruiting plants have been collected locally, as far as I know, the vegetative details are in perfect accord with the Indo-Malayan species and I can, therefore, see no reason for keeping them separate.

Family 12. MNIACEAE

Medium-sized or robust plants in lax patches. Fertile stems erect with the upper leaves in rosulate tufts; sterile branches frequently prostrate and uniformly leaved. Leaves crispate when dry, oblong, short-pointed, usually distinctly bordered; margin serrate with single or paired teeth; costa stout, percurrent; cells short, smooth, hexagonal, parenchymatous. Seta elongate; capsule horizontal, oblong-cylindric; peristome as in *Bryum*; cilia hardly appendiculate.

48. MNIUM Hedwig, Sp. Musc., p. 188, 1801.

Plants with the characters of the family.

Leaf margin with single teeth, lid long rostrate.....1. **M. rostratum**
Leaf margin with the teeth in pairs, lid short-beaked.....2. **M. serratum**

1. **Mnium rostratum** Schwaegrichen, Suppl. 1, pt. 2, p. 136, 1816 (fig. 92).
   Mnium rostratum Schrader, in Linnaeus, Syst. Nat., 13, 2d. ed., vol. 2, p. 1330, 1791.
   Mnium rhynchophorum Hooker, Icones Plant. Asiat. 2, tab. 91, fig. 3, 1847.
   Mnium prorepens C. Müller, Flora, vol. 82, p. 437, 1896.

Synoicous; antheridia and archegonia numerous with abundant filiform paraphyses. In dark green lax patches. Stems erect, about 2 cm. high, densely radiculose at the base, with long, prostrate, stoloniferous branches. Leaves undulate-crisped when dry, broadly oblong to slightly obovate, rounded at the apex and short apiculate, crowded in rosulate tufts at the tips, up to 7 mm. long by 3 mm. broad; those of the stolons smaller, more or less complanate; bordered all around with 3 or 4 rows of elongated, somewhat thickened cells; leaf cells rounded-hexagonal, slightly collenchymatous, 20 to 26 μ in diameter, larger along the costa and at the extreme base; margin serrate about two-thirds of the way down with short, irregular, single teeth, nearly entire below; costa stout, ending in the apiculus. Setae solitary or aggregate, reddish below, paler above, 2 cm. or more long; capsule horizontal or pendulous, oval-oblong, pale brown; peristome teeth yellowish; annulus broad; lid long rostrate from a conic base.

On ground in shaded ravines. Maui: north slope of Haleakala (Forbes); western part of island, altitude 6,000 feet (Baldwin).

Cosmopolitan in temperate and tropical regions. Type locality, Europe.

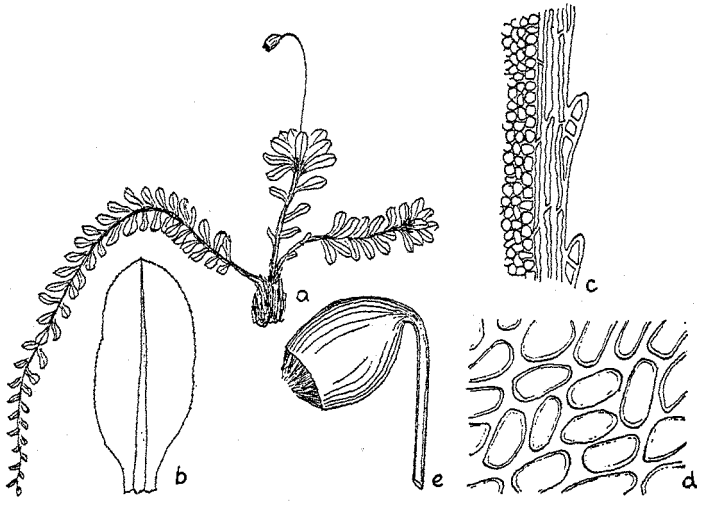


FIGURE 92. *Mnium rostratum* Schwaegrichen: *a*, plant × ¾; *b*, leaf × 6; *c*, upper leaf cells and margin × 120; *d*, upper leaf cells × 300; *e*, capsule × 9.

A variable, widely distributed species to which, I think, the Hawaiian plants can be referred without much question. The fruiting plants collected by Baldwin have shorter setae and smaller, more globose capsules than one ordinarily finds, but these differences seem too slight to outweigh the entire agreement in other essential particulars.

2. **Mnium serratum** Schwaegrichen, Suppl. 1, pt. 2, p. 128, 1816 (fig. 93).
Mnium serratum Schrader, in Linnaeus, Syst. Nat., 13, 2d. ed., vol. 2, p. 1330, 1791.

Synoicous. Slender plants in loose tufts, dark green tinged with red. Stems erect, 2 to 3 cm. high; leaves rather distant, strongly decurrent, the lower oval and entire, the upper oblong-spathulate, acute, apiculate; those of the sterile shoots sub-equal, shorter and broader; all with a distinct reddish border of elongated cells; margins serrate to below the middle with paired teeth; costa red, percurrent or ending below the apex, smooth on the back; leaf cells rounded, collenchymatous, 20 to 24 μ in diameter, larger and short rectangular toward the base. Seta 2 to 3 cm. high, bright red; capsule horizontal, brownish; lid convex with a short beak; spores 20 to 25 μ in diameter.

Maui: east of Ukulele, Haleakala, on ground (Forbes).

Distribution: Europe, Asia, North America. Type locality, Europe.

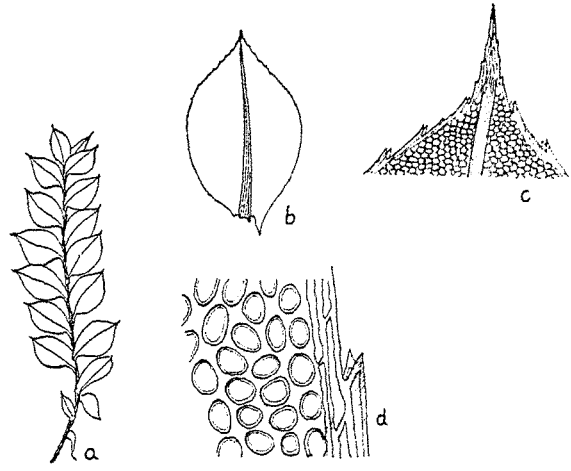


FIGURE 93. *Mnium serratum* Schwaegrichen: *a*, sterile stem × 9; *b*, leaf × 25½; *c*, apex of leaf × 120; *d*, upper leaf cells and margin × 300.

This species is included in the Hawaiian flora on the basis of a few sterile shoots found among other mosses collected by C. N. Forbes on Haleakala. The determination is, necessarily, very doubtful, but the shape and structure of the leaves correspond so closely with those of *M. serratum* that I have tentatively placed them here until more material is available. The plants undoubtedly belong in the section Polla, characterized by bordered leaves with the teeth in pairs. As no other species of this section is known to occur in Hawaii, further collections are needed to establish its definite identity.

FAMILY 13. RHIZOGONIACEAE

Slender to robust plants growing in lax, often deep tufts. Stems laxly erect, densely tomentose below. Leaves erect-spreading, linear-lanceolate, with plane, thickened, spinose-serrate margins; costa stout, excurrent, toothed on the back above; cells small, rounded, smooth, incrassate. Seta elongate; capsule horizontal, ovoid-cylindric; peristome as in *Mnium*.

49. RHIZOGONIUM Bridel, Bryol. Univ., vol. 2, p. 664, 1827.

Plants with the characters of the family.

Dioicous, costa very long excurrent.....**1. R. pungens**
Synoicous or autoicous, costa percurrent or short excurrent.....**2. R. spiniforme**

1. Rhizogonium pungens Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 81, 1854 (fig. 94).

Rhizogonium strictum C. Müller, in Ångström, Öfv. Vet. Akad Förh., no. 4, p. 51, 1876.

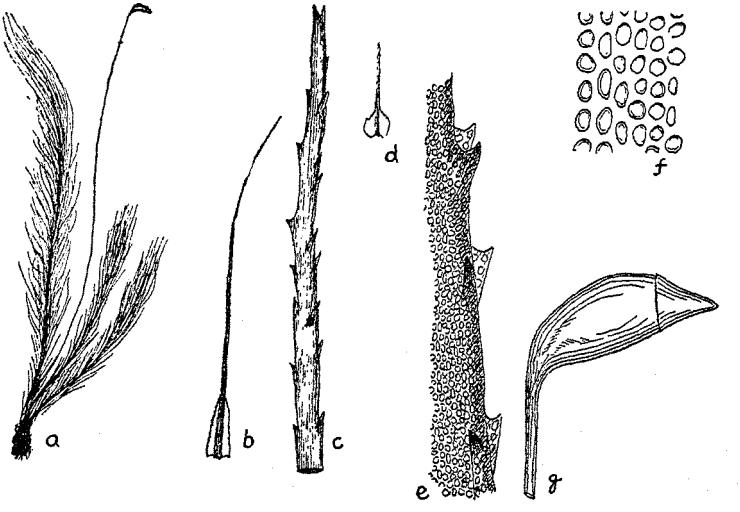


FIGURE 94. *Rhizogonium pungens* Sullivant: *a*, dry plant × ¾; *b*, leaf × 3; *c*, apex of leaf × 60; *d*, perichaetial leaf × 3; *e*, upper leaf cells and margin × 120; *f*, upper leaf cells × 300; *g*, moist capsule × 9.

Dioicous; male flower gemmiform near the base of the stem, imbedded in the dense felt of tomentum. Robust plants growing in deep tufts, yellowish green often tinged with brown, or reddish brown throughout, closely matted together in the lower parts with a dense felt of reddish brown tomentum. Stems up to 10 cm. long, erect or decumbent, simple or branched. Leaves not crowded, erect-spreading and slightly flexuose when dry, more spreading and rigid when moist, up to 17 mm. long, from a short, concave, ovate-lanceolate base, less than 3 mm. long, fleshy near the insertion, quickly narrowed to a very long, coarsely dentate, aristate point 4 to 6 times as long as the leaf blade; margin thickened, spinose-serrate in two rows nearly to the base; costa 150 μ wide below, cylindrical, excurrent in a long arista, distantly spinose-serrate on the back and edges; cells of the leaf base in two layers near the insertion and upward in two rows along the margins, very incrassate, rectangular and sub-quadrate near the extreme base, quickly becoming shorter and irregular upward, in the upper part of the blade irregularly oval, about 7 μ in diameter, smooth. Inner perichaetial leaves 4 mm. long, from a short, laxly areolate base abruptly narrowed to a long aristate point, spinose serrate on the margins and back; laminal cells in one layer throughout; seta erect, flexuose, bright red below, paler above, up to 7 cm. long; capsule horizontal, ovoid-cylindric, slightly

gibbous at the back, urn 2.5 to 3 mm. long, greenish brown; peristome double, teeth greenish yellow, transversely striate on the outer surface, hyaline and coarsely papillose at the apex; inner peristome pale, papillose, basal membrane about half the height of the teeth, segments not split, cilia two, nodose, shorter than the teeth; annulus broad; lid bright red with a short, oblique beak from a conic base, 1.5 mm. long; spores greenish, smooth or minutely papillose, 14 to 18 μ in diameter.

Rotten logs and bases of trees. Oahu: Pupukea-Kahuku trail, altitude 1,200 feet (Bartram); Nuuanu-Kalihi Ridge (Skottsberg); Kawaiiki ditch trail, Koolau Range (Skottsberg). Island of Hawaii: Hiulani forest (Skottsberg); Puna (Wilkes Expedition). Maui: east side of island, altitude 3,700 feet (Baldwin). Kauai: Waimea drainage basin (Forbes).

Endemic. Type locality, island of Hawaii.

The more robust habit and the long, bristle-like leaves with the excurrent costa 4 to 5 times as long as the blade will distinguish this species from *R. spiniforme* at a glance. The sporophyte is rare, but when present the long aristate-pointed perichaetial leaves are in marked contrast to the small short-pointed perichaetial leaves of the other species.

Cryptopodium bartramioides (Hooker) Bridel, has been recorded from the "Sandwich Islands" but, as Dixon has remarked (11, p. 223), the record is a questionable one and is probably based on an erroneous determination of plants representing either this or the following species. Ångström's reference (1, p. 18) to *Cryptopodium bartramioides* is probably the result of a similar error.

2. **Rhizogonium spiniforme** (Hedwig) Bruch, Flora, p. 134, 1846 (fig. 95).
Hypnum spiniforme Linnaeus, Sp. Pl., p. 1587, 1762.
Hypnum spiniforme Hedwig, Sp. Musc., p. 236, 1801.
Rhizogonium latifolium Ångström, Öfv. Vet. Akad. Förh., no. 4, p. 18, 1872.

Synoicous and autoicous; flowers at the base of the stems. Growing in lax or dense tufts, yellowish green or brown, matted together with reddish brown tomentum at the base. Stems up to 5 cm. long, simple or branched below. Leaves erect, flexuose and twisted with incurved points when dry, more erect-spreading and rigid when moist, the lowermost very small, quickly becoming larger upward, the upper leaves narrowly linear-lanceolate, gradually acuminate, carinate-concave, up to 6 or 8 mm. long by about 0.4 mm. wide; margin thickened, spinose-serrate with paired teeth from near the base to the apex; costa up to 180 μ wide below, percurrent or rather shortly excurrent, spinose-serrate on the back to below the middle. Leaf cells oval and rounded-quadrate, incrassate, smooth, up to 12 μ in diameter, two rows at the margins in two layers forming a distinctly thickened border. Perichaetial leaves small, the inner less than 2 mm. long, abruptly narrowed to a lanceolate point slightly longer than the broad oblong base; margins serrate above the middle; costa barely excurrent; seta flexuose, red below, paler above, up to 7 mm. long; fruit as in *R. pungens*.

Rotten logs, exposed tree roots, damp banks. Frequent on all the larger islands from near sea level to an altitude of 4,000 feet or more.

Distribution: general in tropical and subtropical regions throughout the world. Type locality, Jamaica.

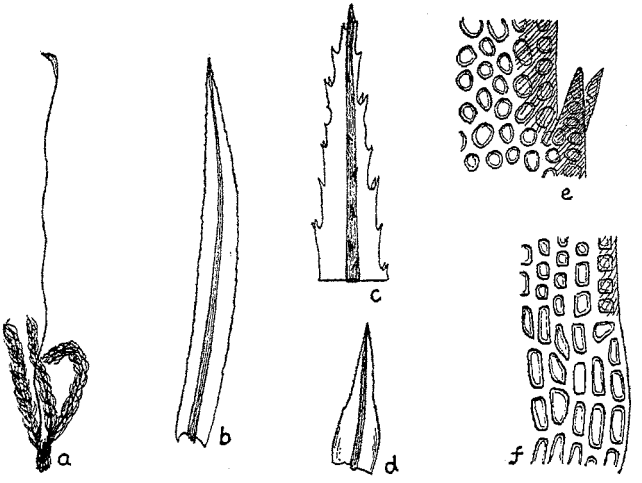


FIGURE 95. *Rhizogonium spiniforme* (Hedwig) Bruch: *a*, dry plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, inner perichaetial leaf × 12; *e*, upper leaf cells and margin × 300; *f*, basal angle of leaf × 300.

This cosmopolitan species is ordinarily less robust than *R. pungens*, fruits abundantly, and will be readily distinguished by the more broadly pointed leaves with the lamina extending nearly to the apex. The larger and smaller forms with longer or shorter leaves have been described as varieties, but it seems doubtful that they can be practically segregated with any degree of satisfaction.

FAMILY 14. HYPNODENDRACEAE

Usually robust plants with erect, dendroid secondary stems. Leaves ovate or ovate-lanceolate, margin often thickened, sharply serrate above; costa single, usually toothed on the back; cells linear or hexagonal. Seta elongate; capsule erect or pendulous, sub-cylindric, usually furrowed when dry; peristome double.

50. LIMBELLA C. Müller, Flora, vol. 82, p. 466, 1896.

Very robust, dendroid, sub-aquatic plants growing in large masses attached to rocks in running streams. Primary stems creeping, secondary stems erect or floating, copiously branched. Leaves with thickened borders similar in appearance to the stout costa; upper cells hexagonal, basal cells rectangular.

1. **Limbella tricostata** (Sullivant) C. Müller, Flora, vol. 82, p. 466, 1896 (fig. 96).

Neckera tricostata Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 81, 1854.
Limbella limbatula C. Müller, Flora, vol. 82, p. 466, 1896.
Limbella leptolomacea C. Müller, Flora, vol. 82, p. 467, 1896.
Sciaromium flagellare Brotherus, Bull. Soc. Bot. Ital., p. 23, 1904.
Sciaromium flexicaule Brotherus, Bull. Soc. Bot. Ital., p. 23, 1904.
Sciaromium porotrichoides Brotherus, Bull. Soc. Bot. Ital., p. 23, 1904.

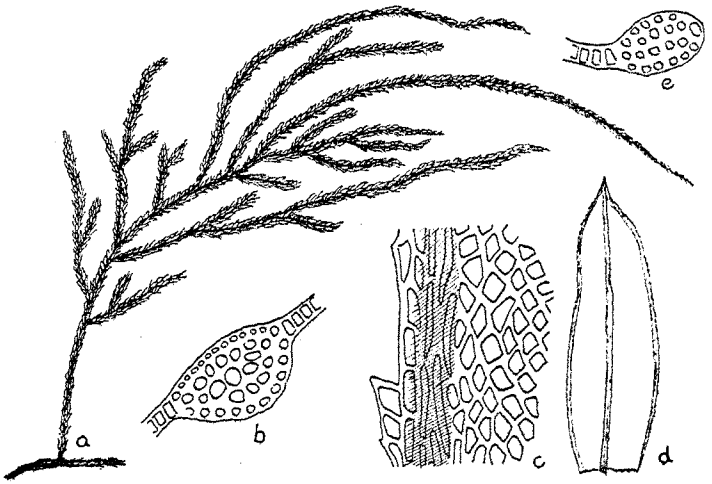


FIGURE 96. *Limbella tricostata* (Sullivant) C. Müller: *a*, plant × ⅜; *b*, cross section of costa × 300; *c*, upper leaf cells and margin × 300; *d*, leaf × 25½; *e*, cross section of leaf margin × 300.

Dioicous (?). Very robust, dendroid, sub-aquatic plants growing in dense masses, yellowish green at the tips of the branches, dark green or brown below. Primary stems creeping, attached to the substratum, stoloniferous; secondary stems erect or floating, up to 20 cm. long, densely radiculose at base, the stipe-like portion rigid and woody, naked or clothed with leaves; copiously branched above, branches erect, tapering and more or less cuspidate at the tips but not flagelliform, about 4 mm. wide with leaves; upper stem and branch leaves not crowded, erect-spreading, complanate, slightly undulate and flexuose when dry, rigid when moist, oblong-ovate, short acuminate, slightly concave, about 3 mm. long by 0.9 mm. wide; margin plane, serrate near the apex, crenulate below; costa yellowish, smooth and convex on the back, percurrent; areolation dense, the upper cells irregular oval-hexagonal, smooth, 7 to 10 μ wide and 12 to 20 μ long, thin-walled, gradually becoming long rectangular and linear with thickened, pellucid walls toward the base; bordered all around with a bistratose band of linear, incrassate cells of about the same width and appearance as the costa, often with a row of cells on the outside edge similar to those of the lamina; lower leaves of the stipe-like stem appressed, cordate-triangular from a broad insertion, gradually narrowed to a flexuose hair-point, denticulate all around; leaf cells linear-oblong, incrassate, sinuose, the marginal band less distinct, alar cells numerous, rectangular and rhomboidal. Inner perichaetial leaves slenderly acuminate from an oblong, erect, convolute-clasping base, ecostate. Fruit unknown.

In flowing streams, locally very abundant. Molokai: Waikalu to Kamoku (Forbes). Maui: Kula pipe line trail, northeast of Olinda (Degener and Weibke; Bartram); north slope of Haleakala (Forbes). Island of Hawaii: Kohala Mountains above Kamuela (Skottsberg); between Kawaiiki and Mohihi (Skottsberg). Kauai: vicinity of Kokee (Skottsberg; Bartram).

Endemic. Type locality, base of Mauna Kea, island of Hawaii.

The systematic position of this unique endemic species will have to remain uncertain until the fruit is known. It is certainly an anomalous element in the genus *Hypnodendron,* and I am well content to follow Brotherus (2, p. 23) in adopting the genus *Limbella,* which Müller unfortunately published without any definition of its limitations or affinities.

Family 15. BARTRAMIACEAE

Plants of variable size, often with whorls of sub-floral branches. Leaves lanceolate, sharp-pointed; costa percurrent or excurrent; cells mostly rectangular, usually papillose on the end walls. Seta elongate; capsule sub-globose, erect or inclined, usually furrowed; peristome none or double, outer peristome of 16 smooth or papillose teeth, inner peristome often imperfect or rudimentary.

1. Alar cells clearly differentiated, leaves plicate at base.....**54. Breutelia**
   Alar cells not differentiated, leaves not plicate.....2
2. Leaf cells smooth.....**51. Plagiopus**
   Leaf cells papillose.....3
3. Plants without whorled branches, leaves 5 to 7 mm. long.....**52. Bartramia**
   Plants with whorled sub-floral branches, leaves less than 3 mm. long.....**53. Philonotis**

51. PLAGIOPUS Bridel, Bryol. Univ., vol. 1, p. 596, 1826.

Rather small, densely tufted plants. Stems triangular in cross-section, tomentose below. Leaves twisted when dry, lanceolate, short-pointed; costa percurrent or excurrent; cells essentially smooth, rectangular, elongated toward the base. Seta terminal, erect; capsule sub-globose, inclined, furrowed when dry; peristome double, smooth; spores rather large.

1. **Plagiopus longisetus** (Bridel), new combination (fig. 97).
   Bryum Oederi Gunnerus, Flor. Norv., no. 1005, 1772.
   Bartramia longiseta Bridel, Musc. Rec. 2, pt. 3, tab. 2, fig. 10, p. 136, 1803.
   Plagiopus hawaiicus Brotherus, Bull. Soc. Bot. Ital., p. 22, 1904.

Synoicous. Growing in compact, yellowish green tufts, slightly glossy. Stems about 1.5 cm. high, dichotomously branched, densely red tomentose below, angular in cross-section. Leaves rather rigidly erect-spreading and lightly twisted when dry, widely spreading with recurved points when moist, linear-lanceolate, carinate, short acuminate, 2 to 3 mm. long by 0.3 to 0.4 mm. wide; margin revolute nearly to the apex, sharply serrate with a double row of teeth on the roll above; costa percurrent or short excurrent, denticulate on the back toward the tip; upper leaf cells rectangular, essentially smooth, 6 to 7 μ wide and 2 to 3 times as long, with firm walls; toward the base longer, up to

65 μ long near the costa, shorter toward the margins, reddish brown across the insertion, a few cells at the basal angles sub-quadrate and more lax. Seta erect, about 1 cm. long, reddish brown; capsule slightly nodding, oblong and striate when dry, sub-globose when moist, about 1.3 mm. in diameter; peristome double; lid conic, 0.5 mm. wide at base; spores brown, coarsely papillose, 25 to 30 μ in diameter.

Rock crevices. Maui: Haleakala, altitude 8,000 feet (Baldwin); crater of Haleakala (Degener).

Distribution: Europe, Central Asia, Japan, North America. Type locality, Europe.

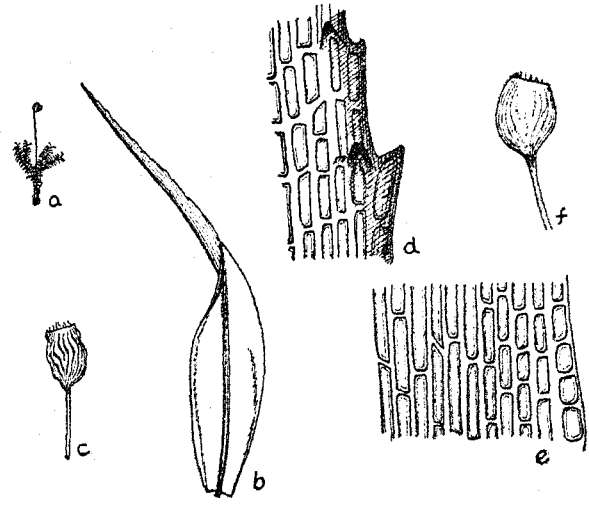


FIGURE 97. *Plagiopus longisetus* (Bridel) Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, dry capsule × 9; *d*, upper leaf cells and margin × 300; *e*, basal angle of leaf × 300; *f*, moist capsule × 9.

Although Brotherus has referred the Baldwin specimen to *P. javanicus*, all the plants from this collection that I have examined show a clearly synoicous inflorescence, as do those collected subsequently by Degener in the same general region. As far as I can see, the Hawaiian plants are indistinguishable from *P. longisetus*.

52. BARTRAMIA Hedwig, Sp. Musc., p. 164, 1801.

Robust plants growing in deep, loose tufts. Stems dichotomously branched, radiculose or tomentose below. Leaves linear-subulate from a broader, often sharply differentiated base; upper cells small, papillose. Seta rather short, erect or slightly curved; capsule sub-globose, striate; peristome double.

Leaf base erect, hyaline, sheathing, upper cells linear.....**1. B. baldwini**
Leaf base scarcely differentiated, upper cells rectangular.....**2. B. halleriana**

1. **Bartramia baldwini** C. Müller, Flora, vol. 82, p. 448, 1896 (fig. 98).
Bartramia mauiensis Brotherus, B. P. Bishop Mus., Bull. 40, p. 16, 1927.

Synoicous. Plants robust in loose, deep tufts; dull, yellowish green above, pale brown and densely radiculose below. Stems up to 5 cm. long, laxly erect, simple or branched, branches erect, curved at the tips, loosely matted with radicles below. Leaves crowded, erect-spreading and flexuose when dry, widely spreading when moist, 5 to 7 mm. long, abruptly contracted above the erect, sheathing, hyaline base, which is wider at the shoulders than below, to a spreading, linear-subulate point; margin narrowly reflexed just above the shoulders, plane and sharply denticulate above; costa distinct except near the tip, excurrent into a sharply denticulate, subulate point; basal leaf cells hyaline, long and narrow with very delicate walls; cells of the leaf blade linear with blunt ends, about 5 μ wide by up to 45 μ long, rather incrassate, end walls thickened and prominently papillose. Perichaetial leaves similar to the stem leaves. Seta up to 1.5 cm. long, erect, reddish; capsule globose, inclined, asymmetrical, about 2.25 mm. in diameter, small-mouthed; peristome double, inflexed, teeth of the outer peristome about 50 μ long, brownish, split or perforated along the median line in the upper half, inner peristome pale yellow, about half as long as the teeth, irregularly cleft on the rim, segments rudimentary or wanting; lid and calyptra unknown; spores dark brown, papillose, 30 to 35 μ in diameter.

Rocks. Maui: Haleakala, shaded ravines, altitude 8,000 feet (Baldwin); crater of Haleakala (Degener).

Endemic. Type locality, Haleakala, Maui.

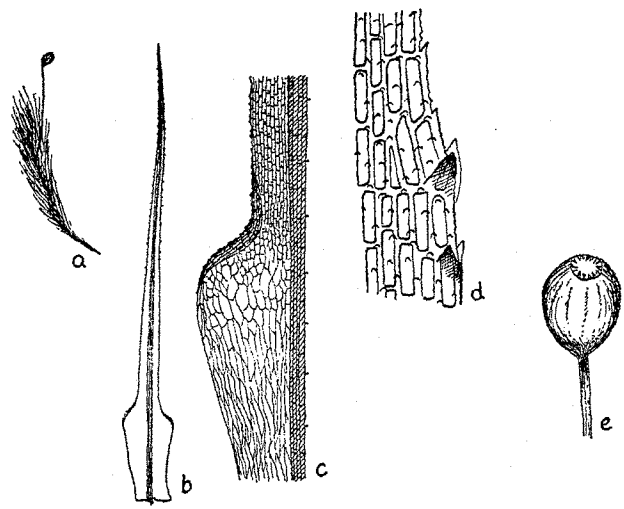


FIGURE 98. *Bartramia baldwini* C. Müller: *a*, plant × ¾; *b*, leaf × 12; *c*, leaf shoulder × 60; *d*, upper leaf cells and margin × 300; *e*, moist capsule × 9.

Shorter than *B. halleriana* and readily distinguished from this species by the erect, pale, sheathing leaf base, abruptly contracted above the rounded shoulders to a long, flexuose, divergent point.

2. **Bartramia halleriana** (Hedwig) Hedwig, Sp. Musc., p. 164, 1801 (fig. 99).

Webera Halleriana Hedwig, Fund. 2, p. 95, 1782.

Autoicous or synoicous. Plants in deep, loose tufts, dull yellowish green above, brown below. Stems robust, up to 15 cm. long, flexuose, usually densely tomentose below. Leaves less crowded than in the preceding species, widely flexouse-spreading, slightly crispate toward the tips of the stems, indistinctly secund, linear-subulate from a short, sub-erect, slightly sheathing base; margin narrowly recurved in the lower half, usually plane and somewhat thickened above, sharply serrate in the upper half, gradually becoming entire toward the expanded base; costa distinct, excurrent into a spinose-denticulate point. Upper leaf cells short rectangular with rounded ends, papillose, incrassate, becoming more elongate below, basal cells linear with firm, pellucid walls. Perichaetial leaves similar to the stem leaves; setae short, reddish, more or less curved, usually shorter than the leaves, about 5 mm. long, frequently in pairs; capsule inclined, asymmetrical, globose, 2 to 2.5 mm. in diameter, deeply furrowed; peristome double.

Maui: Haleakala, on ground in ravines, altitude 8,000 feet (Baldwin); Ukulele, Haleakala (Forbes); Koolau Gap, Haleakala (Degener).

Distribution: Europe, Asia, North America, southern South America, Tasmania, New Zealand. Type locality, Europe.

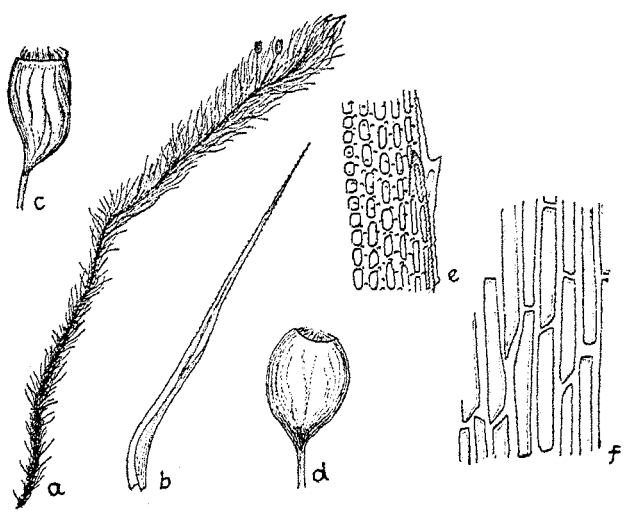


FIGURE 99. *Bartramia halleriana* (Hedwig) Hedwig: *a*, plant × ¾; *b*, leaf × 9; *c*, dry capsule × 9; *d*, moist capsule × 9; *e*, upper leaf cells and margin × 300; *f*, basal leaf cells × 300.

The longer, more laxly foliate stems, shorter setae, and very different leaf base will readily distinguish this plant from the preceding species.

53. PHILONOTIS Bridel, Bryol. Univ., vol. 2, p. 15, 1827.

Usually slender plants, short or moderately tall, with sub-floral whorls of branches, often densely tomemtose below. Leaves short, ovate-lanceolate, sharply pointed. Cells rectangular, usually sharply papillose on the end walls. Seta elongate; capsule short, usually strongly furrowed when dry; peristome none or double. Male flowers often discoid and conspicuous.

1. Capsule erect, peristome none ..... **1. P. hawaiica**
   Capsule nodding, peristome double 2
2. Male flowers gemmiform, leaves blunt ..... **2. P. laxissima**
   Male flowers discoid, leaves acuminate 3
3. Leaf margins plane, costa short excurrent ..... **3. P. falcata**
   Leaf margins revolute, costa long excurrent ..... **4. P. turneriana**

1. Philonotis hawaiica (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 645, 1904 (fig. 100).
Bartramia Hawaiica C. Müller, Flora, vol. 82, p. 447, 1896.

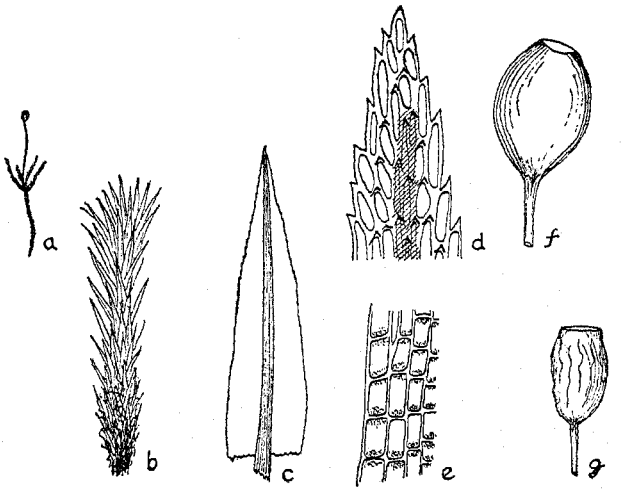


FIGURE 100. *Philonotis hawaiica* (C. Müller) Brotherus: *a*, plant × ¾; *b*, branch × 12; *c*, leaf × 60; *d*, apex of leaf × 300; *e*, basal leaf cells and margin × 300; *f*, moist capsule × 12; *g*, dry capsule × 12.

Dioicous; male flowers gemmiform, terminal, becoming lateral by the innovations; perigonial bracts abruptly subulate-acuminate from a broad, laxly areolate base, up to 1.5 mm. long, antheridia numerous, shorter than the abundant filiform paraphyses. Slender, wiry, yellowish green or brownish plants in dense tufts. Stems up to 2.5 cm. high with whorls of short branches below the flowers, erect, radiculose below. Leaves crowded, erect and closely appressed when dry, rigidly erect-spreading when moist, narrowly oblong-lanceolate, carinate-concave, bluntly acute, about 0.8 mm. long by 0.2 mm. wide; margin plane, sharply serrulate nearly to the base; costa pale yellow, percurrent or ending just below the apex, denticulate on the back; upper leaf cells narrowly rectan-

gular, 7 to 8 μ wide and 4 to 6 times as long, with firm, pellucid walls, slightly mamillose at the ends near the leaf point, smooth below; basal cells lax, short rectangular, 10 to 12 μ wide, smooth. Perichaetial leaves up to 1.5 mm. long, erect, subulate-acuminate from a short, concave, laxly areolate base, denticulate in the point; seta erect, bright red, 10 to 15 mm. long; capsule erect, globose, small-mouthed, about 1.2 mm. in diameter, reddish brown, when dry more oblong, slightly rugose and faintly ribbed; peristome none; lid plano-convex, about 350 μ in diameter; spores brown, minutely papillose, up to 30 μ in diameter.

Damp banks and ledges. Oahu: east side of Nuuanu Valley (Forbes); upper slopes of Tantalus (Forbes; Bartram); Waikane-Schofield trail, Koolau Range (Bartram). Maui: ledges along upper ditch trail, eastern Maui (Bartram); Honokohau ditch trail (Bartram); bank near Haelaau (Bartram). Molokai: edge of Waihanau (Forbes). Island of Hawaii: along Wailuku River, Hilo (Bartram). Kauai: near Haena caves (Bartram).

Endemic. Type locality, Hawaii.

A pretty little moss that will be recognized at once by the minute, rigidly appressed leaves and erect capsules without any peristome. Brotherus refers this species to the section Leiocarpus of *Philonotis,* but if *Bartramidula* is maintained as a distinct genus there seems to be no reason for excluding it.

2. **Philonotis laxissima** (C. Müller) Bryol. Jav., vol. 1, p. 154, 1861 (fig. 101).

Bartramia laxissima C. Müller, Syn., vol. 1, p. 480, 1849.

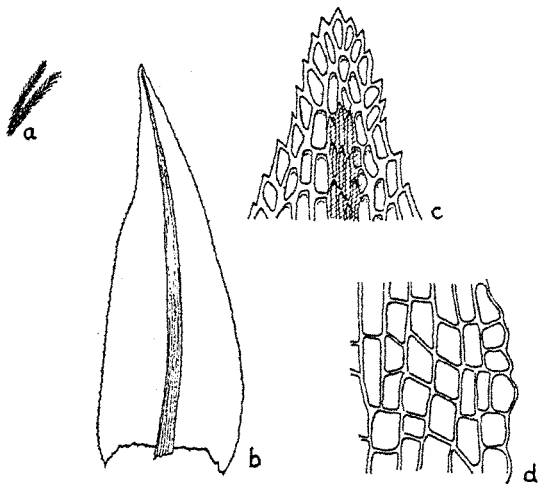


FIGURE 101. *Philonotis laxissima* (C. Müller) Bryol. Jav.: *a,* sterile stems × ¾; *b,* leaf × 60; *c,* apex of leaf × 300; *d,* basal leaf cells and margin × 300.

Dioicous; male plants slender, flowers gemmiform, terminal. Slender, pale green plants in low dense tufts. Stems 1 to 1.5 cm. long, decumbent, red tomentose below.

Leaves rather distant or crowded, erect or slightly incurved when dry, erect-spreading when moist, oblong-lanceolate, short or bluntly pointed, up to 1.5 mm. long by 0.5 mm. wide; margin narrowly reflexed above, denticulate by projecting cells, the teeth in a double row from just below the apex to about the middle of the leaf; costa percurrent or ending just below the point, denticulate on the back above; leaf cells lax, the upper about 10 μ wide and 3 to 4 times as long, smooth or slightly mamillose at the upper end, inner basal cells narrowly rectangular or linear, up to 75 μ long, smooth, at the leaf angles short rectangular, the marginal row rounded and irregularly protuberant. Capsules smaller than in *P. falcata.*

Wet rocks. Oahu: Manoa Valley, waterfall (Skottsberg). Island of Hawaii: slopes of Hualalai, northern Kona (Miss Reed). Maui: edge of cane field near Lahaina, a very slender form with narrow leaves (Bartram).

Distribution: Java, Philippines, Madagascar, Society Islands. Type locality, Java.

The few Hawaiian specimens I have seen are made up entirely of sterile, simple stems, but the vegetative characters correspond very well with those of the Javan plants which, according to Fleischer, are quite variable. The short-pointed or bluntish leaves with lax, nearly smooth cells will readily distinguish this species from *P. falcata* and *P. turneriana.*

3. **Philonotis falcata** (Hooker) Mitten, Musc. Ind. Orient., p. 62, 1859 (fig. 102).

Bartramia falcata Hooker, Trans. Linn. Soc., vol. 9, p. 317, 1808.
Philonotis Baldwinii Brotherus, Bull. Soc. Bot. Ital., p. 21, 1904.

Dioicous; male flowers discoid, terminal, the perigonial bracts widely spreading, with long, setaceous, denticulate points; costa thin and indistinct, ending in the apex. Plants variable but usually rather slender, growing in dense tufts, yellowish green. Stems red, with a large central strand, up to 5 cm. or more long, densely red-tomentose below or nearly throughout, often with whorls of short branches below the flowers. Leaves loosely imbricated all around the stem, slightly, but not clearly, spirally seriate, more or less falcate and slightly hooked at the tips of the branches, triangular-ovate from a broad insertion, acuminate, strongly carinate, up to 1.6 mm. long by 0.6 mm. wide at the base; margin denticulate all around, essentially plane; costa strong, papillose on the back, excurrent; leaf cells narrowly rectangular and linear, incrassate, sharply papillose at the upper end and frequently at both ends, 4 to 6 μ wide near the middle of the leaf, larger, more lax and more coarsely papillose toward the base. Seta red, 3 cm. long; capsule large, nodding or horizontal, brown, deeply sulcate when dry, sub-globose when moist, small-mouthed; peristome double; lid convex; spores brown, finely papillose, up to 20 μ in diameter.

Dripping ledges and wet rocks. Oahu: Hillebrands Glen (Forbes); Moanalua Valley (Forbes); Waikane-Schofield trail, Koolau Range (Bartram). Maui: pipe line back of Lahainaluna School (Bartram); Oopula (Bartram); Waikamoi (Bartram). Molokai: north of Pepeopae (Degener). Kauai: rocks in stream near power plant (Bartram).

Distribution: northern India, China, Korea, Japan, Philippines. Type locality, Sikkim.

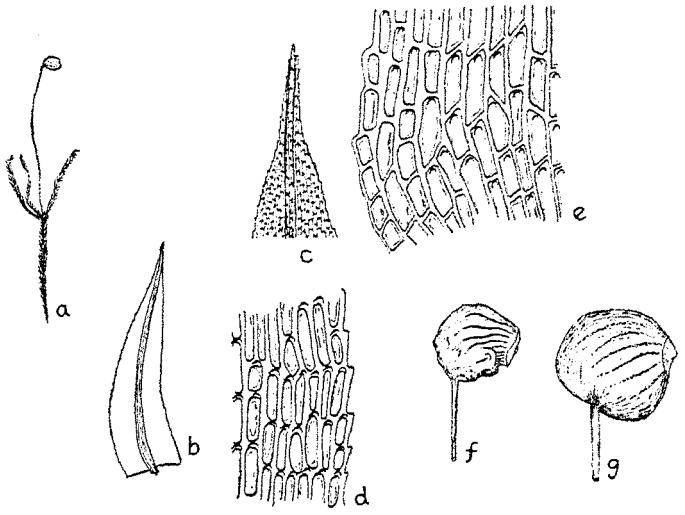


FIGURE 102. *Philonotis falcata* (Hooker) Mitten: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 120; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300; *f*, dry capsule × 9; *g*, moist capsule × 9.

Less common than *P. turneriana* and apparently partial to dripping, rather than moist, ledges and rocks. As compared with *P. turneriana* the leaves are shorter, more falcate, and more inclined to be hooked at the tips of the branches; the stems are rarely as densely matted with tomentum; and the basal leaf cells ar shorter.

4. **Philonotis turneriana** (Schwaegrichen) Mitten, Musc. Ind. Orient., p. 62, 1859 (fig. 103).

Bartramia Turneriana Schwaegrichen, Suppl. 3, pt. 1, fasc. 2, tab. 238, 1828.

Bartramia macroglobus C. Muller, Flora, vol. 82, p. 448, 1896.

Dioicous; male plants slender, flowers discoid, terminal, the perigonial bracts more erect than in *P. falcata*, abruptly contracted above the wide base to a long, sharp point. Plants usually robust, in large, deep tufts, yellowish green above, dark brown below. Stems red with a small central strand, up to 8 cm. high but often much shorter, densely matted with dark red tomentum in the lower parts and often throughout, with whorls of short branches below the flowers. Stem leaves crowded, erect, slightly falcate, ovate-lanceolate, up to 3 mm. long by 1 mm. wide; margin denticulate, revolute on one or both sides except near the apex; costa lightly papillose on the back, longer excurrent than in *P. falcata;* leaf cells linear, 3 to 5 μ wide and 8 to 10 times as long, sharply papillose at the upper end or at both ends, with firm, hardly incrassate walls, slightly broader and shorter at the base; branch leaves noticeably smaller, up to 2 mm. long by 0.5 mm. wide. Fruit similar to that of *P. falcata*.

Wet ledges, rocks, and banks. Oahu: Waikane-Schofield trail, Koolau Range (Bartram). Maui: Kula pipe line trail (Bartram); Ukulele, Haleakala (Forbes); crater of Haleakala (Degener); near Haelaau (Bartram). Molokai: north slope of Hanaliioliio (Degener); Deer trail, Waikapu (Forbes). Lanai: without definite locality (Forbes). Island of Hawaii: Kohala Mountains (Skottsberg); above Pahala, wet ravine (Skottsberg); southwest slope of Hualalai (Williams); near Makaopuhi (Bartram). Kauai: between Hanapepe and Wahiawa rivers (Heller).

Distribution: Nepal, Java, China, Japan. Type locality, Nepal.

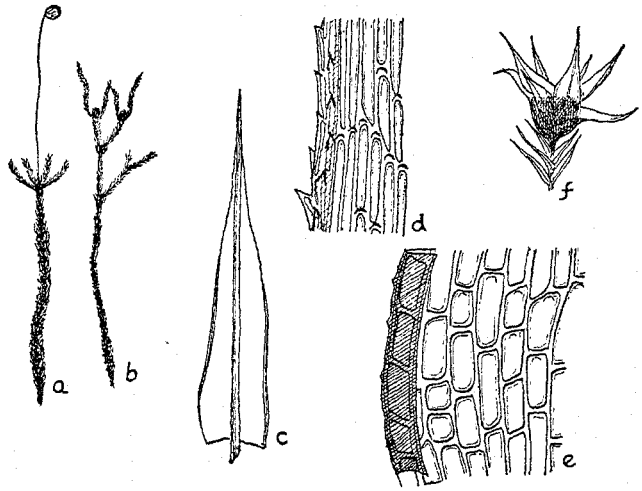


FIGURE 103. *Philonotis turneriana* (Schwaegrichen) Mitten: *a*, plant × ¾; *b*, male plant × ¾; *c*, leaf × 25½; *d*, upper leaf cells and margin × 300; *e*, basal leaf cells and margin × 300; *f*, male flower × 9.

A variable species but ordinarily, because of the longer leaf points, with a more silky appearance than *P. falcata*. The leaves are quite dimorphous, those of the short sub-floral branches being appreciably smaller than the stem leaves. It may be distinguished from *P. falcata* by the revolute leaf margins, the longer, less incrassate leaf cells, and the long excurrent costa.

If the Hawaiian plants are properly referred to *P. turneriana* I can find no reason for separating either *P. macroglobus* or *P. sullivantii* from the specific concept. Plants from different localities show variations in size, habit, and appearance. The less robust forms with sparsely tomentose stems have been rather doubtfully assigned a varietal rank, but the other variants seem to defy any practical classification.

Philonotis turneriana variety **sullivantii** (C. Müller), new combination.
Bartramia Sullivantii C. Müller, Flora, vol. 82, p. 448, 1896.

Stems scarcely radiculose or tomentose, usually less robust than in the type.

Oahu: Nuuanu Pali (Bartram); Waikane-Schofield trail, Koolau Range (Bartram). Maui: Honokohau ditch trail (Bartram). Island of Hawaii: Hilo (Mann and Brigham); vicinity of Kilauea (Bartram).

54. BREUTELIA Schimper, Coroll., p. 85, 1856.

Medium-sized or very robust plants. Stems irregularly branched, densely tomentose. Leaves plicate at the base; cells more or less elongate, incrassate, well-differentiated at the basal angles of the leaf. Capsules sub-pendulous, furrowed; peristome double.

Plants very robust, marginal cells of the leaf-base large and lax.....**2. B. arundinifolia**
Plants small, marginal cells of the leaf-base small.....**1. B. kilaueae**

1. **Breutelia kilaueae** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 655, 1904 (fig. 104).
Philonotis Kilaueae C. Müller, Nat. Ver. Bremen, vol. 16, p. 502, 1900.

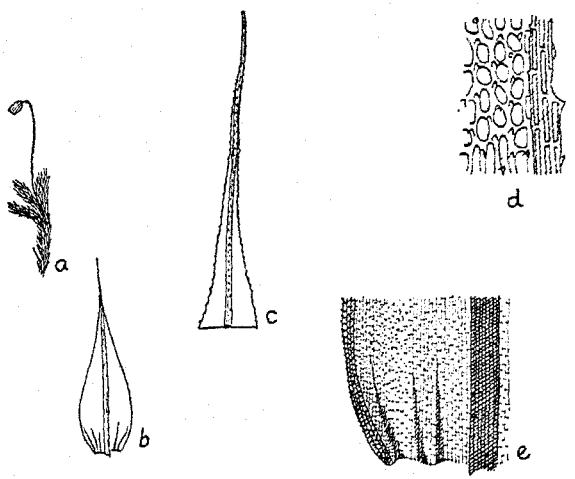


FIGURE 104. *Breutelia kilaueae* (C. Müller) Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 120.

Dioicous; male flower discoid, terminal. Dull brownish or yellowish plants growing in laxly cohering tufts. Stems 1 to 2 cm. long, erect with a few short sub-floral branches, densely brown tomentose below. Leaves crowded, erect, appressed with slightly flexuose points when dry, erect-spreading when moist, ovate-lanceolate, aristate

by the long excurrent costa, plicate at the base, 2 to 2.5 mm. long by 0.7 mm. wide; margin revolute to the base of the acumen, irregularly denticulate below, sharply serrulate near the apex; costa very rough on the back, long excurrent in a yellowish, denticulate arista; upper leaf cells oval-oblong, incrassate, strongly and sharply papillose over the lower end of the lumen, 5 to 6 μ wide and 2 to 3 times as long, more elonagate in the point, the marginal row long and narrow; basal cells narrowly rectangular to linear toward the costa, becoming quadrate in 6 to 8 rows toward the margins, papillose almost or quite to the base, reddish brown across the insertion. Seta erect, reddish, about 2 cm. long; capsule pendulous, brown, urn 2.5 mm. long, oblong, sulcate when dry.

Island of Hawaii: Kilauea (Schauinsland, type).

Endemic. Type locality, Kilauea, island of Hawaii.

The plants from the type collection are all rather old and worn. The leaf characters certainly indicate that Brotherus was thoroughly justified in transferring this species to the section Anacoliopsis of *Breutelia*. The plicate leaf base and the large area of quadrate cells at the basal leaf angles will at once separate it from any of the local species of *Philonotis*. A more pertinent query concerns its relationship with *Breutelia affinis* (Hooker) Mitten, of New Zealand and Australia. Schauinsland's collection is in rather poor condition, but there does not seem to be a single character by which it can be distinguished from the New Zealand plant. Further collections are needed to clear the matter up definitely.

2. **Breutelia arundinifolia** (Duby) Fleischer, Laubm. Java, vol. 2, p. 630, 1902-1904 (fig. 105).

Hypnum arundinifolium Duby, in Moritzi, System. Verz., p. 131, 1854-1855.

Bartramia crassicaulis C. Müller, Flora, vol. 82, p. 447, 1896.

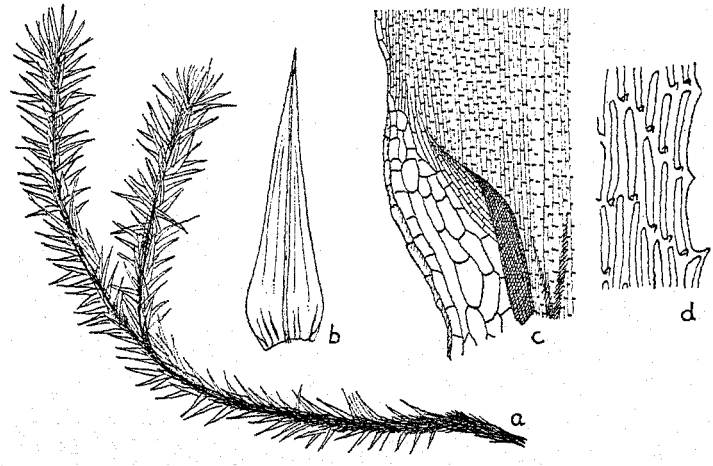


FIGURE 105. *Breutelia arundinifolia* (Duby) Fleischer: *a*, plant × ¾; *b*, leaf × 9; *c*, basal angle of leaf × 120; *d*, upper leaf cells and margin × 300.

Dioicous; male flower large, discoid, perigonial leaves broadly ovate, acuminate. Very robust plants with the aspect of a *Lycopodium*, bright yellow above, brown in the older parts. Stems up to 15 cm. long, decumbent, densely tomentose below, about 1 cm. wide with leaves, simple or remotely dichotomously branched. Leaves densely crowded, papery, widely spreading in all directions from a short sub-clasping, strongly plicate base, striate in the upper half, the points more or less spirally twisted when dry, ovate-lanceolate, gradually acuminate, 6 to 7 mm. long by 1.6 mm. wide at base; margin usually narrowly revolute toward the base, plane above, denticulate more than halfway down; costa percurrent, slightly papillose on the back; upper leaf cells linear with blunt ends, incrassate, slightly pitted, 4 μ wide by up to 50 μ long, sharply papillose on the end walls, toward the base gradually longer with pellucid, more strongly pitted lateral walls, smooth, deeply tinged with golden brown at the insertion, at the leaf angles a conspicuous band of large, lax, oblong, vesicular cells about 4 rows wide extending about 0.7 mm. up the basal margins and gradually merging above with the narrow cells of the leaf base. Seta stout, erect; capsule horizontal or pendulous, peristome double. Fruit unknown in Hawaii.

Mountain bogs. Maui: Puu Kukui (Skottsberg; Bartram); Honokohau, drainage basin (Forbes). Island of Hawaii: Kohala Mountains, near Kamuela (Skottsberg); Kilauea (?), wet humus (Lieut. Hinds).

Distribution: Java, Sumatra, Philippines. Type locality, Java.

A very striking moss not likely to be confused with any other local species on account of its size and widely spreading, papery, straw-colored leaves. The vegetative characters of *B. crassicaulis* (C. Müller) Paris are so exactly similar to those of *B. arundinifolia* that I can find no excuse for keeping them separate.

Family 16. ORTHOTRICHACEAE

Medium-sized plants usually growing in dense tufts or cushions on trees, rarely rupestrine. Stems branched, radiculose below. Leaves crowded, often crispate when dry, usually hygroscopic, oblong to lanceolate in outline; cells rounded, often papillose, elongate toward the base. Capsules immersed or long exserted, smooth or striate; peristome single or double, often imperfect, the teeth frequently in pairs.

1. Calyptra cucullate, smooth, not pilose ..... **55. Zygodon**
   Calyptra campanulate, often pilose 2
2. Stems creeping, branches erect ..... **57. Macromitrium**
   Stems erect ..... **56. Orthotrichum**

55. ZYGODON Hooker and Taylor, Musc. Brit., p. 70, 1818.

Rather small, tufted plants. Leaves crispate when dry; margins plane, entire, or serrate above; upper cells rounded, incrassate, elongate toward the base. Capsule sub-erect, pyriform, small-mouthed, often striate; peristome single or none; lid rostrate; calyptra cucullate, naked.

Peristome single, leaves toothed above ..... **1. Z. reinwardtii**
Peristome none, leaves entire ..... **2. Z. tetragonostomus**

1. **Zygodon reinwardtii** (Hornschuch) A. Braun, in Bryol. Eur., 4, Mon., p. 9, 1838 (fig. 106).
   Syrrhopodon Reinwardtii Hornschuch, Nov. Act. Acad. Leop., 14, vol. 2, p. 700; Schwaegrichen, Suppl. 4, tab. 312, 1842.

Synoicous or heteroicous. Tufts dense, yellowish green above, brown below. Stems about 2 cm. high, erect, usually branched, densely reddish tomentose. Leaves erect, twisted and crisped at the points when dry, widely spreading when moist, oblong-lanceolate, abruptly short acuminate, carinate, decurrent at the basal angles, about 1.5 mm. long; margin erect, slightly undulate, sharply and irregularly serrate toward the apex; costa percurrent or ending just below the apex; cells of the leaf base rectangular with rather thick, pellucid walls, smooth; upper cells rounded-hexagonal, incrassate, 8 to 10 μ in diameter, papillose. Seta about 1 cm. long, yellowish, capsule erect to inclined, narrowly pyriform and eight-striate when dry, ovoid-cylindric when moist, small-mouthed; peristome single, of 16 short, pale, more or less rudimentary teeth; spores papillose, 20 to 25 μ in diameter.

Maui: Haleakala, on trunks, altitude 8,000 feet (Baldwin).

Distribution: East Africa, India, Java, Alaska, Mexico, South America. Type locality, Java.

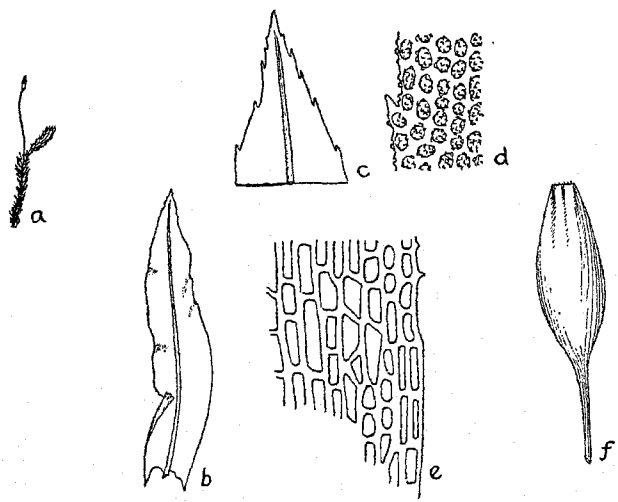


FIGURE 106. *Zygodon reinwardtii* (Hornschuch) A. Braun: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal angle of leaf × 300; *f*, moist capsule × 12.

This species is known locally only from the one collection noted above. The serrate leaves and striate capsules will separate it from either of the species of *Anoectangium*, which are not at all dissimilar in appearance.

2. **Zygodon tetragonostomus** A. Braun, in Bryol. Eur., 4, Mon., p. 9, 1838 (fig. 107).

Heteroicous. Growing in large tufts, yellowish green above, brown below. More robust than *Z. reinwardtii,* stems up to 3 cm. or more high, dichotomously branched, very densely reddish tomentose below. Leaves erect, twisted and flexuose when dry, squarrose-spreading or recurved when moist, oblong-lanceolate, abruptly contracted to a cuspidate point, carinate, slightly decurrent at the basal angles, about 2.5 mm. long; margin erect, slightly undulate, minutely crenulate and papillose above, entire below; costa excurrent in a short cuspidate point; basal cells rectangular with firm pellucid walls; upper cells rounded, about 10 μ in diameter, very incrassate, distinctly papillose. Seta yellowish, 10 to 12 mm. long; capsule greenish when young, becoming light brown with age, striate, pyriform and puckered around the small red mouth when dry, urn 2.5 to 3 mm. long; peristome none; lid long rostrate from a conic base, about half the length of the urn; spores brown, coarsely papillose, 22 to 25 μ in diameter.

Maui: vicinity of Ukulele, Haleakala (Forbes).
Distribution: Nilgiri, Ceylon, Java, Lombok. Type locality, Java.

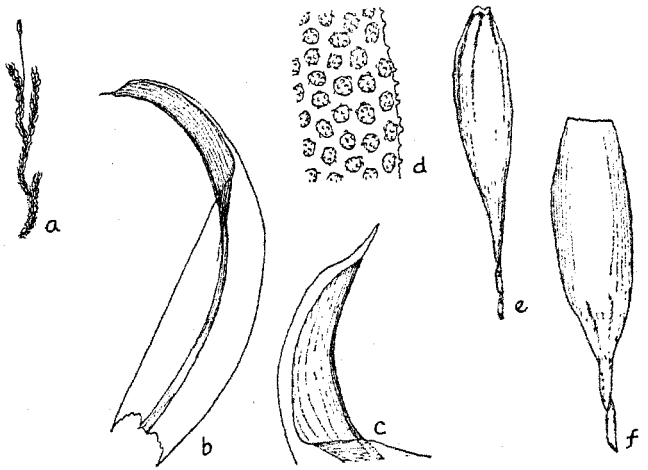


FIGURE 107. *Zygodon tetragonostomus* A. Braun: *a,* plant × ¾; *b,* leaf × 25½; *c,* apex of leaf × 60; *d,* upper leaf cells and margin × 300; *e,* dry capsule × 12; *f,* moist capsule × 12.

This species, which has been determined by N. Malta, is a noteworthy addition to the Hawaiian moss flora, the nearest previous known locality being in Java. In addition to the lack of a peristome the excurrent costa and almost entire leaves will separate it at once from *Z. reinwardtii.* Forbes' collections from the vicinity of Ukulele are in splendid fruiting condition and ample enough to suggest that the species may prove to be not uncommon on the upper slopes of Haleakala.

56. ORTHOTRICHUM Hedwig, Sp. Musc., p. 162, 1801.

Medium-sized plants with sub-erect stems, growing on trees or rocks. Leaves erect and rigid when dry, hygroscopic, lanceolate in outline; costa percurrent or nearly so; upper cells rounded, incrassate, papillose; lower cells elongate, smooth. Capsule immersed or slightly exserted on a short, straight seta, usually striate; stomata, in Hawaiian species, superficial; peristome single or double, the outer of 16 teeth, usually in 8 pairs, the inner of 8 or 16 narrow segments; calyptra campanulate, usually pilose.

1. Capsule cylindric, exserted.....**1. O. hawaiicum**
   Capsule oval-oblong, immersed.....2
2. Leaf cells minutely papillose.....**2. O. hillebrandi**
   Leaf cells with long, linear papillae up to 20 μ high.....**3. O. verrucatum**

1. Orthotrichum hawaiicum C. Müller, Flora, vol. 82, p. 451, 1896 (fig. 108).

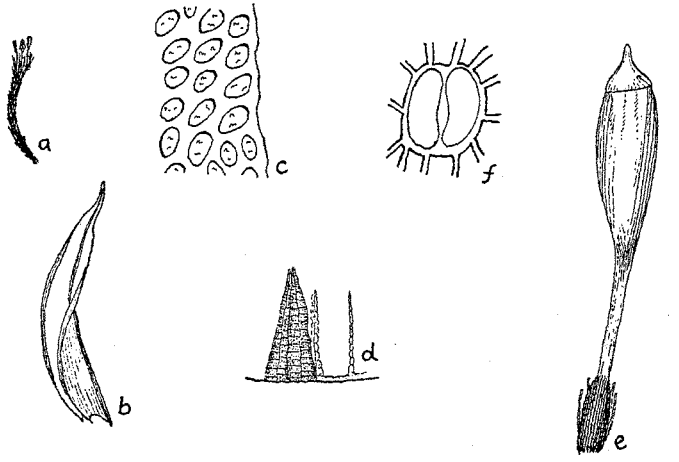


FIGURE 108. *Orthotrichum hawaiicum* C. Müller: *a*, plant × ¾; *b*, leaf × 12; *c*, upper leaf cells and margin × 300; *d*, part of peristome × 60; *e*, capsule × 12; *f*, stoma × 300.

Autoicous; male buds axillary below the perichaetium. Growing in dense tufts, yellowish green or pale brown. Stems erect or decumbent, up to 2 cm. long. Leaves erect and rigid when dry, closely imbricated, erect-spreading when moist, ovate-lanceolate, acuminate, carinate-concave, 3 mm. long by 0.8 mm. wide; margin minutely crenulate and slightly undulate toward the apex, revolute below; costa pale, ending just below the apex; upper cells in one layer, clear and distinct, very incrassate, oval or rounded, 7 or 8 μ in diameter, lightly papillose with bifid papillae; inner basal cells linear, smooth, short rectangular or sub-quadrate toward the margins in about six rows. Capsule emergent or exserted, pale brown, lightly eight-ribbed in the upper half, cylindric, tapering gradually at the base; stomata superficial in the lower half of the urn; about 2 mm. long by 0.5 mm. wide, on a short, erect seta about 1 mm. long; peristome double, the teeth in

eight pairs, recurved when dry, densely papillose, opaque, 300 μ high, segments of the inner peristome 16, nearly as long as the teeth, densely papillose, alternately broad and narrow, the broader ones 50 μ wide at base, composed of two rows of cells and between the pairs of teeth, the narrower ones 25 μ wide at base, composed of one row of cells and opposite the pairs of teeth; lid rostrate, erect, 0.5 mm. long; calyptra yellow, sparingly pilose; spores pale brown, papillose, 20 to 25 μ in diameter.

On trees. Maui: Haleakala, altitude 8,000 feet (Baldwin); on *Sophora chrysophylla,* Oili Puu, crater of Haleakala (Forbes). Island of Hawaii: (Forbes).

Endemic. Type locality, Hawaii.

A very pretty moss and generally abundantly set with fruit. The pale, cylindric, exserted capsules and double peristome will at once separate it from both of the following species. Evidently confined to the trunks of trees.

2. Orthotrichum hillebrandi C. Müller, Flora, vol. 82, p. 450, 1896 (fig. 109).

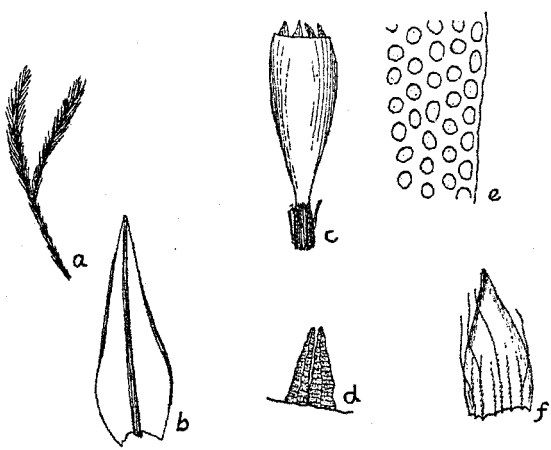


FIGURE 109. *Orthotrichum hillebrandi* C. Müller: *a,* plant × ¾; *b,* leaf × 12; *c,* capsule × 12; *d,* 2 peristome teeth × 60; *e,* upper leaf cells and margin × 300; *f,* calyptra × 12.

Autoicous; male buds on short stalks in the axils of the stem leaves below the perichaetium. Robust plants growing in large dense tufts, brownish or yellowish green above, dark brown to black below. Stems up to 3 cm. long, erect or decumbent, radiculose below. Leaves crowded, erect and rigid when dry, erect-spreading when moist, broadly lanceolate from an ovate base, bluntly acute, carinate-concave, about 3.5 mm. long by 1 mm. wide; margin erose-denticulate at the somewhat hyaline apex, recurved below; costa yellowish, ending just below the point; upper cells in one layer, rounded, incrassate, minutely papillose, up to 10 μ in diameter; basal cells smooth, linear toward the costa, short rectangular and quadrate in 6 or 8 rows toward the margins. Capsule immersed on a short seta, oval-oblong, brownish, tapering at the base, lightly eight-ribbed in the upper half, urn about 1.8 mm. long, stomata superficial near the middle of the urn; peristome teeth erect when dry, in eight pairs, pale yellow, papillose

on both surfaces; lid short rostrate from a convex base, 0.5 mm. long; calyptra pale, sparsely pilose; spores brown, papillose, 20 μ in diameter.

Maui: Haleakala, rocks near Rest House (St. John). Island of Hawaii: (Forbes).

Endemic. Type locality, Haleakala, Maui.

These plants are very closely allied to *O. rupestre* Schleicher, and may prove to be only a form of this widespread, polymorphic species. *O. sturmii,* listed by Sullivant in the mosses collected by the Wilkes Expedition, evidently belongs here. The preference for a rock substratum is characteristic of this group.

3. **Orthotrichum verrucatum** C. Müller, Bull. Herb. Boiss., vol. 5, p. 850, 1897 (fig. 110).

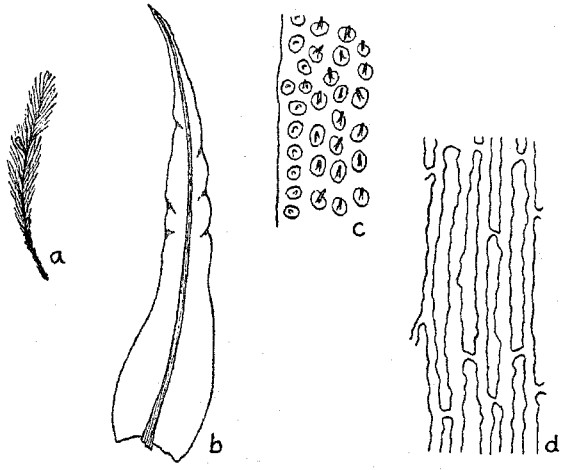


FIGURE 110. *Orthotrichum verrucatum* C. Müller: *a,* plant × ¾; *b,* leaf × 12; *c,* upper leaf cells and margin × 300; *d,* basal leaf cells × 300.

Dioicous; male flowers not seen. Dull olive green or yellowish green. Stems 2.5 to 3 cm. high, denuded of leaves below. Leaves erect and slightly flexuose when dry, erect-spreading when moist, linear-lanceolate from a short, oblong base, deeply carinate above, acuminate, up to 6 mm. long; margin recurved more than halfway up, slightly undulate above, denticulate with double teeth near the base, irregularly spinose-toothed above, especially in the younger leaves, becoming eroded and smoother with age; costa brownish, papillose on the back, percurrent. Upper leaf cells rounded and oval, very incrassate, about 8 μ wide and 10 to 20 μ long, very rough with long, erect, linear papillae up to 20 μ high; basal cells linear, smooth, with sinuose lateral walls, shorter toward the margins. Capsule immersed on a very short seta, oblong, gradually tapering below, pale brown, about 2 mm. long, faintly eight-ribbed in the upper half, stomata superficial near the middle of the urn; peristome teeth reflexed when dry, opaque, densely papillose, inner peristome ? (capsules too old); calyptra with numerous long yellow hairs; spores about 30 μ in diameter.

Endemic. Type locality, Hawaii.

Quite distinct from *O. hillebrandi* in the long, linear papillae of the leaf cells and the densely papillose and more opaque peristome teeth. The two plants from the type collection which I have seen show only old capsules with imperfect peristomes in which I have been unable to find any trace of the inner peristome referred to in the original description. The species, which is known only from Hillebrand's collection, without definite locality, resembles *O. Lyellii* in some respects, but the material available is too meager and incomplete for any critical comparison.

57. MACROMITRIUM Bridel, Mant. Musc., p. 132, 1819, and Bryol. Univ., vol. 1, p. 306, 1826.

Plants of variable size. Primary stems prostrate, branches usually numerous, erect, forming dense mats or cushions. Leaves straight, or twisted and crispate when dry, ligulate or lanceolate, rarely with hair-points; costa ending below the apex or excurrent; upper cells small, rounded, smooth or papillose; basal cells elongate, often with large, knob-like papillae. Seta erect, smooth; capsule smooth or plicate below the mouth; peristome none or double; calyptra campanulate, plicate, naked or pilose; spores large.

1. Seta short, capsule immersed or emergent 2
   Seta elongate, capsule exserted 3
2. Capsule immersed, perichaetial leaves aristate ..... **1. M. brevisetum**
   Capsule emergent, perichaetial leaves acuminate ..... **2. M. emersulum**
3. Leaves ending in a long, flexuose hair-point ..... **3. M. piliferum**
   Leaves not hair-pointed 4
4. Leaves rigid, appressed, not crispate when dry ..... **4. M. intricatum**
   Leaves very crispate when dry 5
5. Seta 15 to 20 mm. long, upper leaf cells incrassate, distinct ..... **5. M. owahiense**
   Seta 5 to 7 mm. long, upper cells not incrassate, obscure ..... **6. M. cumingi**

1. **Macromitrium brevisetum** Mitten, in Seeman, Fl. Vit., p. 279, 1873 (fig. 111).

Macromitrium aristocalyx C. Müller, Flora, vol. 82, p. 454, 1896.

Pseudoautoicous; male flower minute, gemmiform, terminal on small plants 1 to 2 mm. high attached to the older leaves of the sporophyte-bearing plants; antheridia 6 to 10, with numerous filiform paraphyses. Plants rather robust, growing in extensive, intricate mats, yellowish green above, brown below. Primary stems creeping, nearly denuded of leaves, up to 6 cm. or more long; secondary stems erect or ascending, 1 to 2 cm. long, simple or forked. Leaves crowded, crisped with incurved points and lightly spirally twisted around the stem when dry, flexuose-spreading when moist, usually much eroded toward the base of the stems, ligulate, carinate, obtuse, mucronate, 2.5 to 3 mm. long by about 0.4 mm. wide; margin erect, minutely crenulate with papillae except at the base, denticulate at the extreme apex; costa yellowish, percurrent or very shortly excurrent; upper leaf cells rounded-hexagonal, 8 to 10 μ in diameter, papillose; lower cells smooth, incrassate, narrowly rectangular toward the margins, shorter and broader toward the costa. Perichaetial leaves about 4 mm. long, costa excurrent in a long denticulate arista;

seta very short, about 0.5 mm. long, erect, reddish; capsule immersed, bright reddish brown, ovoid, 1.5 mm. long by 1 mm. wide, wide-mouthed, smooth or faintly plicate in the upper half when dry; peristome none; lid 0.7 mm. high, rostrate from a convex base; calyptra campanulate, lobed at the base, densely pilose with coarse, strict, minutely scabrous hairs; spores papillose, up to 50 μ in diameter.

Damp rocks and trees. Oahu: east side of Manoa Valley (Bartram); Nuuanu Pali (Bartram); Palolo Valley (Degener); without definite locality (Beechey, type). Maui: back of Keanae (Bartram); Iao Valley (Bartram). Island of Hawaii: near Hoopuloa, southern Kona (Bartram). Kauai: near Haena caves (Bartram); road to power plant (Bartram).

Endemic. Type locality, Oahu.

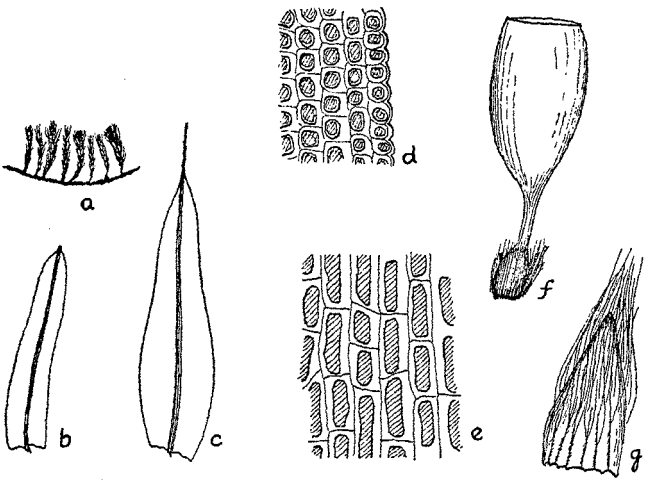


FIGURE 111. *Macromitrium brevisetum* Mitten: *a*, part of plant × ¾; *b*, stem leaf × 12; *c*, perichaetial leaf × 12; *d*, upper leaf cells and margin × 300; *e*, inner basal cells × 300; *f*, capsule × 12; *g*, calyptra × 12.

This and the following species form a unique and sharply defined group distinguished by the lack of a peristome and the immersed or emergent capsules. On damp, shelving rocks, where the wide-mouthed, bright brown capsules and very pilose calyptrae stand out quite promiently, *M. brevisetum* seems to reach its best development. In this species the dwarf male plants are attached to the leaves of the old perichaetia, whereas in *M. emersulum* all the antheridial buds that I have seen are on separate plants.

Müller was evidently unaware of Mitten's species, as it is not mentioned in any of his papers relating to the Hawaiian mosses. Although I have not seen the type of *M. aristocalyx*, the description corresponds exactly with *M. brevisetum*. I have little doubt that they are identical.

2. **Macromitrium emersulum** C. Müller, Flora, vol. 82, p. 451, 1896 (fig. 112).

Dioicous; male buds terminal on secondary stems of separate plants; antheridia numerous with abundant paraphyses. Plants similar to the preceding species but more slender, in extensive, intricate mats, olive-green above, brownish below. Primary stems creeping; secondary stems short, less than 1 cm. long. Leaves very crispate and spirally twisted around the stem when dry, widely-spreading and rather rigid when moist, oblong-ligulate from an ovate base, deeply carinate, broadly rounded or slightly retuse at the apex, minutely mucronate, 1.5 to 2 mm. long by 0.35 mm. wide at the base; margin erect, minutely crenulate with papillae except at the extreme base, occasionally with several minute teeth near the base of the mucro; costa yellowish, very prominent at the back, ending just below the apex; upper leaf cells smaller than in *M. brevisetum*, 5 to 7 μ in diameter, papillose, thin-walled; lower cells incrassate, smooth, linear and sinuose toward the margins, shorter and broader toward the costa. Perichaetial leaves about 2 mm. long, linear-lanceolate, narrower than the stem leaves and gradually narrowed to a slender, brittle acumination, costa percurrent or very slightly excurrent; seta short, 0.5 to 1.5 mm. long; capsule smaller than in *M. brevisetum*, more cylindrical and more strongly sulcate below the contracted mouth; lid, calyptra, and spores as in *M. brevisetum*.

Tree trunks. Maui: trail to Nakalalua swamp (Bartram). Island of Hawaii: trunks of Royal palms, Hilo (Bartram); along Wailuku River, Hilo (Bartram). Kauai: along road to power plant (Bartram).

Endemic. Type locality, Hawaii.

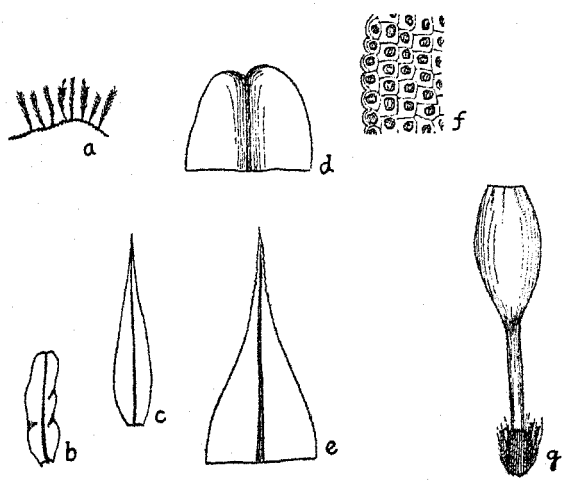


FIGURE 112. *Macromitrium emersulum* C. Müller: *a*, part of plant × ¾; *b*, stem leaf × 12; *c*, perichaetial leaf × 12; *d*, apex of stem leaf × 60; *e*, apex of perichaetial leaf × 60; *f*, upper leaf cells and margin × 300; *g*, capsule × 12.

Less common than *M. brevisetum* and distinguished from it principally by the shorter leaves with broadly rounded or retuse apices, the narrower, more slenderly acuminate (not aristate) perichaetial leaves, and the smaller, more exserted capsules, sulcate and contracted at the mouth.

3. **Macromitrium piliferum** Schwaegrichen, Suppl. 2, pt. 2, fasc. 1, p. 66, 1816 (fig. 113).

Macromitrium plebejum C. Müller, Flora, vol. 82, p. 451, 1896.

? *Macromitrium subpiliferum* C. Müller, Flora, vol. 82, p. 453, 1896.

Dioicous; male flowers not seen. Growing in extensive, intricate mats, sordid yellowish green above, dark reddish brown below. Primary stems up to 10 cm. long, creeping, secondary stems short, erect, very numerous, up to 1 cm. long, simple or with a few short branches. Leaves crowded, curled and spirally twisted around the stem when dry, rigidly erect-spreading when moist, oblong-lanceolate from an ovate base, strongly carinate, bluntly acute or obtuse, prolonged in a long, fragile, denticulate, yellowish or hyaline-tipped hair-point, about 2 mm. long by 0.4 mm. wide below; margin erect, entire below, minutely crenulate with papillae above; costa golden brown, ending just below the base of the hair-point. Upper leaf cells rounded, opaque, obscure and very papillose, 5 to 7 μ in diameter; basal cells linear with narrow lumens and thick, yellowish, pellucid walls, papillose with high knob-like papillae, often nearly smooth. Inner perichaetial leaves erect, longer and broader than the stem leaves, ovate-lanceolate, gradually filiform acuminate, upper cells distinct, linear-rhomboidal, faintly papillose; seta red, smooth, about 6 mm. long; capsule ovoid, reddish brown, small-mouthed, sulcate above the middle when dry, urn 2 mm. long; peristome none; lid erect, rostrate, 1 mm. long; calyptra very hirsute; spores greenish, up to 65 μ in diameter, with scattered clusters of multifid papillae.

Trees, logs, and rocks. Common on all the larger islands from sea level through the rain-forest belt.

Endemic. Type locality, Hawaii.

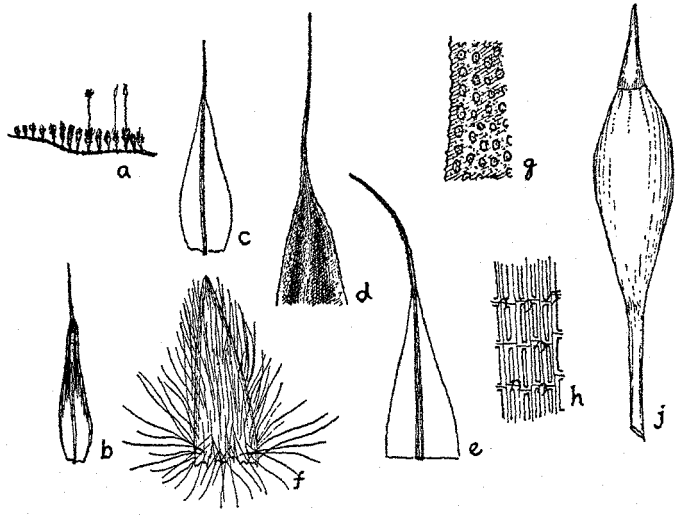


FIGURE 113. *Macromitrium piliferum* Schwaegrichen: *a*, part of plant × ¾; *b*, stem leaf × 12; *c*, perichaetial leaf × 12; *d*, apex of stem leaf × 60; *e*, apex of perichaetial leaf × 60; *f*, calyptra × 9; *g*, upper leaf cells and margin × 300; *h*, inner basal leaf cells × 300; *j*, capsule × 12.

A rather variable species as far as the size and color are concerned but known at once by the hair-pointed leaves. The hair-point is very fragile and seems to be a prolongation of the lamina rather than of the costa. Being invariably present on the young upper leaves and easily visible with a hand lens, it serves as a ready mark of identification in the field.

Plants from the type collection of *M. plebejum,* which I have seen, are certainly referable to *M. piliferum.* There is nothing distinctive in the description of *M. subpiliferum* except the smooth basal cells. As a matter of fact, the basal cells of *M. piliferum* show considerable variation with respect to the number and size of the knob-like papillae, and I am inclined to think that in the absence of any more conclusive evidence *M. subpiliferum* can safely be included among the forms of this widespread local species.

4. Macromitrium intricatum C. Müller, Flora, vol. 82, p. 452, 1896 (fig. 114).

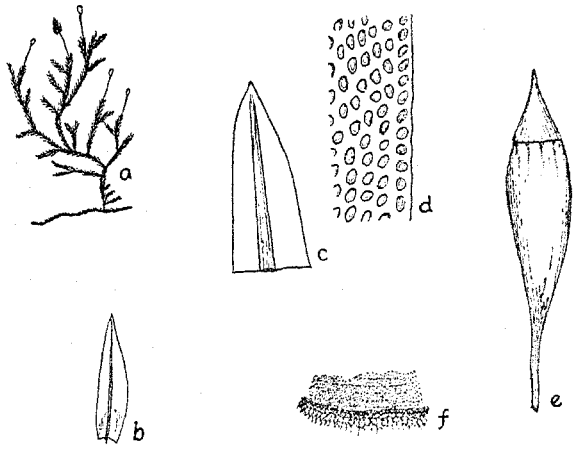


FIGURE 114. *Macromitrium intricatum* C. Müller: *a,* plant × ¾; *b,* stem leaf × 12; *c,* apex of stem leaf × 60; *d,* upper leaf cells and margin × 300; *e,* capsule × 12; *f,* part of peristome × 120.

Autoicous; antheridial buds terminal on short, secondary branches. Slender plants growing in loose, intricate mats, olive green or yellowish brown above, dark brown below. Primary stems creeping; secondary stems rigid and julaceous, up to 2 cm. long, dichotomously branched. Leaves rigidly erect and appressed when dry, erect-spreading when moist, short ovate-lanceolate, bluntly acute or obtuse, deeply concave at the base, 1 to 1.3 mm. long and 0.4 to 0.5 mm. wide below; margin minutely crenulate, narrowly reflexed on one side near the base, otherwise plane; costa reddish, ending just below the apex. Upper cells rounded, incrassate, 6 to 8 μ in diameter, tumid, somewhat larger downward, a few juxta-costal cells at the extreme base slightly elongated, toward the margins transversely oval. Perichaetial leaves 1.5 to 2 mm. long, often irregularly denticulate on the basal margins, lower cells linear; seta 4 to 6 mm. long, yellow becoming brown with age;

capsule erect, ovoid-cylindric, sulcate around the small mouth, urn 2 mm. long, brown; outer peristome wanting, inner peristome a pale, papillose cylinder about 75 μ high, irregularly sinuate on the edge; lid erect, conic-rostrate, 0.7 to 0.8 mm. high; calyptra pilose; spores papillose, 30 to 35 μ in diameter.

Trees and logs in the mountains. Maui: Kaupo Gap, crater of Haleakala (Forbes); trail below Rest House, Haleakala (St. John); Haleakala, on trunks (Baldwin); Kula pipe line trail, northeast of Olinda (Bartram); western part of island, altitude 3,500 feet (Baldwin). Oahu: Makaha Valley, Koolau Range (Forbes).

Endemic. Type locality, Hawaii.

The slender julaceous stems with rigid, appressed leaves distinguish this species at once from all of its Hawaiian associates.

5. **Macromitrium owahiense** C. Müller, Bot. Zeit., p. 359, 1864 (fig. 115).
Macromitrium adstrictum Ångström, Öfv. K. Vet. Akad. Föhr., no. 4, p. 19, 1872.
Macromitrium canum C. Müller, Flora, vol. 82, p. 454, 1896.

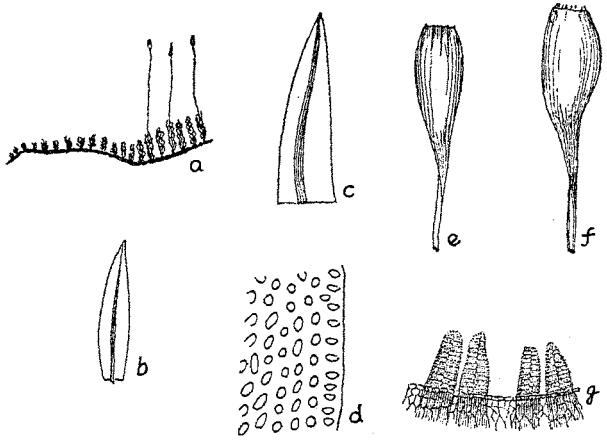


FIGURE 115. *Macromitrium owahiense* C. Müller: *a*, part of plant × ¾; *b*, stem leaf × 12; *c*, apex of stem leaf × 60; *d*, upper leaf cells and margin × 300; *e*, dry capsule × 12; *f*, moist capsule × 12; *g*, part of peristome × 120.

Autoicous; male buds terminal on short, separate branches. Yellowish brown plants in extensive, intricate mats. Primary stems up to 6 cm. or more long, creeping; secondary stems very numerous, short, up to 8 or 10 mm. long but usually shorter, simple or with several very short branches. Leaves erect with incurved, circinate points when dry, usually distinctly spirally seriate around the stem, widely flexuose-spreading when moist, gradually lanceolate from an oblong-ovate base, strongly carinate, shortly and rather broadly acuminate, 1.5 to 2 mm. long by 0.4 mm. wide below; margin usually slightly recurved on one side near the base, otherwise erect, entire; costa yellow, percurrent. Upper leaf cells rounded, 5 to 7 μ in diameter, very incrassate, gradually longer downward; the basal cells linear, smooth, with thick, pellucid walls, usually golden yellow at

the insertion. Perichaetial leaves slightly longer than the stem leaves and more slenderly acuminate; seta reddish, becoming darker with age, 14 to 18 mm. long, smooth; capsule erect, ovoid-cylindric, dark brown when mature, urn 1.5 to 2 mm. long, puckered around the contracted mouth when dry; peristome single, the inner wanting, teeth brownish, opaque, densely papillose, inserted below the rim; lid erect or slightly oblique, conic-rostrate, about 0.9 mm. long; calyptra naked; spores greenish, papillose, up to 50 μ in diameter.

Branches and trunks of trees in wet forests. Oahu: Waikane-Schofield trail, Koolau Range (Bartram); Puu Kaala, Waianae Mountains (St. John). Maui: trail to Nakalalua swamp (Bartram); Ukulele, Haleakala (Forbes). Island of Hawaii: vicinity of Kilauea, common (Bartram; Forbes); vicinity of Napau (Batram); along Wailuku River, Hilo (Bartram). Kauai: vicinity of Kokee (Bartram); Wahiawa Mountains (Forbes).

Distribution: Hawaii, Tahiti. Type locality, Hawaii.

The distinguishing characters of this species are the erect leaves with circinate points, usually imbricated in distinct spiral rows around the stem, the long setae, the naked calyptra, and the capsules wrinkled around the small mouth when dry. The fruit is generally produced in abundance.

M. microstomum (Hooker and Greville) Schwaegrichen, a closely related species, has been credited to the Hawaiian islands. Although I have not seen the collection upon which this record is based, it seems probable that the plants in question should be included with *M. owahiense*.

6. Macromitrium cumingi C. Müller, Flora, vol. 82, p. 452, 1896 (fig. 116). *Macromitrium subsemipellucidum* Brotherus, B. P. Bishop Mus., Bull. 40, p. 19, 1927.

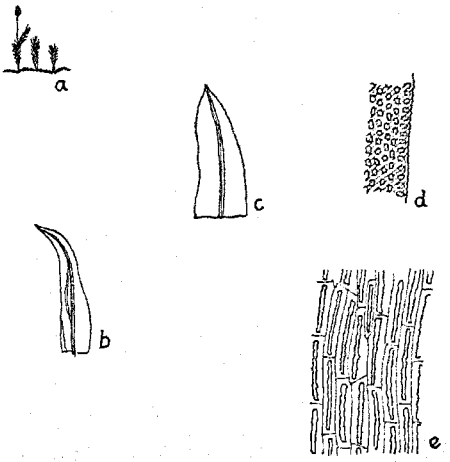


FIGURE 116. *Macromitrium cumingi* C. Müller: *a*, part of plant × ¾; *b*, stem leaf × 12; *c*, apex of stem leaf × 60; *d*, upper leaf cells and margin × 300; *e*, inner basal leaf cells × 300.

Slender, brownish green plants. Primary stems elongate, creeping, densely branched, branches erect, simple, up to 15 cm. long. Leaves crowded, fragile, very crispate with incurved points when dry, erect-spreading and flexuose when moist, linear-lanceolate from an oblong base, bluntly acute, minutely mucronate, carinate-concave, 1.5 to 1.75 mm. long by 0.35 mm. wide below; margin erect, very minutely crenulate; costa brownish, percurrent or minutely excurrent in a very short mucro. Upper leaf cells small and dense, rounded-quadrate, papillose, about 5 μ in diameter, not incrassate, the marginal row transversely oval; basal cells smooth, pellucid, incrassate, the lumens very narrow and sinuose; seta 5 to 7 mm. long, reddish; capsule short oval, brownish, about 1.5 mm. long, small-mouthed; peristome none; lid conic-rostrate.

Trees. Island of Hawaii, without definite locality (Cuming, type). Maui: Olowalu crater (Baldwin).

Endemic. Type locality, Hawaii.

This is a rather unsatisfactory species. I have seen fragments of the type collections of *M. cumingi* and *M. subsemipellucidum* which seem to be identical. Furthermore, there seems to be little or nothing to distinguish the plants of these two collections from *M. subtile* Schwaegrichen, of Tahiti. The bits are too small and incomplete for any really satisfactory judgment. The shorter setae and very different leaf cells will at once separate this species from *M. owahiense*.

Family 17. RHACOPILACEAE

Rather slender plants with creeping, radiculose stems, growing in dense mats. Leaves dimorphous, the lateral or normal leaves in two rows, complanate, strongly curled and twisted when dry, asymmetrical, ovate, cuspidate by the long excurrent costa; cells rounded, smooth, rectangular toward the base. Seta elongate; capsule inclined, furrowed when dry; peristome double, hypnoid in structure; lid rostrate; calyptra cucullate, hairy.

58. RHACOPILUM Palisot de Beauvois, Prod., p. 36, 1805.

Plants with the characters of the family.

1. **Rhacopilum cuspidigerum** (Schwaegrichen) Mitten, in Seeman, Fl, Vit., p. 491, 1873 (fig. 117).
   Hypnum cuspidigerum Schwaegrichen, in Freycinet, Voy. Bot., p. 227, 1826.

Pseudoautoicous; male flowers gemmiform at the base of minute plants attached to the tomentum of the fertile stems near the perichaetia. Variable plants with regard to size and color, usually growing in dense, intricate, yellowish green or dark green mats,

brown below. Stems up to 5 or 6 cm. long, creeping, matted together in the older parts, and where in contact with the substratum, with a dense felt of reddish brown radicles, irregularly branched, the branches laxly flexuose when dry, more rigid when moist, flat, up to 3 mm. wide with leaves; lateral leaves much curled and shrunken when dry, widely spreading when moist, complanate, oblong-oval, slightly concave, asymmetrical, acute, cuspidate by the long excurrent costa, blade up to 1.7 mm. long by 0.7 mm. wide; margin plane, entire below, irregularly denticulate toward the apex; costa pale, tapering slightly upward, excurrent in a smooth yellowish arista up to one-fourth as long as the leaf blade; amphigastria smaller, erect-spreading, gradually narrowed from an ovate base to a slender point; costa excurrent in a smooth arista, from half as long to as long as the blade; leaf cells smooth, rounded-hexagonal, up to 10 μ wide and 10 to 14 μ long, more lax and short-rectangular toward the base. Perichaetium densely radiculose, inner leaves laxly areolate with long, flexuose points; seta 1.5 to 2.2 cm. long, reddish below, paler above; capsule inclined, oblong-cylindric, brown, strongly sulcate when dry, contracted below the oblique mouth, urn 2 mm. long; peristome teeth yellowish, finely transversely striate on the outer plates, inner peristome pale, basal membrane about half the height of the teeth, segments widely split along the median line, cilia 2 or 3, slightly appendiculate; lid with a short, oblique beak from a conic base, 0.9 mm. long; calyptra cucullate, with numerous long, spreading, crispate hairs similar to those of the vaginula; spores yellowish, smooth, up to 17 μ in diameter.

One of the most abundant species of the Hawaiian moss flora, growing on damp rocks, banks, and tree trunks throughout all of the larger islands from sea level to an altitude of 4,000 feet or more.

Distribution: Pacific islands to Java. Type locality, Hawaii.

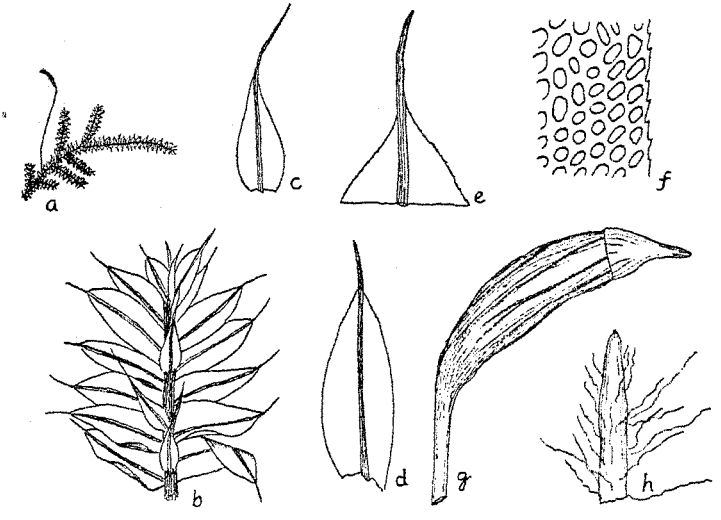


FIGURE 117. *Rhacopilum cuspidigerum* (Schwaegrichen) Mitten: *a*, plant × ¾; *b*, tip of branch × 12; *c*, amphigastrial leaf × 25½; *d*, lateral leaf × 25½; *e*, apex of lateral leaf × 60; *f*, upper leaf cells and margin × 300; *g*, capsule × 12; *h*, calyptra × 12.

It will be easily recognized when in fruit by the inclined, sulcate capsules and the pale, hairy calyptrae, but even when sterile the strongly curled and

twisted leaves in the dry state, with long aristate points, and the characteristic amphigastria on the dorsal side of the stem will identify it at once. When growing on dry, exposed banks or rocks the plants are often of a bright golden yellow color, but in the shade the darker shades of green predominate.

It seems entirely probable that this species is inseparable from *R. pacificum* Bescherelle, as outlined by Dixon (10).

Family 18. CYRTOPODACEAE

Robust plants; secondary stems elongate, branched. Leaves long acuminate from an oblong, sub-sheathing base; upper cells oval, very incrassate; inner basal cells linear, more or less porose, rounded toward the margins; costa long excurrent, toothed on the back. Seta short; capsule exserted, ovoid-cylindric, smooth; peristome double, the outer of 16 papillose teeth, the inner of 16 linear segments alternating with the teeth, from a low basal membrane, cilia none; calyptra cucullate; spores small.

59. CYRTOPUS (Bridel) Hooker, J. D., New Zealand Fl., vol. 2, p. 461, 1867.

Neckera section *Cyrtopus* Bridel, Bryol. Univ., vol. 2, p. 235, 1827.

Plants with the characters of the family.

1. **Cyrtopus setosus** (Hedwig) Hooker, J. D., New Zealand Fl., vol. 2, p. 461, 1867 (fig. 118).

Anictangium setosum Hedwig, Sp. Musc., p. 43, 1801.

Dioicous. Robust plants, loosely tufted, yellowish or brownish green, scarcely glossy. Primary stems short, radiculose; secondary stems erect or pendent, up to 8 or 10 cm. long, simple below, branched above, branches erect-spreading or curved. Leaves crowded, the lowermost small, rapidly increasing in size upward, appressed with flexuose, spreading points when dry, widely spreading when moist, from an oblong, sub-clasping base gradually narrowed to a linear-subulate, serrate point, 6 or 7 mm. long by 1.2 mm. wide below; margin plane, entire below, remotely serrate above; costa yellowish, about 100 μ wide below, long excurrent, slightly toothed on the back above; laminal cells of the leaf point oval to short linear, very incrassate, mostly in two layers; basal cells toward the margins oval or rounded, irregular, incrassate, in 14 to 18 rows, changing abruptly to the linear, porose cells of the median portion. Perichaetial leaves smaller, abruptly narrowed to a long, subulate, entire point formed by the excurrent costa; seta 3 to 4 mm. long, reddish with age; capsule erect, oblong-cylindric, urn about 2.5 mm. long; peristome double, inserted below the rim, the teeth linear, yellowish brown, papillose, with a fine zigzag median line; segments of the inner peristome from a low basal membrane, papillose; lid conic-rostrate, curved, 1.5 mm. long; calyptra cucullate; spores small, smooth, 7 to 8 μ in diameter.

Island of Hawaii: Mauna Kea (Douglas ?).

Distribution: Tasmania, New Zealand. Type locality, New Zealand.

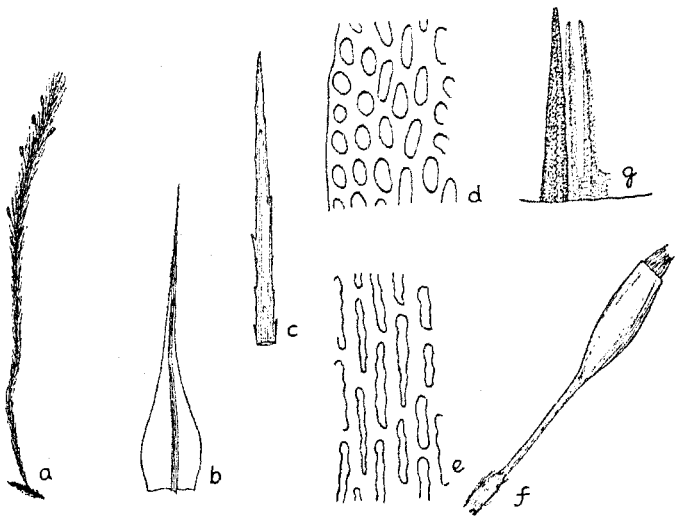


FIGURE 118. *Cryptopus setosus* (Hedwig) Hooker, J. D.: *a*, plant × ¾; *b*, leaf × 9; *c*, tip of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, inner median cells × 300; *f*, capsule × 9; *g*, part of peristome × 60.

As detailed by Dixon (9, note, p. 290), this unique moss seems to be definitely established as an element of the Hawaiian flora. I have not seen the original collection. The description and sketches here presented have been taken from New Zealand specimens.

FAMILY 19. PTYCHOMNIACEAE

Robust, glossy plants growing in large masses. Stems elongate, branched. Leaves squarrose-spreading, plicate, ovate, ecostate; cells linear, incrassate, very porose. Seta elongate; capsule sulcate; peristome double, segments of the inner peristome from a high basal membrane, cilia two, nodose; lid long-beaked; calyptra cucullate.

60. PTYCHOMNION Mitten, Jour. Linn. Soc., vol. 12, p. 536, 1869.

Plants with the characters of the family.

1. **Ptychomnion aciculare** (Bridel) Mitten, Jour. Linn. Soc., vol. 12, p. 536, 1869 (fig. 119).
   Hypnum aciculare Bridel, Musc. Rec. 2, pt. 2, p. 158, 1801.

Dioicous. Very robust plants growing in large, intricate masses, pale green tinged with brown, glossy. Stems deep red, up to 15 cm. or more long, rather wiry, decumbent or ascending, with numerous long, flexuose, laxly ascending branches. Leaves squar-

rose-spreading, papery, lightly plicate and rugose when dry, broadly ovate, abruptly narrowed to a slender, linear, flexuose, coarsely toothed acumen of variable length, 4 to 5 mm. long by 2 mm. wide; margin plane or lightly recurved here and there; costa none; leaf cells linear, vermicular, very incrassate, strongly pitted, 5 μ wide and 7 to 10 times as long, several rows across the insertion shorter and broader, golden brown. Perichaetia often toward the tips of the branches, inner leaves about 3.5 mm. long, from a wide, convolute-clasping base suddenly contracted to a slender, erect, flat point nearly as long as the basal portion; seta up to 3 cm. long, flexuose, dark red or black at the base, paler above, smooth; capsule horizontal or inclined, narrowly oval-cylindric, eight-striate, deeply sulcate when dry, urn about 2.5 mm. long, very thick walled, exothecial cells rounded-hexagonal; peristome teeth yellowish brown and finely cross-striate below, paler and papillose at the tips, broadly furrowed along the median line, inner peristome pale, papillose, basal membrane more than half the height of the teeth, segments split along the median line, cilia two, nodose; lid very long rostrate from a conic base; spores pale, smooth, 10 to 12 μ in diameter.

Distribution: southern South America, Australia, New Zealand, Campbell Islands, New Caledonia, Samoa, Society Islands. Type locality, Tasmania.

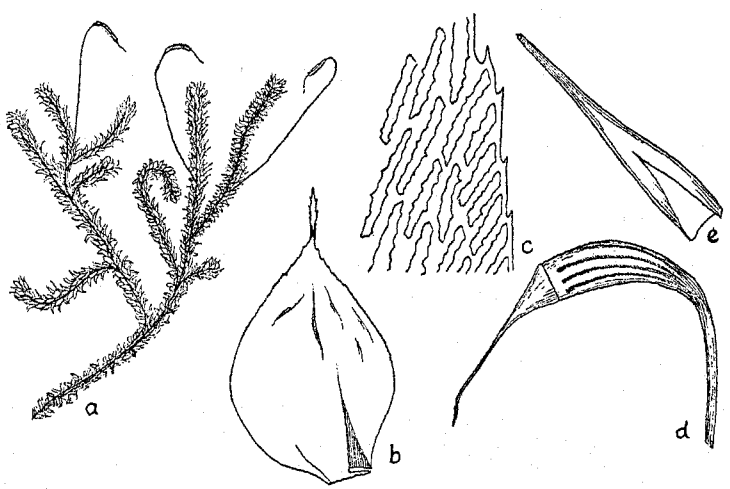


FIGURE 119. *Ptychomnion aciculare* (Bridel) Mitten: *a*, plant × ¾; *b*, leaf × 12; *c*, upper leaf cells and margin × 300; *d*, capsule × 9; *e*, calyptra × 9.

A beautiful, conspicuous moss that could hardly be mistaken for any other species. There is no good reason why it should not occur in Hawaii. Although I have seen no specimens to substantiate the record, it has been credited to our flora in many publications. It is one of the dominant moss species of the Society Islands. Like *Orthorrhynchium cylindricum*, it is a plant of comparatively low altitudes and may be looked for in the regions below the rain-forest belt rather than above it.

FAMILY 20. TRACHYPODACEAE

Robust or slender plants. Secondary stems branched. Leaves often plicate, long acuminate, margins toothed; costa single, ending below the apex or shorter; cells narrow, smooth or papillose, incrassate; seta papillose; capsule erect, exserted; peristome double; lid beaked; calyptra smooth or hairy.

Leaf cells papillose, obscure.....**61. Trachypus**
Leaf cells smooth.....**62. Trachypodopsis**

61. TRACHYPUS Reinwald and Hornschuch, Nov. Act. Acad. Leop. Carol. 14, pt. 2, suppl., p. 708, 1826.

Slender or medium-sized plants with branched stems and widely spreading leaves. Costa single, short or ending above mid-leaf; cells narrow, very obscure, densely papillose, more distinct and somewhat pellucid at the extreme base. Seta elongate, papillose; capsule erect; peristome double; calyptra hairy.

Rather large plants, leaves plicate.....**1. T. bicolor**
Slender plants, leaves not plicate.....**2. T. mauiensis**

1. **Trachypus bicolor** Reinwardt and Hornschuch, Nov. Act. Acad. Leop. Carol. 14, pt. 2, Suppl., p. 708, 1826 (fig. 120).
Trachypus haleakalae Brotherus, Bull. Soc. Bot. Ital., p. 24, 1904.

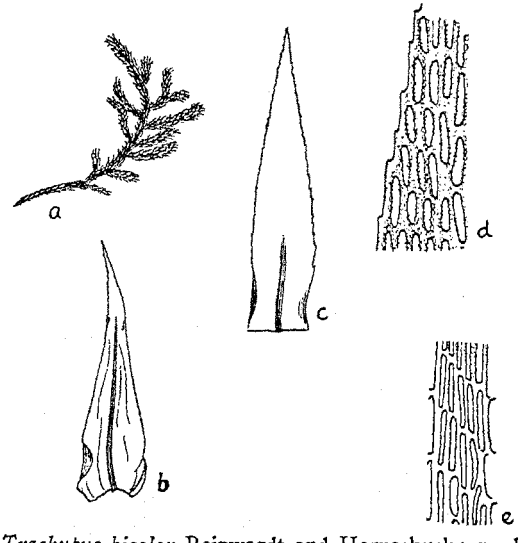


FIGURE 120. *Trachypus bicolor* Reinwardt and Hornschuch: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, inner basal leaf cells × 300.

Dioicous. Rather robust plants, bright yellowish green in the younger parts, brown or blackish below. Secondary stems procumbent or pendent, 5 cm. or more long, irregularly pinnately branched, branches erect-spreading, blunt. Leaves crowded, widely spreading and slightly twisted when dry, hardly changed when moist; the stem leaves usually slightly secund from a short, strongly clasping base, gradually narrowed to a linear-lanceolate point, acuminate, plicate, carinate-concave, 1.4 to 2 mm. long by 0.5 to 0.6 mm. wide; margin irregularly revolute on one side above, denticulate all around, usually broadly inflexed on one or both sides at the base; costa yellowish, ending about two-thirds up the leaf; upper leaf cells obscure, narrowly elliptic or short linear, incrassate, pitted, with numerous low, rounded papillae over the lateral walls; narrowly linear toward the base, more distinct, slightly pellucid; a few cells at the basal angles short elliptic but not forming a distinct group. Seta 1.5 to 2 cm. long, densely spinose-papillose; capsule erect, short ovoid.

Trees. Maui: mountain ridges, western part of island, altitude 5,000 feet (Baldwin).

Distribution: Sikkim, Nilgiri, Ceylon, Sumatra, Java, Lombok, Ceram. Type locality, Java.

Like many other Hawaiian mosses this species is known only from a sterile collection, but the vegetative details are so characteristic that its identity is unmistakable.

2. **Trachypus mauiensis** Brotherus, B. P. Bishop Mus., Bull. 40, p. 20, 1927 (fig. 121).
Papillaria mauiensis Brotherus, Bull. Soc. Bot. Ital., p. 21, 1904.
Claopodium laevicaule Brotherus, in herbaria.

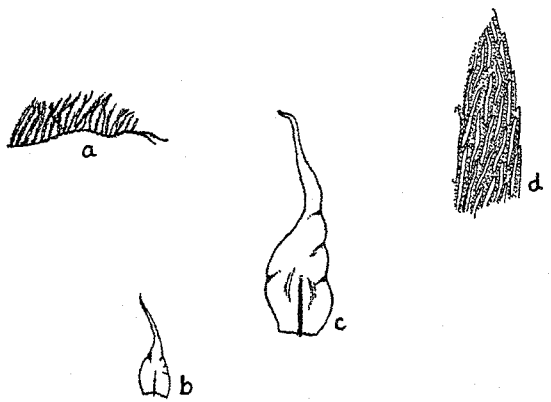


FIGURE 121. *Trachypus mauiensis* Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, leaf × 60; *d*, upper leaf cells and margin × 300.

Slender plants growing in dense, flat mats, dull yellowish green above, brown below. Stems up to 2 or 3 cm. long, prostrate, pinnately branched, branches numerous, erect or ascending, up to 5 mm. long, blunt at the tips. Stem leaves widely spreading, slightly secund, from an ovate base gradually narrowed to a long, filiform flexuose point, concave,

not plicate, up to 0.7 mm. long by 0.2 mm. wide; margin erect, obscurely denticulate all around, often broadly inflexed on one side toward the base; costa very faint, pale, extending about one-third up the leaf or nearly wanting; leaf cells very obscure, linear, densely papillose with numerous low, rounded papillae, more distinct and slightly pellucid in the interior of the extreme leaf base, several rows at the insertion much shorter; branch leaves smaller with shorter points, about 0.5 mm. long by 0.15 mm. wide, more distinctly serrulate. Sporophyte unknown.

Maui: valleys, western part of island, altitude 800 feet (Baldwin); Uku lele, Haleakala (Forbes).

Endemic. Type locality, western Maui.

A much more slender, delicate plant than the preceding, with minute, not plicate leaves and an entirely different habit. Through an obvious error this species and *T. bicolor* were listed by Brotherus (2, p. 20) as *Trachypodopsis,* but as they are under the proper generic heading of *Trachypus* the intention is perfectly clear.

62. TRACHYPODOPSIS Fleischer, Hedwigia, vol. 45, p. 64, 1905.

Robust, glossy plants, usually bright reddish brown, growing in dense mats or pendent from trees. Leaves crowded, erect-spreading, plicate, auriculate at the base; costa slender, ending below the apex; cells linear, incrassate, smooth, very porose.

1. **Trachypodopsis ornans** (Reichardt) Fleischer, Hedwigia, vol. 45, p. 68, 1906 (fig. 122).

   Hemiragis ornans Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 577, 1877.

Dioicous (?). Male flowers not seen. Robust, showy plants in dense mats or pendent masses, bright rufous brown above, sordid brown below, glossy. Secondary stems up to 10 cm. or more long, sub-pinnately branched, branches widely spreading, up to 3 cm. long, slightly flattened, sometimes hooked at the tips, often with several short lateral branches. Leaves crowded, rather widely erect-spreading with flexuose tips, often undulate-crisped at the tips of the branches, strongly plicate, narrowly oblong-lanceolate from an auriculate base, gradually narrowed to a long, flat acumen, 5 or 6 mm. long by 1 mm. wide; margin plane, sharply and irregularly serrate in the upper half, distantly serrulate below; costa slender, ending in the acumen some distance below the apex; leaf cells linear, smooth, with incrassate, pitted walls, about 7 μ wide and 8 to 10 times as long in the upper part of the leaf, gradually narrower below, shorter and wider again toward the extreme base and golden brown across the insertion, at the basal angles and in the large inflexed auricles short oval, angular or pitted. Sporophyte not seen.

Trees and banks in rain-forests. Molokai: Papaala Pali (Degener). Maui: crater of Eke (Baldwin); Puu Kukui (Baldwin; Bartram; Skottsberg); Kula pine line trail, northeast of Olinda (Bartram; Skottsberg); Ukulele (Forbes). Kauai: top of Waialeale (Meinecke).

Endemic. Type locality, Hawaii.

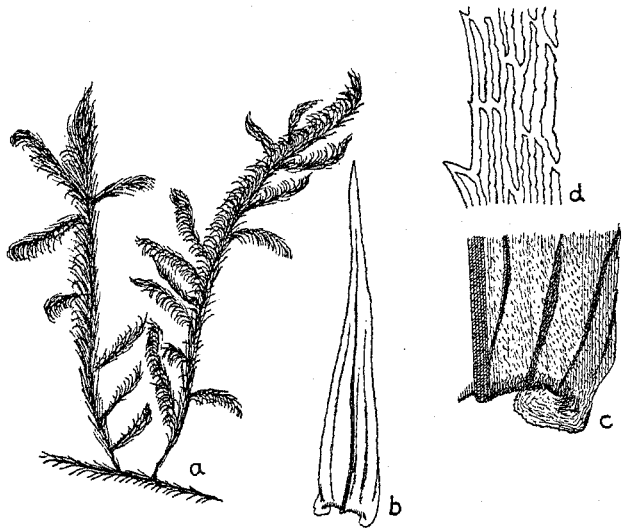


FIGURE 122. *Trachypodopsis ornans* (Reichardt) Fleischer : *a*, plant × ¾; *b*, leaf × 12; *c*, one side of leaf base × 60; *d*, upper leaf cells and margin × 300.

A very handsome moss that will be recognized at a glance by the characteristic bright rufous color. The leaves, in a general way, resemble those of *Pleuropus wilkesianus* but are more strongly plicate and clearly distinguished by the large incurved auricles at the basal angles.

FAMILY 21. PTEROBRYACEAE

Robust, often frondose plants. Primary stems creeping; secondary stems simple or branched, not radiculose. Leave ovate; margin plane, more or less toothed; costa faint or none; cells rhomboidal, incrassate, often porose, more elongate toward the base. Capsule immersed or exserted, smooth; peristome double, often rudimentary.

Secondary stems frondose, much branched, costa single.....**63. Trachyloma**
Secondary stems simple, costa none.....**64. Garovaglia**

63. TRACHYLOMA Bridel, Bryol. Univ., vol. 2, p. 227, 1827.

Robust plants; secondary stems simple below, bipinnately branched above in a flat, frond-like head. Lower stem leaves small, squarrose-spreading, upper leaves ovate, more or less complanate; costa faint, single or forked; cells rhomboidal to elongate, smooth, porose.

1. **Trachyloma tahitense** Bescherelle, Bull. Soc. Bot. France, p. 118, 1898 (fig. 123).

Trachyloma hawaiiense Brotherus, Bull. Soc. Bot. Ital., p. 24, 1904.

Dioicous. Large frondose plants in loose tufts, bright yellowish or brownish green, glossy. Primary stems creeping, densely brown tomentose; secondary stems erect, woody, up to 7 cm. or more high, simple and stipe-like below, pinnately or bipinnately branched above, branches complanate, forming a large frond-like head, ovate in outline, the uppermost branches much shorter, all rather blunt and with numerous axillary clusters of brown, filiform, septate propagulae near the tips. Lower stem leaves small, distant, squarrose-spreading or recurved, laxly areolate, gradually larger and more crowded upward, the upper leaves widely spreading, complanate, broadly ovate, slightly asymmetrical, short acuminate, up to 3.5 mm. long by 2 mm. wide; margin narrowly recurved near the base, plane above, serrulate toward the apex, very distantly serrulate or denticulate below; costa very faint, single or forked, extending about halfway up the leaf. Upper cells oval-rhomboidal with firm walls, 10 to 13 μ wide and 6 to 8 times as long, longer and narrower in the median and basal portions, several rows across the insertion golden yellow, more incrassate, slightly pitted, short rhomboidal. Branch leaves similar but smaller; margin nearly plane throughout, at the tips more appressed and nearly ecostate. Sporophyte unknown.

Trees. Maui: mountain ravines, western part of island, altitude 3,500 feet (Baldwin).

Distribution: Java, New Caledonia, New Guinea, Tahiti. Type locality, Tahiti.

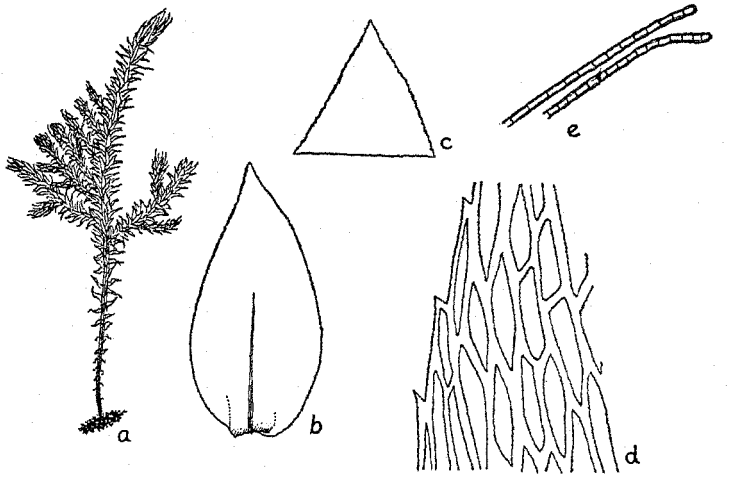


FIGURE 123. *Trachyloma tahitense* Bescherelle: *a*, plant × ¾; *b*, stem leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, 2 propagula × 60.

The only Hawaiian plants of this species that I have seen are from the collection noted above. Such a showy, conspicuous moss is not easily overlooked. It is hoped that knowledge of its local distribution will be broadened

by further collections. The leaves of this species, like its congeners, are apt to turn white and papery in spots, giving the plants a peculiar character.

64. GAROVAGLIA Endlicher, Gen. Pl., p. 57, 1836.

Rather robust plants. Secondary stems simple. Leaves ovate, escostate, slightly complanate; cells narrowly rhomboidal, porose, colored at the insertion. Capsule immersed; peristome double; calyptra campanulate, naked.

1. **Garovaglia haleakala** Brotherus, B. P. Bishop Mus., Bull. 40, p. 20, 1927 (fig. 124).

Pale yellowish green, slightly glossy. Secondary stems simple, up to 11 cm. long, 5 or 6 mm. wide with leaves, ascending. Leaves crowded, erect-spreading, rather complanate, 3 to 3.5 mm. long by 1.5 mm. wide, ovate, apiculate, concave, plicate, not undulate; margin erect, minutely denticulate toward the apex, entire below; costa none; upper leaf cells elliptic-rhomboidal, 10 to 12 μ wide and 40 to 50 μ long, very incrassate, slightly porose, longer in the median and basal portions, toward the basal angles short rectangular and rhomboidal but not forming a well-defined alar group, several rows across the insertion more lax and golden brown. Inner perichaetial leaves clasping, abruptly contracted to a short, nearly entire, subulate point; capsule immersed, oblong, brown.

Maui: Haleakala (Baldwin, type).

Endemic. Type locality, Haleakala, Maui.

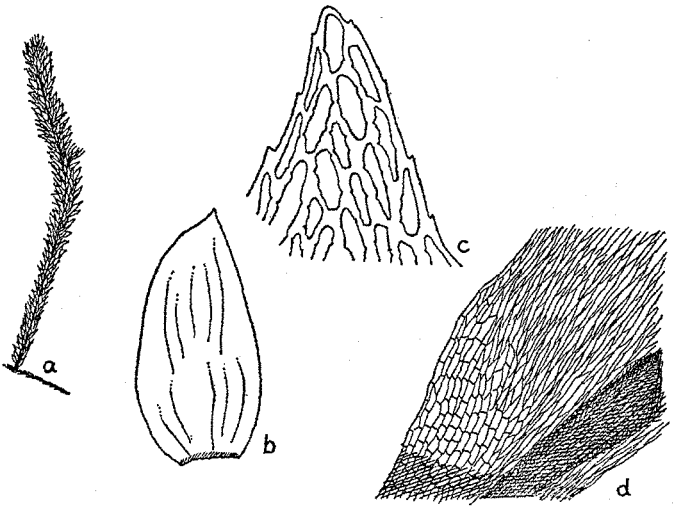


FIGURE 124. *Garovaglia haleakala* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 300; *d*, basal angle of leaf × 120.

I am hopeful that additional collections of this unique moss will aid in making its characters and local distribution more familiar. I have seen only

a single plant, evidently the one figured in the plate accompanying the original description, and the solitary capsule was obviously too old to show any details of the peristome structure.

Family 22. METEORIACEAE

Slender or robust plants with filiform creeping primary stems and long, branched, often pendent, secondary stems. Leaves usually long acuminate, rarely apiculate; costa single and slender or none; leaf cells linear, more or less porose, smooth or papillose. Fruit rare, capsule small, erect; peristome double.

1. Leaves obovate, deeply concave, apiculate.....**65. Pilotrichella**
   Leaves lanceolate, long acuminate.....2
2. Costa none.....**67. Barbella**
   Costa single.....3
3. Leaf point undulate and crispate, cells unipapillate.....**66. Aerobryopsis**
   Leaf point not crispate, cells seriate papillose.....**68. Floribundaria**

65. PILOTRICHELLA (C. Müller) Bescherelle, Mem. Soc. Sci. Nat. Cherbourg, vol. 16, p. 222, 1872, in part.

Robust plants growing in pendent masses. Secondary stems elongate, pinnately branched, terete. Leaves crowded, deeply concave, apiculate, ecostate; cells linear, incrassate, sinuose, smooth, colored at the insertion.

1. **Pilotrichella mauiensis** (Sullivant) Jaeger, Adumb., vol. 2, p. 159, 1875-1876 (fig. 125).
   Meteorium mauiense Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 182, 1854.
   Meteorium vulcanicum Mitten, in Seeman, Fl. Vit., p. 395, 1873.
   Pilotrichella desmoclada C. Müller, Flora, vol. 82, p. 464, 1896.

Dioicous. Robust plants in large pendent masses, pale green tinged with various shades of brown in the older parts, glossy. Secondary stems up to 10 cm. or more long, flexuose, densely or distantly pinnately branched, the branches widely spreading, usually simple but occasionally with a few short lateral branchlets, up to 3 mm. wide with leaves, terete. Leaves crowded, widely spreading, indistinctly seriate in spiral rows, oblong-obovate from a deep sub-clasping, cordate-auriculate base, deeply concave, broadly inflexed on both sides above the middle, abruptly apiculate, up to 2 mm. long by 1 mm. wide; margin erect, minutely crenulate near the apex, entire below; costa none; leaf cells linear, smooth, very incrassate, lateral walls strongly pitted, at the basal angles short, very sinuose, golden yellow, forming a small but distinct convex group. Fruit not seen.

Trunks and branches of trees. Oahu: Makaha Valley, Waianae Mountains (Forbes). Maui: north bank of the crater of Haleakala, altitude 10,200 feet (Wilkes Expedition, type); Kula pipe line trail, northeast of Olinda (Bartram). Island of Hawaii: Makahanaloa, Puu Kauku (Skottsberg).

Distribution: Hawaii, Samoa. Type locality, Haleakala, Maui.

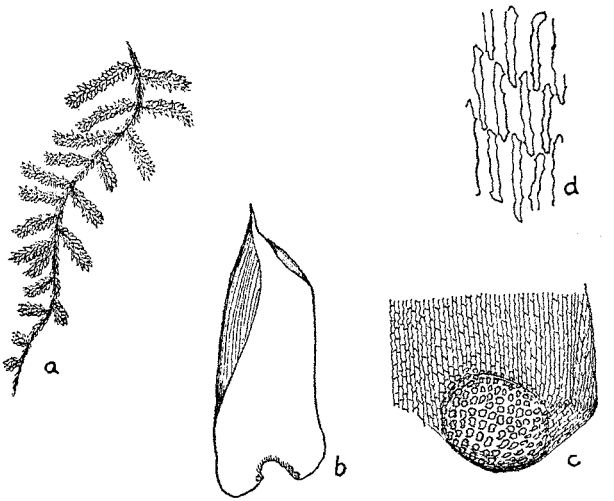


FIGURE 125. *Pilotrichella mauiensis* (Sullivant) Jaeger: *a*, part of plant × ¾; *b*, leaf × 25½; *c*, basal angle of leaf × 120; *d*, upper leaf cells × 300.

Plants from the type collections of *Meteorium vulcanicum* and *Pilotrichella desmoclada*, which I have seen, are a trifle more slender than the average, but, in the absence of any structural differences, I cannot see what excuse there is for keeping them separate. Some variation in size and branching arrangement is shown, just as in *P. flexilis* of the tropical Americas, but the leaf characters are so constant that it seems perfectly safe to include all the forms within the concept of a single species.

66. AEROBRYOPSIS Fleischer, Hedwigia, vol. 44, p. 304, 1905.

Robust plants growing in pendent masses, often strongly tinged with black. Secondary stems elongate, irregularly pinnate, the branches slightly flattened. Leaves crowded, long acuminate, undulate and crispate at the tips; costa slender, ending below the apex; cells linear, unipapillate.

1. **Aerobryopsis longissima** (Dozy and Molkenboer) Fleischer, Hedwigia, vol. 44, p. 305, 1905 (fig. 126).
   Neckera longissima Dozy and Molkenboer, Musc. Frond. N. Sp. Archip., p. 18, 1844.
   ? *Meteorium atrocaule* C. Müller, Flora, vol. 82, p. 463, 1896.

Dioicous. Plants robust, usually pendent from tree trunks or branches in soft, loose, intricate tufts, slightly glossy. Primary stems slender, flexuose, irregularly branched,

up to 20 cm. or more long, with erect, flexuose, rather loosely imbricated leaves, deep brown or black; secondary stems and branches greenish yellow, flexuose, rather blunt, slightly flattened, about 5 mm. wide with leaves; branch leaves widely spreading from the base, slightly concave, oblong-lanceolate, gradually long acuminate, transversely undulate in the upper half, especially toward the margins, the slender acumen strongly flexuose-crispate, one side of the leaf base usually inflexed, up to 3 or 4 mm. long by 1 mm. wide; margin denticulate throughout, plane below, undulate in the upper half; costa slender, extending well into the acumen; leaf cells linear, slightly incrassate, with pale lateral walls, a single distinct papilla over the center of the lumen, toward the extreme base shorter and broader, distinctly pitted, smooth, without any clearly differentiated alar group. Perichaetial leaves small; seta elongate, smooth; capsule sub-cylindric, erect or inclined; peristome double; lid rostrate; calyptra cucullate.

Trees and ledges in wet forests. Frequent on all the larger islands.

Distribution: Indo-Malayan regions, southern China, Philippines, Samoa. Type locality, Java.

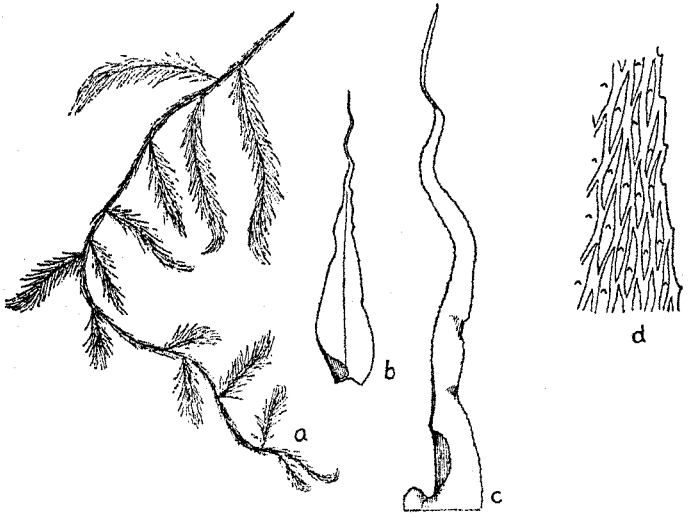


FIGURE 126. *Aërobryopsis longissima* (Dozy and Molkenboer) Fleischer: *a*, part of plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300.

This fine species rarely if ever fruits in the Hawaiian islands, but the pendent feathery masses form a conspicuous element of the moss vegetation in the rain-forests. The plants are usually tinged with dark brown or black in the older parts and sometimes throughout. The filiform apices of the widely spreading leaves are conspicuously undulate-crisped, both wet and dry, and unmistakably mark the species when this character has become familiar.

Aerobryopsis longissima variety **dozyana** (C. Müller) Fleischer, Laubm. Java, vol. 3, p. 783, 1907.

Neckera Dozyana C. Müller, Syn. 2, pp. 141, 642, 1851.

More slender; stems simple or with few scattered branches; leaves less crowded and narrower, with rather shorter points.

This form seems to be uncommon and confined to a few localities in Hawaii.

67. BARBELLA (C. Müller) Fleischer, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 823, 1906.

Pilotrichella section *Barbella* C. Müller, Flora, vol. 82, p. 464, 1896.

Slender, glossy plants growing in loose masses. Secondary stems elongate, usually filiform and tangled, pinnately branched. Leaves very slenderly acuminate, escostate; cells linear, smooth or faintly papillose, alar cells differentiated.

1. **Barbella trichophora** (Montagne) Fleischer, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 824, 1906 (fig. 127).

   Isothecium trichophorum Montagne, Ann. Sci. Nat., 2d Ser., vol. 19, p. 238, 1843.

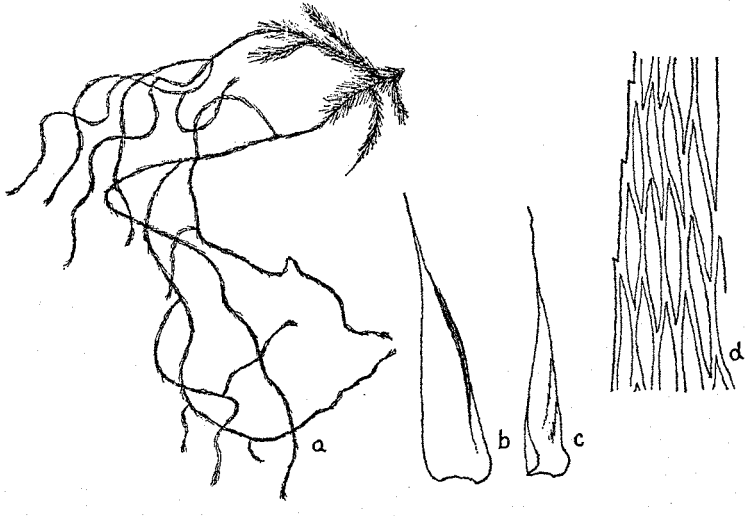


FIGURE 127. *Barbella trichophora* (Montagne) Fleischer: *a*, plant × ¾; *b*, lower spreading leaf × 12; *c*, leaf from capillary stem × 12; *d*, upper leaf cells and margin × 300.

Probably dioicous; male flowers unknown. Plants densely tufted, glossy, yellowish green. Secondary stems numerous, variable, usually very long, filiform and intricately tangled, laxly foliate with erect, flexuose, capillary-pointed leaves, pinnately branched, branches short, attenuate at the tips, somewhat flattened, rather densely foliate, sometimes shorter, flattened, with crowded, spreading leaves and attenuate at the tips or short and curved with crowded, appressed leaves and slightly julaceous with the leaves crisped toward the ends. Leaves erect or widely spreading, lightly plicate, from a triangular-ovate, auriculate base, broad at the insertion, gradually and slenderly acuminate to a fine, almost capillary, usually more or less flexuose point, 2 or 3 mm. long by up to 1 mm. wide just above the base; margin plane, minutely denticulate throughout or sometimes nearly entire in the middle; costa none; leaf cells linear, 5 or 6 μ wide by 70 μ or more long, smooth or lightly papillose with 1 to 3 small, indistinct papillae over the lumen, shorter and broader and slightly pitted at the extreme base, alar cells differentiated forming a small but distinct group. Sporophyte not seen.

Frequent on bushes or small trees on the windward slopes of the larger islands or in moist open forests.

Endemic. Type locality, Hawaii.

The tangled, glossy, yellowish green tufts hanging from bushes or small trees easily identify this species. The shorter stems as well as the lower parts of the elongated ones are very different in appearance from the tangled masses of slender, thread-like stems which constitute the conspicuous part of the, often, sizable masses which seem to find congenial habitats on the windward slopes of the mountains where there is an abundance of moisture.

68. FLORIBUNDARIA C. Müller, Linnaea, vol. 40, p. 267, 1876.

Slender plants growing in loose, feathery masses. Secondary stems elongate, pinnately branched, the branches short and flattened. Leaves long acuminate; costa slender, ending about mid-leaf; cells linear with a vertical row of papillae over the lumen; alar cells indistinct or sometimes well-defined in the branch leaves.

Alar cells not or scarcely differentiated.....1. **F. floribunda**
Alar cells of branch leaves in a well defined group.....2. **F. baldwinii**

1. **Floribundaria floribunda** (Dozy and Molkenboer) Fleischer, Hedwigia, vol. 44, p. 302, 1905 (fig. 128).

   Leskea floribunda Dozy and Molkenboer, Ann. Sci. Nat., vol. 2, p. 310, 1844, and Musc. Frond. Archip. Ind., p. 15, 1845.

Slender, feathery, pale green, scarcely glossy plants, pendent or in lax, intricate masses. Stems up to 20 cm. or more long, flexuose, flagelliform at the tips, radiculose on the under side when in contact with the substratum, pinnately branched, branches short, widely spreading, complanate, frequently with short lateral branchlets. Leaves complanate, divaricately spreading, shriveled and flexuose when dry, more rigid when moist, slightly decurrent, gradually lanceolate from an ovate, concave, slightly clasping base, 1 or 2 mm. long by 0.6 mm. wide, one side of the leaf base usually broadly inflexed;

margin plane, serrulate all around; costa very slender, pale, ending a little above mid-leaf; leaf cells linear, very dense and obscure, 2 or 3 μ wide and 10 to 15 times as long, with a row of 6 to 8 small sharp papillae over the lumen; at the extreme base slightly wider, smooth and rather pellucid, at the basal angles a few cells shorter, oblong and sub-quadrate, scarcely defined in the stem leaves but often forming a more distinct group in the branch leaves. Seta short, smooth, often curved; capsule erect or inclined, ovoid-cylindric; peristome double; calyptra cucullate, slightly hairy.

Oahu: Waikane-Schofield trail, Koolau Range, altitude 2,200 feet (Bartram). Maui: Haleakala, altitude 4,000 feet (Baldwin).

Distribution: East Indies, Pacific islands, Philippines, Tonkin, Japan, India, Africa. Type locality, Java.

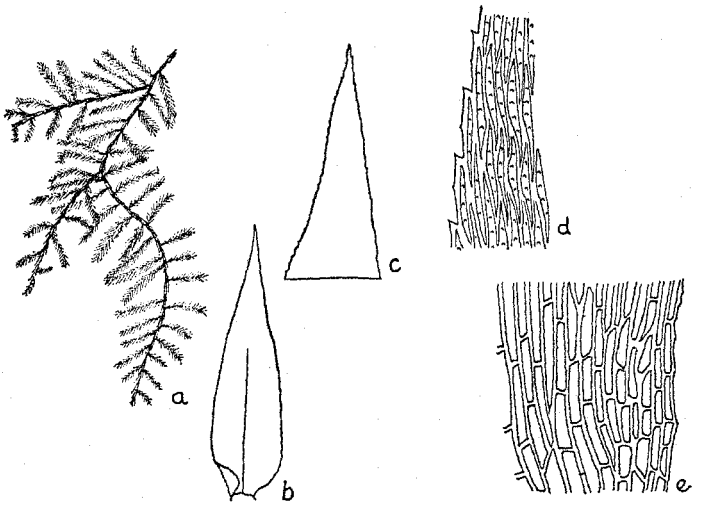


FIGURE 128. *Floribundaria floribunda* (Dozy and Molkenboer) Fleischer: *a*, part of plant × ¾; *b*, branch leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, basal angle of leaf × 300.

A beautiful feathery moss that is apparently confined to the windward sides of Oahu and Maui. Under a power of about 80 diameters, with a rather subdued light, the leaves of this and the following species appear to be obliquely marked with alternating light and dark bands due to the seriate arrangement of the papillae and the arrangement of the leaf cells. This "herringbone" appearance is characteristic of these two mosses and will readily serve to identify them. As far as I know, the fruit has never been found in the Hawaiian islands.

2. **Floribundaria baldwinii** Brotherus, B. P. Bishop Mus., Bull. 40, p. 22, 1927.

Meteorium baldwinii Brotherus, Bull. Soc. Bot. Ital., p. 20, 1904.

Very close to *F. floribunda* but with a well-defined group of lax, oval, hyaline or yellowish smooth cells at the basal angles of the branch leaves, convex on the inner or ventral side of the leaf. Sporophyte unknown.

Oahu: altitude 2,500 feet (Baldwin, type); Waikane-Schofield trail, Koolau Range, altitude 2,000 feet (Bartram).

Endemic. Type locality, Oahu.

Not a satisfactory species, especially as the characteristic convex group of alar cells is apparently confined to the branch leaves and not uniformly developed even there. The branch leaves of *F. floribunda* occasionally show a similar structure, and it seems probable that *F. baldwinii* may prove to be no more than a form of this plastic and widespread species.

Family 23. PHYLLOGONIACEAE

Conspicuously glossy plants with long, sub-pinnately branched, flat secondary stems. Leaves equitant, distichous, cymbiform, short-pointed, ecostate; cells linear, smooth, alar cells not differentiated. Perichaetial leaves distinct.

69. ORTHORRHYNCHIUM Reichardt, Verh. Zool. Bot. Wien, p. 115, 1868.

Plants with the characters of the family. Capsule immersed on a short seta; peristome single, teeth pale, smooth; calyptra, in *O. cylindricum*, strongly scabrous; spores large.

1. **Orthorrhynchium cylindricum** (Lindberg) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 835, 1906 (fig. 129).
Phyllogonium cylindricum Lindberg, Öfv. Vet. Akad. Förh., p. 603, 1864.

Dioicous; male buds gemmiform, about 1 mm. long, lateral on the secondary stems and branches. Plants loosely gregarious, pale green, very glossy. Primary stems prostrate, usually denuded of leaves, radiculose. Secondary stems pendent, up to 10 cm. long, very flat, 3 or 4 mm. wide with leaves, sub-pinnately branched, branches distant forming an irregular frond. Leaves distichous, erect-spreading, cymbiform, oblong, abruptly narrowed to a short, blunt, slightly recurved point; margin erect, entire; costa none; leaf cells linear, 5 or 6 μ wide and 8 to 10 times as long, smooth, slightly shorter and broader at the apex, at the extreme base more lax, shorter and broader, not differentiated at the basal angles, slightly colored across the insertion. Perichaetial leaves erect, the inner about 5 mm. long, from a long, ovate, clasping base rapidly narrower to a slender, sharp, acuminate point; margins minutely denticulate in the upper half; capsule immersed on a short, thick seta about 0.5 mm. long; vaginula hairy; urn brown, cylindric, 2.5 mm. long by a scant 1 mm. wide; peristome teeth pale yellow, smooth, blunt, projecting about 65 μ above the rim, incurved when moist; lid conic-apiculate; calyptra very papillose-scabrous in the lower half, with a few long erect hairs near the lower edge, very indistinctly lobed at the base.

Distribution: Marquesas, Society Islands, Samoa. Type locality, Tahiti.

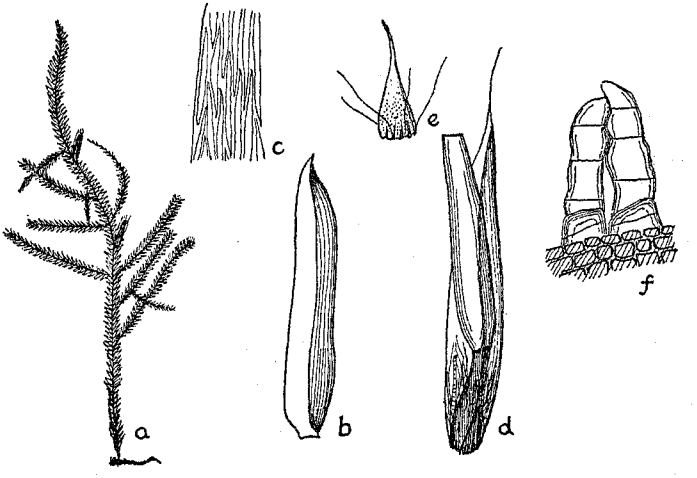


FIGURE 129. *Orthorrhynchium cylindricum* (Lindberg) Brotherus: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, capsule and inner perichaetial leaf × 12; *e*, calyptra × 12; *f*, peristome tooth × 300.

I have seen no plants of this beautiful species from the Hawaiian islands. It has been credited to the local flora for many years by several authors, and there is no apparent reason why its geographical distribution should not extend this far. Any positive evidence will be welcome. The description and sketches were made from plants collected on Moorea, Society Islands, by Temarii, October 1, 1900.

FAMILY 24. NECKERACEAE

Usually robust, glossy plants with creeping, filiform primary stems and erect, sub-pinnately branched, flattened secondary stems. Leaves usually very complanate, transversely undulate and asymmetrical; costa none, single or double; leaf cells narrow, smooth. Capsule immersed or exserted, erect; peristome double, segments of the inner peristome narrow, from a basal membrane of varying height; cilia none; spores small or large.

1. Costa ending about mid-leaf, or shorter, leaves very complanate.....2
   Costa ending near the apex, leaves slightly complanate.....**74. Thamnium**
2. Costa double, very short.....3
   Costa single, ending about mid-leaf.....4
3. Leaves rounded at the apex.....**71. Neckeropsis**
   Leaves acute.....**70. Neckera**
4. Leaves coarsely serrate above.....**73. Homaliodendron**
   Leaves denticulate above.....5
5. Leaves rounded or truncate at the apex.....**71. Neckeropsis**
   Leaves acute.....**72. Baldwinella**

70. NECKERA Hedwig, Sp. Musc., p. 200, 1801.

Rather robust, glossy plants with sub-pinnately branched secondary stems. Leaves in eight rows, complanate, usually transversely undulate; upper cells rhomboidal, smooth; costa double, faint; capsule immersed; peristome double, basal membrane of inner peristome short, segments narrow; calyptra cucullate.

1. Neckera hawaiico-pennata C. Müller, Flora, vol. 82, p. 462, 1896 (fig. 130).

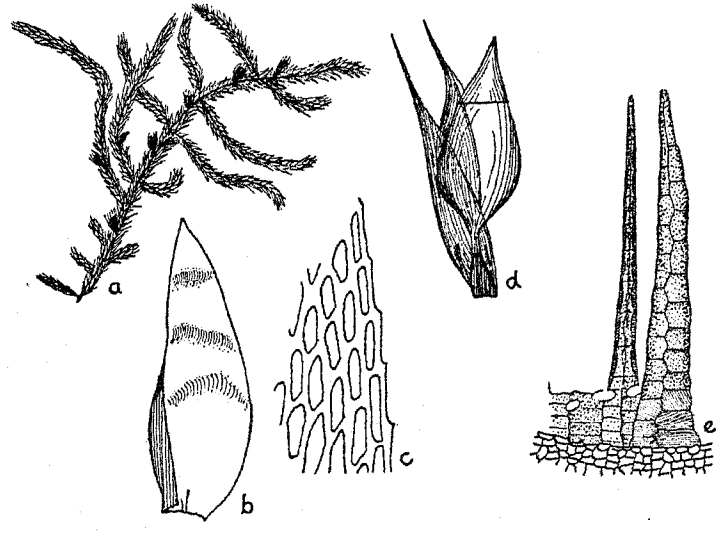


FIGURE 130. *Neckera hawaiico-pennata* C. Müller: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cell and margin × 300; *d*, capsule and inner perichaetial leaves × 12; *e*, part of peristome × 120.

Autoicous; male buds numerous in the axils of the branch leaves. Robust plants, pale yellowish green tinged with brown, glossy. Secondary stems up to 8 cm. long, irregularly pinnate; branches complanate, up to 4 cm. long, flexuose, with a few short lateral branchlets. Leaves complanate, spreading, transversely undulate both wet and dry, oblong-ligulate from a slightly ovate base, acute, slightly asymmetrical, broadly inflexed on one side toward the base, up to 2.5 mm. long by 0.8 mm. wide; margin plane, minutely denticulate above, entire below; costa double, the unequal forks very faint and short; apical cells oval-rhomboidal, 7 or 8 μ wide and 2 or 3 times as long, gradually longer and narrower downward; basal cells linear, 10 to 15 times as long as wide, several rows across the insertion shorter and strongly pitted; at the basal angles a few short, irregular, sub-quadrate cells, but not forming a distinct group. Perichaetial leaves sheathing, oblong-ovate, long cuspidate, the inner 3 mm. long; capsule immersed, ovoid-cylindric, brown, urn 1.8 mm. long, wide-mouthed; peristome teeth yellowish, linear-subulate, about 0.6 mm. long, transversely and obliquely striate toward the base, papillose above; basal membrane of the inner peristome 0.1 mm. high, segments narrow, papillose, as long as the teeth; lid reddish brown, conic-rostrate, erect, 0.8 mm. long; spores yellowish, papillose, up to 30 μ in diameter.

Maui: Haleakala, altitude 4,000 feet (Baldwin).

Endemic. Type locality, Hawaii.

This species has been collected only a few times and seems to be confined to the upper slopes of Haleakala. The short, faint double costa will easily separate it from *Baldwinella kealeensis,* and the acute leaves from *Neckeropsis lepineana.*

71. NECKEROPSIS Reichardt, Novara Exp. Bot., vol. 1, p. 181, 1870; amended by Fleischer, Laubm. Java, vol. 3, p. 875, 1907.

Plants with the habit of *Neckera,* leaves in four rows, broadly rounded at the apex; peristome double, the teeth papillose, not striate; calyptra campanulate, slightly hairy.

Costa very short and double.....1. **N. lepineana**
Costa extending beyond mid-leaf.....2. **N. obtusata**

1. **Neckeropsis lepineana** (Montagne) Fleischer, Laubm. Java, vol. 3, p. 879, 1907 (fig. 131).

Neckera Lepineana Montagne, Ann. Sci. Nat., p. 107 and Syll., p. 23, 1848.

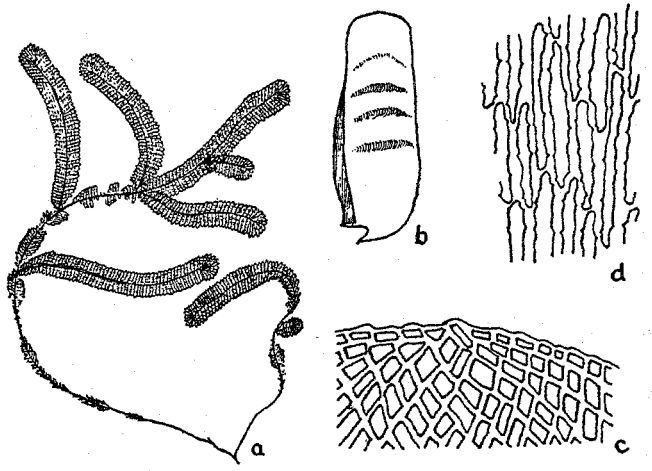


FIGURE 131. *Neckeropsis lepineana* (Montagne) Fleischer: *a,* plant × ¾; *b,* leaf × 12; *c,* apex of leaf × 300; *d,* inner basal leaf cells × 300.

Dioicous. Robust plants in lax, intricate, yellowish green, slightly glossy tufts. Secondary stems reclining or pendent, up to 20 cm. or more long, irregularly branched, branches simple, 2 or 3 cm. long, complanate, up to 5 mm. wide with leaves. Leaves almost horizontally spreading, very complanate, with 3 to 5 curved transverse undulations, broadly ligulate from a partly clasping, decurrent base, inflexed on one side below, very broadly rounded at the apex, 2.5 to 3 mm. long by 1 mm. wide; margin plane, minutely crenulate above, entire below; costa faint, double, with unequal forks, short; leaf cells rhomboidal, 5 μ wide and 3 to 6 times as long, shorter at the apex,

longer with sinuose walls toward the base, several rows across the insertion and in the decurrent wings short and strongly sinuose. Sporophyte on a short, lateral branch; capsule ovoid-cylindric, immersed in the sheathing, lanceolate perichaetial leaves; seta 0.5 mm. long; peristome yellowish, papillose; spores papillose, 20 to 30 μ in diameter.

Maui: valleys in western part of island, altitude 800 feet (Baldwin).

Distribution: East Africa, Malayan and Pacific islands. Type locality, Tahiti.

Readily distinguishable from *Baldwinella kealeensis,* which it resembles superficially, by the broadly rounded leaves without any trace of a point and the short, double costa. It is apparently rare in Hawaii and known only through Baldwin's collection.

2. **Neckeropsis obtusata** (Montagne) Brotherus, Engler and Prantl, Pflanzenf., 2d ed., vol. 11, p. 187, 1925 (fig. 132).

Neckera obtusata Montagne, Ann. Sci. Nat., 2d ser., vol. 19, p. 240, 1843.

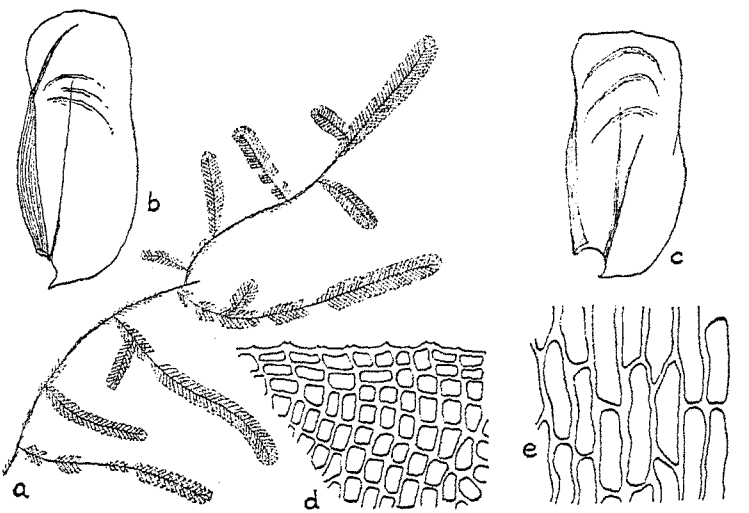


FIGURE 132. *Neckeropsis obtusata* (Montagne) Brotherus: *a*, part of plant × ¾; *b, c*, leaves × 15; *d*, apical leaf cells and margin × 360; *e*, inner basal leaf cells ×360.

Dioicous (?). Robust plants, pale green, glossy. Secondary stems reclining, up to 30 cm. long, wiry, nearly denuded of leaves in the older parts, distantly and irregularly branched, branches very flat, obtuse, about 4 mm. wide with leaves. Leaves widely spreading, very complanate, oblong-ligulate, 2 to 2.25 mm. long and 1 to 1.25 mm. wide, strongly transversely undulate, asymmetrical at the base, slightly decurrent on one side, broadly inflexed on one side, very broadly rounded or truncate at the apex; margin plane, minutely crenulate above, entire below; costa extending beyond mid-leaf, usually slender and single, but often forked; upper leaf cells oval-rhomboidal, 5 to 7 μ wide and 2 or 3 times as long, gradually becoming linear and slightly sinuose toward the extreme base, inner basal cells 4 to 6 times as long as wide, shorter and narrower toward the margins. Fruit unknown.

Kauai: Waimea Canyon, Koiae River, one-half mile below waterfall (d'A. Welch).

Distribution: Cochin China, Tonkin, China (Kwantung Province). Type locality, Cochin China.

A fine addition to the local moss flora. The relatively long, conspicuous costa will at once distinguish this species from *N. lepineana.* The rounded leaf apex precludes any confusion with *Baldwinella kealeensis.*

The Hawaiian plants are in perfect agreement with plants from Tonkin and Kwantung, even in the unfortunate particular of complete sterility. Until fruiting plants are available the exact systematic position of this species must remain in doubt.

72. BALDWINELLA Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 850, 1906.

Robust, frondose, glossy plants. Secondary stems sub-pinnately branched, branches complanate. Leaves complanate, in eight rows, transversely undulate, acute; costa single or forked, ending about mid-leaf; leaf cells linear. Seta short, capsule exserted; peristome double, segments of the inner peristome from a relatively high basal membrane.

1. **Baldwinella kealeensis** (Reichardt), new combination (fig. 133).

Neckera kealeensis Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 571, 1877.

Neckera Hillebrandtii Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 572, 1877.

Neckera aquatalis C. Müller, Flora, vol. 82, p. 462, 1896.

Neckera Baldwini C. Müller, Flora, vol. 82, p. 462, 1896.

Neckera lepto-frondosa C. Müller, Bull. Herb. Boiss., vol. 5, p. 851, 1896.

Neckera rhynchostegioides Brotherus, Bull. Soc. Bot. Ital., p. 20, 1904.

Baldwinella sandwicensis Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 850, 1906.

Dioicous; male flower gemmiform, axillary on the secondary stems, 1 mm. long, antheridia numerous, with abundant filiform paraphyses of about equal length, inclosed in 6 or 7 broadly ovate, deeply concave, short acuminate, ecostate, clasping bracts. Plants robust in loose intricate tufts, yellowish green in the younger parts, dark green or brown below, glossy. Primary stems creeping, tough, naked at the extreme base, the lowermost leaves small, appressed with spreading points, acuminate, with scattered tufts of radicles. Secondary stems rather distant, up to 12 cm. or more long, rather stiff, ascending or erect, irregularly pinnately branched, the branches widely spreading, very flat, 6 or 7 mm. wide with leaves, usually blunt at the ends, but often attenuated and flagellaceous. Leaves rather crowded, in 8 rows, divaricately spreading, very complanate, transversely undulate, lingulate, abruptly acute, one side of the asymmetrical base inflexed; margin denticulate at the apex, entire below; costa variable, sometimes single

and ending in or above the middle, sometimes double or forked and shorter; leaf cells linear, rather short, not incrassate, 5 or 6 μ wide by 35 μ long, minutely papillose by projecting ends on the back, more elongate and smooth toward the base, at the insertion slightly shorter and broader, but without any differentiated alar cells. "Inner perichaetial leaves much smaller, erect, narrowly linear-lanceolate from a partly sheathing, oval base, entire, ecostate or nearly so. Seta about 2 mm. long, curved above; capsule exserted, inclined, small, symmetrical, short oval, wide-mouthed, thin-walled, dark brown; peristome teeth linear-lanceolate, narrowly acuminate, bordered, median line zigzag, densely cross-striate, brownish yellow, with closely spaced plates, hyaline and papillose at the apex, inner peristome yellowish, smooth, basal membrane high, keeled, segments as long as the teeth, broad, carinate, cilia none; lid and calyptra unknown. Spores small."

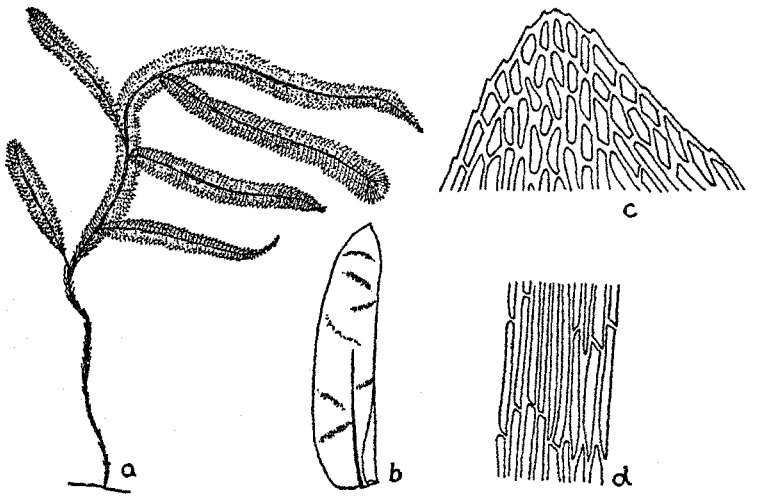


FIGURE 133. *Baldwinella kealeensis* (Reichardt) Bartram: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 300; *d*, inner basal leaf cells × 300.

Damp rocks and wet ledges in shaded ravines. Frequent on the larger islands where the conditions are suitable.

Endemic. Type locality, Hawaii.

This rather protean species is not difficult to recognize in spite of its variability. The robust, dendroid habit, strongly flattened stems, and undulate, glossy leaves with acute points readily separate this plant from all other local mosses except *Neckeropsis lepineana,* in which the costa is very short and double, the leaf apex truncate or broadly rounded, and the leaf cells much shorter. The fruit is rare.

Although the plant had been described by Müller under three different names, Brotherus christened it again with the specific name *sandwicensis* when the monotypic genus *Baldwinella* was created. Furthermore, Reichardt, in 1877, described two new species under the names of *Neckera kealeensis*

and *Neckera Hillebrandtii* respectively. Parts of the type collections of these two species have been examined and prove to be identical with each other and with *Baldwinella sandwicensis*. As Reichardt's name has undoubted priority it has, unfortunately, been necessary to make a new combination for this beautiful endemic species.

73. HOMALIODENDRON Fleischer, Hedwigia, vol. 45, p. 72, 1906.

Robust, frondose plants. Secondary stems bipinnately or tripinnately branched above, branches complanate. Leaves complanate, not undulate, coarsely incised-serrate above; costa single; upper cells rhomboidal, elongated below. Capsule exserted on a short seta; peristome double.

1. **Homaliodendron flabellatum** (Dickson, Smith) Fleischer, Hedwigia, vol. 45, p. 74, 1905-1906 (fig. 134).
   Hookeria flabellata Smith, Trans. Linn. Soc., vol. 9, p. 280, 1808.
   Neckera dendroides Hooker, Musc. Exot., tab. 69, 1818.
   Homalia densa Boswell, Jour. Bot., p. 98, 1892.
   Neckera australasica C. Müller, Syn., vol. 2, p. 42, 1851.
   Omalia intermedia Ångström, Örf. Vet. Akad. Föhr., no. 4, p. 17, 1872.
   Homalia praelonga Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 573, 1877.

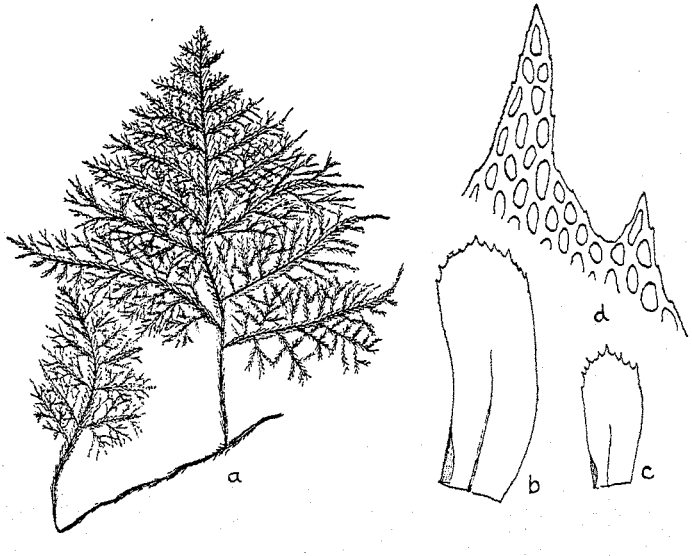


FIGURE 134. *Homaliodendron flabellatum* (Dickson, Smith) Fleischer: *a*, plant × ¾; *b*, stem leaf × 12; *c*, branch leaf × 12; *d*, upper leaf cells and margin × 300.

Dioicous. Large fern-like plants with broadly triangular or elongate fronds, growing in large, loose tufts, pale glossy green. Primary stems creeping, with closely appressed, scale-like leaves, densely radiculose on the under side, often stoloniferous. Secondary stems erect or ascending, bipinnate and tripinnate with widely spreading branches in one plane forming a frond of very variable size and outline, either triangular, dense, and as broad or broader than long or linear, lax and 5 or 6 times as long as broad, up to 10 to 15 cm. long. Lower stem leaves acute, erect and closely appressed, more spreading near the base of the frond and gradually merging with the normal leaves of the upper stem which are crowded and very complanate, oblong-ligulate to slightly spathulate, up to 3 mm. long by 1.2 mm. wide, coarsely incised-serrate at the broadly rounded apex, entire below; margin plane; costa single, ending about halfway up; leaves of the ultimate branches smaller, less than 1 mm. long, coarsely incised above the middle; lower leaf cells linear, pitted, several rows at the insertion shorter, golden yellow, incrassate, at the basal angles sinuosely rectangular, but not forming a well-differentiated group; median cells oval and oval-rhomboidal, incrassate, slightly sinuose, 6 to 8 μ wide and 12 to 15 μ long. Seta 2 to 3 mm. long; capsule exserted.

Tree trunks and rocks in wet, shady forests. Frequent on all the larger islands.

Distribution: East Indies, Japan, Philippines, Pacific islands. Type locality, East Indies.

A conspicuous and beautiful moss, known at sight by the broad, flat fronds resembling a small fern, standing out at right-angles from tree trunks and vertical rock faces. A number of species have been described from the Pacific and Indo-Malayan regions, based principally upon the size and outline of the fronds. This is such an unstable character, even in the limited area of the Hawaiian islands, that I am satisfied to follow the judgment of Dixon (10, p. 286) and subordinate the local forms to *H. flabellatum,* with which they agree perfectly in every structural detail. The fruit is very rare. I have examined scores of colonies without ever finding a single capsule. The forms with narrow, lax fronds may be designated as form *elongata,* as compared with the other extreme in which the frond is short, broad, and dense (*Homalia densa* Boswell), but as almost no two plants are alike in outline, any such distinction is rather useless except as it relates to the extremes.

74. THAMNIUM Bruch and Schimper, Bryol. Eur., fasc. 49-51, Mon., 1852.

Very robust, dendroid plants, scarcely glossy. Secondary stems erect, much-branched above. Leaves ovate, slightly complanate, acute; costa stout, single, ending a little below the apex; upper cells rhomboidal, incrassate, elongated below. Seta short, smooth; capsule sub-erect; peristome double.

1. **Thamnium speciosum** Brotherus, B. P. Bishop Mus., Bull. 40, p. 23, 1927 (fig. 135).
   Homalia procera Brotherus, Bull. Soc. Bot. Ital., p. 19, 1904.

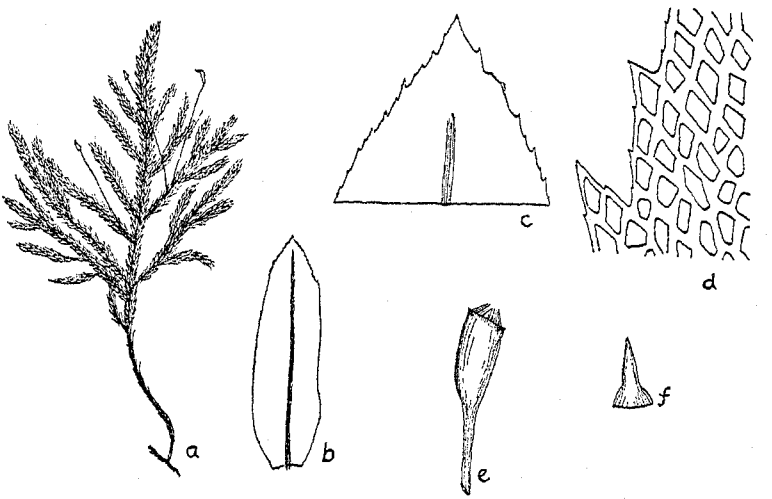


FIGURE 135. *Thamnium speciosum* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, moist capsule × 9; *f*, lid × 9.

Synoicous. Very robust dendroid plants, pale green when young, becoming yellowish brown with age, scarcely glossy. Primary stems creeping, radiculose; secondary stems erect, 8 to 14 cm. high, rigid, woody, simple below, pinnately and bipinnately branched above, branches erect-spreading, blunt or often cuspidate at the tips. Lower stem leaves small, distant, appressed, scale-like, ovate, acute, gradually larger upward, the upper stem leaves crowded, slightly complanate, erect-spreading, oblong-ovate, acute, concave, up to 3.5 mm. long by 1.2 mm. wide; margin erect, usually broadly inflexed on one or both sides, entire below, sharply serrate with irregular teeth toward the apex; costa about 70 μ wide at the base, tapering upward and ending some distance below the apex; upper leaf cells rhomboidal, incrassate, about 10 μ wide by 14 to 18 μ long; basal cells elongated, broadly linear and somewhat vermicular toward the costa, rectangular toward the margins, several rows across the insertion shorter, yellowish and slightly pitted; branch leaves similar but smaller. Inner perichaetial leaves erect, broadly ovate, abruptly short acuminate, entire, about 1.2 mm. long; seta 1 cm. long, reddish brown, curved at the top when dry, nearly erect when moist; capsule short oblong, brown, urn 1.5 mm. long; peristome yellow; lid erect, conic-rostrate, 1.5 mm. long; spores yellowish, up to 16 μ in diameter.

Shaded rocks in ravines. Maui: Haleakala, altitude 4,000 feet (Baldwin, type); rocks in bottom of small ravine, Haleakala, altitude 8,000 feet (Baldwin).

Endemic. Type locality, Haleakala, Maui.

A very beautiful and striking moss which seems to be unique in the genus through the synoicous type of inflorescence. In addition to the Baldwin

specimens there is a collection in the herbarium of Bernice P. Bishop Museum from Haleakala, collector unknown, in which the branches are widely spreading or decurved and more turgid by reason of the less complanate leaves, but as the inflorescence and structural details are the same it is evidently nothing but a form of the species.

Family 25. LEMBOPHYLLACEAE

Mostly robust, sub-dendroid plants with erect or ascending secondary stems, much branched above. Leaves lanceolate, short-pointed, denticulate above; costa none or double and short; upper cells linear, incrassate. Seta short, smooth; capsule sub-erect; peristome double; calyptra cucullate, naked.

75. CAMPTOCHAETE Reichardt, Novara Exp., vol. 1, p. 190, 1870.

Plants with the characters of the family. Secondary stems, in *C. pulvinata,* slender, subpinnately branched; leaves small with falcate points.

1. **Camptochaete pulvinata** (Hooker, J. D., and Wilson) Jaeger, Adumb., vol. 2, p. 213, 1875-1876 (fig. 136).

   Hypnum pulvinatum Hooker, J. D., and Wilson, Lond. Jour. Bot., vol. 3, p. 555, 1844.

   Camptochaete falcifolia Brotherus, B. P. Bishop Mus., Bull. 40, p. 23, 1927.

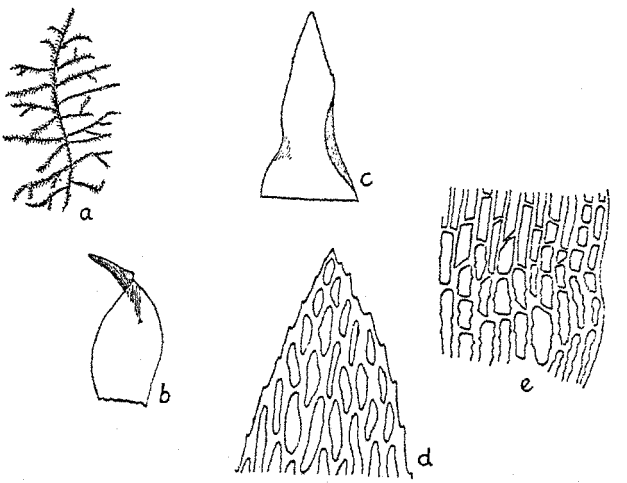


Figure 136. *Camptochaete pulvinata* (Hooker, J. D., and Wilson) Jaeger: *a*, part of plant × ¾; *b*, stem leaf × 25½; *c*, apex of leaf × 60; *d*, apex of leaf × 300; *e*, basal angle of leaf × 300.

Dioicous. Plants with woody, erect, pinnately branched secondary stems about 6 cm. high, growing in loose yellowish tufts, glossy. Stem leaves crowded, concave, with falcate points, short lanceolate from an ovate base, short acuminate, rather broad in the point, up to 1.75 mm. long; margin plane, slightly denticulate toward the apex, entire below; costa short and double or none; branch leaves similar but smaller, with shorter, broader, bluntish points; upper leaf cells linear, incrassate, slightly vermicular, 6 to 8 μ wide and 5 to 8 times as long, slightly papillose on the back by the projecting ends, a little longer and narrower toward the base, several rows across the insertion much shorter, incrassate, slightly pitted, without any differentiated alar cells. Seta about 1 cm. long, red; capsule suberect, slightly contracted under the mouth when dry and empty, brown.

Maui: without definite locality (Baldwin).

Distribution: New Zealand. Type locality, New Zealand.

Upon comparing plants from the type collection of *C. falcifolia* with authentic specimens of *C. pulvinata* the essential characters seem to be in almost complete accord. Under these circumstances it seems unwise to attempt to maintain *C. falcifolia* as a distinct species, notwithstanding the wide leap in geographical distribution. The wiry, pinnately branched secondary stems and ecostate, short-pointed, falcate leaves should readily distinguish this plant from any other local species. It is apparently rare, and more material is needed to determine its status with certainty.

Family 26. HOOKERIACEAE

Small or robust, often succulent plants. Stems branched, radiculose below. Leaves usually complanate; costa single or double and extending beyond mid-leaf, or none; cells smooth, often wide and lax. Seta elongate, smooth or scabrous; capsule erect or horizontal; peristome double; calyptra mitriform, frequently lobed or fringed at the base.

1. Costa single 2
   Costa double or none 3
2. Peristome teeth papillose with a zigzag median line ..... **76. Daltonia**
   Peristome teeth striate, furrowed along the median line ..... **77. Distichophyllum**
3. Costa none, leaf cells very large, up to 50 μ wide ..... **78. Hookeria**
   Costa double, cells much smaller ..... **79. Hookeriopsis**

76. DALTONIA Hooker and Taylor, Musc. Brit., p. 80, 1818.

Small or medium-sized plants. Leaves complanate, ovate or lanceolate, distinctly bordered; costa ending below the apex; upper leaf cells rhomboidal, more elongate below. Seta scabrous; capsule erect; peristome double, the teeth papillose; calyptra fringed at the base.

1. Leaf cells lax, thin-walled, costa extending nearly to apex ..... **2. D. baldwinii**
   Leaf cells firm, incrassate, costa shorter 2
2. Leaf border indistinct, especially below ..... **4. D. pseudostenophylla**
   Leaf border distinct 3
3. Leaf border 12 to 16 rows wide at base ..... **1. D. contorta**
   Leaf border about five rows wide at base ..... **3. D. rufescens**

1. Daltonia contorta C. Müller, Syn., vol. 2, p. 660, 1851 (fig. 137).
Daltonia perlimbata Brotherus, Bull. Soc. Bot. Ital., p. 16, 1904.

Autoicous. Robus plants, tawny green and glossy above, brown below. Stems 1.5 to 2 cm. high, densely radiculose below, 4 or 5 mm. wide with leaves. Leaves very crowded, appressed and somewhat flexuose when dry, slightly spreading when moist, carinate with a broad median fold in the lower half, oblong-ovate, short acuminate, 3 mm. long and 0.8 to 0.9 mm wide; margin plane, entire; costa reddish at the base, paler above, ending about three-fourths up; upper leaf cells oval-rhomboidal with thick yellowish, pellucid walls, 8 to 10 μ wide and 25 to 30 μ long; basal cells elongate, linear with slightly sinuose walls toward the costa, shorter and broader toward the very broad, distinct border of elongated cells which is 12 to 16 rows wide at the base, 8 to 10 rows wide near mid-leaf and 3 or 4 rows wide above. Seta 4 or 5 mm. long, rather stout, dark red, scabrous nearly to the base; capsule erect, ovoid, dark reddish brown, with a short neck, 0.8 to 1 mm. long; calyptra copiously fringed, slightly scabrous near the apex; spores papillose, about 25 μ in diameter.

Maui: tree trunks, Haleakala, altitude 8,000 feet (Baldwin).
Distribution: Ceylon, Java, Luzon. Type locality, Java.

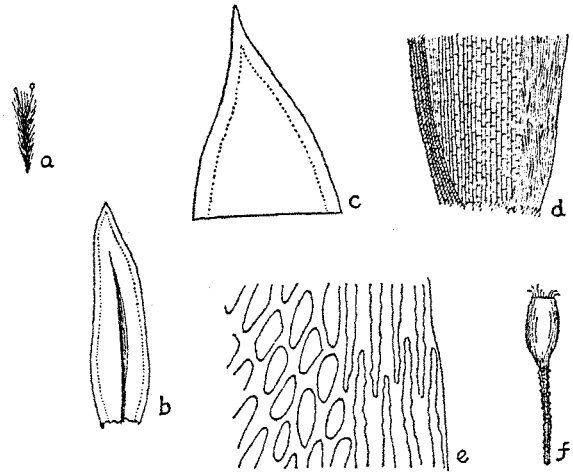


FIGURE 137. *Daltonia contorta* C. Müller: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 120; *d*, basal leaf cells and margin × 120; *e*, upper leaf cells and margin × 300; *f*, capsule × 12.

Readily distinguished from all the other Hawaiian species by the plane-margined leaves with a very broad, distinct border of elongated cells.

2. Daltonia baldwinii Brotherus, B. P. Bishop Mus., Bull. 40, p. 24, 1927 (fig. 138).

Autoicous (?). In small, dense tufts, pale green, glossy. Stems 1 to 1.5 cm. long, simple or fastigiately branched, radiculose at base, 3 to 4 mm. wide with leaves. Leaves crowded, erect-spreading, slightly shriveled and contorted when dry, carinate with a median fold in the lower half, essentially flat above, oblong-lanceolate, cuspidate, up to

3.5 mm. long by 0.8 mm. wide; margin plane, entire; costa relatively long, ending just below the apex; areolation lax with delicate, pale, pellucid walls; upper cells oval-hexagonal, 15 to 20 μ in diameter, gradually elongated and larger toward the base, the lower cells rectangular, up to 80 μ long, toward the margins linear with thickened yellowish, pellucid walls forming a distinct border 5 or 6 rows wide toward the base, about 3 rows wide above, confluent at the apex in a rather long, flexuose point. Seta 5 mm. long, reddish, smooth or minutely scabrous near the top; capsule erect, oval or pyriform, urn 1 mm. long; peristome teeth papillose; lid rostrate, 0.8 mm. long, erect; spores pale, smooth, 10 to 12 μ in diameter.

Maui: mountain ridges, on ferns, altitude 5,000 feet (Baldwin, type). Endemic. Type locality, western Maui.

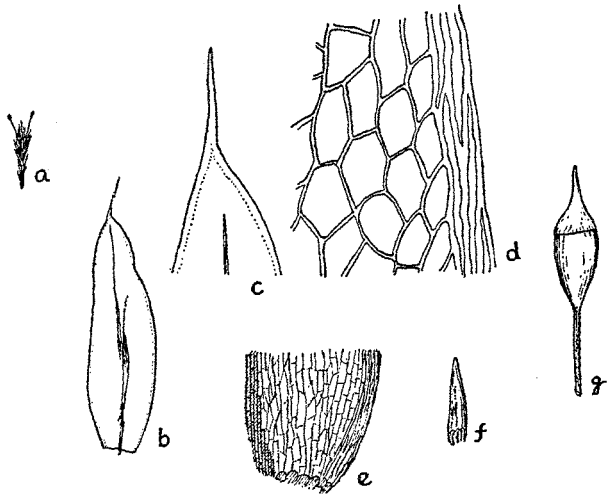


FIGURE 138. *Daltonia baldwinii* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 60; *f*, calyptra × 12; *g*, capsule × 12.

Clearly distinguished from the other three species by the lax, thin-walled leaf cells and the long costa which extends nearly to the base of the cuspidate leaf point. The spores are smaller than in any of the other associated species, but I am not sure that this character is constant enough to be of much value.

Brotherus (2, p. 25) lists *Distichophyllum cuspidatum* from western Maui on the basis of Baldwin's collection, number 118. Although this number is the same as that used for the type collection of *Daltonia baldwinii,* the label reads "mountain ravines" instead of "mountain ridges" and the date is 1875 instead of 1878. As the plants in both of these packets seem to be identical there is as yet no satisfactory evidence to support the occurrence of *Distichophyllum cuspidatum* in Hawaii.

3. **Daltonia rufescens** Brotherus, B. P. Bishop Mus., Bull. 40, p. 24, 1927 (fig. 139).

Autoicous. Glossy, yellowish green plants tinged with red, growing in small, dense tufts. Stems 1 to 3 cm. long, radiculose below, fastigiately branched, about 3 mm. wide with leaves. Leaves crowded, appressed and contorted when dry, erect-spreading when moist, carinate with a median fold in the lower half, oblong-lanceolate, short acuminate, 2 to 2.3 mm. long by 0.65 mm. wide; margin narrowly reflexed or nearly plane, entire; costa reddish, ending about four-fifths up; areolation firm, upper cells oval-rhomboidal, 7 to 9 μ wide and 15 to 24 μ long, with thick, yellowish, pellucid walls, more elongate and less incrassate toward the base, lower cells rectangular, pale, up to 40 to 50 μ long, distinctly bordered all around with linear, incrassate, deeply colored cells, about 5 rows wide at the base, 2 to 3 rows wide above. Seta 8 mm. long, dark red, smooth below, scabrous above; capsule erect, oval with a short neck, urn 1.5 mm. long, dark reddish brown; calyptra copiously fringed at base; spores brownish, papillose, 18 to 30 μ in diameter.

Maui: mountain ridges, on trunks, western part of island, altitude 5,000 feet (Baldwin, type).

Endemic. Type locality, western Maui.

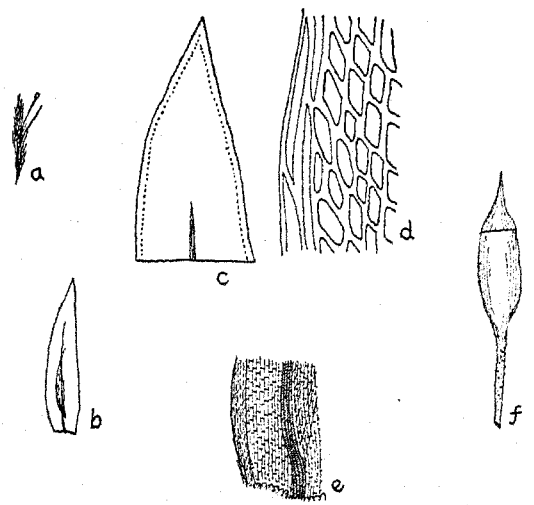


FIGURE 139. *Daltonia rufescens* Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 60; *f*, capsule × 12.

The few plants of this species that I have seen resemble *D. baldwinii* in gross appearance but under a microscope are readily separated from this species by the gradually acuminate, rather than cuspidate, leaf points, the firmer, more incrassate leaf cells, and the shorter costa.

4. Daltonia pseudostenophylla, new species (fig. 140).

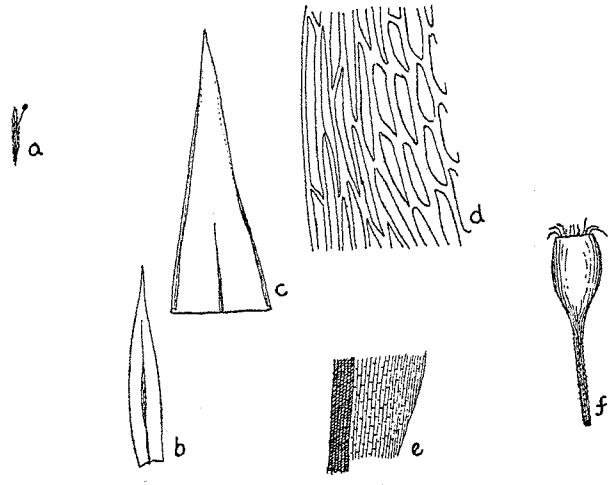


FIGURE 140. *Daltonia pseudostenophylla* Bartram: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 60; *f*, capsule × 12.

Caulis 10-12 mm. longus, circa 1.5 mm. latus cum foliis. Folia sicca adpressa, rigida, humida erecto-patentia, ad 2.2 mm. longa et ad 0.4 mm. lata; marginibus integerrimus, recurvis; nervo pallido sat longe infra apicem folii evanido; cellulis ovali-rhombodeis, pallidis, basilaribus linearibus, limbum pallidum, indistinctum, basi 7.8 seriatum, superne angustiorem efformatibus. Seta ad 4 mm. alta, rubra, superne scaberula. Theca erecta, ovalis, ad 1 mm. longa. Sporae minutissime, papillosi, 15-20 μ.

Autoicous. Slender plants in small dense tufts, pale green and glossy above, brown below. Stems 10 to 12 mm. long, sparingly radiculose below, 1.5 mm. wide with leaves. Leaves crowded, erect-appressed, rather rigid and little if any contorted when dry, erect-spreading when moist, carinate with a narrow median fold in the lower half, slightly concave above, narrowly lanceolate, acuminate, 2 to 2.2 mm. long and 0.3 to 0.4 mm. wide; margin narrowly recurved, entire; costa ending about three-fourths up; upper leaf cells narrowly oval-rhomboidal, 5 to 7 μ wide and 18 to 25 μ long, with pale firm walls, basal cells narrowly oblong to linear, blending with the elongated marginal cells; border indistinct, pale, 7 or 8 rows wide toward the base, but not clearly differentiated, 2 to 4 rows wide above and merging with the apical cells. Seta 3 or 4 mm. long, dark red, very scabrous in the upper half; capsule erect, oval with a short neck, dark reddish brown, 0.8 to 1 mm. long without the lid; calyptra copiously fringed; spores minutely papillose, 15 to 20 μ in diameter.

Type: on branches in wet forest, trail to Nakalalua swamp, western Maui, altitude 4,300 feet, February 6, 1930, E. B. Bartram, number 435.

More slender than any of the other local species, with shorter setae, narrower leaves, more elongated areolation, and a less distinct border which merges with the apical cells and the linear cells of the leaf base. It is probably nearest to *D. stenophylla* of the tropical Americas but has broader, shorter leaves and a wider border of elongated cells.

77. DISTICHOPHYLLUM Dozy and Molkenboer, Musc. Frond. ined. Archip. Ind., p. 99, 1846, in part.

Rather robust, tufted plants with procumbent, branched stems. Leaves oblong-ovate, complanate, distinctly bordered; cells hexagonal, lax at the base, smooth. Capsule horizontal; peristome double, the teeth transversely striate, furrowed along the median line; calyptra fringed.

Upper leaf cells uniform, leaves slightly undulate when dry.....**1. D. paradoxum**
Upper leaf cells large and lax toward the costa, leaves strongly contorted when dry.....**2. D. freycinetii**

1. Distichophyllum paradoxum (Montagne) Mitten, in Seeman, Fl. Vit., p. 392, 1873 (fig. 141).

Hookeria paradoxa Montagne, Voy. Bonite, Bot., p. 596, 1846, and Syll., p. 15.

Mniadelphus wawraeanus Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 574, 1877.

Distichophyllum longisetum C. Müller, Nat. Ver. Bremen, vol. 16, p. 506, 1900.

Distichophyllum hookerioides Brotherus, Bull. Soc. Bot. Ital., p. 17, 1904.

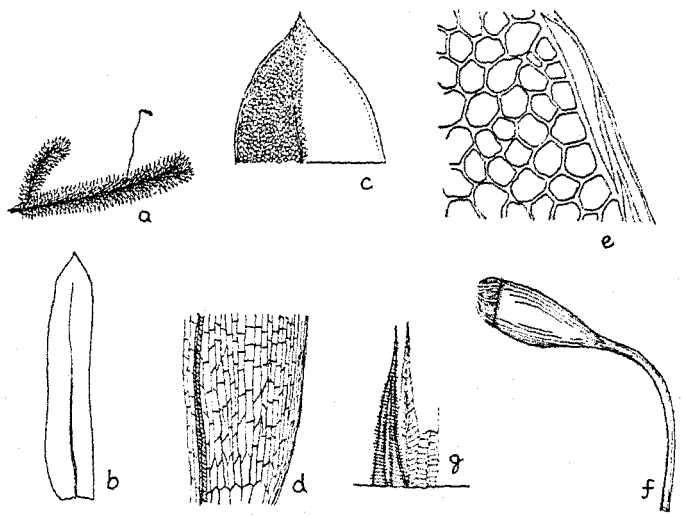


FIGURE 141. *Distichophyllum paradoxum* (Montagne) Mitten: *a*, plant × ¾; *b*, leaf × 12; *c*, apex of leaf × 60; *d*, one side of leaf base × 60; *e*, upper leaf cells and margin × 300; *f*, moist capsule × 12; *g*, part of peristome × 60.

Dioicous. Pale green or yellowish plants, glossy, growing in dense mats. Stems dark brown, up to 3 or 4 cm. long, procumbent, sparingly radiculose, simple or with scattered short branches, 4 or 5 mm. wide with leaves. Leaves complanate, the lateral

rows widely spreading, lightly contorted and undulate when dry, from an ovate-oblong, concave base slightly narrowed to an oblong limb of about equal length, short acuminate, 3 mm. long by 0.5 to 0.6 mm. wide; margin plane, usually minutely denticulate near the apex, entire below; costa slender, pale, ending well below the apex; several rows of cells across the insertion brownish, short and tumid, lower basal cells rectangular, up to 25 μ wide by 85 μ long, gradually becoming hexagonal above and extending obliquely upward along the costa to a little above the top of the leaf base, toward the margins and in the limb rounded-hexagonal with firm, pellucid walls, 15 to 20 μ in diameter, nearly uniform, bordered all around with 2 or 3 rows of pale, narrow cells. Inner perichaetial leaves about 1.5 mm. long, ecostate, not bordered, oblong-ovate, broadly rounded or minutely apiculate; seta slender, dark red, smooth or very slightly scabrous at the top, up to 2 cm. long; capsule horizontal, dark brown, oblong with a distinct neck, urn 1 to 1.5 mm. long, constricted under the mouth when dry; peristome teeth yellowish brown, broadly furrowed along the median line, finely cross-striate, strongly articulated, inner peristome pale, papillose, segments as long as the teeth; annulus none; lid conic-rostrate, 0.8 mm. long; calyptra scabrous, copiously fringed; spores brown, 6 to 8 μ in diameter.

Frequent on trees and humus in wet forests in all the larger islands.

Endemic. Type locality, Hawaii.

Apart from the differences in the leaf areolation referred to in the notes under *D. freycinetii,* the leaves of *D. paradoxum* are acuminate rather than cuspidate and are usually minutely denticulate toward the apex. As far as I can see, *Mniadelphus wawraeanus* is absolutely identical with this species.

2. **Distichophyllum freycinetii** (Schwaegrichen) Mitten, in Seeman, Fl. Vit., p. 392, 1873 (fig. 142).

Hypnum Freycinetii Schwaegrichen, Suppl. 3, pt. 2, tab. 279, 1830.
Hookeria contortifolia Montagne, Ann. Sci. Nat., p. 240, 1843.
Mniadelphus Hillebrandi C. Müller, Flora, vol. 82, p. 459, 1896.

Dioicous. Robust, in dense mats, lemon-yellow above, pale brown below. Stems procumbent, dark brown, up to 6 cm. or more long, simple or with scattered branches, densely radiculose on the under side, up to 8 or 10 mm. wide with leaves. Leaves much shriveled and contorted when dry, the lateral rows widely spreading, complanate but less so than in the preceding species, especially when dry, oblong-ovate, abruptly narrowed at the apex to a cuspidate point, up to 4 or 5 mm. long by 1.4 mm. wide, distinctly bordered all around with 2 or 3 rows of long, narrow cells; margin plane, entire; costa slender, ending well below the apex; interior cells of the leaf base hexagonal, thin-walled, about 40 μ wide, extending upward in a wide median band to or slightly beyond the end of the costa; rectangular toward the basal margins; in the upper part of the leaf hexagonal with firm, pellucid walls, progressively larger toward the costa. Inner perichaetial leaves oblong-ovate, abruptly narrowed to a short, slender acuminate point, ecostate; seta slender, smooth, 2 cm. long; capsule short, ovoid, horizontal, without a distinct neck, urn 1.5 mm. long; peristome teeth yellowish, finely cross-striate, not furrowed along the median line, segments of the inner peristome equaling the teeth, from a high basal membrane; lid and calyptra not seen; spores smooth, 10 to 12 μ in diameter.

Ground, banks, and bases of trees, in wet forests. Frequent on all the larger islands.

Endemic. Type locality, Hawaii.

More robust than *D. paradoxum* with broader, more strongly contorted leaves when dry and of a deeper yellow color. The upper leaf cells in this species are distinctly smaller and more incrassate toward the margins than in the median part of the leaf; in other words, the large lax basal cells are produced upward through the center of the leaf to the end of the costa. This characteristic areolation is in strong contrast to the uniform cell structure in the leaf of *D. paradoxum* and will distinguish the respective species without difficulty.

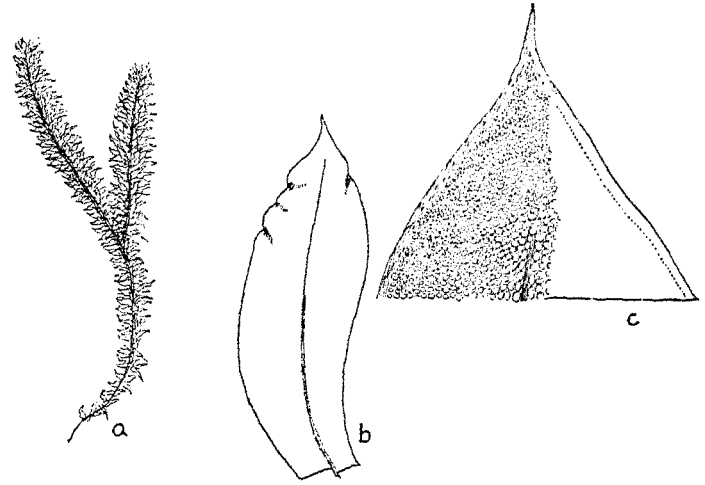


FIGURE 142. *Distichophyllum freycinetii* (Schwaegrichen) Mitten: *a*, plant × ¾; *b*, moist leaf × 12; *c*, apex of leaf × 60.

I doubt that the three varieties proposed by Müller (16) can be practically segregated with any satisfaction. The more robust forms of a bright yellow color are included in the variety *crasseturgescens*, but beyond this the forms seem too inconstant to admit of any classification.

The fruit of this species seems to be very rare. I have seen only a few over-ripe capsules. All of the peristome teeth, instead of being furrowed along the median line, show a fine zigzag line. This character, if constant, is a highly important one in connection with the striated teeth and utterly at variance with the structure of the teeth credited to the genus *Distichophyllum*.

Distichophyllum freycinetii variety **crasseturgescens** C. Müller, Flora, vol. 82, p. 458, 1896.

Mniadelphus Baldwini C. Müller, in herbaria.

Stems elongate, curved; leaves crowded, very broad, bright yellow.

Found with the type.

78. HOOKERIA Smith, Trans. Linn. Soc., vol. 9, p. 276, 1808.

Robust plants with flattened, procumbent, branched stems. Leaves large, ovate, acute, ecostate, entire, indistinctly bordered; cells hexagonal, very large.

1. **Hookeria acutifolia** Hooker, in Schwaegrichen, Suppl. 2, pt. 2, fasc. 1, p. 36, 1826 (fig. 143).
   Hookeria megablastum C. Müller, Flora, vol. 82, p. 460, 1896.

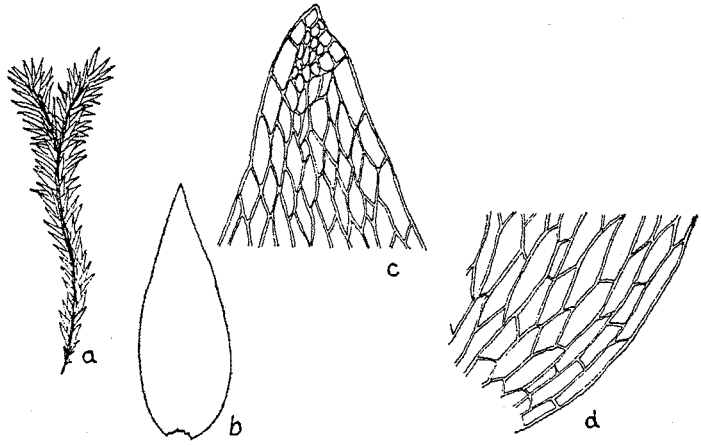


FIGURE 143. *Hookeria acutifolia* Hooker: *a*, plant × ¾; *b*, leaf × 9; *c*, apex of leaf × 60; *d*, basal angle of leaf × 60.

Autoicous. Robust, yellow-green, glossy plants in dense, extensive mats. Stems prostrate, simple or dichotomously branched, up to 6 cm. long, about 8 mm. wide with leaves, sparingly radiculose in the lower parts. Leaves crowded, complanate, the lateral row widely spreading, ovate, acute, 4 to 4.5 mm. long by 2 mm. wide, frequently with several short, cylindrical, septate propagulae growing from the apical cells which become more or less eroded and lacerate with age; margin plane, entire; costa none; leaf cells very lax, pellucid, oval-hexagonal, thin-walled, up to 50 μ wide by 175 μ long, at the margins a single row rectangular, forming a narrow, indistinct border. Sporophyte not known in Hawaii.

Very wet, shaded banks. Oahu: Waikane-Schofield trail, Koolau Range, altitude 2,000 feet (Bartram). Maui: Kula pipe line trail, northeast of Olinda (Bartram); mountain ravines, western part of island (Baldwin).

Distribution: North America, South America, India, Ceylon, Java. Type locality, Nepal.

A very distinct moss easily recognized by the complanate leaves and unusually broad, lax areolation which is large enough to be distinctly visible with an ordinary hand lens. This species is a rare fruiter and the sporophyte

does not seem to have been found, so far, in Hawaii. Agrees in every particular with *H. megablastum*.

79. HOOKERIOPSIS (Bescherelle) Jaeger, Adumb., vol. 2, p. 262, 1874-1875.

Hookeria subgenus *Hookeriopsis* Bescherelle, Ann. Sci. Nat., 1876.

Stems procumbent, flattened, often tinged with purple. Leaves complanate, oblong, obtuse, serrate above; costae two, slender, ending about two-thirds up the leaf. Seta slightly scabrous above; capsule horizontal; calyptra lobed at the base.

1. **Hookeriopsis purpurea** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 942, 1907 (fig. 144).

Hookeria purpurea C. Müller, Flora, vol. 82, p. 459, 1896.

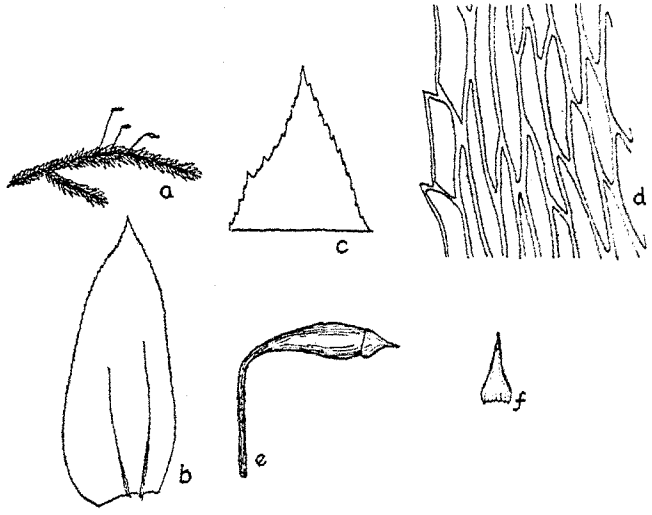


FIGURE 144. *Hookeriopsis purpurea* (C. Müller) Brotherus: a, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 60; *d*, upper leaf cells and margin × 300; *e*, capsule × 9; *f*, calyptra × 9.

Autoicous; male bud minute in the axils of the lower leaves below the perichaetium, antheridia numerous, reddish, slightly exceeded by the filiform paraphyses. Pale yellowish green plants more or less variegated with bright reddish purple, glossy. Stems up to 5 or 6 cm. long, procumbent, slightly radiculose in the older parts, irregularly branched, branches spreading, complanate, 3 mm. wide with leaves. Leaves crowded, very complanate, the lateral rows widely spreading, slightly shrunken and contorted when dry, transversely undulate when moist, ovate-oblong, broadly obtuse or rounded at the apex, slightly concave, asymmetrical, 2 mm. long by 0.8 to 0.9 mm. wide; margin erect, broadly inflexed on one side at the base, entire below, coarsely serrate in the

upper half; costae two, slender, divergent, smooth on the back, ending in a blunt spine on the back about two-thirds up the leaf; lower leaf cells firm, narrowly rectangular, 75 to 100 μ long, becoming linear toward the margins, gradually shorter upward, the upper cells hexagonal and oval-hexagonal, 10 to 14 μ wide and 2 to 4 times as long, gradually elongated toward the margins but not forming a distinct border. Inner perichaetial leaves about 1 mm. long, acute, entire, ecostate; seta 6 to 16 mm. long, slender, reddish, smooth below, scabrous above, hooked at the apex; capsule horizontal or pendent, ovoid-cylindric with a thick neck, contracted under the mouth when dry, urn 1.5 mm. long; peristome double, the teeth yellowish brown, transversely striate and broadly furrowed along the median line; inner peristome pale, papillose, basal membrane less than half the height of the teeth; annulus none; lid conic-rostrate, 0.5 mm. long; calyptra narrowly mitriform, incurved and lobed at the base; spores smooth, 12 to 18 μ in diameter.

Wet rocks. Oahu: Waikane-Schofield trail, Koolau Range, altitude 2,000 feet (Bartram); Wahiawa to headgates (Forbes); Castle trail, Pauoa Heights to Konahuanui (Forbes). Maui: mountain ravines (Baldwin). Kauai: vicinity of Kokee (Bartram).

Endemic. Type locality, Hawaii.

The upper leaf cells, in different leaves from the same stem, vary from short hexagonal to oval-hexagonal but are nearly always shorter in the extreme point and more elongated toward the margins. I cannot see that there is any correlation between the ruddy color and the more elongate areolation of the upper blade and doubt very much if there is more than one distinct insular species.

The following varieties seem worthy of remark but may prove difficult to separate clearly in a larger series of collections.

Hookeriopsis purpurea variety **ligulacea** (C. Müller), new combination.

Hookeria ligulacea C. Müller, Flora, vol. 82, p. 460, 1896.
Hookeria pallidissima C. Müller, Flora, vol. 82, p. 477, 1896.
Hookeria Hillebrandii C. Müller, Bull. Herb. Boiss., vol. 5, p. 851, 1897.

Softer and more flaccid than the type, pale yellowish green, hardly glossy, without any tinge of red.

Oahu: Waikane-Schofield trail, Koolau Range (Bartram); valleys on rocks (Baldwin). Maui: shaded ravines, western part of island (Baldwin). Molokai: Waikapu to Kamoku (Forbes).

Hookeriopsis purpurea variety **acuminatula** (C. Müller), new combination.

Hookeria acuminatula C. Müller, Flora, vol. 82, p. 478, 1896.

Leaves acute or short acuminate; costae ending about mid-leaf.

Maui: western part (Baldwin).

Family 27. HYPOPTERYGIACEAE

Gregarious, rather flaccid plants with erect, branched secondary stems from a creeping primary stem. Leaves dimorphous, the normal leaves lateral in two rows, complanate, bordered, ovate, serrate above; costa single, ending about two-thirds up the leaf; upper cells hexagonal, smooth; amphigastria on the ventral side of the stem, much smaller than the lateral leaves, long acuminate. Seta elongate; capsule horizontal; peristome double, the teeth striate, not furrowed along the median line; calyptra cucullate, naked.

80. HYPOPTERYGIUM Bridel, Bryol. Univ., vol. 2, p. 709, 1827.

Frondose plants with the characters of the family.

1. **Hypopterygium sandwicense** Brotherus, B. P. Bishop Mus., Bull. 40, p. 25, 1927 (fig. 145).

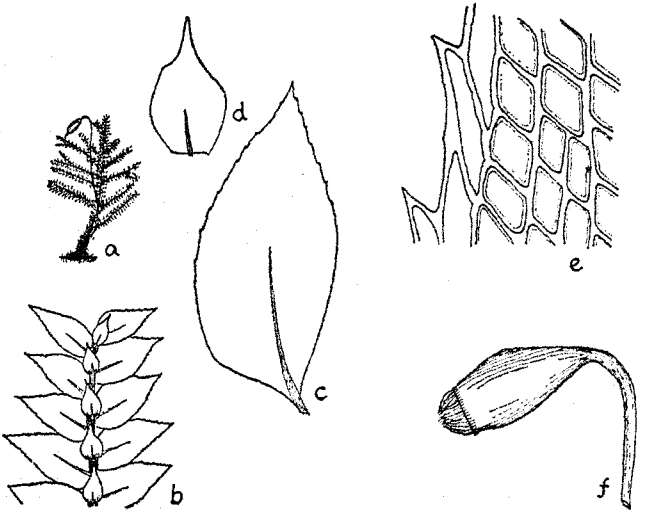


Figure 145. *Hypopterygium sandwicense* Brotherus: *a*, plant × ¾; *b*, part of branch × 9; *c*, lateral leaf × 25½; *d*, amphigastrial leaf × 25½; *e*, upper leaf cells and margin × 200; *f*, capsule × 9.

Autoicous. Gregarious, yellowish green, frondose plants, slightly glossy. Primary stems elongate, creeping, densely brown tomentose; secondary stems erect, up to 3 cm. high, brown tomentose at base, pinnately and bipinnately branched above, branches up to 1 cm. long, spreading, about 4 mm. wide with leaves, blunt at the tips; lower stem leaves scale-like, appressed, leaves of the upper part of the stem and the branches flattened in one plane, slightly convex and little shrunken when dry, asymmetrical, ovate, short acuminate, 2 mm. long by 1 mm. wide; margin plane, serrate in the upper half, entire below; costa pale, thin, ending one-half to two-thirds up the leaf; upper leaf

cells oval-hexagonal, about 15 μ wide and 35 to 45 μ long, thin-walled, rather pellucid; juxta-costal cells toward the base larger, up to 85 μ long; distinctly bordered from the base to just below the apex with 1 or 2 rows of linear cells with faintly sinuose lateral walls; amphigastria much smaller, broadly ovate, abruptly subulate-acuminate, about 1.2 mm. long, costa ending near mid-leaf. Inner perichaetial leaves erect, entire, ecostate, slenderly acuminate from an oblong, clasping base; seta about 15 mm. long, reddish brown, hooked at the top; capsule horizontal to pendulous, oval-oblong, brown, slightly constricted under the mouth, urn 3 mm. long; annulus none; lid long rostrate, 2 mm. long; calyptra cucullate, smooth.

Trees in wet forests. Maui: mountain ravines, western part of island, altitude 4,700 feet (Baldwin, type); Nakalalua swamp, Puu Kukui, altitude 4,500 feet (Bartram).

Endemic. Type locality, western Maui.

The frondose habit and the ventral row of small leaves (amphigastria) distinguishes this species at a glance. It is apparently rare and local. The plants I collected in Nakalalua swamp are smaller than those of the type collection but agree perfectly in all other particulars.

Family 28. FABRONIACEAE

Slender, microphyllous plants growing in thin mats on trees or rocks. Leaves minute, long acuminate; costa slender, ending about two-thirds up the leaf; cells smooth, the upper rhomboidal, quadrate at the basal angles. Capsule minute, erect, on a short seta; peristome single, of 16 teeth in 8 pairs, inserted below the rim.

81. FABRONIA Raddi, Atti Acad. Sci. Siena, vol. 9, p. 230, 1808.

Delicate plants with filiform stems and minute leaves having the characters of the family.

1. **Fabronia degeneri,** new species (fig. 146).

Autoica, dense caespitulosa, subsericea. Folia sicca erecta, madida patentissima, ovata, in acumen angustum, subulatum contracta, superne denticulata, costa ultra medium evanida, cellulis rhombeis, alaribus quadratis. Capsula in pedicello pallido, minuta, ovata, operculo conico; peristomii dentes bigeminati, brunnei, papilloso-striati; sporae papillosi, 15-18 μ.

Autoicous. Extremely slender, delicate plants growing in dense, intricate silky mats, olivaceous or yellowish green, glossy. Stems prostrate, about 1 cm. long, radiculose here and there, densely branched, branches 3 to 5 mm. long, ascending, closely matted together. Leaves minute, appressed, with slightly spreading points when dry, erect-spreading when moist, long and slenderly acuminate from an ovate, slightly concave base, up to 0.7 mm. long by 0.2 mm. wide; margin plane, entire below, sharply denticulate above by the projecting marginal cells; costa ending about two-thirds up the leaf; upper leaf cells rhomboidal, 7 to 8 μ wide and 4 to 6 times as long, the marginal row shorter and obliquely rectangular, at the basal angles quadrate, extending to the costa and obliquely up the margins. Perichaetium radiculose, the inner leaves erect,

laxly areolate, ecostate, sharply and irregularly toothed, about 0.8 mm. long; seta 2 to 3 mm. long, pale, erect or slightly curved; capsule erect, short ovoid, urn 0.5 to 0.7 mm. long, pale brown, exothecial cells with thin, very sinuose walls, several rows around the mouth much smaller, reddish, stomata large, superficial, near the base of the urn; peristome teeth paired, brownish, slightly split at the apex, inserted below the rim, about 75 μ high by 35 μ wide, transversely papillose-striate on the outer face, vertically and obliquely striate on the inner face; lid conic, acute, 0.3 mm. long; spores greenish, coarsely papillose, 15 to 18 μ in diameter.

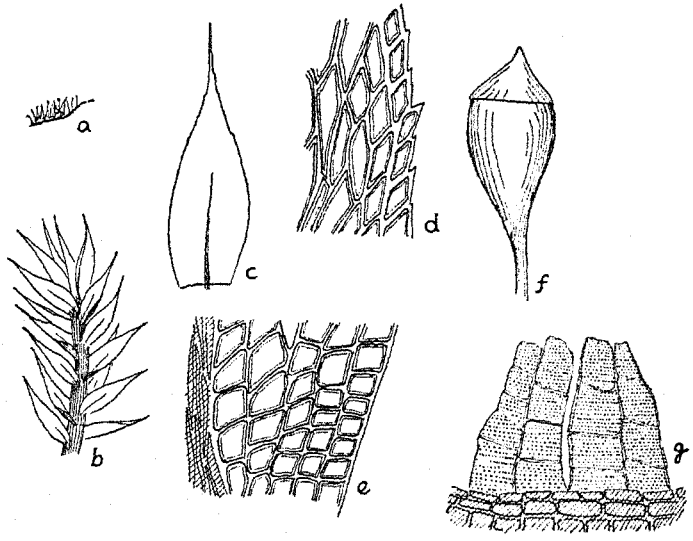


FIGURE 146. *Fabronia degeneri* Bartram: *a*, plant × ¾; *b*, part of branch ×25½; *c*, leaf × 60; *d*, upper leaf cells and margin × 300; *e*, one side of leaf base × 300; *f*, moist capsule × 25½; *g*, part of peristome × 300.

Type: rocks in kukui forest, valley west of East Ohia, Molokai, July 16, 1928, Otto Degener and Henry Weibke, number 3048.

An extremely delicate species with silky, thread-like stems and minute fruit, barely visible to the naked eye. Degener's collection is the first record of this genus in the Hawaiian islands, and though the plants are closely allied to two species known to occur in Java, the differences appear to be sufficiently well marked and constant enough to constitute a distinct endemic species. The sharply denticulate leaves separate it from *F. Nietneri* C. Müller, which it resembles in the sporophyte characters, and the smaller, shorter capsule and short, conic lid, are equally distinctive as compared with *F. curvirostris* Dozy and Molkenboer. As a matter of fact, the Hawaiian plants seem to combine the vegetative characters of *F. curvirostris* with the sphorophyte characters of *F. Nietneri.*

FAMILY 29. THUIDIACEAE

Small or robust plants with branched stems and more or less abundant paraphyllia. Branch leaves short, often concave; costa single; cells rounded, papillose; stem leaves usually differentiated, frequently long acuminate and more or less plicate. Capsule erect or curved; peristome double, hypnoid in structure; calyptra cucullate.

1. Stem and branch leaves similar, not clearly differentiated.....2
   Stem and branch leaves clearly differentiated.....84. **Thuidium**
2. Very slender plants, costa ending below mid-leaf.....82. **Haplohymenium**
   More robust, costa percurrent or nearly so.....83. **Claopodium**

82. HAPLOHYMENIUM Dozy and Molkenboer, Ann. Sci. Nat., vol. 2, p. 310, 1844.

Very slender creeping plants with terete, wiry stems and extremely brittle leaves; costa short; cells rounded, papillose. Capsule erect, exserted.

1. **Haplohymenium triste** (Cesati) Kindberg, Rev. Bryol., p. 25, 1899 (fig. 147).
   Leskea tristis Cesati, De Not. Syllab. Musc., p. 67, 1838.

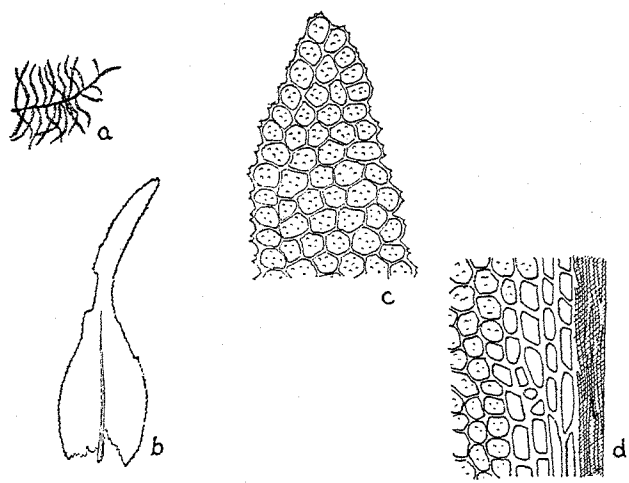


FIGURE 147. *Haplohymenium triste* (Cesati) Kindberg: *a*, plant × ¾; *b*, leaf × 60; *c*, apex of leaf × 300; *d*, juxta-costal leaf cells at base × 300.

Dioicous. Extremely slender, wiry plants, growing in loose intricate mats, yellowish or sordid green, not at all glossy. Stems creeping, filiform, 1 to 2 cm. long, with small scattered tufts of radicles, pinnately branched, branches ascending, flexuose and

curved, blunt, up to 6 or 7 mm. long, terete foliate, barely 0.25 mm. wide with leaves when dry. Leaves closely appressed when dry, erect-spreading when moist, abruptly linear-ligulate from a short, oblong, concave base, extremely brittle, 0.6 to 0.8 mm. long, blunt at the apex; margin coarsely crenulate all around with the protuberant, papillose cells; costa narrow, yellowish, obscure, ending near the top of the expanded base; upper leaf cells rounded-hexagonal, about 12 μ in diameter, thin-walled, turgid, verrucose-papillose with 4 to 6 salient papillae over the lumens; lower cells similar but more transversely oval, especially toward the basal margins, at the extreme base a few juxtacostal cells linear and smooth.

Maui: east of Ukulele, Haleakala (Forbes); Iao Valley, dry ledges (Bartram).

Distribution: Europe, Asia, India, China, Japan, North America. Type locality, Italy.

The brittle strap-shaped leaves with large papillose cells, bulging on the margins, will identify this moss at once.

83. CLAOPODIUM (Lesquereux and James) Renauld and Cardot, Musc. Am., sep., p. 50, 1893.

Hypnum subgenus *Claopodium* Lesquereux and James, Manual, p. 327, 1884.

Slender rupestrine plants growing in mats. Stems prostrate, irregularly branched. Leaves small, crisped when dry, serrulate; costa single, percurrent or nearly so; cells rounded-hexagonal, papillose. Capsule horizontal; peristome double.

Leaf cells uniform, marginal row not different.....**2. C. amblystegioides**
Marginal row of cells elongated, smooth.....**1. C. hawaiiense**

1. Claopodium hawaiiense R. S. Williams, Bull. Tor. Bot. Club, vol. 42, p. 576, 1915 (fig. 148).

Dioicous. Slender plants growing in thin mats, yellowish green above, brown below. Stems prostrate, irregularly branched, 1 cm. or less long, smooth, slightly radiculose in the older parts. Leaves about 0.5 mm. long, ovate-lanceolate, flexuose-spreading with incurved points, complanate, slightly secund, especially at the tips of the branches; margin plane, serrulate all around; costa pale, about 16 μ wide at the base, smooth, indistinct in the acumen, percurrent or slightly excurrent. Upper leaf cells rhomboidal, thin-walled, 5 to 6 μ wide and 14 to 18 μ long, papillose on both sides with a single salient papilla over the lumen, the marginal row elongated and smooth, about 2 or 3 μ wide and 8 to 10 times as long, basal cells rectangular or linear-rhomboidal, usually papillose but frequently smooth in the stem leaves. Perichaetial leaves erect, loosely clasping, smooth, oblong-lanceolate, the inner 1.5 to 1.75 mm. long with linear, flexuose, denticulate points; seta pale brown, scabrous throughout, 10 to 12 mm. long, flexuose; capsule horizontal or sub-penduous, oblong, pale brown, 1 to 1.5 mm. long, exothecial cells collenchymatous, constricted under the mouth when dry; peristome teeth yellow, finely cross-striate below, papillose above, inner peristome pale, papillose, basal membrane more than half the height of the teeth, segments keeled and split along the median line, cilia 1 or 2, nodose, slightly shorter than the segments; lid conic, acute, 0.75 mm. high; spores minutely papillose, about 10 μ in diameter.

Oahu: Honolulu (Leiberg, type). Maui: east of Ukulele, Haleakala (Forbes).

Endemic. Type locality, Honolulu, Oahu.

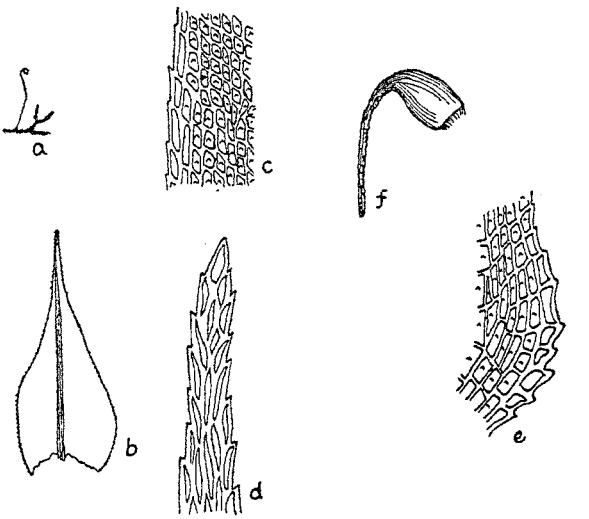


FIGURE 148. *Claopodium hawaiiense* R. S. Williams: *a*, plant × ¾; *b*, leaf × 60; *c*, upper leaf cells and margin × 300; *d*, apex of leaf × 300; *e*, basal angle of leaf × 300; *f*, capsule × 9.

This and the following species may be recognized by the slender, wiry stems and minute, laxly imbricated leaves with the costa ending in the apex. Fruit is produced sparingly, but when present the rough setae in connection with the slender stems and sharply papillose leaf cells will assist materially in locating the plants.

2. **Claopodium amblystegioides** Dixon, Proc. Linn. Soc. New South Wales, vol. 55, pt. 3, p. 291, 1930 (fig. 149).

Dioicous. Slender plants growing in thin, dark green mats, brown below. Stems wiry, prostrate, irregularly or sub-pinnately branched, 1 to 2 cm. long, smooth, applied to the substratum by numerous tufts of reddish radicles in the older parts. Leaves 0.5 to 0.6 mm. long, laxly imbricated, ovate-lanceolate, more broadly pointed than in the previous species, crisply flexuose when dry, erect-spreading when moist, not at all complanate; margin plane, serrulate all around; costa pale, about 25 μ wide at base, slightly papillose on the back, ending just below the apex. Leaf cells rounded-hexagonal, thin-walled, 5 to 7 μ in diameter, unipapillate on both sides over the lumens, nearly uniform throughout the leaf, a few juxta-costal cells at the extreme base slightly elongate but scarcely differentiated. Fruit unknown.

Maui: Honokohau ditch trail, damp rocks (Bartram); rocks in ravine near Punalau (Bartram).

Distribution: Fiji. Type locality, Fiji.

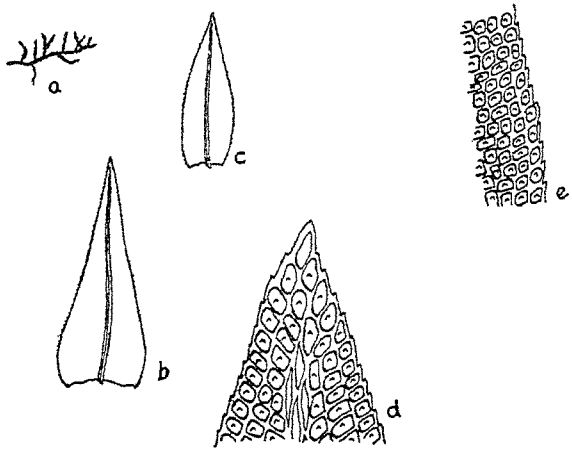


FIGURE 149. *Claopodium amblystegioides* Dixon: *a*, plant × ¾; *b*, upper stem leaf × 60; *c*, branch leaf × 60; *d*, apex of branch leaf × 300; *e*, upper leaf cells and margin × 300.

Resembling *C. hawaiiense* but darker in color, with more crisped leaves which are broader in the point and spreading in all directions when moist, a stronger costa ending below the apex, and a more uniform dense areolation of short hexagonal cells without any differentiated marginal row. It will be interesting to compare the sporophyte characters of the two plants when the fruit of *C. amblystegioides* is available.

84. THUIDIUM Bruch and Schimper, Bryol. Eur., fasc. 49-51, 1852.

Slender or robust plants with bipinnately or tripinnately branched stems, paraphyllia abundant. Branch leaves and stem leaves differentiated; costa single, cells rounded, papillose. Capsule often large, curved; peristome well-developed.

1. Slender plants, stem leaves not plicate.....2
   Robust plants, stem leaves plicate.....3
2. Seta smooth, perichaetial leaves not ciliate.....**1. T. crenulatum**
   Seta rough above, perichaetial leaves ciliate.....**2. T. nanophyllum**
3. Costa of stem leaves ending below the apex.....**3. T. plicatum**
   Costa of stem leaves ending in a long, filiform point.....**4. T. hawaiiense**

1. **Thuidium crenulatum** Mitten, in Seeman, Fl. Vit., p. 402, 1873 (fig. 150).

Autoicous. Very slender, minute-leaved, wiry plants growing in thin, intricate mats, yellowish green. Stems prostrate, up to 1 to 1.5 cm. long, densely bipinnately branched, primary branches widely spreading, 3 or 4 mm. long, paraphyllia small, usually simple

and of a single row of 3 or 4 cells. Leaves all strongly crisped with incurved points when dry, spreading when moist; stem leaves triangular-ovate from a broadly cordate base, short acuminate, concave, scarcely or not at all plicate, 0.5 mm. long by 0.4 mm. wide, margin narrowly recurved below, plane above, coarsely crenulate-papillose all around, costa ending well below the apex, papillose on the back, cells rounded-hexagonal, about 6 μ in diameter, with 1 to 3 papillae over the lumens; branch leaves ovate, bluntly acute, carinate, up to 0.4 mm. long, margin crenulate-papillose all around, end cell of the apex with 2 or 3 papillae; costa ending below the apex, cells obscure, thin-walled, papillose. Inner perichaetial leaves filiform-acuminate from an oblong base, about 1.8 mm. long, margins denticulate, not ciliate; seta smooth, reddish, up to 2 cm. long; capsule inclined or horizontal, oval-oblong, reddish brown, urn about 1.2 mm. long; peristome yellowish; lid rostrate from a convex base, 0.9 mm. long.

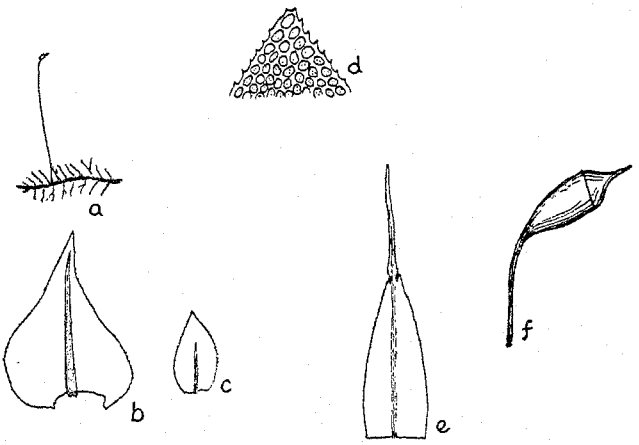


FIGURE 150. *Thuidium crenulatum* Mitten: *a*, plant × ¾; *b*, stem leaf × 60; *c*, branch leaf × 60; *d*, apex of branch leaf × 300; *e*, perichaetial leaf × 25½; *f*, capsule × 9.

Maui: mountain ridges in western part of island, on ground, altitude 2,000 feet (Baldwin); Haleakala (?). Island of Hawaii: woods, Kona (Mann and Brigham).

Endemic. Type locality, Hawaii.

A minute species that seems to be rare but may easily be overlooked on account of its small size.

2. Thuidium nanophyllum C. Müller, Flora, vol. 82, p. 476, 1896.

Closely resembling the preceding species but distinguished from it, according to Brotherus, by the seta rough at the apex and the ciliate inner perichaetial leaves.

The distinctions between this and the preceding species are far from clear in my mind. Müller describes the perichaetial leaves as minutely denticulate and the seta as smooth, both of which characters agree with *T. crenu-*

latum, but Brotherus (5) has placed *T. nanophyllum* among the species characterized by the seta rough above and the perichaetial leaves ciliate. The only specimen of *T. nanophyllum* I have seen (Skottsberg, no. 1566) is from Bird Park, Kilauea, named by Brotherus. The setae are smooth, as far as I can see, and the perichaetial leaves merely denticulate; in other words, the plant is inseparable from *T. crenulatum*. Müller (16, p. 476) seems to have been unaware of either of the species described by Mitten (12), as he makes no reference to them. There is nothing in the original description of *T. nanophyllum* to distinguish it from *T. crenulatum*.

3. **Thuidium plicatum** Mitten, in Seeman, Fl. Vit., p. 402, 1873 (fig. 151).

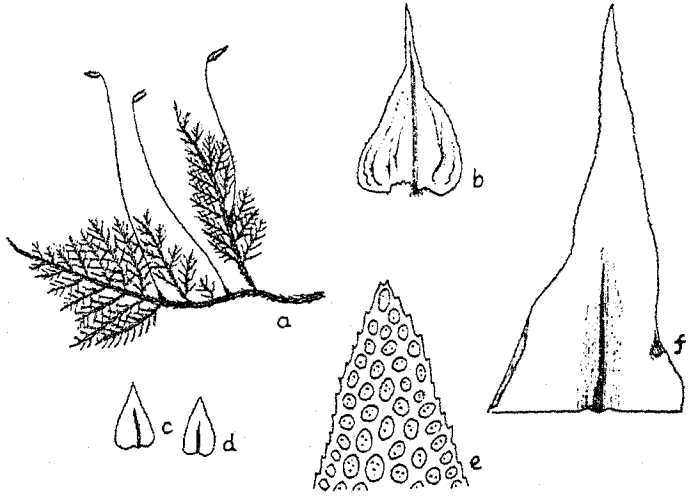


FIGURE 151. *Thuidium plicatum* Mitten: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, *d*, branch leaves × 25½; *e*, apex of branch leaf × 300; *f*, apex of stem leaf × 120.

Dioicous. Robust plants growing in large intricate mats, yellowish green in the younger parts, reddish brown below. Stems elongated, up to 10 cm. or more long, tripinnately branched, densely paraphyllose, branches complanate, gradually shorter upward giving the frond-like stem a lanceolate outline, the ultimate branchlets slender and attenuated. Stem leaves from a broadly cordate base rather quickly contracted to a sharp acumen of variable length, deeply plicate, loosely appressed with incurved points when dry, erect-spreading when moist, up to 1.7 mm. long by 1 mm. wide; margin denticulate, plane in the acumen, narrowly revolute below; costa stout, yellowish, ending in the acumen some distance below the apex; leaf cells short, rounded or angular, incrassate, papillose, 6 to 8 μ in diameter, quite uniform except at the extreme base, where several rows across the insertion are short linear, pitted and yellow or reddish brown; leaves of the ultimate branches much smaller, broadly ovate, acute, concave, 0.25 to 0.3 mm. long; margin erect, denticulate; costa ending about two-thirds up the leaf, more or less pectinate on the back; cells oval or rounded, very incrassate, with several small sharp papillae over the lumens, the apical cell blunt with 2 or 3 projecting papillae.

Inner perichaetial leaves 4 or 5 mm. long, from an erect, narrowly oblong, slightly plicate base, gradually narrowed to a long, slender, flexuose, denticulate point; margins sparsely ciliate or often with the cilia poorly developed or wanting; seta 2.5 to 6.5 cm. long, red, smooth; capsule large, greenish or reddish brown, arcuate, urn up to 3.5 mm. long, contracted under the mouth when dry; peristome yellowish, teeth 0.7 mm. long; annulus large; spores yellow, smooth, 10 μ in diameter.

Trees, rocks, and banks, in shaded places. Oahu: Puu Kaala, altitude 3,500 feet (St. John); Palehua, in forest, Waianae Mountains (Skottsberg). Molokai: west of Pepeopae, rain-forest (Degener). Maui: Kula pipe line trail, northeast of Olinda (Bartram); trail to Nakalalua swamp (Bartram); Honokohau drainage basin (Forbes); east of Ukulele, Haleakala (Forbes). Island of Hawaii: vicinity of Kilauea, common (Bartram). Kauai: Wainiae (Seale); vicinity of Kokee (Bartram).

Endemic. Type locality, Hawaii.

This and the following species will be recognized at sight by the elongated, lacy fronds. The two species are very much alike in general appearance but can be separated by the characters of the stem leaves. In *T. plicatum* the point of the stem leaf, even when slender and attenuated, is composed of short, papillose cells similar to those of the lamina, and the costa clearly ends in the acumen some distance below the apex, whereas in *T. hawaiiense* the costa is prolonged in a long, filiform point composed of a single row of 10 to 15 elongated, smooth, nearly hyaline cells.

This species resembles *T. glaucinoides* and *T. glaucinum* of the Indo-Malayan regions but seems to be distinct from both in the deeply plicate or sulcate stem leaves, the ciliate inner perichaetial leaves, and the small sharp papillae of the branch leaves. I am inclined to think that any local records of *T. glaucinum,* if traced back to their source, would prove to be based on some of the forms of *T. plicatum.*

Thuidium plicatum variety **brevifolium,** new variety.

Minoribus, rami brevioribus, rigidioribus; folia caulina brevioribus, ad 1 mm. longa, breviter et lata acuta.

Smaller throughout; branches shorter, more rigid; stem leaves less than 1 mm. long with short, blunt points. Fruit unknown.

Maui: trail to Nakalalua swamp, on tree (Bartram). Island of Hawaii: shaded ledges, Bird Park, Kilauea (Bartram, no. 281-b, type).

4. **Thuidium hawaiiense** Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 579, 1877 (fig. 152).
Hypnum cymbifolium Sullivant, U. S. Expl. Exped., Musci, p. 17, 1859.
Tamariscella cymbifolia C. Müller, Flora, vol. 82, p. 476, 1896.

Very similar in general appearance to the preceding species but usually of a brighter green color and inclined to be rather more slender. Stem leaves from a broadly cordate base rapidly narrowed to a very long, filiform point composed of a single row of numerous, linear, smooth, nearly hyaline cells, less deeply plicate; costa excurrent and merging with the elongated cells of the point. Perichaetial leaves copiously fringed with long, flexuose, articulated cilia; capsule larger, urn about 4 mm. long.

Shaded ledges and banks. Oahu: upper slopes of Tantalus (Bartram); Waikane-Schofield trail, Koolau Range (Bartram); Puu Kaala, Waianae Mountains (St. John); top of Mount Kaala (Degener). Molokai: Deer trail, Waikapu (Forbes). Maui: Honokohau ditch trail (Bartram); trail to Nakalalua swamp (Bartram). Island of Hawaii: slopes of Mauna Loa (Miss Reed). Kauai: Hii Mountains (Forbes); vicinity of Kokee (Bartram).

Endemic. Type locality, Hawaii.

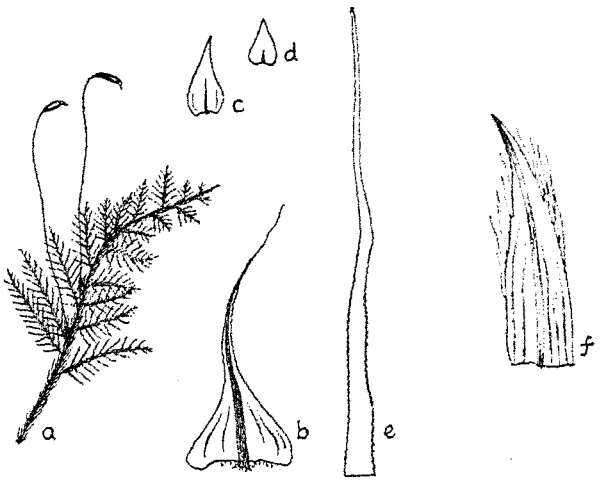


FIGURE 152. *Thuidium hawaiiense* Reichardt: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, *d*, branch leaves × 25½; *e*, apex of stem leaf × 120; *f*, inner perichaetial leaf × 12.

After the relative differences between the stem leaves of this and the preceding species have been established there will be no difficulty in separating them. In addition to the filiform points of the stem leaves the upper leaf cells in this species are more elongated and nearly or quite smooth; in fact, the areolation of the stem leaves throughout is less incrassate than in *T. plicatum*.

T. cymbifolium (Dozy and Molkenboer) is a closely related species but may be separated at once by the nearly smooth costa and the salient, curved papillae of the branch leaves. I have found no evidence to support the record of *T. cymbifolium* in Hawaii.

Family 30. BRACHYTHECIACEAE

Slender or robust plants with procumbent, irregularly branched stems, growing in mats. Leaves usually erect-spreading, often plicate; costa single, ending above mid-leaf; cells usually linear, more lax below, often sub-rectangular at the basal angles. Seta elongate, smooth or scabrous; capsule usually curved and horizontal, seldom erect; lid conic or rostrate; peristome double, teeth striate or papillose, cilia usually well-developed.

1. Capsule erect 2
   Capsule inclined or horizontal 3
2. Leaves plicate, large plants, seta smooth ..... **85. Pleuropus**
   Leaves not plicate, small plants, seta rough ..... **88. Rhynchostegiella**
3. Lid conic ..... **86. Brachythecium**
   Lid rostrate ..... **87. Eurhynchium**

85. PLEUROPUS Griffith, Not., p. 468; Icon. Pl. Asiat., pt. 2, tab. 90, 1849.

Large plants with laxly procumbent stems, sub-pinnately or irregularly branched. Leaves ovate-lanceolate, plicate; costa ending near base of acumen; upper cells rounded to linear, incrassate, smooth. Seta slender, elongate; capsule erect, sub-cylindric; peristome double, teeth papillose, segments of inner peristome fragile; lid rostrate; spores large.

1. **Pleuropus wilkesianus** (Sullivant) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 1138, 1908 (fig. 153).
   Hypnum Wilkesianum Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 73, 1854.
   Meteorium pallido-virens C. Müller, vol. 82, p. 464, 1896.
   Leucodon sandwichensis C. Müller, Flora, vol. 82, p. 465, 1896.
   Palmocladium sciurellum C. Müller, Flora, vol. 82, p. 466, 1896.
   Palmocladium aptychoides C. Müller, Nat. Ver. Bremen, vol. 16, p. 508, 1900.
   Palmocladium angustirete Brotherus, Bull. Soc. Bot. Ital., p. 21, 1904.
   Palmocladium longipes Brotherus, Bull. Soc. Bot. Ital., p. 21, 1904.
   Palmocladium pulchellum Brotherus, Bull. Soc. Bot. Ital., p. 21, 1904.
   Palmocladium spiripes Brotherus, Bull. Soc. Bot. Ital., p. 21, 1904.

Dioicous. Large, exceptionally variable plants growing in rather loose, extensive mats, pale yellowish green in the younger parts, brown or black below, glossy. Stems from a few to 20 cm. long, procumbent, flexuose, sub-pinnately branched, branches procumbent or ascending, up to 4 or 5 cm. long, often longer, usually attenuate at the tips or very slender and flagelliform. Leaves crowded, rather loosely erect-spreading or slightly appressed, with 3 or 4 distinct longitudinal plicae especially evident when dry, ovate-lanceolate, long and slenderly acuminate or shorter pointed, deeply excavate at the base on both sides of the costa, lightly auriculate, up to 4 mm. long by 0.8 mm. wide; margin denticulate all around, very narrowly recurved on one or both sides at the base;

plane above; costa slender, ending near the base of the acumen; leaf cells incrassate, smooth, oval or rounded in the short-leaved forms, linear in the long-leaved forms, pitted, more elongated downward, several rows across the insertion shorter with sinuose walls, a few cells at the basal angles short rectangular but not forming a distinct group. Sporophyte from the lower parts of the branches; inner perichaetial leaves erect, with long, flexuose, filiform, denticulate points; seta slender, flexuose, smooth, bright red at the base, paler above, 2.5 to 7 cm. long; capsule erect, ovoid-cylindric, urn up to 2.5 mm. long, contracted under the mouth when dry, becoming dark brown with age; peristome double, the teeth erect, linear-lanceolate, yellowish, about 450 μ high, densely papillose on both surfaces, with a zigzag median line and 30 to 35 articulations; inner peristome free, the segments very fragile, usually shorter than the teeth, linear, keeled, with very irregular, scalloped edges, pale yellow, densely papillose, basal membrane rudimentary, slightly less than half the height of the teeth, very fragile, irregularly split or perforated in vertical lines corresponding with the edges of the segments, cilia none; annulus narrow; lid long rostrate from a conic base, erect or slightly oblique, up to 2 mm. long; spores pale yellow, slightly papillose, about 30 μ in diameter.

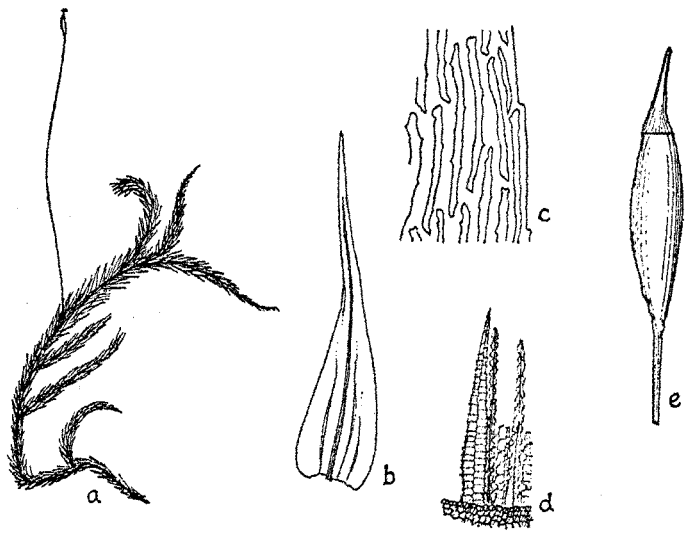


FIGURE 153. *Pleuropus wilkesianus* (Sullivant) Brotherus: *a*, plant × ¾; *b*, leaf × 12; *c*, upper leaf cells and margin × 300; *d*, part of peristome × 60; *e*, capsule × 9.

Frequent on ledges, trees, and banks, in moist shady places. Widely distributed over all the larger islands.

Endemic. Type locality, island of Hawaii.

As scarcely any two tufts of this variable species are alike, no practical object will be served by attempting to describe them in detail. Roughly speaking, the forms may be divided into two groups: one, which, as I interpret it, represents the typical form of the species, with erect-spreading, long-pointed leaves with narrow cells; the other, which I have segregated as variety *sciuroides,* with shorter-pointed, more rigidly erect leaves with short

cells. The twilight zone between these widely divergent forms is rather wide, and I doubt if there is any sharp line of demarcation.

The list of synonyms will indicate how perplexing this species has been from a taxonomic standpoint. Plants from the type collection of *Leucodon sandwichensis,* which I have seen, can certainly be included here, as can also number 25, Mann and Brigham, which was referred to *Meteorium miquelianum* by Brotherus.

In spite of its polymorphic tendencies, this species as a composite whole is not difficult to recognize. The plicate leaves and a peculiar translucent green of the younger parts, tinged with various shades of brown below, form an ensemble that soon becomes familiar in the field. *Trachypodopsis ornans* has a similar leaf structure but will be easily distinguished by the bright rufous color and the large inrolled auricles of the leaf base.

The fruit is not rare; when present, the long, filiform setae and erect capsules are very distinctive. As a rule the smaller plants with appressed leaves are found in relatively drier habitats, but I am not sure that the variations are entirely the result of environmental conditions.

Pleuropus wilkesianus variety **sciuroides** (C. Müller), new combination (fig. 154).

Meteorium sciuroides C. Müller, Flora, vol. 82, p. 463, 1896.

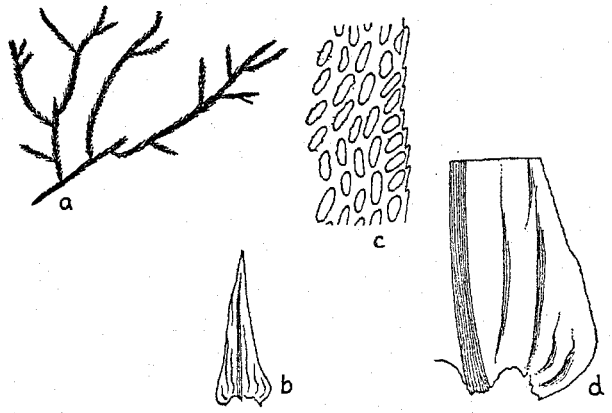


FIGURE 154. *Pleuropus wilkesianus* variety *sciuroides* (C. Müller) Bartram: *a,* plant × ¾; *b,* leaf × 12; *c,* upper leaf cells and margin × 300; *d,* one side of leaf base × 60.

Less robust than the typical form, branches shorter, seldom attenuate; leaves shorter and more rigidly appressed, more strongly plicate and often with larger, rounded auricles at the basal angles; leaf cells short, oval, not or hardly pitted. Setae usually shorter.

Frequent and distributed with the typical form but usually in drier situations.

86. BRACHYTHECIUM Bruch and Schimper, Bryol. Eur., fasc. 52-54, 1853.

Medium-sized plants, stems usually procumbent, irregularly branched. Leaves ovate-lanceolate, smooth or plicate; costa ending above mid-leaf; upper cells linear, more lax below. Seta smooth or scabrous; capsule curved, inclined or horizontal; peristome as in *Hypnum;* lid conic, short.

1. Leaves plicate.....2
   Leaves not plicate.....3. B. oxyrrhynchium
2. Seta smooth, leaves long acuminate.....1. B. lamprocarpum
   Seta scabrous, leaves short acuminate.....2. B. rutabulum

1. Brachythecium lamprocarpum (C. Müller) Jaeger, Adumb., vol. 2, p. 387, 1876-1877 (fig. 155).

Hypnum lamprocarpum C. Müller, Syn., vol. 2, p. 359, 1851.

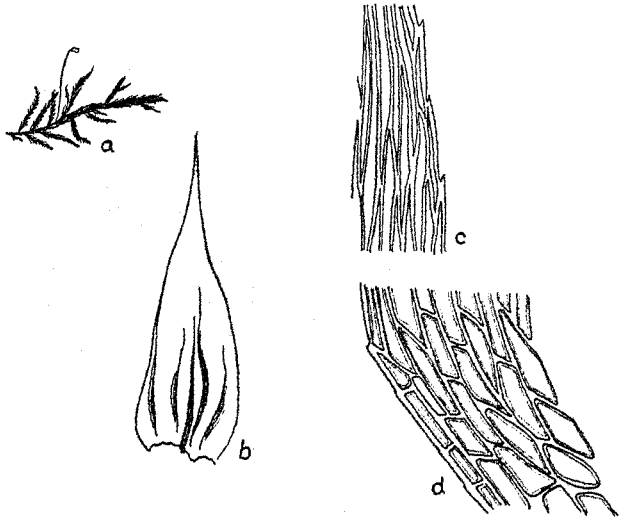


FIGURE 155. *Brachythecium lamprocarpum* (C. Müller) Jaeger: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300.

Autoicous. Plants in extensive, pale glossy green mats, dark brown below. Stems 3 cm. or more long, rather densely and irregularly branched, branches somewhat terete, scarcely flattened, acute. Leaves crowded, appressed, with flexuose tips, lanceolate, up to 1.6 mm. long by 0.5 mm. wide, strongly plicate; margin plane, entire below, denticulate toward the apex; costa slender, ending about mid-leaf; leaf cells very long and narrow, acutely pointed, without chlorophyll, about 5 μ wide and 80 to 100 μ long, toward the extreme base shorter and broader throughout the width of the leaf base but without any distinct alar group. Inner perichaetial leaves erect, sheathing at the base, with filiform, flexuose points. Seta slender, reddish, smooth, 1 or 2 cm. long; capsule arcuate, ovoid-cylindric, reddish brown; peristome normal; lid conic.

Maui: Haleakala, trail to Rest House (St. John). Island of Hawaii: Bird Park, Kilauea, bank (Bartram); flow of 1852 (Forbes). Kauai: vicinity of Kokee, on exposed tree roots (Bartram).

Distribution: Java, Celebes. Type locality, Java.

The appressed, plicate, filiform pointed leaves give this plant a silky appearance which is quite distinct from either of the other species. When in fruit the smooth seta is also a good distinguishing character. The occurrence of *B. lamprocarpum* in Hawaii is a wide extension of its former known geographical range, but the local collections agree perfectly with authentic specimens from Java and I have little hesitation in referring them here.

2. **Brachythecium rutabulum** (Hedwig) Bruch and Schimper, Bryol. Eur., fasc. 52-54, 1853 (fig. 156).
Hypnum rutabulum Linnaeus, Sp. Pl., p. 1124, 1753.
Hypnum rutabulum Hedwig, Sp. Musc., p. 276, 1801.

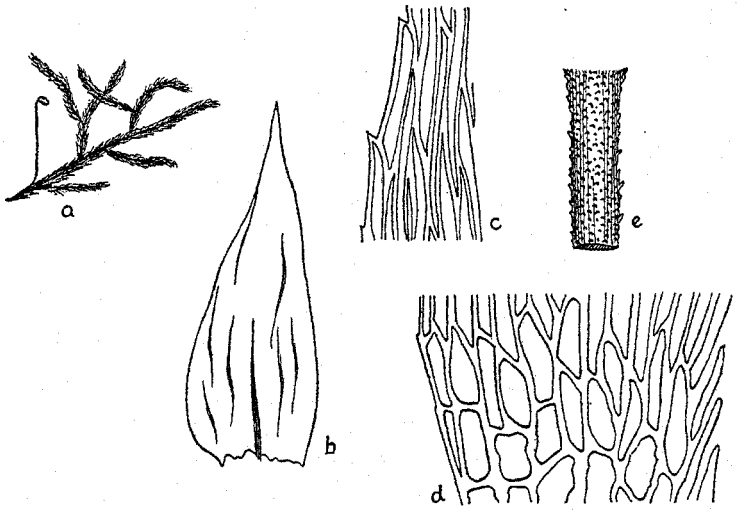


FIGURE 156. *Brachythecium rutabulum* (Hedwig) Bruch and Schimper: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300; *e*, upper end of seta × 25½.

Autoicous. Plants in loose, yellowish green, glossy mats. Stems creeping, elongate, slightly radiculose, up to 5 cm. or more long, irregularly branched, branches erect or ascending. Leaves ovate-lanceolate, rather long acuminate, loosely spreading both wet and dry, slightly decurrent, faintly plicate, concave, about 2 mm. long by 0.7 mm. wide; margin plane, denticulate all around; costa ending in or above mid-leaf, indistinct except at the base. Leaf cells narrowly linear, slightly vermicular, about 5 μ wide and 15 to 20 times as long, gradually shorter and wider toward the base, a few rows across the base just above the insertion oval-hexagonal, pitted, at the basal angles irregularly oval with thickened, pellucid walls, obscure, not forming a well-defined group. Peri-

chaetial leaves sheathing at the base, with spreading, flexuose points, ecostate; seta 2 cm. or more long, reddish, very scabrous throughout; capsule arcuate, reddish brown, 2.5 mm. long by 1 mm. wide; spores 12 to 15 μ in diameter.

Maui: Waikamoi (Forbes); Haleakala, altitude 8,000 feet (Baldwin).

Distribution: Europe, northern Africa, Asia, North America, South America, New Zealand, Japan. Type locality, Europe.

The presence of this cosmopolitan species in Hawaii adds a new and interesting element to the insular flora. It is a more robust plant than the last with more stiffly spreading, shorter-pointed leaves. The stout, papillose seta will at once distinguish it when in fruit.

3. **Brachythecium oxyrrhynchium** (Dozy and Molkenboer) Jaeger, Adumb., vol. 2, p. 387, 1876-1877 (fig. 157).

Hypnum oxyrrhynchium Dozy and Molkenboer, Ann. Sci. Nat., p. 308, 1844.

Rhynchostegium tapetiforme C. Müller, Bull. Herb. Boiss., vol 5, p. 853, 1897.

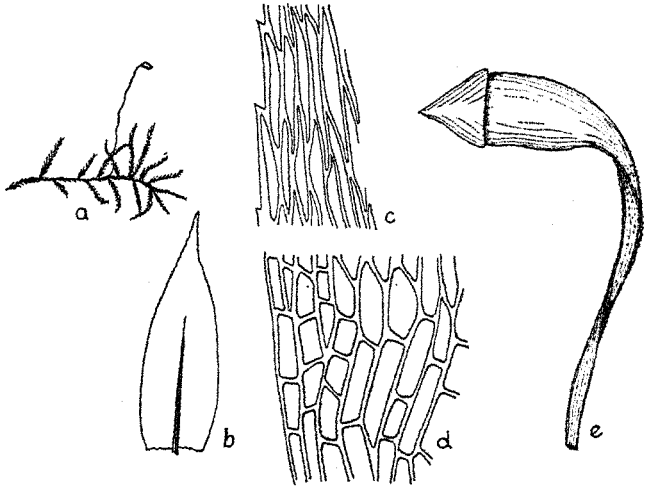


FIGURE 157. *Brachythecium oxyrrhynchium* (Dozy and Molkenboer) Jaeger: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300; *e*, capsule × 12.

Autoicous. Plants in extensive, dense mats, yellowish green on the surface, brown below, glossy. Stems creeping, 2 to 4 cm. long, with dense, irregular or sub-pinnate erect or curved branches, cuspidate at the tips. Leaves crowded, erect-spreading moist and dry, ovate-oblong, concave, short acuminate, not at all plicate, 1.5 mm. long by 0.55 mm. wide; margin minutely denticulate all around, plane or slightly inflexed in the upper half; costa stout, ending about two-thirds up the leaf, or shorter and forked above. Leaf cells linear, firm, 5 μ wide by up to 60 μ long, abruptly shorter and more

lax at the extreme base, with yellowish, pellucid walls, forming a distinct band across the leaf base without any differentiated alar group. Perichaetial leaves sheathing at the base, erect, with short spreading points; seta up to 22 mm. long, dark red, smooth below, scabrous near the top; capsule dark brown, oval-oblong, wide-mouthed, 1.5 mm. long by a scant 1 mm. wide, horizontal or inclined; lid conic.

Damp banks and rocks in the mountains. Oahu: Makaleha Canyon, Waianae Mountains (Skottsberg); valleys, altitude 1,500 feet (Baldwin). Molokai: end of Hanaliioliio pipe line (Degener and Weibke). Maui: mountain ravines, eastern part of island (Baldwin); east of Ukulele, Haleakala (Forbes); Honokohau drainage basin (Forbes). Island of Hawaii: Hilo, rocks along Wailuku River (Bartram). Kaui: damp rocks above Waimea (Heller); vicinity of Kokee, damp rocks (Bartram).

Distribution: Java, Philippines. Type locality, Java.

Quite distinct from the other local species in the stiffly spreading, slightly scarious leaves and the seta rough above and smooth below. Although the description of *Rhynchostegium tapetiforme* deviates in several important particulars from this species, an examination of a portion of the type collection shows that they are identical.

The variety *sandvicense* Brotherus has proved to be a rather intangible segregate in my experience. The distinguishing characters are all subject to considerable variation within reasonable limits, and I fail to find them correlated in any way that will serve to distinguish the variety from a reasonable interpretation of the species.

87. EURHYNCHIUM Bruch and Schimper, Bryol. Eur., fasc. 57-61, Mon., 1854.

Slender or robust, often sub-aquatic plants. Stems usually long and much branched. Leaves as in *Brachythecium,* often more or less complanate; costa frequently ending in a minute prickle on the back; cells linear, more lax at the base. Seta smooth or scabrous; capsule horizontal; peristome normal; lid long rostrate.

1. Stems slender, stem leaves long acuminate, nearly entire ..... 1. **E. vagans**
   Stems robust, stem leaves scarcely differentiated 2
2. Leaves obtuse ..... 2. **E. mülleri**
   Leaves acute or acuminate 3
3. Dioicous, costa ending in a prickle on the back ..... 3. **E. selaginellifolium**
   Autoicous, costa not ending in a prickle ..... 4. **E. celebicum**

1. **Eurhynchium vagans** (Harvey), new combination (fig. 158).
   Hypnum vagans Harvey, in Hooker, Icon. Pl., var. t. 24, fig. 2, 1841.
   Rhynchostegium vagans (Harvey) Jaeger, Adumb., vol. 2, p. 435, 1876-1877.

Dioicous. Slender, much-branched plants growing in intricate feathery mats, pale green and glossy in the growing parts, sordid green below. Stems up to 6 cm. or more long, wiry, with numerous widely spreading, flexuose branches up to 2 cm. long, attenuate at the tips, radiculose here and there in small tufts. Leaves slightly dimorphous; stem leaves ovate-lanceolate, slenderly acuminate, slightly decurrent, margin minutely denticulate to nearly entire; branch leaves slightly larger, complanate, oblong-ovate, abruptly short acuminate, margin sharply serrulate all around; costa ending about two-thirds up the leaf; leaf cells linear, smooth, not incrassate, 5 to 7 μ wide and 12 to 15 times as long, shorter at the extreme apex and at the insertion. Fruit not seen.

Wet rocks and banks. Oahu: east side of Manoa Valley (Bartram). Molokai: edge of Waihanu (Forbes). Maui: Honokohau ditch trail (Bartram); pipe line back of Lahainaluna School (Bartram); ditch trail, eastern part of island (Bartram). Kauai: vicinity of Kokee (Bartram).

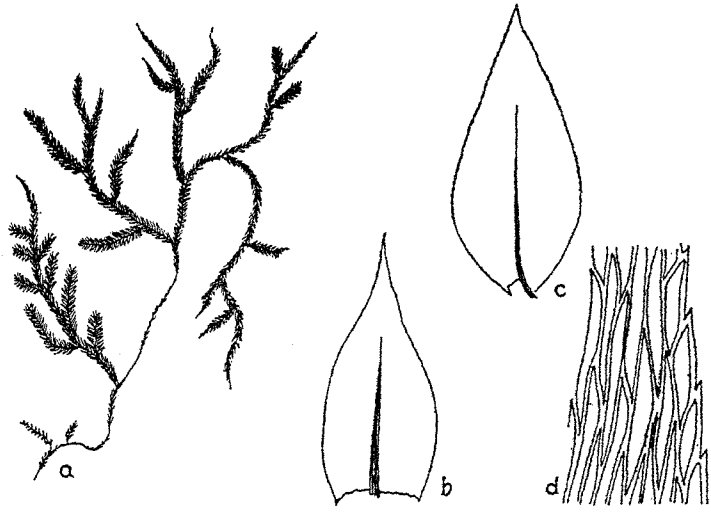


FIGURE 158. *Eurhynchium vagans* (Harvey) Bartram: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, branch leaf × 25½; *d*, upper cells and margin of branch leaf × 300.

Distribution: Nepal, Sikkim, Java, Borneo, Philippines. Type locality, Nepal.

As far as I can see, the Hawaiian collections agree perfectly with the plants of this species distributed by Fleischer in his exsiccatae.

2. **Eurhynchium mulleri** (Lacoste), new combination (fig. 159).
Hypnum Mülleri Lacoste, Bryol. Jav., vol. 2, p. 162, 1867.
Platyhypnidium Mülleri (Lacoste) Fleischer, Laubm. Java, vol. 4, p. 1537, 1922.

Autoicous. Robust aquatic plants growing in extensive flat mats, yellowish green with a metallic luster at the tips of the branches, dark sordid green below. Stems pros-

trate, up to 12 cm. or more long, irregularly branched. Lower leaves much eroded, the upper crowded, spreading, more or less shrunken and striate when dry, more rigidly spreading when moist, broadly ovate, obtuse or slightly acute, concave, up to 2.2 mm. long by 1.5 mm. wide; margin plane, denticulate all around; costa up to 100 μ wide at base, tapering upward and ending some distance below the apex, frequently in a minute prickle on the back. Leaf cells not at all incrassate, linear, slightly vermicular, very chlorophyllose, about 7 μ wide and 5 to 8 times as long, shorter and irregularly rhomboidal toward the apex, several rows across the extreme base broader and shorter but not clearly differentiated. Sporophyte unknown.

Maui: rock face in running water, Iao Valley (Bartram); wet rocks in stream back of Lahainaluna School (Bartram).

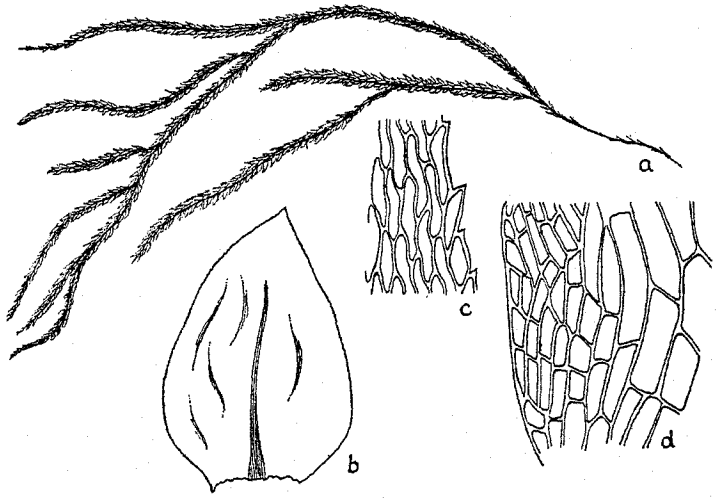


FIGURE 159. *Eurhynchium mülleri* (Lacoste) Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300.

Although these plants are in most respects similar to *E. mülleri* of Java, they may, because of the consistently larger and slightly striate leaves, shorter areolation, and the usual minute terminal prickle on the back of the costa, be separable as an insular form.

3. **Eurhynchium selaginellifolium** (C. Müller), new combination (fig. 160).
Rhynchostegium selaginellifolium C. Müller, Flora, vol. 82, p. 475, 1896.

Dioicous (?). Male flowers not seen. Robust sub-aquatic plants in dense, extensive, intricate mats, sordid yellowish green, slightly glossy. Stems up to 10 cm. or more long, prostrate, stiff and wiry, irregularly branched, branches numerous, more or less complanate, flexuose, sub-pinnately rebranched, the branchlets short and spreading. Leaves distant, erect-spreading, somewhat shrunken and flexuose when dry, not or scarcely complanate, broadly oblong-ovate, rather abruptly narrowed to a short, acuminate point, slightly concave, indistinctly plicate, up to 2 mm. long by 1 mm. wide; margin plane, serrulate all around; costa ending in a minute prickle on the back about two-thirds

up the leaf. Leaf cells chlorophyllose, linear-rhomboidal with firm, hardly incrassate walls, 6 to 10 μ wide and 5 to 8 times as long, shorter and more rhomboidal at the apex, one or two rows at the extreme base slightly shorter but scarcely differentiated. Sporophyte unknown.

Wet dripping rocks and banks. Maui: Olowalu crater, altitude 1,500 feet (Baldwin, type); near Waikamoi (Bartram).

Endemic. Type locality, Olowalu crater, Maui.

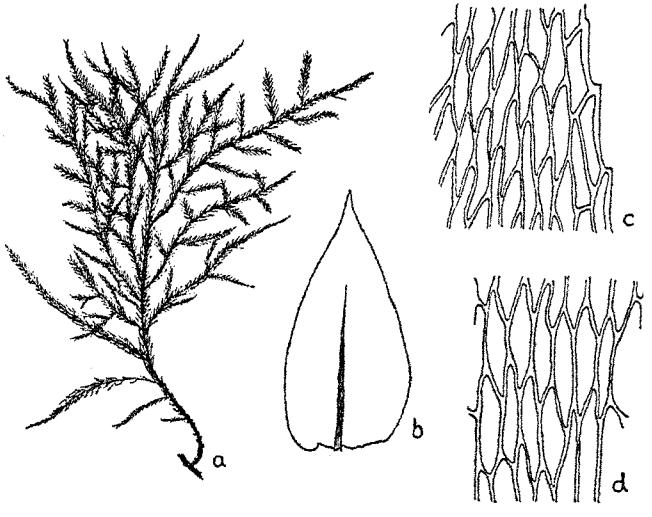


FIGURE 160. *Eurhynchium selaginellifolium* (C. Müller) Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, inner basal leaf cells × 300.

The robust habit and more abruptly and shorter acuminate branch leaves will generally separate this species from *E. vagans*. Smaller, more densely tufted forms are apt to be confusing, but can usually be distinguished by the wider areolation and the distinct terminal prickle of the costa.

Eurhynchium selaginellifolium variety **recurvirameum** (C. Müller), new combination.

Rhynchostegium recurvirameum C. Müller, Flora, vol. 82, p. 475, 1896.

Leaves more complanate than in the species, branches scattered, often attenuate at the tips and more or less recurved.

Wet banks. Oahu: Waikane-Schofield trail, Koolau Range, altitude 2,000 feet (Bartram). Kauai: vicinity of Kokee, shaded rock, a slender, more densely tufted form (Bartram). Hawaii without definite locality (Wheeler).

4. **Eurhynchium celebicum** (Lacoste), new combination (fig. 161).
Hypnum celebicum Lacoste, Bryol. Java, vol. 2, p. 159, 1867.
Rhynchostegium celebicum (Lacoste) Jaeger, Adumb., vol. 2, p. 440, 1876-1877.

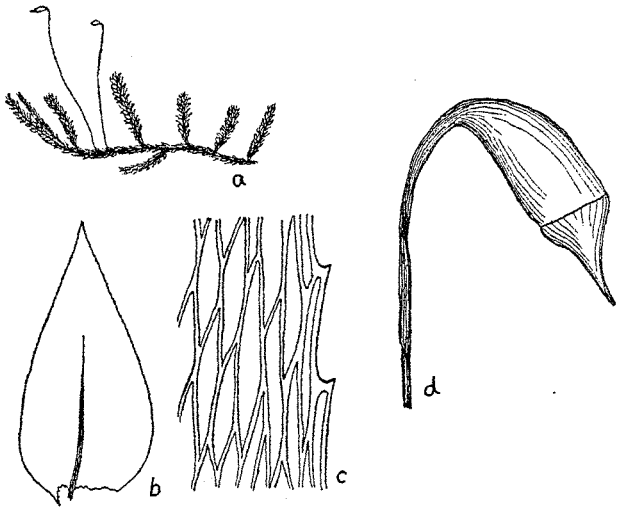


FIGURE 161. *Eurhynchium celebicum* (Lacoste) Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, capsule × 12.

Autoicous. Rather robust, pale green and glossy in the growing parts, dirty brown below. Stems prostrate, up to 8 cm. long, sparingly radiculose, sub-pinnately branched, branches simple, up to 2 cm. long. Leaves not crowded, widely spreading, slightly complanate, shrunken and twisted when dry, concave, ovate, acuminate, up to 2 mm. long by 1 mm. wide, slightly asymmetrical; margin frequently recurved on one side at the base, otherwise plane, serrulate all around; costa faint, ending slightly above mid-leaf. Leaf cells linear, about 10 μ wide and 8 to 10 times as long, shorter toward the apex, several rows across the extreme leaf base shorter and sub-rectangular. Perichaetial leaves ecostate, laxly areolate, subulate-acuminate from a sheathing base, denticulate above; seta reddish brown, up to 2 cm. long, smooth; capsule horizontal or pendulous, brown, ovoid-cylindric, strongly contracted under the mouth when dry, urn 1.5 mm. long; peristome teeth reddish brown, finely transversely striate on the outer surface, strongly trabeculate on the inner face, inner peristome pale yellow, finely papillose, segments narrowly split along the median line; lid with a long, slightly curved beak from a conic base, 1 mm. long; spores smooth, up to 14 μ in diameter.

Damp banks and rocks. Molokai: head of Waihanu stream (Degener). Kauai: vicinity of Kokee (Bartram).

Distribution: Java, Sumatra, Celebes, Tonkin. Type locality, Celebes.

A much more glossy plant than any of its associates and easily known by the autoicous inflorescence and smooth seta.

88. RHYNCHOSTEGIELLA (Bruch and Schimper) Limpricht, Laubm., vol. 3, p. 207, 1896.

Diminutive plants distinguished from *Eurhynchium* principally by the small size and narrower leaves.

1. **Rhynchostegiella hawaiica** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 1161, 1908 (fig. 162).
Remyella Hawaiica C. Müller, Flora, vol. 82, p. 477, 1896.

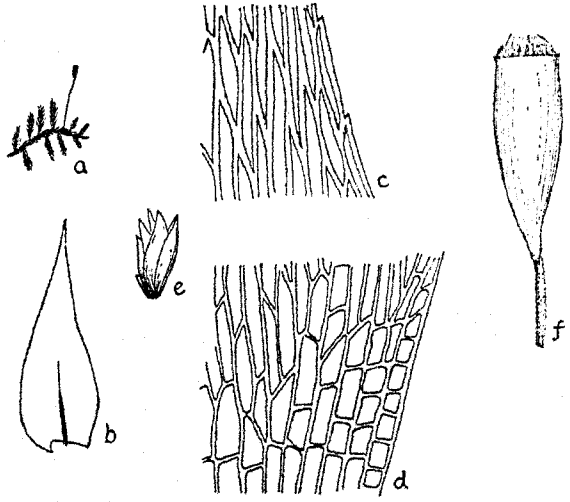


FIGURE 162. *Rhynchostegiella hawaiica* (C. Müller) Brotherus: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300; *e*, male bud × 25½; *f*, capsule × 12.

Autoicous. Small plants growing in yellowish green mats, slightly glossy. Stems prostrate with numerous short, ascending branches and small scattered tufts of radicles. Stem leaves rather widely spreading when dry, more erect-spreading when moist, ovate-lanceolate, long and slenderly acuminate, slightly concave, 1.5 mm. long by 0.5 mm. wide; margin plane, minutely denticulate nearly to the base; costa slender, ending about mid-leaf; branch leaves similar but slightly smaller and more crowded; upper leaf cells long and narrow, smooth, 5 μ wide and 10 to 15 times as long, several rows across the insertion shorter and broader, at the basal angles short rectangular, forming a rather distinct, slightly convex group. Perichaetial leaves larger, the inner subulate-acuminate from a sheathing base; seta erect, flexuose, reddish, scabrous, about 10 mm. long; capsule erect, cylindric, urn 2 mm. long by 0.75 mm. wide; peristome as in *Eurhynchium*.

Apparently a rare and local species. I have seen but a scrap of the original specimen, collected by J. Remy, and know of no other collection.

Endemic. Type locality, Hawaii.

The small size, rough seta, and erect capsule form an unmistakable combination of characters.

Family 31. ENTODONTACEAE

Slender glossy plants growing in flattened mats or tufts. Stems prostrate, elongate, usually sub-pinnately branched. Leaves ovate, normally complanate; costa none or double and short; upper cells very long and narrow, more lax toward the insertion, usually sub-quadrate at the basal angles and well defined. Seta elongate; capsule erect, cylindric; peristome double, basal membrane of inner peristome low or wanting, segments about as long as the teeth, cilia none.

89. ENTODON C. Müller, Bot. Zeit., p. 740, 1844.

Slender plants with the characters of the family.

Stems flattened, leaves complanate, acute.....**1. E. solanderi**
Stems terete, leaves obtuse.....**2. E. subcuspidata**

1. **Entodon solanderi** (Ångström) Jaeger, Adumb. vol. 2, p. 358, 1876-1877 (fig. 163).
   Cylindrothecium Solanderi Ångström, Öfv. K. Vet. Akad. Förh., no. 5, p. 122, 1872.
   Entodon flavifrons C. Müller, Flora, vol. 82, p. 461, 1896.
   Entodon reflexisetus C. Müller, Flora, vol. 82, p. 461, 1896.
   Entodon Hillebrandi C. Müller, Flora, vol. 82, p. 461, 1896.
   Entodon longipes Brotherus, Bull. Soc. Bot. Ital., p. 18, 1904.

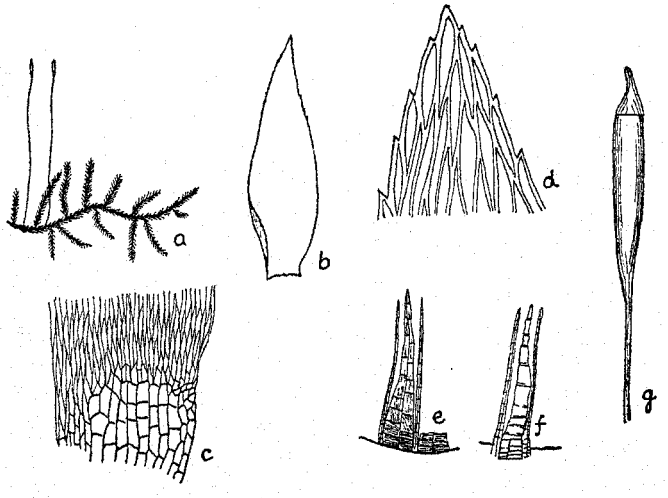


Figure 163. *Entodon solanderi* (Ångström) Jaeger: *a*, plant × ¾; *b*, leaf × 25½; *c*, basal angle of leaf × 120; *d*, apex of leaf × 300; *e*, part of peristome × 60; *f*, part of peristome from inside × 60; *g*, capsule × 9.

Autoicous. In extensive, thin, intricate mats, pale yellowish or brownish green, glossy. Stems up to 3 or 4 cm. long, prostrate, sub-pinnately branched, branches short, complanate, attenuate, frequently hooked at the tips. Leaves crowded, complanate-spreading, ovate from a constricted base, acute, cymbiform-concave, 1.6 mm. long by about 0.8 mm. wide; margin erect, minutely denticulate at the apex, entire below; costa none or very short and double. Leaf cells very long and narrow, acutely pointed, 5 μ wide and 20 to 25 times as long, 3 or 4 rows across the leaf base at the insertion abruptly larger, lax, pellucid, hexagonal and rectangular, 15 μ wide and 25 to 35 μ long. Inner perichaetial leaves erect, 2.5 to 3 mm. long, slenderly acuminate from an oblong, clasping, laxly areolate base; seta pale yellow, about 2.5 cm. long; capsule erect, cylindric, brown, urn 2 to 2.5 mm. long; peristome teeth brownish, with 5 or 6 distant articulations, solid or with several small perforations along the median line, cross-striate at the base, vertically and obliquely striate above, segments of the inner peristome linear, brownish, without striae; lid conic-rostrate, 1 mm. long; spores pale, 15 to 18 μ in diameter.

Damp rock faces. Oahu: ridge between Hillebrands Glen and Nuuanu Valley (Forbes); Cooke trail, east side of Nuuanu Valley (Forbes); Makaleha Canyon, Waianae Mountains (Skottsberg). Maui: Olowalu crater (Baldwin); Honokohau drainage basin (Forbes); Iao Valley (Bartram); Waikamoi (Bartram).

Distribution: Tahiti, Rapa. Type locality, Tahiti.

The plants referred here vary somewhat in color and branching, but otherwise they seem to fall well within the limits of a single specific type. After carefully comparing the Hawaiian specimens with numerous and abundant collections from Tahiti, I am convinced that they are all minor variants of one species and that no practical separation is feasible.

2. **Entodon subcuspidatus** (Hampe), new combination (fig. 164).

Hypnum subcuspidatum Hampe, in herbaria.

Cuspidaria subcuspidata (Hampe) C. Müller, Flora, vol, 82, p. 474, 1896.

Catagonium subcuspidatum (Hampe) Brotherus, Engler and Prantl, Pflanzenf., pt. 1, fasc. 3, p. 1088, 1908.

Entodon tereticaulis Brotherus, B. P. Bishop Mus., Bull. 40, p. 27, 1927.

Dioicous. Slender plants, golden brown and glossy above, pale brown below. Stems rather rigid, up to 10 cm. long, procumbent, curved at the tips, not at all radiculose, terete foliate, cuspidate at the tips, with scattered, short, flexuose, attenuate branches. Stem leaves closely imbricated, erect, 2 to 2.3 mm. long by 0.8 or 0.9 mm. wide, ovate-oblong, obtuse, concave, slightly decurrent; margin entire, narrowly recurved for a short distance above the base, plane above; costa short and double or none; leaf cells 4 μ wide and 15 to 20 times as long, much shorter at the apex, near the insertion slightly shorter and wider with sinuose, slightly thickened walls, at the basal leaf angles quadrate, hyaline or brownish, forming a distinct convex group extending a little way up the margins; branch leaves similar but smaller, ovate-lanceolate toward the tips. Sporophyte unknown.

Maui: Haleakala, altitude 7,500 feet, on ground (Baldwin).

Endemic. Type locality, Hawaii.

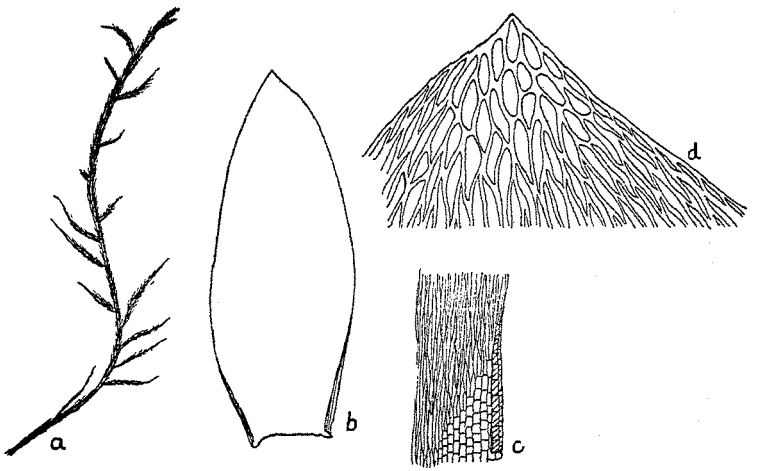


FIGURE 164. *Entodon subcuspidatus* (Hampe) Bartram: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, basal angle of leaf × 120; *d*, apex of leaf × 300.

A very distinct species in the elongated, sub-julaceous stems with short, attenuate branches. Müller's description of *Hypnum subcuspidatum* Hampe agrees so exactly with the type collection of *Entodon tereticaulis* Brotherus that even though I have not seen the type of Hampe's species I feel reasonably sure that the two plants are identical. Until fruit has been found, the systematic position of *E. subcuspidatus* must remain open to question.

FAMILY 32. PLAGIOTHECIACEAE

Slender to robust plants, usually glossy. Stems prostrate, irregularly branched. Leaves complanate, ovate, short acuminate, often asymmetrical; upper cells narrowly linear, more lax below, often with numerous sub-quadrate alar cells; costa single or double. Seta elongate; capsule horizontal or erect; peristome double, usually perfect, segments of inner peristome from a high basal membrane.

Costa single, quadrate alar cells numerous.....**90. Stereophyllum**
Costa double, short, quadrate alar cells few or none.....**91. Plagiothecium**

90. STEREOPHYLLUM Mitten, Musc. Ind. Orient., p. 117, 1859.

Slender plants with flattened, prostrate stems. Leaves complanate, short-pointed; costa single; upper cells linear, quadrate alar cells numerous. Seta smooth; capsule erect or horizontal; peristome double.

1. Sterophyllum oahuense Brotherus, B. P. Bishop Mus., Bull. 40, p. 28, 1927 (fig. 165).

Autoicous. Slender plants in lax, depressed tufts, pale green, glossy. Stems prostrate, up to 4 cm. long, with few short branches and scattered tufts of radicles on the under side, up to 3 mm. wide with leaves. Leaves complanate, widely spreading, asymmetrical, ovate-lingulate, concave, obtuse or bluntly acute, up to 1.7 mm. long by 0.5 mm. wide; margin minutely denticulate toward the apex, entire below, plane above, erect or broadly inflexed on one or both sides toward the base; costa tapering quickly upward and ending about mid-leaf; leaf cells linear, smooth, thin-walled, 6 to 8 μ wide and 7 to 10 times as long, lower cells subquadrate and rectangular, filling the entire leaf base on one side and extending obliquely upward toward the margins. Seta up to 8 mm. long, slender, reddish, smooth; capsule small, erect, oblong-cylindric, brownish.

Endemic. Type locality, Oahu.

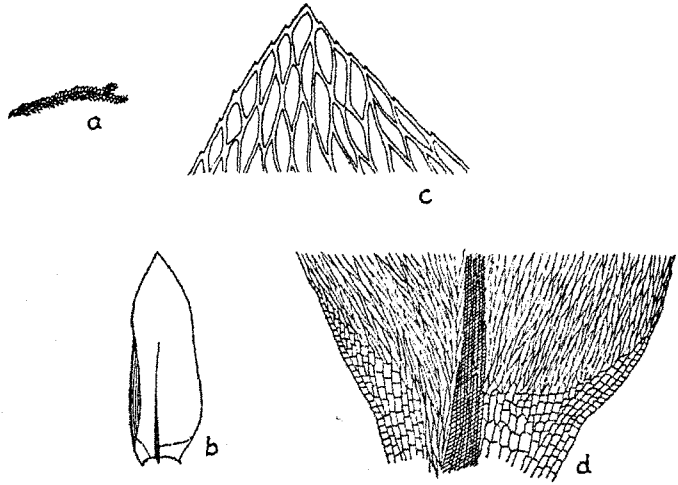


FIGURE 165. *Stereophyllum oahuense* Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 300; *d*, base of leaf × 120.

This unique species is known only from the type collection by F. Didrichsen from Oahu, without more definite locality; it seems never to have been rediscovered. The short single costa and asymmetrical leaf base with a large area of short cells extending obliquely upward at the margins are salient characters which will identify the plant at once. I have seen only a few sterile stems from the type collection. The description of the sporophyte is transcribed from the original publication.

91. PLAGIOTHECIUM Bruch and Schimper, Bryol. Eur., fasc. 48, Mon., 1851.

Stems irregularly branched. Leaves complanate, ovate, concave; costa double and short; upper cells narrowly linear, more lax below, differentiated

alar cells few or none. Seta elongate, smooth; capsule sub-cylindric, inclined or horizontal, often striate; peristome double, pale; lid conic.

1. Rather robust plants, leaves deeply concave, more or less undulate.....1. **P. draytoni**
   More slender plants, leaves lightly concave, not undulate.....2
2. Leaves up to 2 to 2.25 mm. long, margin plane, cells 12 to 15 μ wide....3. **P. mauiense**
   Leaves up to 1.4 mm.long, margin revolute below, cells 8 to 10 μ wide..2. **P. denticulatum**

1. **Plagiothecium draytoni** (Sullivant), new combination (fig. 166).

Hypnum Draytoni Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 76, 1854.

Hypnum Eudorae Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 77, 1854.

Catagonium Draytoni (Sullivant) C. Müller, Flora, vol. 82, p. 468, 1896.

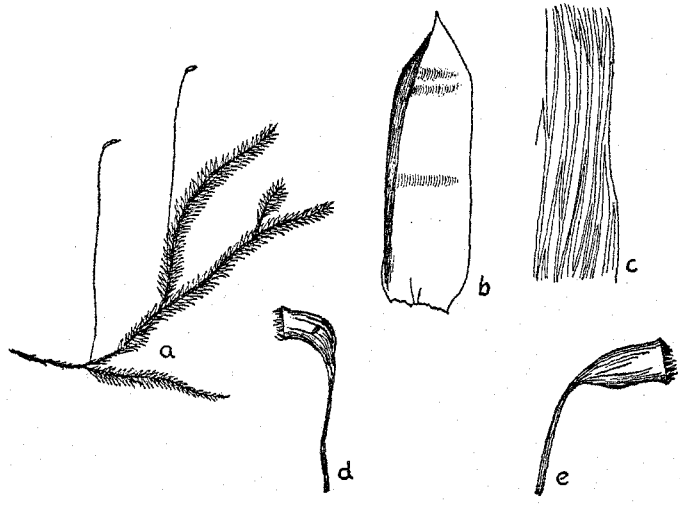


FIGURE 166. *Plagiothecium draytoni* (Sullivant) Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, dry capsule × 9; *e*, moist capsule × 9.

Dioicous. Male flowers gemmiform, axillary, about 0.7 mm. long, antheridia 6 to 8, with filiform paraphyses, inclosed by about six broadly ovate, acuminate, ecostate, entire perigonial bracts. Plants growing in extensive soft mats, pale green, very lustrous. Stems sparingly branched, elongate, prostrate, 5 to 10 cm. long, slightly radiculose in the older parts, branches flattened, up to 4 or 5 mm. wide with leaves. Leaves rather crowded, very complanate, spreading, often transversely undulate, little different when dry, oblong-ovate, abruptly short acuminate, very deeply concave, about 2 mm. long by a scant 1 mm. wide; margin plane, entire; costa double, very short; leaf cells long and narrow, 5 to 8 μ wide and 15 to 20 times as long, several rows across the leaf base shorter and broader, but without any differentiated alar cells. Perichaetial leaves more laxly areolate, erect, clasping, more gradually acuminate, frequently with several denticulations near the base of the acumen; seta reddish brown, filiform, smooth, 3 to 4 cm. long; capsule inclined or horizontal, rarely suberect, brown, 1.5 mm. long, cylindric, symmetrical or slightly gibbous on the back, striate and contracted under the mouth

when dry; peristome teeth yellow, coarsely papillose at the apex, finely cross-striate below, closely articulated, inner peristome pale, papillose, basal membrane two-thirds the height of the teeth, cilia nodose, well developed, shorter than the segments; annulus present; lid conic, 1 mm. long; spores pale, smooth, 10 μ in diameter.

On humus and logs in wet forests. Common on all the larger islands. Endemic. Type locality, eastern base of Mauna Kea, Hawaii.

Closely resembles some of the more robust species of *Plagiothecium,* notably *P. neckeroideum* Bruch and Schimper, but the leaves are symmetrical, deeply concave, and not at all decurrent. Whether or not these relatively slight differences are sufficient to justify a generic separation is open to question. The dividing line between *Catagonium* and *Plagiothecium* is at best a slender one as far as *P. draytoni* is concerned. I have therefore decided that the genus *Plagiothecium* might be here used in an inclusive sense without much violence to systematic bryology.

Hypnum Eudorae is described as autoicous by Sullivant. The fruiting plants from the type collection, which I have examined, show no trace of antheridial flowers; the only male buds are on a separate stem. Clearly, a dioicous inflorence is indicated. Also the position of the capsules varies in the same colony from horizontal to sub-erect. I can therefore find no valid reason for separating this plant from *P. draytoni.* The genus *Catagonium* was presented by Müller (16, p. 468) in the form of two mere names without any suggestion as to why or how it was distinct. Brotherus (3, p. 1088) accepted the genus and described it for the first time in 1909. He included several species from Central America and South America and one other species from Hawaii, which proves to be an *Entodon.* I am not familiar with the American plants, but as far as *C. draytoni,* which happens to be the type species of the genus, is concerned, there seems to be little reason for separating it from *Plagiothecium.*

The Hawaiian species is a very attractive one easily recognized by the flattened, elongated stems and the lustrous, almost opalescent leaves which are commonly cross-undulate toward the tips.

2. **Plagiothecium denticulatum** (Hedwig) Bruch and Schimper, Bryol. Eur., fasc. 48, Mon., p. 12, 1851 (fig. 167).
Hypnum denticulatum Linnaeus, Sp. Pl., 2d ed., vol. 1, p. 1122, 1753.
Hypnum denticulatum Hedwig, Sp. Musc., p. 237, 1801.

Autoicous. In dense, flat, olive-green mats, glossy. Stems prostrate, irregularly branched, branches up to 2.5 mm. wide with leaves, frequently flagelliform with minute, appressed leaves. Leaves complanate, widely spreading, scarcely shriveled when dry, ovate or oblong-ovate, short acuminate, very asymmetrical, narrowly decurrent at the basal angles, up to 1.4 mm. long by 0.5 mm. wide; margin narrowly revolute on one or both sides to above the middle, entire or minutely denticulate at the point; costa double with unequal forks, extending to about mid-leaf; leaf cells linear, smooth, 8 to 10 μ

wide and 10 to 14 times as long, shorter and more lax at the extreme base, subrectangular and hyaline in the decurrent angles. Seta up to 2 cm. long; capsule slightly inclined, cylindric, brown, smooth or faintly striate when dry and empty, urn 1.5 mm. long, contracted under the wide mouth when dry.

Distribution: Europe, Asia, Japan, North America. Type locality, Europe.

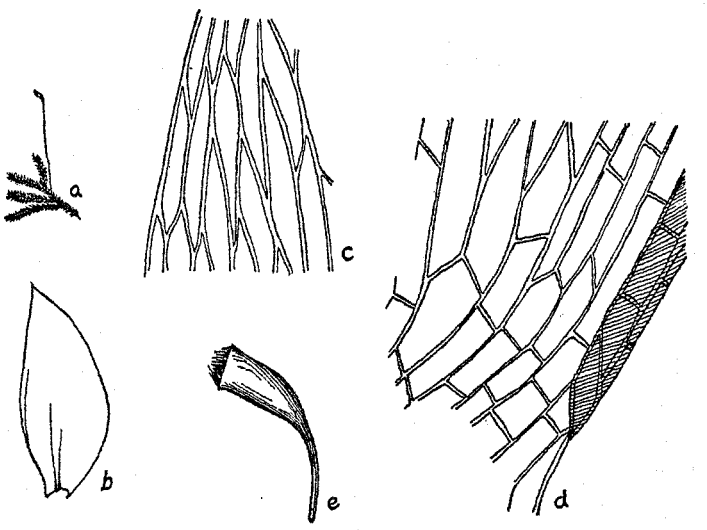


FIGURE 167. *Plagiothecium denticulatum* (Hedwig) Bruch and Schimper: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300; *e*, capsule × 9.

This species is included in Hawaiian flora on the basis of a collection made in Hawaii by C. N. Forbes, number 992, without any definite locality. The capsules are all deoperculate and over-ripe, but the details of the plants correspond so closely with some of the smaller forms of the variable and widespread *P. denticulatum* that I have tentatively referred them here until better and more ample collections are available.

3. **Plagiothecium mauiense** Brotherus, B. P. Bishop Mus., Bull. 40, p. 28, 1927 (fig. 168).

Dioicous. Growing in dense, yellowish green mats. Stems prostrate, slightly radiculose, irregularly branched, branches up to 5 mm. wide with leaves. Leaves complanate, widely spreading, somewhat shriveled when dry, oblong-ovate, asymmetrical, short acuminate, up to 2.5 mm. long by 1 mm. wide, slightly decurrent; margin plane, minutely denticulate near the apex, entire below; costa double with unequal forks, extending about one-third up the leaf; cells linear, 12 to 15 μ wide and 8 to 10 times as long, shorter and more lax at the extreme base. Fruit unknown.

Maui: Haleakala, on ground in damp ravine, altitude 8,000 feet (Baldwin, type).

Endemic. Type locality, Haleakala, Maui.

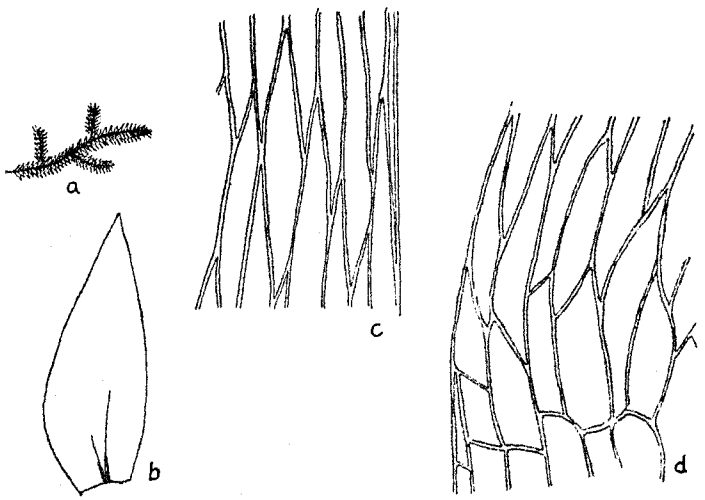


FIGURE 168. *Plagiothecium mauiense* Brotherus: *a*, plant × 3/4; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300.

In the absence of the sporophyte characters the definition of this species remains rather obscure. The larger leaves, broader cells, and plane margins will distinguish it from the preceding.

FAMILY 33. SEMATOPHYLLACEAE

Slender or robust plants, often glossy, growing in mats. Stems procumbent or ascending, irregularly or pinnately branched. Leaves ovate or ovate-lanceolate, acuminate, erect-spreading or falcate-secund; costa double and short or none; cells linear, smooth or papillose, more lax below; alar cells clearly differentiated, often large and vesiculose at the basal angles. Seta elongate, smooth or scabrous; capsule inclined or horizontal; peristome usually double; lid conic or rostrate; calyptra cucullate.

1. Alar cells oval or subrectangular, not inflated 2
   Alar cells large, inflated 4
2. Small, slender plants, often with terminal clusters of microphyllous branches ..... **92. Aptchella**
   Robust plants without microphyllous branches 3
3. Leaves with linear-lanceolate, coarsely serrate points, lid rostrate .. **94. Heterophyllium**
   Leaves rounded or short-pointed, denticulate or serrate above, lid conic ..... **100. Glossadelphus**

4. Small, slender plants, leaves less than 1.5 mm. long.....5
   More robust, leaves 2 mm. or more long.....7
5. Leaves sharply serrulate above.....**93. Hageniella**
   Leaves entire or minutely denticulate above.....6
6. Lid short-beaked, cells 2 or 3 μ wide, often seriate papillose.....**99. Taxithelium**
   Lid, with a long needle-like beak, cells smooth.....**96. Sematophyllum**
7. Seta 3 to 4 cm. long, smooth, exothecial cells of urn not collenchymatous.....**95. Brotherella**
   Seta less than 1.5 cm. long, more or less scabrous above.....8
8. Capsule cylindric, seta very scabrous above, cells often papillose.....**98. Trichosteleum**
   Capsule ovoid, seta slightly scabrous above, cells smooth.....**97. Acroporium**

92. APTCHELLA Herzog, Bibl. Bot., vol. 87, p. 157, 1916.

Slender glossy plants with procumbent, irregularly branched stems often bearing terminal clusters of filiform propagula. Leaves ovate, concave; costa double and short; cells linear, smooth, alar cells rounded, not inflated.

1. **Aptchella robusta** (Brotherus) Fleischer, Laubm. Java, vol. 4, p. 1671, 1923 (fig. 169).

   Clastobryum robustum Brotherus, Philipp. Jour. Sci., vol. 5, pt. 2, p. 155, 1910.

   Clastobryopsis robusta (Brotherus) Fleischer, Laubm. Java, vol. 4, p. 1181, 1919.

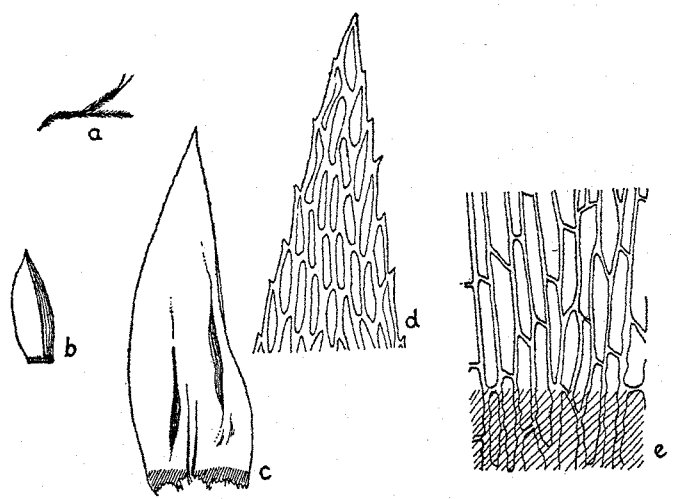


FIGURE 169. *Aptchella robusta* (Brotherus) Fleischer: *a*, plant × ¾; *b*, leaf from flagellate branch × 25½; *c*, stem leaf × 25½; *d*, apex of leaf × 300; *e*, inner basal cells × 300.

Dioicous; male flowers unknown. Plants slender, in yellowish green mats, glossy. Stems prostrate, up to 2 cm. long, irregularly branched, without radicles, frequently bearing terminal clusters of slender, curved microphyllous, flagellate branches. Leaves closely imbricated, erect, appressed, oblong-ovate, short acuminate, lightly plicate, concave, 2 to 2.5 mm. long by 0.7 mm. wide; margin narrowly and irregularly recurved on one or both sides, sometimes nearly or quite plane, entire below, minutely serrulate toward the apex; costa double, yellowish, extending about one-fifth up the leaf; leaf cells narrowly linear, 5 μ wide by 70 μ or more long, not or hardly incrassate, toward the base slightly wider and shorter, the lowermost 2 or 3 rows across the insertion colored a rich brown, a few cells at the basal angles larger and rounded, but not forming any distinct alar group. Leaves of the flagellate branches similar but minute, 0.5 to 1 mm. long, acute. Fruit unknown.

Maui: top of mountain in western part of island, in marshy soil, altitude 6,000 feet (Baldwin). Kauai: Waimea drainage basin, west side (Forbes).

Distribution: Philippine Islands. Type locality, Luzon, Philippine Islands.

Apparently quite rare or else easily overlooked. Both of the above collections are scanty but seem to agree very well with the description of the Luzon plant. When present, the clusters of filiform branches are very characteristic.

93. HAGENIELLA Brotherus, Öfv. Finska Vet. Soc. Förh. 52, Afd. A, no. 7, p. 4, 1909-1910.

Slender, very glossy plants growing in dense mats on wet rocks. Stems prostrate, elongate, branched. Leaves ovate, concave, with a short, oblique point, sharply serrulate above; costa double and short or none; upper cells narrowly linear, alar cells large, inflated. Fruit unknown in Hawaii.

1. **Hageniella pacifica** Brotherus, B. P. Bishop Mus., Bull. 40, p. 29, 1927 (fig. 170).

Slender plants in dense, intricate mats, yellowish green at the tips, brown below, very glossy, with a metallic sheen. Stems up to 5 cm. long, prostrate, radiculose below, sub-pinnately or irregularly branched, branches spreading, flexuose, up to 1.5 cm. long, slightly attenuate and cuspidate at the tips; leaves erect-spreading, ovate from a short contracted base, concave, acute, the point often a little oblique, 1 to 1.1 mm. long by 0.5 mm. wide; margin narrowly recurved on one or both sides in the lower half, erect and distantly but sharply serrulate above; costa none or very short and double; leaf cells very long and narrow, dense, 3 or 4 μ wide and 15 to 20 times as long, minutely papillose on the back by the projecting end walls, yellow at the insertion, at the basal angles a group of 2 or 3 large inflated hyaline or brownish cells, above which are 3 or 4 large rectangular hyaline cells extending up the margins. Fruit unknown.

Maui: mountain ravines in western part of island (Baldwin, type); Kula pipe line trail, northeast of Olinda (Bartram). Island of Hawaii: Mauna Loa above Pahala, altitude 3,800 feet (Skottsberg).

Endemic. Type locality, western Maui.

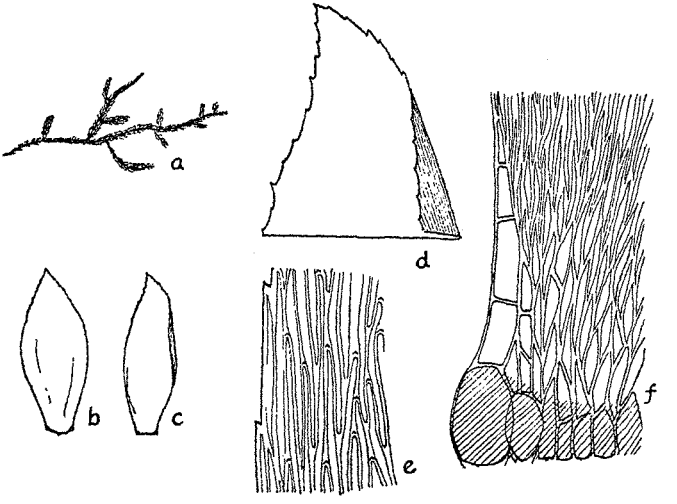


FIGURE 170. *Hageniella pacifica* Brotherus: *a*, plant × ¾; *b*, *c*, leaves × 25½; *d*, apex of leaf × 120; *e*, upper leaf cells and margin × 300; *f*, basal angle of leaf × 300.

A very pretty moss on account of the brilliant metallic luster of the leaves, which are broader and more abruptly pointed than in any of the other allied local species with large inflated alar cells.

94. HETEROPHYLLIUM (Schimper) Kindberg, Check List Eur. and North Am. Musc., p. 72, 1894.

Hypnum subgenus *Heterophyllium* Schimper, Syn., p. 629, 1860.

Robust, glossy plants. Stems pinnately branched. Leaves ovate, lanceolate, coarsely serrate above, falcate; costa double; upper cells linear, more lax below; alar cells sub-rectangular, not or scarcely inflated. Seta elongate, capsule inclined or horizontal; peristome normal.

1. **Heterophyllium subauriculatum** (Hampe) Brotherus, in herbaria (fig. 171).

Hypnum subauriculatum Hampe, in herbaria.

Trismegista subauriculata C. Müller, Flora, vol. 82, p. 474, 1896.

Acanthocladium oahuense Brotherus, Bull. Soc. Bot. Ital., p. 14, 1904.

Heterophyllium sandvicense Brotherus, B. P. Bishop Mus., Bull. 40, p. 29, 1927.

Autoicous (?). Robust, glossy, golden brown. Stems up to 7 cm. long, 2 to 2.5 mm. wide with leaves, radiculose in scattered tufts, pinnately branched, branches widely spreading, the upper short and simple, the lower sometimes sub-pinnately rebranched

with numerous slender, flagelliform branchlets. Leaves crowded, spreading, slightly falcate, about 2.5 mm. long by 0.8 mm. wide at base, abruptly linear-lanceolate from a broadly ovate, concave base; margin often narrowly recurved and entire below, sharply serrate in the upper half and frequently narrowly recurved toward the base of the acumen; costa double, the slender, widely spreading forks up to one-third the length of the leaf base; cells linear, 4 or 5 μ wide and 6 to 8 times as long, with firm walls, smooth, toward the extreme base shorter and broader, incrassate, porose, several rows across the insertion golden brown, at the basal angles a well-defined group of much larger, oblong cells, hyaline at the margins, brown within, supra-alar cells few, small, rhomboidal and sub-quadrate. Fruit not seen.

On trees and bushes. Maui: mountain ridges in western part of island, on trunks, altitude 5,500 feet (Baldwin); on bushes, mountain top, western part of island, altitude 6,000 feet (Baldwin).

Endemic. Type locality, Hawaii.

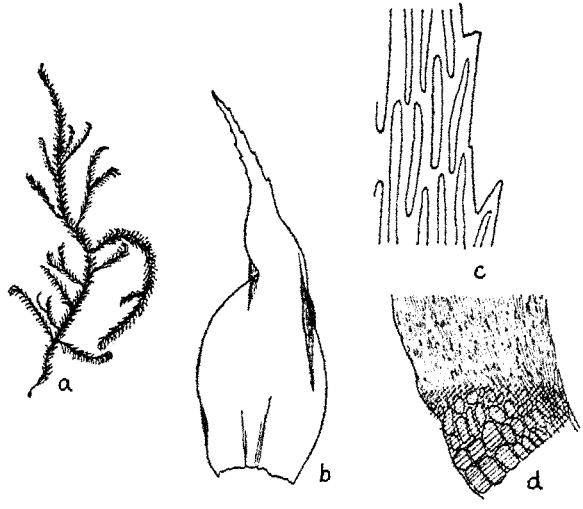


FIGURE 171. *Heterophyllium subauriculatum* (Hampe) Brotherus: *a*, plant × ¾; *b*, leaf, × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 120.

As the differences between *H. subauriculatum* and *H. sandvicense* are only relative and confined to size and general appearance, I doubt very much if they are more than variants of one species. In fact, in the absence of more complete material it is questionable to just what extent, if any, these plants differ from *H. affine* (Hooker) Fleischer of Mexico and South America. The Hawaiian plants that I have seen are more robust with larger stem leaves from a more broadly ovate base than the South American plants with which they have been compared, but in the absence of further details this cannot be considered as a very tangible distinction.

In Müller's description of *Trismegista subauriculata* the reference to "entire" leaves must have been an oversight, as plants collected by Wheeler in 1879 are indistinguishable from those collected by Baldwin in western Maui and show the upper leaf margins sharply serrate.

95. BROTHERELLA Loeske, Stud., p. 175, 1910.

Slender, glossy plants. Stems elongate, sub-pinnately branched. Leaves ovate-lanceolate, more or less falcate-secund, denticulate above; cells long and narrow, smooth; alar cells large and inflated. Seta slender, elongate; capsule inclined or horizontal, exothecial cells not collenchymatous, peristome double; lid long-beaked.

1. **Brotherella opaeodon** (Sullivant) Brotherus, Engler and Prantl, Pflanzenf., 2d ed., vol. 11, p. 425, 1925 (fig. 172).
   Hypnum opaeodon Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 77, 1854.

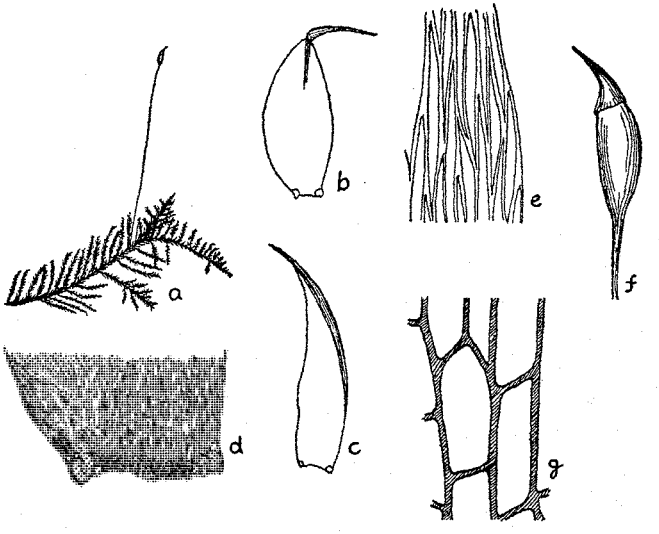


FIGURE 172. *Brotherella opaeodon* (Sullivant) Brotherus: *a*, plant × ¾; *b*, *c*, leaves × 25½; *d*, base of leaf × 120; *e*, upper leaf cells and margin × 300; *f*, capsule × 9; *g*, exothecial cells × 300.

Dioicous (?). Male flowers not seen. Plants in rather dense, golden yellow mats, glossy. Stems 6 cm. or more long, prostrate, sub-pinnately branched, the ultimate branches rather short, flexuose, flattened in one plane. Stem leaves crowded, falcate-secund, concave, practically ecostate, from a broadly ovate or ovate-lanceolate base rather quickly narrowed to a slender acumen which is shorter than the basal portion,

up to 1.5 mm. long; margin entire and often lightly reflexed below, plane above, denticulate in the acumen; costa none or double and short; leaf cells very long and narrow, vermicular, 4 μ wide and 15 to 20 times as long, a few rows across the insertion much shorter and wider, bright yellow, with thickened, slightly pitted walls, at the leaf angles a conspicuous group of 3 to 5 large, oblong-oval, vesiculose hyaline or yellowish cells, very distinct from the smaller median cells. Branch leaves similar but smaller, basal portion narrower, more gradually tapering to the shorter, broader point. Inner perichaetial leaves erect, sheathing, about 2.5 mm. long, with spreading, flexuose, denticulate points, the outer leaves smaller; seta 3 or 4 cm. long, slender, reddish, flexuose, smooth; capsule erect or slightly inclined, oblong-cylindric, 2 mm. long by 1 mm. wide, slightly asymmetrical, exothecial cells short rectangular or oblong-hexagonal, irregular, with uniformly thickened walls, not collenchymatous; peristome teeth yellow, transversely striate; annulus none; lid rostrate from a conic base, 1.5 mm. long; calyptra cucullate.

Maui: western part of island, on trunks (Baldwin); Puu Kukui, very wet forest (Skottsberg); bog near top of Puu Kukui (St. John); Ukulele, Haleakala (Forbes); Kula pipe line trail, northeast of Olinda, on old fern stipes (Bartram). Kauai: Waimea drainage basin, west side (Forbes).

Endemic. Type locality, forest, eastern base of Mauna Kea, island of Hawaii.

A very beautiful moss, locally abundant in the mountain districts subject to heavy rainfall. The golden yellow color and short feathery branches with neatly falcate-secund leaf points will distinguish it at once from all other species but *Ctenidium decurrens,* which it resembles superficially. The latter species is usually of a paler, yellowish green color, less regularly pinnate, and has rather tumid branches with more laxly imbricated leaves lacking the large inflated cells at the basal angles. When in fruit the erect, cylindric capsules of *B. opaeodon* are readily distinguishable from the curved capsules of the other species.

96. SEMATOPHYLLUM Mitten, Jour. Linn. Soc., p. 5, 1865.

Rather small plants growing in dense mats. Stems prostrate, branches erect or ascending. Leaves crowded, often slightly secund, ovate to lanceolate, ecostate; upper cells narrow, smooth, alar cells large and inflated. Seta smooth. Capsule inclined or horizontal, exothecial cells strongly collenchymatous; peristome double, the teeth cross-striate with a fine zigzag median line; lid with a long, slender beak.

1. **Sematophyllum hawaiiense** (Brotherus) Brotherus, B. P. Bishop Mus., Bull. 40, p. 30, 1927 (fig. 173).
   Rhaphidostegium hawaiiense Brotherus, Denk. math.-natur. Kl. K. K. Akad. Wiss. Wien, vol. 89, p. 466, 1913.

Autoicous. In dense, yellowish green or dark vivid green mats, glossy. Stems prostrate, up to 2 cm. long, radiculose on the underside, densely branched, branches short, up to 6 or 8 mm. long, ascending. Branch leaves crowded, secund, lanceolate-subulate from an oblong base, concave, up to 1.5 mm. long by 0.4 mm. wide; margin minutely denticulate above, entire below, narrowly recurved on one or both sides near mid-leaf; costa none. Leaf cells narrowly linear, rather incrassate, 4 or 5 μ wide and 12 to 16 times as long, smooth, slightly vermicular, several rows across the insertion golden yellow, shorter and pitted, 3 or 4 cells at the basal angles greatly enlarged, oval or oblong, just above these a group of 6 to 10 small, irregularly quadrate cells. Perichaetium radiculose at base, inner leaves about 1 mm. long, ovate-lanceolate, gradually acuminate, margin sinuate in the upper half; seta erect, smooth, red below, paler above, flexuose, 6 to 9 mm. long; capsule horizontal, brown, oblong, urn 1 mm. long, exothecial cells short, very collenchymatous; peristome teeth yellowish brown, finely cross-striate, with a slender zigzag median line, hyaline and coarsely papillose at the tips, inner peristome pale yellow, papillose, basal membrane about half the height of the teeth, segments narrowly split along the median line; annulus none; lid 1 mm. long, with a long needle-like beak from a conic base; calyptra narrow, cucullate; spores yellowish, minutely papillose, up to 17 μ in diameter.

Trees, rocks, and stone walls, in shady places. Frequent on all the larger islands but apparently more abundant on Hawaii than elsewhere.

Endemic. Type locality, Kilauea, island of Hawaii.

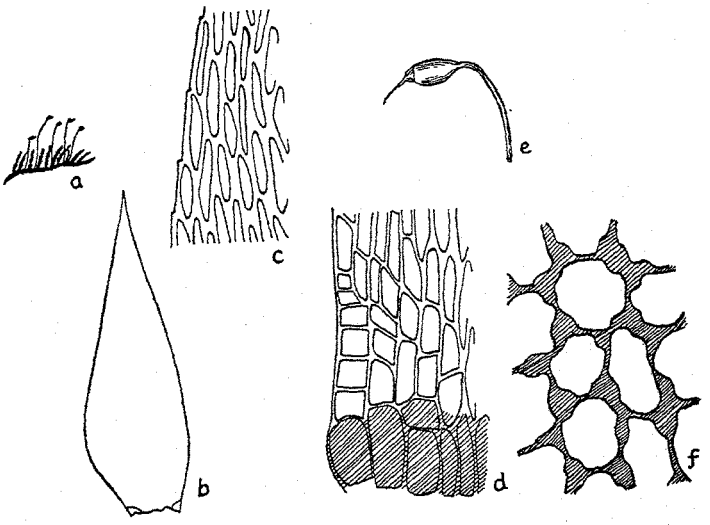


FIGURE 173. *Sematophyllum hawaiiense* (Brotherus) Brotherus: *a*, plant × ¾; *b*, leaf × 60; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300; *e*, capsule × 9; *f*, exothecial cells × 300.

This species will be recognized by the small size, the secund leaves with large, swollen alar cells, and the small capsules with long beaked lids. The fruit is often produced in great abundance.

97. ACROPORIUM Mitten, Jour. Linn. Soc., p. 182, 1868.

Rather robust, glossy plants growing in dense tufts or mats. Stems prostrate, branches ascending or erect. Leaves crowded, erect-spreading, ovate-lanceolate, escostate; cells linear, smooth, slightly porose, alar group very conspicuous, large and inflated. Seta slender, often scabrous above; capsule ovoid, erect or inclined; peristome double, the teeth finely cross-striate and furrowed along the median line; lid with a long, slender beak.

1. **Acroporium fusco-flavum** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., 2d ed., vol. 11, p. 436, 1925 (fig. 174).
   Pungentella fusco-flava C. Müller, Flora, vol. 82, p. 470, 1896.
   Sematophyllum fumarioli C. Müller, Nat. Ver. Bremen, vol. 16, p. 508, 1900.

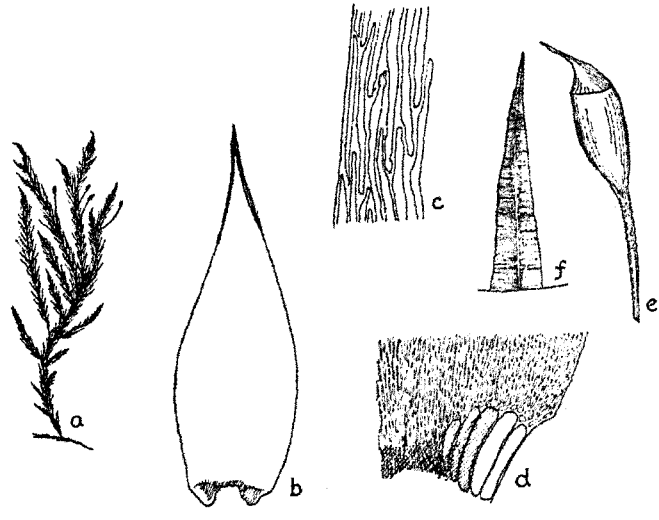


FIGURE 174. *Acroporium fusco-flavum* (C. Müller) Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 120; *e*, capsule × 12; *f*, peristome tooth × 120.

Synoicous. Plants in rather loose, deep tufts, glossy, yellowish green. Primary stems prostrate; secondary stems flexuose, decumbent or erect, rather robust, simple or irregularly branched, up to 5 cm. long, about 3 mm. wide with leaves. Leaves densely imbricated, erect to widely spreading, indistinctly secund, in cuspidate tufts at the tips, ovate-lanceolate, acuminate, slightly concave, about 2.5 mm. long by 0.8 mm. wide; margin entire except at the minutely denticulate apex, plane below, involute above; costa none; leaf cells smooth, narrowly linear, slightly vermicular, pitted, 4 or 5 μ wide by about 50 μ long, lateral walls pale, slightly incrassate; alar cells very conspicuous, abruptly enlarged and vesiculose, the outer pale or hyaline, the inner more strongly colored, usually of a rich, golden brown. Perichaetial leaves minute, erect, appressed,

abruptly acuminate, minutely denticulate above, about half the length of the stem leaves; seta reddish, flexuose, erect, about 7 mm. long, smooth below, usually minutely scabrous at the extreme apex; capsule erect or slightly inclined, oval-cylindric, brown, about 1 mm. long, slightly contracted under the mouth when dry, exothecial cells rectangular and strongly collenchymatous; peristome teeth pale yellow, finely and densely cross-striate, with a narrow furrow along the median line, segments of the inner peristome pale, keeled, slightly longer than the teeth, with several narrow apertures along the median line; annulus none; lid subulate-rostrate from a convex base, 0.6 mm. long, oblique; spores minutely papillate, up to 32 μ in diameter.

Frequent on trees and stumps in damp forests on all the larger islands. Endemic. Type locality, Molokai.

This species may be readily distinguished by the spreading, lustrous leaves, usually in conspicuous cuspidate tufts at the tips of the stems. It is a more robust plant than *Trichosteleum hamatum*, with broader, less distinctly secund leaves. When in fruit the almost smooth seta is an unmistakable character. Within somewhat narrow limits it is a variable species, but the forms intergrade so smoothly that I have found it impossible to segregate the varieties *cuspidissima* and *robusta* of Müller. *Acroporium capillariseta* (C. Müller) Brotherus seems, almost surely, to be one of the robust forms of *Trichosteleum hamatum* with smooth leaf cells.

The setae of *A. sigmatodontium* (C. Müller) Fleischer are more strongly and constantly scabrous above than in *A. fusco-flavum*. This distinction is admittedly slight, yet it seems to be constant enough in all the Hawaiian collections I have seen to warrant the continuance of Müller's name.

Typically *A. fusco-flavum* is a rather robust plant with densely imbricated leaves, narrowed to a straight, involute point. The more slender forms with elongated stems and secund leaves, spirally twisted at the apex, may be referred to the following variety, but the separation is by no means a clear one.

Acroporium fusco-flavum variety **baldwini** (C. Müller), new combination.

Pungentella Baldwini C. Müller, Flora, vol. 82, p. 471, 1896.

Plants slender; stems more elongate; leaves widely flexuose-spreading, with more or less spirally twisted points, often secund.

Type locality, western Maui.

With the same range as the typical form and possibly a variant confined to more moist, shaded situations.

98. TRICHOSTELEUM (Mitten) Jaeger, Adumb., vol. 2, p. 477, 1876-1877.

Sematophyllum section 3. *Trichosteleum* Mitten, Jour. Linn. Soc., vol. 12, p. 477, 1869.

Small or medium-sized plants. Stems prostrate, branches ascending. Leaves ovate-lanceolate, often falcate-secund, ecostate; cells narrow, slightly pitted, usually papillose over the lumens; alar cells large and inflated. Seta scabrous above; capsule horizontal or pendulous, cylindric; peristome double, the teeth with a median furrow; lid with a long, slender beak.

1. **Trichosteleum hamatum** (Dozy and Molkenboer) Jaeger, Adumb., vol. 2, p. 486, 1876-1877 (fig. 175).

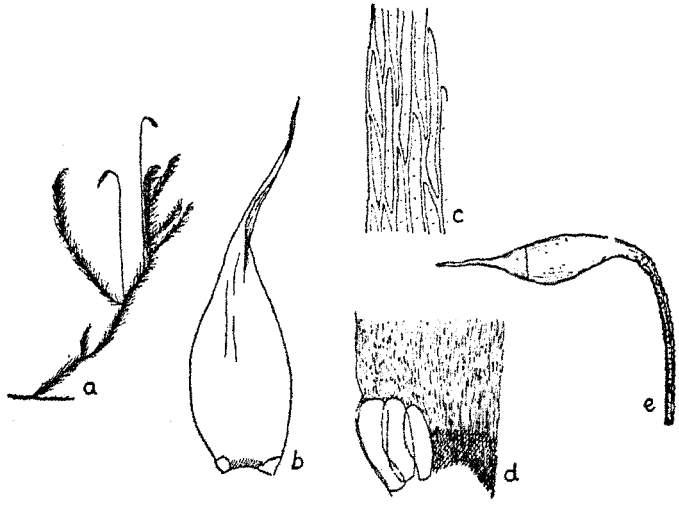


FIGURE 175. *Trichosteleum hamatum* (Dozy and Molkenboer) Jaeger: *a*, plant × ¾; *b*, leaf × 25½; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 120; *e*, capsule × 12.

Hypnum hamatum Dozy and Molkenboer, Ann. Sci. Nat., p. 307, 1844, and M. Frond., Archip. Ind., p. 11, 1844.

Hypnum Pickeringii Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 74, 1854.

Pungentella capillariseta C. Müller, Flora, vol. 82, p. 470, 1896.

Pungentella lepto-cylindrica C. Müller, Flora, vol. 82, p. 470, 1896.

Cupressina luridissima C. Müller, Flora, vol. 82, p. 473, 1896.

Pungentella semi-asperula C. Müller, Bull. Herb. Boiss. vol. 5, p. 852, 1897.

Acanthocladium hamatum C. Müller, Nat. Ver. Bremen, vol. 16, p. 507, 1900.

Sematophyllum microstichum Brotherus, Bull. Soc. Bot. Ital., p. 23, 1904.

Autoicous. Variable in color and habit, usually growing in dense rounded tufts or mats, pale, lurid green, glossy. Main stems prostrate, up to 4 or 5 cm. long, radiculose where in contact with the substratum, sparingly foliate with small reflexed leaves, sub-pinnately and irregularly branched, branches numerous, decumbent or ascending, usually hooked at the tips. Branch leaves crowded, more or less falcate secund, from an ovate or oblong-ovate concave base gradually narrowed to a lanceolate, acuminate, grooved point a little longer than the basal portion, up to 2.2 mm. long by 0.5 mm. wide; margin erect, minutely denticulate, sharply serrate toward the apex; costa none; upper leaf cells shortly linear or narrowly elliptic, about 5 μ wide and 6 to 10 times as long, with slightly sinuose or pitted, incrassate walls, papillose with a row of small papillae over the lumen, or smooth; basal cells longer, more pitted and usually smooth, as the basal angles 2 or 3 very large, oval-oblong, inflated hyaline cells about 100 μ long, across the insertion between the alar groups golden yellow. Inner perichaetial leaves from a long clasping base rapidly narrowed to a slender, sharply serrate point, up to 1.6 mm. long; seta slender, 1 to 1.5 cm. long, bright red, hooked at the top, smooth below, coarsely papillose or tuberculose for some distance below the capsule; capsule horizontal or pendulous, brown, urn 0.8 to 1 mm. long, cylindric, strongly contracted under the mouth when dry; peristome teeth yellowish brown, finely cross-striate except at the papillose tips, deeply furrowed along the median line; lid about 1 mm. long, with a slender needle-like beak from a conic base; spores yellowish, smooth, 12 to 18 μ in diameter.

Trees and banks, in wet forests. Frequent.

Distribution: Sunda Islands and Pacific islands. Type locality, Java.

The forms of this plastic species parallel those of *Taxithelium mundulum* as far as the papillae of the leaf cells are concerned, varying from distinctly papillose to essentially smooth, and seem to be no more amenable to satisfactory classification.

I agree thoroughly with Dixon (10, p. 299) that no practical distinction can be made between this species and *T. pickeringii* Sullivant. *T. hamatum* seems to have a wide range throughout the islands of the Pacific and no doubt includes a much more extensive synonymy than that given above, which applies only to the local forms.

The tuberculose seta, small cylindric capsule, and long beaked lid in connection with the falcate-secund leaves will identify the species without much trouble. *Acroporium fusco-flavum* is a more robust plant, differing in the nearly entire leaves, smoother setae, and synoicous inflorescence as well as in the constantly smooth leaf cells.

99. TAXITHELIUM Spruce, Catal., 1867.

Slender plants with prostrate stems growing in thin, flat mats. Leaves complanate, ovate-lanceolate, ecostate; cells long and very narrow, usually with a row of papillae over the lumens but often smooth in Hawaiian species; alar cells normally well differentiated, often inflated. Seta smooth; capsule short, inclined or horizontal; peristome double, the teeth not furrowed along the median line; lid short-beaked.

1. **Taxithelium mundulum** (Sullivant), new combination (fig. 176).
   Hypnum mundulum Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 75, 1854.
   Plagiothecium tenerrimum Ångström, Öfv. K. Vet. Akad. Förh., no. 4, p. 16, 1872.
   Taxicaulis catagonioides C. Müller, Flora, vol. 82, p. 469, 1896.
   Taxicaulis linearis C. Müller, Bull. Herb. Boiss., vol. 5, p. 852, 1897.
   Rhaphidostegium filirameum Brotherus, Bull. Soc. Bot. Ital., p. 22, 1904.
   Rhaphidorrhynchium integrifolium Brotherus, B. P. Bishop Mus., Bull. 40, p. 29, 1927.

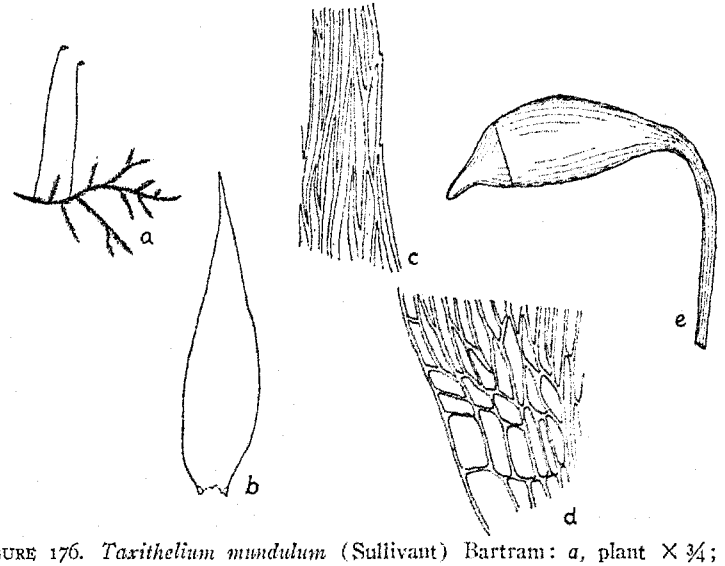


FIGURE 176. *Taxithelium mundulum* (Sullivant) Bartram: *a*, plant × ¾; *b*, leaf × 60; *c*, upper leaf cells and margin × 300; *d*, basal angle of leaf × 300; *e*, capsule × 25½.

Autoicous. Very slender, pale green, glossy plants growing in thin, flat mats. Stems creeping, up to 4 or 5 cm. long, sub-pinnately branched, branches numerous, complanate, widely spreading, about 1.5 mm. wide with leaves. Leaves erect-spreading, complanate, narrowly ovate-lanceolate from a constricted base, long and slenderly acuminate, concave, up to 1.5 mm. long by 0.3 mm. wide; margin erect, entire below, minutely denticulate to nearly entire above; costa none; leaf cells very long and narrow, slightly vermicular, thin-walled, 2 to 3 μ wide and 15 to 20 times as long, varying from smooth to plainly seriate-papillose, several rows across the extreme base shorter, alar cells about three, greatly enlarged, oblong, hyaline or yellowish. Inner perichaetial leaves up to 2.2 mm. long, from an oblong, clasping base quickly narrowed to a slender, flexuose, minutely denticulate point; seta slender, reddish, smooth, up to 2.5 or 3 cm. long; capsule inclined, short oblong, brown, gibbous at the back, constricted under the mouth when dry, urn 0.5 to 0.8 mm. long, exothecial cells short, slightly collenchymatous; peristome teeth yellowish brown, with a zigzag median line, finely cross-striate below, hyaline and coarsely papillose at the apex, basal membrane of inner peristome about half the height of the teeth, segments keeled, equaling the teeth; lid with a short, oblique beak from a conic base, about 0.25 mm. long; spores smooth, up to 17 μ in diameter.

Bark of living trees, logs, and damp rocks in shaded ravines and forests. Frequent on all the larger islands.

Endemic. Type locality, Puna, island of Hawaii.

This is a perplexing species from a taxonomic viewpoint on account of the variation in the papillae of the leaf cells. In some forms these papillae are well developed, but in others they are either so minute as to be scarcely visible, or entirely wanting. The instability of this character, together with a certain amount of variation in the denticulation of the leaves, has resulted in a rather involved series of synonyms. Comparative studies with a large series of collections have failed, however, to develop any workable plan by which the extremes can be separated from the chain of intermediate forms.

The short-beaked lid precludes *Rhaphidorrhynchium,* in spite of the similarity of leaf structure. The symmetrical leaves with large vesiculose alar cells will distinguish it at once from *Isopterygium albescens,* which it resembles very closely in the field.

100. GLOSSADELPHUS Fleischer, Laubm. Java, vol. 4, p. 1351, 1920.

Slender to rather robust plants growing in mats, mostly on damp rocks. Stems prostrate, irregularly or subpinnately branched. Leaves more or less complanate, ovate or oblong, rounded or acute; margin usually toothed; costa double and short or none; cells narrow, usually papillose on the back by the projecting ends. Seta smooth; capsule and peristome as in *Taxithelium*; lid short, conic, apiculate.

Differing from *Taxithelium* principally in the rounded or short-pointed leaves and the cells papillose at the ends.

Most of the following species are known only from sterile collections. The group of local species is a complex one and the species may be radically modified in the light of more detailed knowledge. It is a curious fact worth remarking that all the Hawaiian species, so far as known, are confined to the island of Maui.

1. Leaves entire or nearly so 2
   Leaves serrate or serrulate 3
2. Leaves obtuse, branches cuspidate at tips ..... **2. G. irroratus**
   Leaves rounded, branches blunt at tips ..... **1. G. mauiensis**
3. Leaves obtuse 4
   Leaves acute 5
4. Leaves narrowed at apex, cells smooth ..... **4. G. limnobioides**
   Leaves rounded and retuse, cells papillose ..... **3. G. baldwinii**
5. Alar cells none or very few ..... **6. G. zollingeri**
   Alar cells numerous, quadrate 6
6. Costa one-half of the leaf length ..... **5. G. chrysobasilaris**
   Costa none ..... **7. G. acutifolius**

1. **Glossadelphus mauiensis** Brotherus, B. P. Bishop Mus., Bull. 40, p. 31, 1927 (fig. 177).

Dioicous (?). Yellowish green, glossy plants growing in flat mats. Stems procumbent, up to 10 cm. long, not at all radiculose, irregularly branched, branches erect-spreading, blunt at the tips, about 2 mm. wide with leaves. Leaves crowded, erect-spreading, complanate, soft, more or less rugose when dry, broadly oblong, rounded at the apex, cochleariform-concave, 1.3 to 1.5 mm. long by 0.8 mm. wide; margin erect or broadly inflexed above, minutely crenulate at the extreme apex, entire below; costa double, strong, the forks nearly equal and extending to or beyond mid-leaf; leaf cells linear, smooth, 5 μ wide and 12 to 15 times as long, several rows across the insertion shorter, yellowish brown, without any differentiated alar cells. Fruit unknown.

Maui: on wet rocks, mountain ravines in western part of island, altitude 4,500 feet (Baldwin, type).

Endemic. Type locality, western Maui.

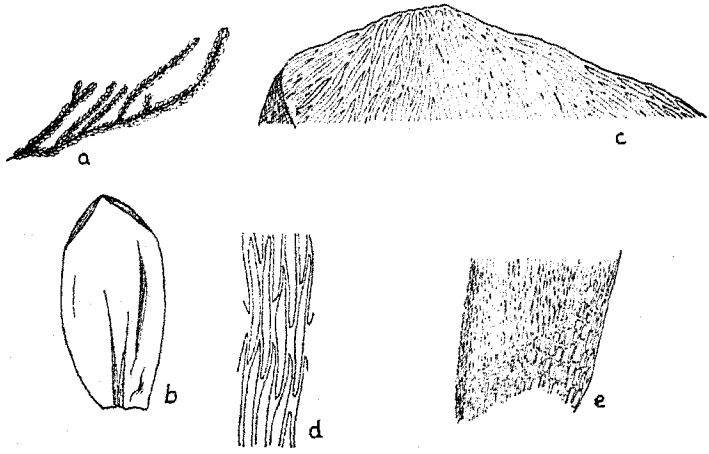


FIGURE 177. *Glossadelphus mauiensis* Brotherus: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 300; *d*, upper median leaf cells × 300; *e*, one side of leaf base × 120.

A very distinct species, readily known by the soft, deeply concave, nearly entire leaves, rounded at the apex. I have examined a number of leaves from the type collection but fail to find the quadrate alar cells mentioned in the original description and illustrated (2, fig. 24, *d*). In all the leaves I have seen the cells at the basal leaf angles are rectangular and scarcely distinguishable from the relatively lax cells of the extreme leaf base.

2. **Glossadelphus irroratus,** new species (fig. 178).

Caulis prostratis, laxe foliosis, ramis cuspidatis. Folia oblongo-ovata, obtusa, nec rotundata.

Dioicous (?). Bright glossy green plants tinged with brown, growing in thin, flat mats. Stems prostrate, up to 7 cm. long, not radiculose, sub-pinnately branched, branches erect-spreading, about 2 mm. wide with leaves, cuspidate at the tips. Leaves

erect-spreading, complanate, oblong-ovate, obtuse, concave, 1.5 mm. long by 0.6 mm. wide; margin erect, entire or very minutely crenulate at the extreme apex; costa and leaf cells as in *G. mauiensis*. Fruit unknown.

Type: wet rocks in stream, Kula pipe line trail, northeast of Olinda, altitude 4,200 feet, February 11, 1930, E. B. Bartram, number 556 .

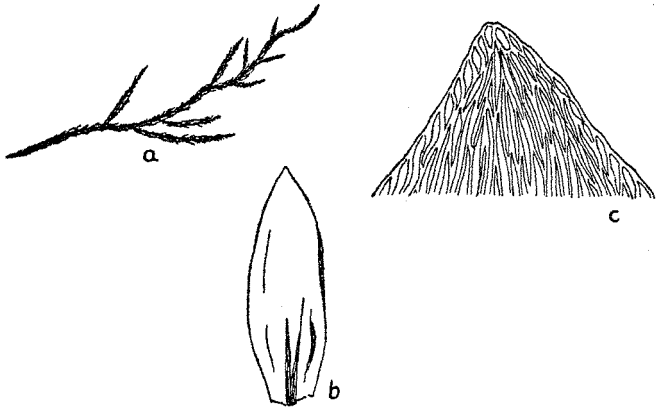


FIGURE 178. *Glossadelphus irroratus* Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 300.

Close to *G. mauiensis* but more laxly foliate, the branch tips cuspidate, the leaves less flaccid, obtusely pointed at the apex, not rounded.

3. **Glossadelphus baldwinii** Brotherus, B. P. Bishop Mus., Bull. 40, p. 31, 1927 (fig. 179).
Chaetomitrium taxithelioides Brotherus, Bull. Soc. Bot. Ital., p. 16, 1904.

Dioicous. Relatively robust plants, yellow-green, slightly glossy. Stems prostrate, slightly radiculose where applied to the substratum, irregularly pinnate, branches 1 cm. or less long, 1.5 to 2 mm. wide with leaves. Leaves soft, somewhat crowded, widely spreading, complanate, oblong-ligulate, broadly rounded or retuse at the apex, about 1 mm. long by 0.4 mm. wide, concave; margin erect, distantly denticulate in the lower half, coarsely serrate with simple and bifid teeth at the apex; costa short and double or none; leaf cells linear, 4 or 5 μ wide and 12 to 15 times as long, spiculose-papillose on both sides by the projecting end walls, a few rows at the extreme base slightly shorter and broader, without any differentiated alar cells. Perichaetial leaves erect, lanceolate, acuminate, from an ovate base, spinose serrate with simple and bifid teeth in the upper half; seta erect, flexuose, smooth, reddish, about 2.5 cm. long; capsule short oval, rounded on the upper side, 1.5 mm. long by 1 mm. wide, mouth oblique; lid 1 mm. long, short apiculate from a conic base.

Maui: Olowalu crater, on rocks, altitude 800 feet (Baldwin, type).
Endemic. Type locality, Olowalu crater, Maui.

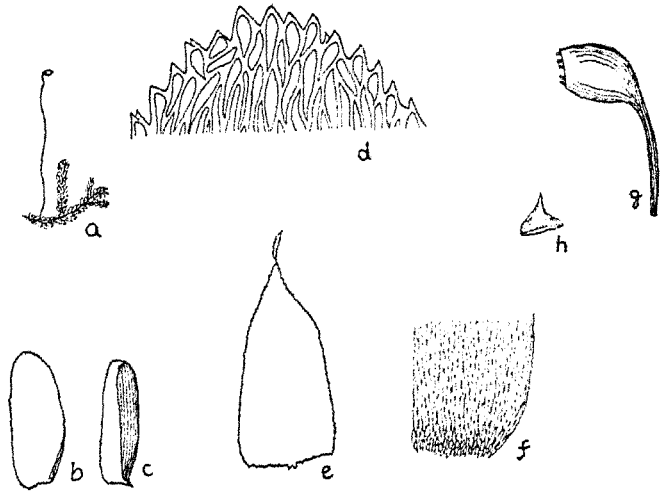


FIGURE 179. *Glossadelphus baldwinii* Brotherus: *a*, plant × ¾; *b*, *c*, stem leaves × 25½; *d*, apex of leaf × 300; *e*, perichaetial leaf × 25½; *f*, one side of leaf base × 120; *g*, capsule × 9; *h*, lid × 9.

A commonplace-looking species to the naked eye but distinctive under the microscope in the oblong leaves, broadly rounded or retuse and coarsely serrate at the apices.

4. **Glossadelphus limnobioides** Brotherus, B. P. Bishop Mus., Bull. 40, p. 32, 1927 (fig. 180).
Entodon limnobioides Brotherus, Bull. Soc. Bot. Ital., p. 17, 1904.

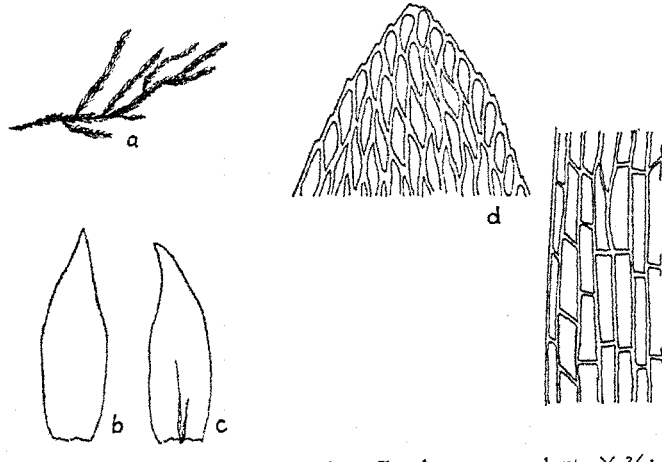


FIGURE 180. *Glossadelphus limnobioides* Brotherus: *a*, plant × ¾; *b*, *c*, leaves × 25½; *d*, apex of leaf × 300; *e*, basal angle of leaf × 300.

Robust plants growing in dense mats, yellowish green and glossy in the younger parts, sordid green below. Stems procumbent, up to 6 cm. long, irregularly branched, branches erect-spreading, flexuose, about 2 cm. long, 2 mm. wide with leaves. Leaves erect-spreading or slightly secund, more or less spirally twisted when dry, oblong-ovate, obtuse, slightly concave, 1.5 mm. long by 0.4 mm. wide; margin erect, serrulate in the upper half, denticulate below; costa variable, from almost none to unequally forked with one prong extending nearly to mid-leaf; upper cells linear, thin-walled, smooth, rather obscure, 7 to 8 μ wide and 5 to 7 times as long, shorter in the point, toward the base longer and narrower with firmer walls, without any differentiated alar cells. Fruit unknown.

Maui: Haleakala (Baldwin, type); ditch trail in eastern part of island, damp rocks, altitude 1,000 feet (Bartram).

Endemic. Type locality, Haleakala, Maui.

The distinctive characters of this species consists of the obtuse, not broadly rounded, leaves, plainly serrate above.

5. **Glossadelphus chrysobasilaris** Brotherus, B. P. Bishop Mus., Bull. 40, p. 31, 1927 (fig. 181).

Microthamnium chrysobasilare Brotherus, Bull. Soc. Bot. Ital., p. 20, 1904.

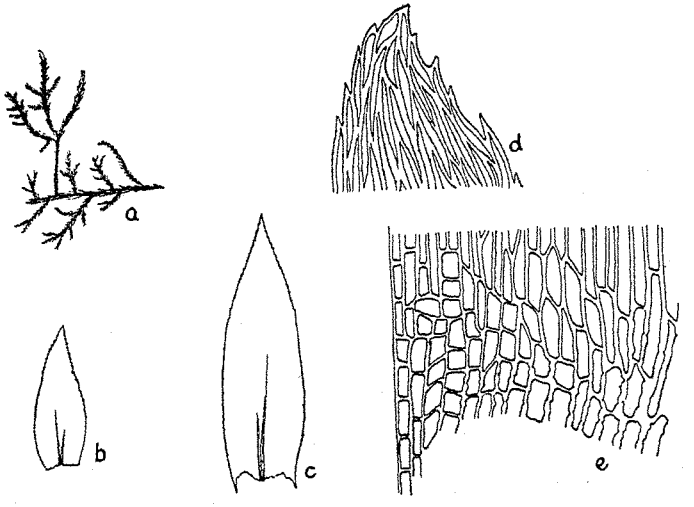


FIGURE 181. *Glossadelphus chrysobasilaris* Brotherus: *a*, plant × ¾; *b*, branch leaf × 25½; *c*, stem leaf × 25½; *d*, apex of branch leaf × 300; *e*, basal angle of stem leaf × 300.

Dioicous (?). Slender, rigid plants, pale yellow and very glossy in the younger parts, light brown below. Stems prostrate, reddish, without radicles, bipinnately branched, branches rigidly spreading, complanate, about 2 mm. wide with leaves. Stem leaves and leaves of the primary branches erect-spreading, transversely undulate toward the tips when dry, oblong-ovate, short acuminate, decurrent, slightly concave, up to 2 mm. long by 0.6 mm. wide; branch leaves more widely spreading, shorter, acute, scarcely decurrent;

margin erect or narrowly reflexed near the apex, sharply serrate in the upper half, distantly serrulate below; costa variable, double or single with short lateral prongs near the base, extending about halfway up the leaf; leaf cells very narrow, vermicular, 2 or 3 μ wide and 15 to 20 times as long, papillose on the back by the projecting end walls, lateral walls firm, at the extreme base much shorter, incrassate, with sinuose walls, alar cells oval-quadrate, rather numerous. Fruit unknown.

Maui: mountain ravines in western part of island, altitude 4,500 feet (Baldwin, type).

Endemic. Type locality, western Maui.

A handsome moss distinguished from the associated species by the rigid habit, bipinnate branching, and pale yellow color. Its affinities may prove to be with some other genus when the sporophyte characters are known.

6. Glossadelphus zollingeri (C. Müller) Fleischer variety **filicaulis** (Fleischer) Fleischer, Laubm. Java, vol. 4, p. 1356, 1920 (fig. 182).

? *Rhynchostegium limbelloides* C. Müller, Flora, vol. 82, p. 475, 1896.

Ectropothecium filicaule Fleischer, Hedwigia, vol. 44, p. 326, 1906.

Trichosteleum pilotrichelloides Brotherus, Bull. Soc. Bot. Ital., p. 25, 1904.

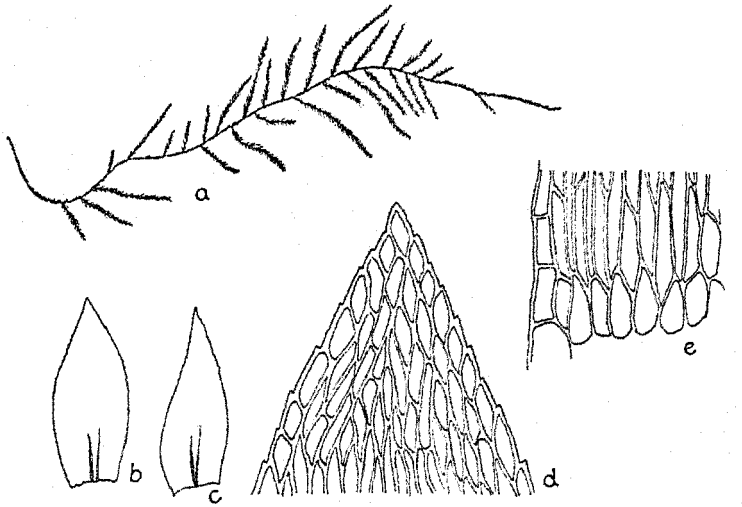


FIGURE 182. *Glossadelphus zollingeri* (C. Müller) Fleischer variety *filicaulis* (Fleischer) Fleischer: *a*, plant × ¼; *b*, *c*, leaves × 25½; *d*, apex of leaf × 300; *e*, basal angle of leaf × 300.

Dioicous. Slender plants growing mats, yellowish or sordid green, glossy. Stems filiform, up to 10 cm. or more long, attenuate and flagelliform at the tips, pinnately branched, branches numerous, widely spreading, up to 1.5 cm. long, laxly foliate, 1.5 mm. wide with leaves, often flagelliform. Leaves erect-spreading, lightly twisted and contorted when dry, complanate when moist, ovate, acute, 0.9 to 1.1 mm. long by 0.5 mm. wide; concave; margin erect, bluntly denticulate all around; costa none, or double and

extending about one-third up the leaf; leaf cells linear, thin-walled, smooth, the upper 5 or 6 μ wide and 6 to 8 times as long, more elongated toward the base, without any differentiated alar cells. Sporophyte unknown.

Maui: Iao Valley, frequent (Bartram).

Distribution: Java. Type locality, Java.

Characterized by the slender habit and small acute leaves. As far as the vegetative structure is concerned, the Hawaiian plants seem to be identical with those from Java.

The only collection of *Rhynchostegium limbelloides* C. Müller is in poor condition but seems to be in no way different from the other collections referred here.

7. **Glossadelphus acutifolius,** new species (fig. 183).

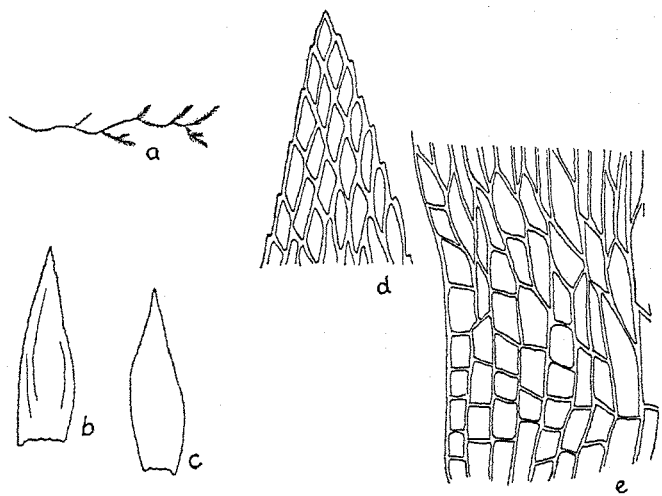


FIGURE 183. *Glossadelphus acutifolius* Bartram: *a*, plant × ¾; *b*, *c*, leaves × 25½; *d*, apex of leaf × 300; *e*, basal angle of leaf × 300.

Gracilis, nitidiusculis. Caulis prostratus, filiformis, ramosus. Folia ovato-lanceolata, acuminata, asymmetrica, denticulata; cellulis linearibus, basilaribus laxioribus, alaribus numerosis, quadratis.

Dioicous (?). Slender, wiry plants in thin, very intricate mats, bright green and glossy above, brownish below. Stems filiform, denuded of leaves in the older parts, densely and irregularly branched, branches short, about 1 mm. wide with leaves, often slender and flagelliform. Leaves erect-spreading, complanate with decurved points, occasionally slightly falcate-secund, 1 mm. long by 0.4 mm. wide, ovate-lanceolate, short acuminate, concave, the lateral rows more or less asymmetrical; margin erect, denticulate all around; costa none or very short and double; leaf cells linear, 5 μ wide and 10 to 14 times as long, at the extreme base shorter, broader and irregular, alar cells quadrate, forming a triangular group extending 5 or 6 cells up the margin and about halfway to the costa. Fruit unknown.

Type: Maui, damp rock, Kula pipe line trail, altitude 4,000 feet, E. B. Bartram, number 533, February 11, 1930.

Resembling *G. zollingeri* variety *filicaulis* but with shorter stems, more slenderly pointed leaves, and a distinct group of quadrate alar cells.

Family 34. HYPNACEAE

Plants usually glossy, of variable size. Stems prostrate, usually pinnately branched. Leaves ovate or ovate-lanceolate, acuminate; costa double and short or none; cells mostly linear, prosenchymatous, smooth or minutely papillose by the projecting ends, alar cells small, not well differentiated. Seta slender, elongate, smooth; capsule ovoid, usually horizontal or pendulous; peristome double, the teeth finely cross-striate, with a zigzag median line; segments of the inner peristome from a relatively high basal membrane, usually with intermediate cilia; lid short, apiculate; calyptra cucullate, spores small.

1. Leaf cells lax, thin-walled, up to 15 or 18 μ wide.....**103. Vesicularia**
   Leaf cells firm, narrow.....2
2. Leaves entire or nearly so.....**102. Isopterygium**
   Leaves serrulate above or all around.....3
3. Leaves decurrent, capsule short, pendulous.....**101. Ectropothecium**
   Leaves with fragile, decurrent auricles, capsule oblong, horizontal.....**104. Ctenidium**

101. ECTROPOTHECIUM Mitten, Jour. Linn. Soc., p. 22, 1868, and 108 in part.

Slender glossy plants with prostrate stems, regularly pinnate or irregularly branched. Leaves ovate-lanceolate, falcate, ecostate; cells linear, often minutely papillose by the projecting ends, more lax below, alar cells few, indistinct. Seta smooth, elongate; capsule short; peristome normal; calyptra cucullate, naked or sparsely hairy.

1. Leaves less than 1 mm. long, serrulate all around.....**3. E. viridifolium**
   Leaves about 1.5 mm. long, serrulate above, entire below.....2
2. Stems elongate, regularly pinnate.....**1. E. arcuatum**
   Stems short, irregularly branched.....**2. E. sandwichense**

1. Ectropothecium arcuatum (Sullivant) Mitten, in Seeman, Fl. Vit., p. 400, 1873 (fig. 184).

Hypnum arcuatum Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 74, 1854.
Cupressina micro-hemisphaerica C Müller, Flora, vol. 82, p. 472, 1896.
Cupressina hawaiico-cupressiformis C. Müller, vol. 82, p. 472, 1896.
Cupressina tristissima C. Müller, Flora, vol. 82, p. 473, 1896.

Autoicous. Slender plants in extensive, thin mats, pale green or yellowish, glossy. Stems up to 8 or 10 cm. long, prostrate, radiculose on the under side and closely applied to the substratum, densely and regularly pinnately branched, branches short, complanate. Leaves laxly imbricated, widely spreading, complanate with falcate points, from a broad insertion narrowly ovate-lanceolate, slenderly acuminate, concave; margin erect, subentire toward the base, serrulate above; costa none; leaf cells linear, dense, thin-walled, smooth or minutely papillose on the back by projecting ends, 3 or 4 μ wide and 15 to 20 times as long, slightly wider and shorter in the point and toward the base, with a single row of enlarged, pellucid, oval cells across the insertion and 1 to 3 still larger, hyaline, very fragile cells at the extreme basal angles. Inner perichaetial leaves about 2.5 mm. long, erect, from an oblong, laxly areolate base quickly narrowed to a long, slender, flat serrulate point; seta slender, reddish, up to 2 or 3 cm. long, curved or hooked at the top; capsule pendulous, short oval or oblong, wide-mouthed, constricted under the mouth when dry; lid variable, broadly convex and apiculate to conic; calyptra slightly hairy when young.

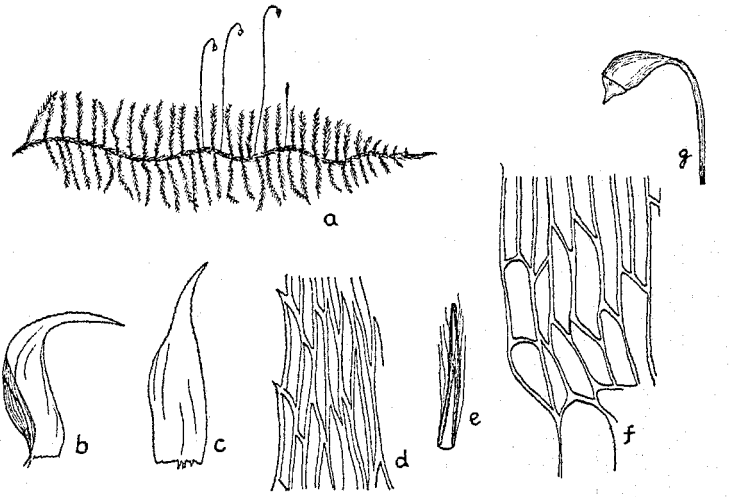


FIGURE 184. *Ectropothecium arcuatum* (Sullivant) Mitten: *a*, plant × ¾; *b*, lateral branch leaf × 25½; *c*, median branch leaf × 25½; *d*, upper leaf cells and margin × 300; *e*, calyptra × 9; *f*, basal angle of leaf × 300; *g*, moist capsule × 9.

Damp rocks. Oahu: Kawaiiki ditch trail, Koolau Range (Skottsberg); Tantalus, on damp stone wall (Bartram). Maui: Haleakala (Baldwin); Honokohau ditch trail (Bartram); mountain in western part of island, rocks (Baldwin). Island of Hawaii: crater of Kilauea, damp rocks in cave (Bartram). Kauai: (Brodie).

Endemic. Type locality, eastern Maui.

When well-developed the elongated, densely and regularly pinnately branched stems readily separate this plant from *E. sandwichense*. I have not seen the types of the three species described by Müller, but there are certainly no tangible characters in the respective descriptions by which they

can be satisfactorily separated. The capsules are subject to considerable variation in form which depends to some extent, but not entirely, on the degree of maturity. I have not succeeded in correlating these capsule forms with any other characters and am not convinced that they have any particular value as a means of classification. Brotherus (5, p. 457) distinguishes these species from *E. arcuatum* by the shorter setae and more narrowly hooked capsules. In a good series of specimens these characters seem to be too inconstant for practical use.

The enlarged hyaline cells at the leaf angles of this and the following species are extremely delicate and generally remain attached to the stem when the leaves are removed. Among a number of leaves a few will usually be found with these hyaline cells plainly evident.

2. **Ectropothecium sandwichense** (Hooker and Walker Arnott) Mitten, in Seeman, Fl. Vit., p. 400, 1873 (fig. 185).

Hypnum sandwichense Hooker and Walker Arnott, Beechey, Voy., Bot., p. 109, 1841.

Hypnum paucipilum Sullivant, Bull. Tor. Bot. Club, vol. 5, p. 11, 1878.

Cupressina trachylocarpa C. Müller, Flora, vol. 82, p. 478, 1896.

Autoicous. Growing in thin, pale green mats, glossy. Resembling *E. arcuatum*, but with shorter, more irregularly branched stems. Setae variable in length, but averaging 16 to 20 mm. long, reddish below, paler above; capsules pendulous or abruptly hooked, short oval or oblong, constricted under the mouth and more or less asymmetrical when dry; lid broadly convex, apiculate; calptra usually slightly hairy when young.

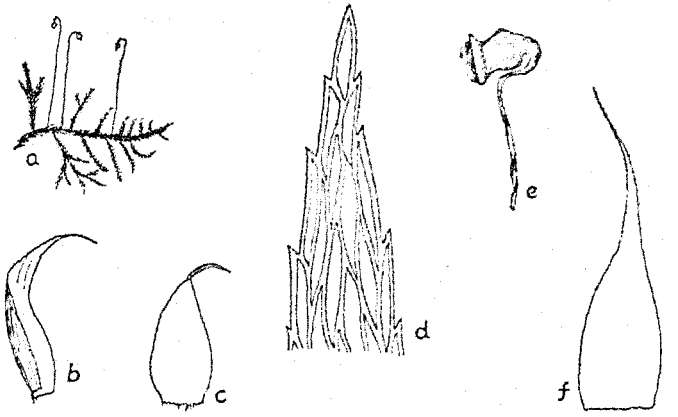


FIGURE 185. *Ectropothecium sandwichense* (Hooker and Walker Arnott) Mitten: *a*, plant × ¾; *b*, lateral branch leaf × 25½; *c*, median branch leaf × 25½; *d*, apex of leaf × 300; *e*, dry capsule × 9; *f*, inner perichaetial leaf × 25½.

Wet rocks and trees. More abundant than *E. arcuatum* and of frequent occurrence on all the larger islands.

Distribution: Australia, New Zealand, Pacific islands from Fiji to Hawaii. Type locality, Hawaii.

Variable in size and branching. The more regularly pinnate forms are difficult to separate from *E. arcuatum* with any degree of satisfaction. Occasional plants are found in which the young calyptrae are naked, but in the absence of any correlating characters it seems inadvisable to segregate this form in any systematic way. Plants from the type collection of *C. trachylocarpa,* which I have seen, are certainly to be referred here.

3. **Ectropothecium viridifolium,** new species (fig. 186).

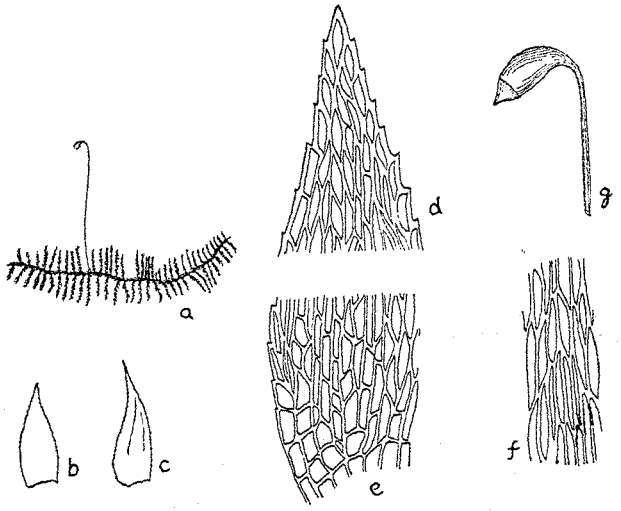


FIGURE 186. *Ectropothecium viridifolium* Bartram: *a,* plant × ¾; *b, c,* leaves × 25½; *d,* apex of leaf × 300; *e,* basal angle of leaf × 300; *f,* median leaf cells × 300; *g,* moist capsule × 9.

Autoicum; gracilescens, caespitibus depressis, viridibus. Caulis repens, ad 5 cm. longus, hic illic parce radiculosus, pinnatim ramosus, ramis brevibus, complanatis. Folia enervia, lateralia complanato-patula, concava, ovata-lanceolata, acuminata, ad 0.8 mm. longa, toto ambitu serrulata; cellulis linearibus, ad 3-4 μ latis et 40-60 μ longis, folia media breviora, cellulis brevioribus, alaribus haud diversis. Seta ad 2 cm. alta, tenuissima, rubra; theca parva, oblonga, nutans, macrostoma.

Autoicous. Slender, dark green plants in thin mats, hardly glossy. Stems up to 4 or 5 cm. long, prostrate, slightly radiculose, densely pinnately branched, branches short and complanate. Leaves small, closely imbricated, the lateral rows complanate, spreading, with decurved points, ovate-lanceolate from a broad insertion, rather sharply acuminate, 0.7 to 0.8 mm. long by about 0.3 mm. wide, the median rows erect, slightly smaller, with shorter, broader points; margin plane, serrulate nearly all around; costa none; upper leaf cells of the lateral leaves 3 or 4 μ wide and 10 to 15 times as long, smooth, not differentiated at the insertion or at the basal angles; areolation of the median leaves shorter, 4 to 8 times as long as broad and uniform throughout the leaf. Inner perichaetial leaves about 2 mm. long, erect, sheathing, long acuminate, laxly

areolate at the base; seta 2 cm. long, reddish below, paler above; capsule pendulous, short oblong, urn 0.8 mm. long, constricted under the wide mouth, greenish brown; lid apiculate from a broad, convex base; calptra naked.

Type: shaded rock face, Waikane-Schofield trail, Koolau Range, Oahu, January 19, 1930, E. B. Bartram, number 135. Also from Hillebrands Glen, Oahu (Forbes).

Distinguished from both *E. arcuatum* and *E. sandwichense* by the shorter, less falcate leaves, serrulate all around, the shorter, more chlorophyllose leaf cells, and the lack of any differentiated alar cells.

102. ISOPTERYGIUM Mitten, Jour. Linn. Soc., vol. 12, p. 21, 1869.

Slender or medium-sized, usually glossy plants, growing in mats. Stems prostrate, irregularly branched. Leaves ovate or ovate-lanceolate; costa short and double or none; cells linear, usually smooth, more lax below, alar cells seldom well differentiated. Seta smooth, elongate; capsule small, usually inclined or horizontal; peristome normal; lid conic.

Leaves up to 1.8 mm. long, ovate, short pointed.....1. **I. vineale**
Leaves less than 1 mm. long, slenderly acuminate.....2. **I. albescens**

1. Isopterygium vineale, new species (fig. 187).

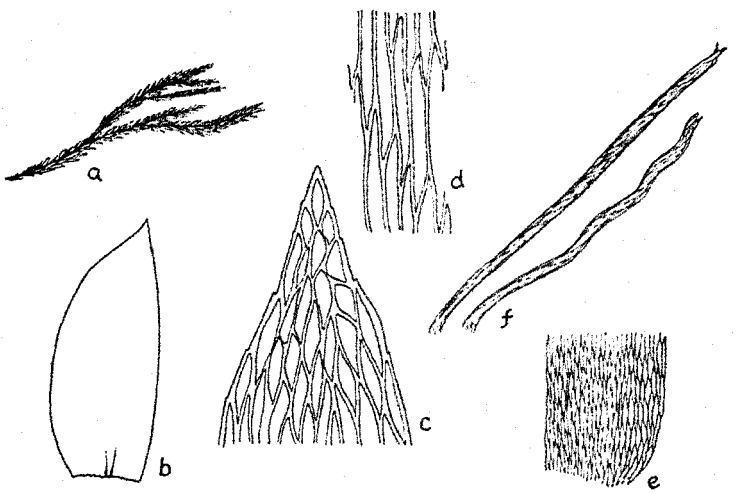


FIGURE 187. *Isopterygium vineale* Bartram: *a*, plant × ¾; *b*, leaf × 25½; *c*, apex of leaf × 300; *d*, median leaf cells × 300; *e*, one side of leaf base × 120; *f*, 2 propagula × 120.

Dioicum; robustiusculum, viride vel purpuracentibus, nitidum; caulis ad 6 cm. longus, ramosus, superne propagulis numerosis filiformis instructis. Folia ovata, complanata, breviter acuminata; marginibus planis, superne denticulatis; nervis binis, brevibus vel nullis; cellulis anguste linearibus, alaribus nullis.

Robust plants in dense mats, bright green and glossy above, brown below, often variegated with vinous red. Stems up to 6 cm. or more long, prostrate, dichotomously branched, about 3 mm. wide with leaves, sparingly radiculose below; frequently with copious clusters of filiform propogula, up to 0.7 mm. long, in the axils of the upper leaves. Leaves crowded, spreading, complanate, slightly shrunken and flexuose when dry, erect-spreading when moist, asymmetrical, ovate, short acuminate, slightly concave, about 1.8 mm. long by 0.8 mm. wide; margin erect, denticulate toward the apex, entire below; costa short and double or none; leaf cells 4 to 6 μ wide and 15 to 20 times as long, smooth, much shorter at the apex, broader, shorter and chlorophyllose at the extreme base without any differentiated alar cells. Sporophyte unknown.

Type: damp bank, Kula pipe line trail, northeast of Olinda, altitude 4,200 feet, February 11, 1930, E. B. Bartram, number 571-a.

Shallow pockets in steep, damp banks. Molokai: west of Pepeopae (Degener and Weibke). Maui: Kula pipe line trail, damp banks, frequent (Bartram); Haleakala, east of Ukulele (Forbes); Honokohau ditch trail (Bartram). Kauai: vicinity of Kokee, frequent (Bartram).

Similar in many respects to *I. arquifolium* (Lacoste) Jaeger, of the East Indies, but readily distinguished by the more robust habit, longer leaf cells, and the abundant filiform propagula in the upper leaf axils, similar in structure to those of *I. elegans.*

2. **Isopterygium albescens** (Schwaegrichen) Jaeger, Adumb., vol. 2, p 499, 1876-1877 (fig. 188).

Hypnum albescens Schwaegrichen, Suppl. 3, pt. 1, fasc. 2, tab. 226, 1828.

Hypnum molliculum Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 78, 1853.

Plagiothecium Anderssoni, Ångström, Öfv. K. Vet.-Akad. Förh., no. 4, p. 15, 1872.

Taxicaulis hawaiicus C. Müller, Flora, vol. 82, p. 469, 1896.

Autoicous. Slender, pale green or whitish green, glossy plants, in thin, intricate, feathery mats. Stems up to 3 cm. long, prostrate, irregularly branched, with small scattered tufts of brownish radicles, surface cells about 10 μ wide. Leaves distant, complanate, widely spreading both moist and dry, slightly asymmetrical, ovate-lanceolate, slenderly acuminate, concave, 0.8 to 0.9 mm. long by about 0.25 mm. wide; margin erect and minutely denticulate or entire; costa none; leaf cells linear, pale, slightly vermicular, smooth, 3 or 4 μ wide and about 20 times as long, slightly broader and shorter at the insertion, usually with 2 or 3 small subquadrate cells at the basal angles. Perichaetium densely radiculose at base, inner leaves abruptly filiform-acuminate from an ovate, deeply concave, laxly areolate base; seta filiform, reddish, 15 to 18 mm. long, hooked at the top; capsule oval, short and turgid, brown, strongly constricted under the mouth when dry and empty, urn 0.5 to 0.6 mm. long, exothecial cells rounded-quadrate, slightly collenchymatous; peristome teeth pale yellow with hyaline tips, finely cross-striate, inner peristome pale, papillose, basal membrane about half the height of the teeth, segments narrow, keeled, cilia solitary, nodose, slightly shorter than the segments; annulus none; lid short conic, bluntly apiculate, a scant 0.5 mm. long, slightly rough at the tip by the protruding cells; calyptra cucullate; spores pale yellow, smooth, 10 to 12 μ in diameter.

Logs and fallen trunks of tree ferns, in woods. Frequent on all the larger islands.

Distribution: Indo-Malayan regions and Pacific islands. Type locality, Nepal.

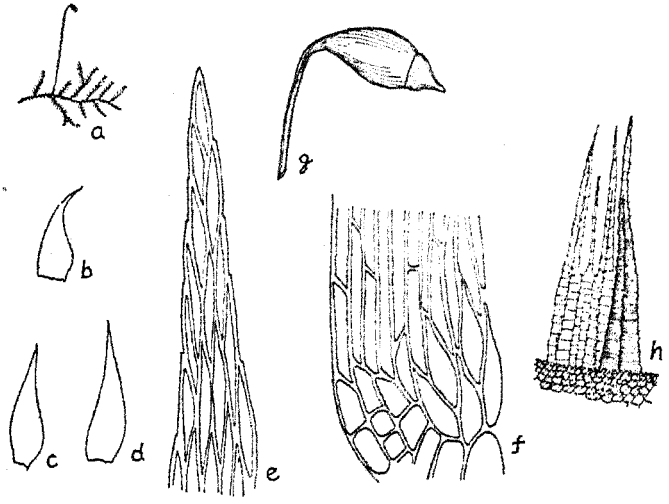


FIGURE 188. *Isopterygium albescens* (Schwaegrichen) Jaeger: *a*, plant × ¾; *b*, *c*, *d*, leaves × 25½; *e*, apex of leaf × 300; *f*, basal angle of leaf × 300; *g*, capsule × 12; *h*, part of peristome × 120.

A very delicate little moss not likely to be confused with any other species but *Taxithelium mundulum*, from which it can easily be separated by the asymmetrical leaves without any enlarged, vesiculose alar cells. The thin, pale mats are usually more feathery and looser than *T. mundulum* on account of the distant, more widely spreading leaves.

103. VESICULARIA (C. Müller) C. Müller, Flora, vol. 82, p. 407, 1896.

Omalia subsection 1. *Vesicularia* C. Müller, Syn., vol. 2, p. 233, 1851.

Rather slender, scarcely glossy plants with long sub-pinnately branched prostrate stems. Leaves ovate, complanate, ecostate; cells oval-rhomboidal, very lax, thin-walled. Sporophyte as in *Ectropothecium*.

1. **Vesicularia graminicolor** (Ångström) Brotherus, B. P. Bishop Mus., Bull. 40, p. 33, 1927 (fig. 189).

   Hypnum graminicolor Ångström, Öfv. K. Vet. Akad. Förh., no. 4, p. 15, 1872.

Hookeria sandvicensis Reichardt, Sitz. K. K. Akad. Wiss. Wien, vol. 75, p. 576, 1877.

Hypnum perviride Ångström, Öfv. K. Vet. Akad. Förh., p. 151, 1873.

Vesicularia sandwichensis C. Müller, Flora, vol. 82, p. 467, 1896.

Vesicularia condensatula C. Müller, Flora, vol. 82, p. 467, 1896.

Vesicularia rhynchostegiopsis C. Müller, Flora, vol. 82, p. 468, 1896.

Vesicularia Hanapepeana C. Müller, Bull. Herb. Boiss, vol. 5, p. 852, 1897.

Ectropothecium flaccidulum Brotherus, Bull. Soc. Bot. Ital., p. 17, 1904.

Autoicous. Growing in large flat mats, dark green or yellowish green, scarcely glossy. Stems variable, up to 10 cm. or more long, with small scattered tufts of radicles on the under side, creeping, pinnately branched, branches numerous, widely spreading, complanate, up to 2 cm. long. Leaves crowded, complanate, slightly shrunken and twisted when dry, the lateral rows widely spreading, broadly ovate, abruptly narrowed to a short but variable acumen, concave, slightly asymmetrical, up to 1.4 mm. long by 0.6 mm. wide; margin erect, entire or minutely denticulate toward the apex; costa none; median rows of leaves on both the dorsal and ventral sides of the stem slightly smaller, symmetrical, with shorter points. Leaf cells very lax, thin-walled, oval-rhomboidal, 15 to 18 μ wide by 2 or 3 times as long, the marginal row on one or both sides linear, more elongated toward the base, usually a few cells at the basal angles short rectangular or subquadrate but not well differentiated. Inner perichaetial leaves erect, 2 to 2.5 mm. long, from an oblong base gradually narrowed to a long setaceous point; seta up to 2.5 cm. long, reddish, smooth, hooked at the top; capsule horizontal or pendulous, short oblong, brown, urn 1.5 mm. long, constricted under the mouth when dry; lid short conic, apiculate, 0.6 mm. long; calptra smooth; spores smooth, up to 12 μ in diameter.

Wet, shaded rocks and banks. Frequent on all the large islands. Endemic. Type locality, Honolulu, Oahu.

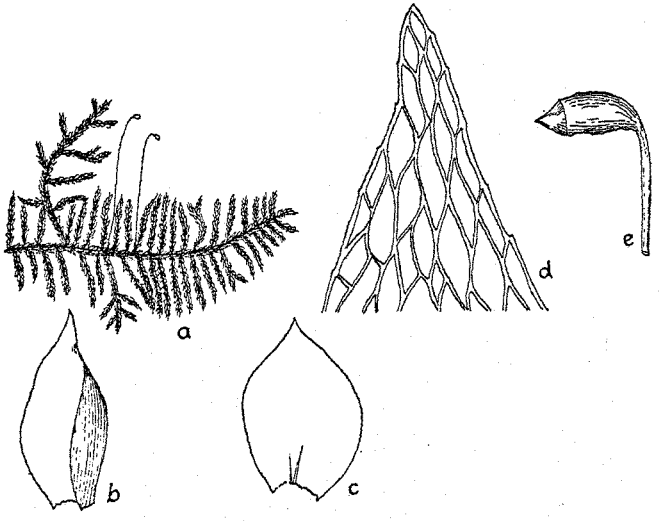


FIGURE 189. *Vesicularia graminicolor* (Ångström) Brotherus: *a*, plant × ¾; *b*, *c*, leaves × 25½; *d*, apex of leaf × 300; *e*, moist capsule × 9.

Although a variable species in color, size, and habit, it is easily distinguished from *Ectropothecium* by the wide, lax leaf cells. It is, as a rule, a smaller, less glossy plant than *V. inflectens* (Bridel), but as the species of this genus are all closely allied it is difficult to find any sharp lines of demarcation. The dull color, pinnate branching, and complanate leaves give the plants a characteristic appearance that quickly becomes familiar in the field.

104. CTENIDIUM (Schimper) Mitten, Linn. Soc., Jour., vol. 12, p. 509, 1869.

Hypnum subgenus *Ctenidium* Schimper, Syn. 1st ed., p. 631, 1860.

Robust or slender glossy plants growing in feathery masses. Stems procumbent, rather regularly pinnate. Leaves lanceolate from a cordate-auriculate base, serrulate all around, decurrent at the basal angles; costa short and double or none; cells long and narrow, in the decurrent auricles shorter and sub-hyaline. Seta elongate, smooth; capsule oblong, horizontal; peristome normal; lid conic; calyptra often slightly hairy.

Robust plants, branches not flagelliform.....1. **C. decurrens**
Slender plants, ultimate branches filiform-attenuate, microphyllous.....2. **C. elegantulum**

1. **Ctenidium decurrens** (Sullivant) Brotherus, B. P. Bishop Mus., Bull. 40, p. 33, 1927 (fig. 190).

   Hypnum decurrens Sullivant, Proc. Am. Acad. Arts Sci., vol. 3, p. 77, 1854.

   Ctenidium pulcherrimum Brotherus, Denk., math.-natur. Kl. K. K. Akad. Wiss. Wien, vol. 89, p. 465, 1913.

   Ectropothecium rockii Brotherus, B. P. Bishop Mus., Bull. 40, p. 32, 1927.

   Taxiphyllum gracile Brotherus, B. P. Bishop Mus., Bull. 40, p. 33, 1927.

   Ctenidium submalacobolum Brotherus, B. P. Bishop Mus., Bull. 40, p. 34, 1927.

Dioicous. Variable but typically robust, growing in dense, feathery, bright yellowish green masses, glossy, pale brown below. Stems procumbent, flexuose, up to 10 cm. or more long, with distant, unequal, complanate branches. Leaves rather laxly imbricated, falcate or flexuose and spreading, hooked at the tips of the branches, oblong-lanceolate, broadly cordate at the rounded-auriculate base, decurrent, slenderly acuminate, slightly concave, 1.5 to 1.75 mm. long by about 0.4 mm. wide below; margin plane, serrulate all around; costa none or very short and double; leaf cells long and narrow with thin walls, 3 to 4 μ wide and 15 to 20 times as long, several rows across the insertion shorter and broader with slightly pitted walls, cells of the decurrent auricles much larger but variable, usually oval or subquadrate, lax and pellucid or hyaline, fragile and difficult to remove from the stem with the leaves. Perichaetial leaves erect, clasping, ecostate, the inner about 3 mm. long, from an ovate-oblong base gradually contracted to a long, slender, flexuose, denticulate point, vaginula densely clothed with septate hairs as long as the inner leaves; seta about 2.5 cm. long, flexuose, bright red, smooth; capsule hori-

zontal, short-oblong, rounded on the upper side, urn 1.5 mm. long, curved and constricted under the mouth when dry; lid conic, acute, 0.8 mm. long, dark brown at the tip; calyptra slightly hairy.

Frequent on rocks and soil in damp woods.
Endemic. Type locality, Mount Kaala, Oahu.

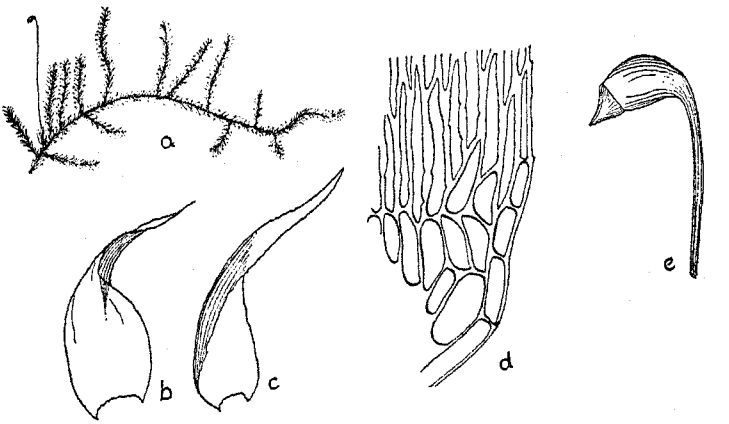


FIGURE 190. *Ctenidium decurrens* (Sullivant) Brotherus: *a*, plant × ¾; *b*, *c*, leaves × 25½; *d*, basal angle of leaf × 300; *e*, capsule × 9.

An exceedingly variable species but generally easily known by the dense, soft mats of a pale yellow color. *Ectropothecium arcuatum* is a more slender plant, growing in thinner mats and more closely applied to the substratum. *Brotherella opaeodon* may be distinguished by the deeper golden color, the more regularly pinnate branching, and notably by the group of large vesiculose alar cells without the decurrent auricles.

I have seen parts of the type collections of both *Taxiphyllum gracile* and *Ectropothecium rockii*. They are assuredly nothing but slender or depauperate forms of *C. decurrens*, in which the decurrent auricles are very poorly developed.

2. Ctenidium elegantulum Brotherus, B. P. Bishop Mus., Bull. 40, p. 34, 1927 (fig. 191).

Campylium elegantulum Brotherus, Bull. Soc. Bot. Ital., p. 15, 1904.

Dioicous. Exceedingly slender and delicate, growing in very thin, feathery mats of a pale yellowish green color, glossy. Stems elongate, subpinnately branched with very numerous, intricate, flagellaceous, microphyllous branches, sparingly radiculose. Stem leaves widely spreading, falcate or flexuose with decurved points, broadly cordate but often very similar in size, shape, and areolation to those of the preceding species, usually with rather longer, more attenuated points; leaves of the flagellaceous branches

up to 1 mm. long, but often smaller, narrowly lanceolate from a triangular or slightly ovate base, gradually long acuminate, hardly or not at all decurrent, flexuose, spreading, or slightly falcate, sharply serrate all around. Sporophyte unknown.

Tree trunks in damp, shaded woods. Frequent.

Endemic. Type locality, Haleakala, Maui.

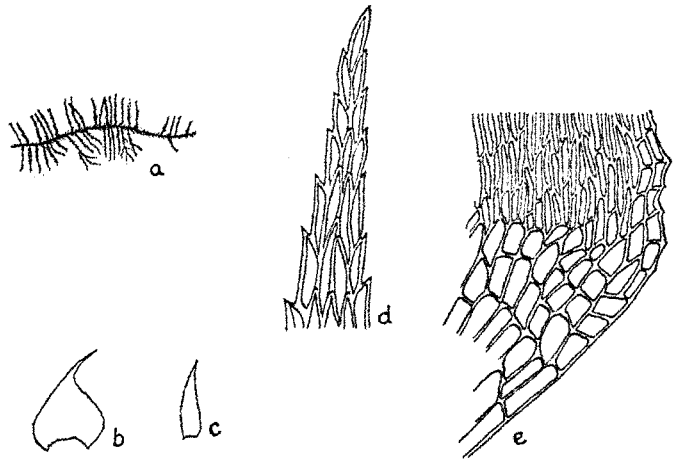


FIGURE 191. *Ctenidium elegantulum* Brotherus: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, branch leaf × 25½; *d*, apex of branch leaf × 300; *e*, basal angle of stem leaf × 300.

In spite of the great dissimilarity in appearance between this and the preceding species, there are various intermediate forms that are difficult to place. In its extreme development the delicate, loosely applied mats, composed almost entirely of the slender microphyllous branches, resemble an alga more than a moss to the naked eye, yet it is not unusual to find colonies in which there is a mixture of coarser plants quite inseparable from *C. decurrens*. Judging from my own experience, *C. elegantulum* is confined to the trunks of large trees in the rain-forest belt. It is possible that for some unknown reason the habit of the plant has been modified to conform to these environmental conditions.

FAMILY 35. HYLOCOMIACEAE

Mostly robust, rigid plants. Stems prostrate, bipinnately or tripinnately branched, the branches ascending or erect. Stem and branch leaves usually differentiated; costa double; cells linear, often papillose by the projecting ends. Seta elongate; capsule horizontal or pendulous; peristome as in *Hypnaceae*.

105. MACROTHAMNIUM Fleischer, Hedwigia, vol. 44, p. 307, 1905.

Robust, rigid plants with bipinnately branched stems. Leaves oval, short-pointed, coarsely serrate above.

1. **Macrothamnium macrocarpum** (Reinwardt and Hornschuch) Fleischer, Hedwigia, vol. 44, p. 308, 1905 (fig. 192).
   Hypnum macrocarpum Hornschuch, in Nov. Act. Acad. Caes. Leop., vol. 14, pt. 2, Suppl., p. 725, 1828.
   Microthamnium mauiense Brotherus, Bull. Soc. Bot. Ital., p. 20, 1904.
   Macrothamnium mauiense Brotherus, B. P. Bishop Mus., Bull. 40, p. 34, 1927.

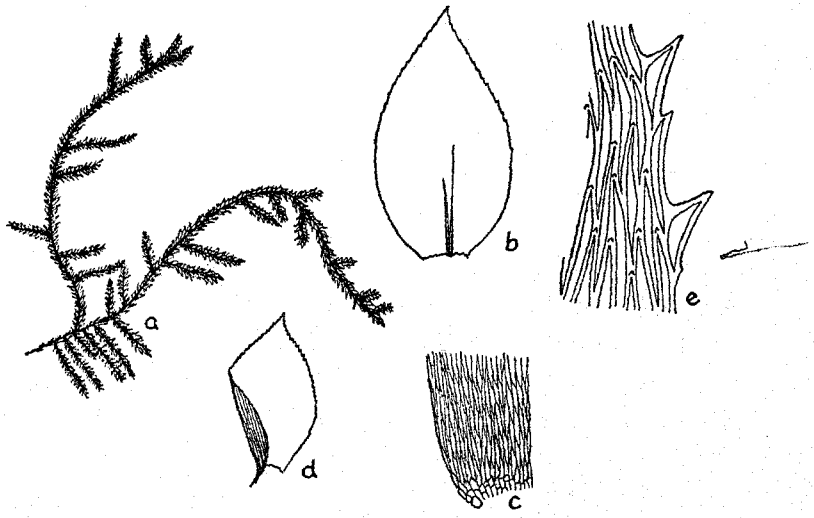


FIGURE 192. *Macrothamnium macrocarpum* (Reinwardt and Hornschuch) Fleischer: *a*, plant × ¾; *b*, stem leaf × 25½; *c*, basal angle of stem leaf × 120; *d*, branch leaf × 25½; *e*, upper cells and margin of branch leaf × 300.

Dioicous. Robust, rather rigid plants, golden green tinged with brown, glossy. Stems prostrate, up to 10 cm. or more long, bipinnately branched, branches ascending, arcuate and flexuose, the ultimate branches spreading, 1 to 1.5 cm. long. Stem leaves widely spreading, slightly concave, broadly oval, abruptly contracted to a short, sharp acumen, up to 1.6 mm. long and 1 to 1.3 mm. wide; margin narrowly reflexed just above the insertion, erect above, coarsely serrate with spreading teeth in the upper half, denticulate below; costae double, pale, unequal, extending one-third to one-half the length of the leaf; leaf cells linear with firm pale walls, 4 to 5 μ wide and 10 to 15 times as long, minutely papillose by the projecting end walls, more lax across the insertion, oblong, hyaline or brownish, a few smaller cells at the basal angles, but not forming a distinct group; leaves of the ultimate branches similar but smaller. Seta about 5 cm. long, reddish; capsule pendulous, ovoid-cylindric, reddish brown, urn about 3 mm. long; peristome teeth transversely striate, basal membrane of the inner peristome about half the height of the teeth, segments split along the median line, cilia 3 to 5,

slightly appendiculate; annulus broad; lid convex, apiculate; spores smooth, 12 to 14 μ in diameter.

Maui: mountain ravines in western part of island, altitude 4,500 feet (Baldwin).

Distribution: Java, Sumatra, Borneo, Ceylon, Philippines. Type locality, Java.

There seems to be no appreciable difference between the scanty Hawaiian collection that I have seen and *M. macrocarpum*, of the Malayan regions. Brotherus distinguishes *M. mauiense* by the more robust habit and more strongly serrate leaves, but I have found these distinctions too slight, in comparison with plants of other regions, to be of much practical value.

It seems to be an exceedingly rare species in Hawaii and is localized, so far as known, in the ravines of western Maui. The description of the sporophyte characters has been taken from plants collected in Java, as no fruiting plants have been collected locally.

Tribe 2. Nematodonteae

Peristome teeth thick, solid, not transversely articulated; developed from several concentric rows of cells of the sporogonium.

Family 36. POLYTRICHACEAE

Medium-sized or very robust terrestrial plants with erect, simple or little-branched stems. Leaves narrow, rigid, the costa broader on the inner or ventral surface, bearing numerous, crowded longitudinal lamellae. Seta elongate, smooth; capsule inclined or erect, cylindrical or angular; peristome single, of 32 or 64 solid, short teeth, triangular in cross-section; columella bearing an expanded shield-like membrane at the apex covering the mouth of the capsule; calyptra cucullate, usually densely felted with deflexed hairs.

Capsule cylindric, not angled, stomata wanting.....**106. Pogonatum**
Capsule usually four-angled, stomata present.....**107. Polytrichum**

106. POGONATUM Palisot de Beauvois, Prod., p. 84, 1805.

Stems up to 2 cm. high, in Hawaiian species. Leaf margin erect, denticulate above. Capsule sub-cylindric, striate when mature.

1. **Pogonatum baldwini** (C. Müller) Paris, Index Bryol., p. 977, 1898 (fig. 193).

   Polytrichum Baldwini C. Müller, Flora, vol. 82, p. 438, 1896.

Dioicous; antheridia numerous in a terminal cup-like receptacle formed by the perigonial bracts. Plants gregarious, dark green. Stems erect, up to 1.5 or 2 cm. high, from a more or less persistent felt of green protonema. Leaves strongly curled and twisted with incurved, circinate points when dry, rigidly erect-spreading or slightly incurved when moist, linear-lanceolate from an erect sheathing base, bluntly acute, much smaller and more distant toward the base of the stem, the upper about 5 mm. long; margin erect and sharply denticulate in the upper half, plane and entire below; costa percurrent, minutely denticulate on the back toward the apex, broadening in the blade and covered on the ventral surface with 30 to 35 longitudinal rows of lamellae which in cross-section are 5 or 6 cells high with the terminal cell rounded or oval and smooth; basal cells narrowly rectangular, becoming shorter toward the leaf shoulder, in the narrow border of the blade in one layer, oval-hexoganal, up to 10 μ in diameter. Seta red, flexuose, up to 3 cm. long; capsule inclined, oblong-cylindric, smooth and greyish green when young, constricted under the mouth, dark brown and distinctly striate when old, urn 2 or 3 mm. long, exothecial cells mamillate, columella four-winged; peristome teeth 32, about 200 μ high, oblong, deep reddish brown in the median portion; lid short-beaked from a convex base; calyptra densely covered with deflexed hairs, extending below the base of the capsule; spores yellow, smooth, up to 12 μ in diameter.

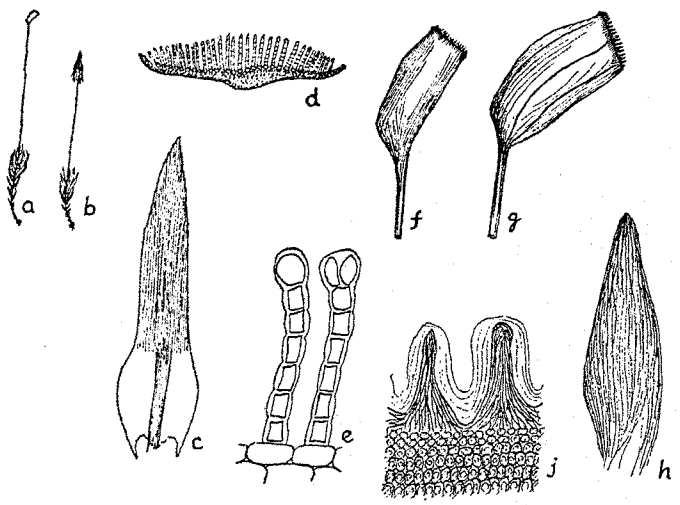


FIGURE 193. *Pogonatum baldwini* (C. Müller) Paris: *a, b,* plants × ¾; *c,* leaf × 12; *d,* cross section from upper part of leaf × 60; *e,* 2 lamellae in cross section × 300; *f,* young capsule × 9; *g,* old capsule × 9; *h,* calyptra × 9; *j,* 2 peristome teeth × 120.

Damp rocks and wet banks. Oahu: upper slopes of Tantalus (Bartram); Waikane-Schofield trail, Koolau Range, altitude 2,200 feet (Bartram); Manoa Valley (Bartram); Konahuanui (Forbes); foot of Mount Kaala (Degener). Maui: Honokohau drainage basin (Forbes; Bartram); western part of island (Baldwin; Bartram). Molokai: west of Pepeopae (Degener); between Waikolu Valley and Puu Alii (Degener). Island of Hawaii: vicinity of Kilauea (Bartram); ravine above Pahala (Skottsberg). Kauai: Hii Mountains (Forbes).

Endemic. Type locality, western Maui.

Although this species is exceedingly close to *P. tahitense* Bescherelle, the leaves seem to be more strongly crisped and the marginal teeth a little stronger and sharper in Hawaiian plants than in the limited number of specimens from Tahiti with which they have been compared.

The species will be encountered frequently on all the larger islands. It varies somewhat in size but never enough to raise any question as to identity. When dry and empty the capsules are often horizontal, or even a little pendent, and conspicuously lined with about six sharp ridges extending the entire length of the urn.

107. POLYTRICHUM Dillenius Hedwig, Sp. Musc. p. 88, 1801.

Robust plants with stems up to 10 cm. long, in Hawaiian species. Leaf margins inflexed over the lamellose blade. Capsule oblong, four-angled.

1. **Polytrichum juniperinum** Hedwig, Sp. Musc., p. 89, 1801 (fig. 194).

Dioicous. Robust plants growing in dense, deep tufts, bright ruddy brown, paler below. Stems about 10 cm. high, simple or sparingly branched, closely matted together. Leaves erect, very rigid and appressed when dry, slightly spreading when moist, lanceolate from a short, oblong base, with the edges broadly inflexed over the lamellose costa, 5 or 6 mm. long; costa excurrent in a stiff reddish denticulate arista, sharply denticulate on the back below the point, covered on the ventral side with 30 to 35 longitudinal rows of lamellae, 6 or 7 cells high in cross-section with the terminal cell slightly larger and narrowed above the middle to a blunt, rounded point, smooth. Sporophyte unknown in Hawaii, but no doubt typical of the species.

Cosmopolitan. Type locality, Europe.

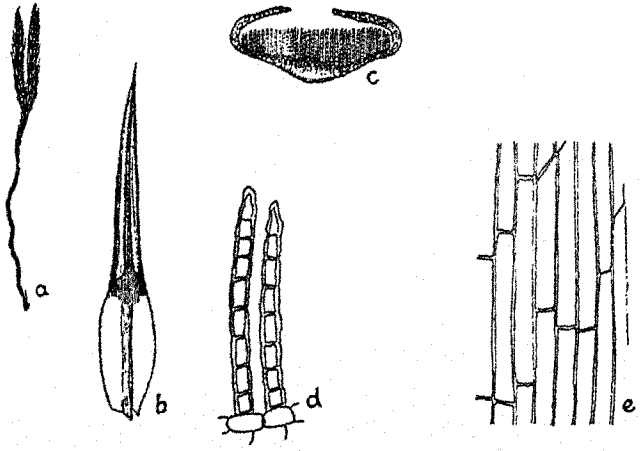


FIGURE 194. *Polytrichum juniperinum* Hedwig: *a*, plant × ¾; *b*, leaf × 12; *c*, cross section from upper part of leaf × 60; *d*, 2 lamellae in cross section × 300; *e*, basal leaf cells × 300.

This well-known moss is credited to the local flora on the basis of a sterile collection from the island of Hawaii without any definite locality. It came possibly from the upper slopes of Mauna Loa or Mauna Kea and is likely to be rediscovered when these regions are more thoroughly explored. The characteristic leaves with the margins broadly inflexed over the lamellae of the ventral surface will identify the plant at a glance.

EXCLUDED AND UNCERTAIN SPECIES

1. **Dicranella exilis** Sullivant, Bull. Torr. Bot. Club, vol. 5, p. 10, 1878.

The terms "foliis erecto-patentibus, rigidus" and "peristomio dicranoideo" in the original description evidently place this species very close to *Dicranella rigidula,* but so far I have been unable to locate the type collection for comparison.

2. **Microdus filicaulis** Brotherus, B. P. Bishop Mus., Bull. 40, p. 5, 1927.

In the absence of fruit it is difficult to know what the affiliations of this plant may be.

3. **Syrrhopodon laevigatus** Mitten, in Seemann, Fl. Vit., p. 389, 1873.

This species seem to have been credited to Hawaii in error. It is definitely known from Samoa and Fiji, but I can find no tangible evidence of its occurrence in Hawaii.

4. **Macromitrium alatum** C. Müller, Flora, vol. 82, p. 453, 1896.

Described as having long, slender secondary stems; leaves crisped when dry, spreading when moist, very fragile, long acuminate from a narrowly oblong base; seta short; capsule erect, small, cylindric. Collected by Menzies on Oahu.

I have not seen the type collection of this species and cannot place it accurately from the description.

5. **Papillaria flaviuscula** C. Müller, Flora, vol. 82, p. 463, 1896.

There are no salient characters in the original description of this species that clearly suggest its natural affinities. Until the type collection can be located and examined the species will have to remain open to question.

6. **Pilotrichum rugifolium** C. Müller, Syn., vol. 2, p. 177, 1849.

I have seen a scrap of the original collection and a sketch of the entire plant from the Kew Herbarium, collected by Menzies on "Owyhee" in 1794. It is undoubtedly a *Pilotrichum,* but its connection with the Hawaiian flora is so problematical that it seems the wiser plan to exclude it for the time being.

Müller, in the original description, gives the locality as "Insula Owyhee Australiae" while Brotherus mentions it as "pazifische Insel Owyee." The natural inference would be that "Owyhee" is a phonetic spelling of Hawaii, but as the genus is almost purely one of the American tropics, this species is a thoroughly anomalous element in the Hawaiian flora.

7. **Chaetomitrium wheeleri** Hampe, on sheet, Flora, vol. 82, p. 460, 1896.

I am unable to connect the description of this plant with any familiar Hawaiian species and have not so far had an opportunity to examine any plants from the type collection.

8. **Rhynchostegium gaudichaudi** (Montagne) C. Müller, Flora, vol. 82, p. 475, 1896.

Hypnum Gaudichaudi Montagne, Ann. Sci. Nat., vol. 19, p. 238, 1843.

The actual plant represented by this specific name is still uncertain. A portion of what was supposed to be the type collection in the Paris Museum, received through the kindness of M. G. Dismier, shows a mixture of *Floribundaria floribunda*, *Thuidium plicatum*, and *Ctenidium elegantulum* without any trace of *Rhynchostegium*. Dr. Reimers has very courteously sent me a preparation from the Müller Herbarium consisting of a fragment of a branch and several detached leaves between sheets of mica, which seems to agree very closely with *Rhynchostegium selaginellifolium* C. Müller, as far as a rough comparison between the dry structures is concerned, but I should hesitate to combine them without a better opportunity to decide just what Montagne's species really is. The habitat of *R. gaudichaudi* on the "bark of trees" is certainly very different from that of *R. selaginellifolium*, which is a plant of wet, dripping rock faces or ledges.

The moss recorded by Sullivant, in the collection of the Wilkes Expedition, as *Hypnum praelongum* shows the seta scabrous throughout and is therefore clearly distinct from *R. gaudichaudi*, but the fragment I have seen is too small to give a satisfactory clue to its identity.

9. **Brotherella subarcuata** (C. Müller) Brotherus, Engler and Prantl, Pflanzenf., 2d ed., vol. 11, p. 425, 1925.

Cupressina subarcuata C. Müller, Flora, vol. 82, p. 473, 1896.

Dr. Brotherus has apparently seen the original collection and includes the species in *Brotherella*. From the description, the plant might be referred indifferently to any one of several nearly related species. Until an opportunity is offered to study the type collection critically, it seems advisable to include the species among those of uncertain identity.

10. **Microthamnium trichopelmatum** C. Müller, Flora, vol. 82, p. 475, 1896.

I have not seen the type collection of this species, but the description corresponds closely in almost every particular with *Isopterygium albescens* (Schwaegrichen) Jaeger.

11. **Pogonatum cirratum** (Swartz) Bridel, Bryol. Univ., vol. 2, p. 110, 1827.

Brotherus includes Hawaii in the geographical distribution of this species. Fleischer does likewise, but says that he has seen no local specimen. Any information with regard to the occurrence of *P. cirratum* in Hawaii will be most welcome.

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GLOSSARY

Acrocarpous	With the fruit terminal on stem or branch.
Acumen	A slender, tapering point.
Acuminate	With an acumen.
Acute	With a short, sharp point.
Alar	Referring to the cells at the basal angles of the leaf.
Amphigastria	The stipule-like leaves on the under side of the stem, as contrasted with the lateral leaves.
Annulus	The ring of specialized cells between the rim of the capsule and the lid.
Antheridium	The male reproductive organ.
Apiculus	A short, abrupt point.
Apophysis	A swelling of the seta just below the capsule.
Appendiculate	Referring to the short, transverse appendages of the cilia.
Archegonium	The female reproductive organ.
Arcuate	Curved like a bow.
Areolation	The cellular network of the leaf.
Arista	A fine, bristle-like point.
Auricle	A small lobe at the basal angle of the leaf.
Autoicous	Having the antheridia and archegonia in separate clusters on the same plant.
Beak	The prolonged apex of the lid.
Bifid	Cleft into two parts.
Bistratose	With the cells in two layers.
Caespitose	Tufted.
Calyptra	The membranous hood covering the lid of the capsule.
Campanulate	Bell-shaped.
Canaliculate	Channeled.
Cancellinae	The sharply defined, large, hyaline basal leaf cells in Calymperaceae.
Capsule	The fruit or spore-bearing case of the sporophyte.
Carinate	Keeled like a boat.
Cernuous	Somewhat drooping.
Chlorophyllose	Containing chlorophyll grains.
Cilia	Fine threads or hairs, often applied to the structures alternating with the segments of the inner peristome.
Circinate	Coiled inward from the apex.
Cirrate	Curled.
Columella	The sterile central axis of the capsule.
Comose	Tufted at the tips, in a comal tuft.
Complanate	Flattened in one plane.
Costa	The nerve or midrib of the leaf.
Crenulate	With fine, rounded teeth.
Crispate	Variously curled and twisted.
Cucullate	Like a hood.
Cuspidate	With a sharp, stiff point.
Cygneous	Curved downward like a swan's neck.
Cymbiform	Shaped like a boat.

Decumbent	Prostrate with ascending tips.
Decurrent	With the leaf edges extending down the stem below the insertion.
Dendroid	Like a tree.
Dentate	With sharp, pointed teeth.
Denticulate	With minute or obscure teeth.
Dimorphous	Of two forms.
Dioicous	With the antheridia and archegonia on separate plants.
Discoid	Like a disc (male inflorescence).
Distichous	In two opposite rows.
Divaricate	Widely spreading.
Dorsal	Relating to the back, the surface or part of a leaf facing away from the stem.
Ecostate	Without a costa.
Emarginate	With an apical notch.
Emergent	With the rim of the capsule elevated slightly above the tips of the perichaetial leaves.
Endemic	Confined to a single country or area.
Endothecium	The inner layers of cells of the sporogonium.
Erose	Irregularly notched.
Excavate	Hollowed out in a curve, applied to the leaf insertion.
Excurrent	With the costa extending beyond the leaf apex.
Exothecial	The outer cells of the capsule wall.
Exserted	With the base of the capsule elevated beyond the tips of the perichaetial leaves.
Falcate	Curved like a sickle.
Falcate-secund	Falcate and turned to one side of the stem.
Fasciculate	In short bunches, applied to branches.
Fastigiate	With erect branches of equal height.
Fibrillose	With fine fibers, applied to the hyaline cells of Sphagnum.
Filiform	Like a thread.
Flagelliform	Like the lash of a whip.
Flexuose	Waved or bent alternately backward and forward.
Frondose	Like a frond.
Fusiform	Spindle-shaped.
Gemmae	Small bud-like bodies serving the purpose of vegetative reproduction.
Geniculate	Bent like a knee.
Gibbous	Swollen on one side.
Glabrous	Smooth.
Glaucous	Overcast with a whitish bloom.
Gregarious	Growing close together but not in tufts or mats.
Gymnostomous	Without a peristome.
Hamate	Hooked.
Heteroicous	With several forms of inflorescence in the same species.
Hispid	With short, stiff hairs.
Homomallous	Applied to leaves all pointing in the same direction.
Hyaline	Colorless and transparent.
Hygroscopic	Changing form and position by the absorption of water.

Imbricated	Overlapping, like shingles on a roof.
Immersed	With the rim of the capsule not elevated above the tips of the perichaetial leaves.
Incrassate	Thickened, as of cell walls.
Inflorescence	Clusters of reproductive organs.
Innovation	A young branch or shoot from the stem.
Insertion	The line of attachment of the leaf with the stem.
Involute	Inwardly rolled.
Julaceous	Smoothly cylindrical, like a catkin.
Laciniate	Cut or torn into narrow strips.
Lamellae	Thin plates or sheets.
Lamina	The leaf blade as distinguished from the costa.
Lanceolate	Shaped like a lance.
Lid	The cap covering the mouth of the capsule.
Ligulate	Strap-shaped.
Lingulate	Tongue-shaped.
Lumen	The cavity of a cell.
Mamillate	Convex with a nipple-like tip.
Micron	A thousandth of a millimeter, represented by the Greek letter μ.
Mitriform	Miter-shaped, symmetrical, cleft on several sides.
Mucronate	With a short abrupt point or mucro, usually formed by the excurrent costa.
Muticous	Not pointed.
Neck	The lower part of the capsule between the urn and the seta.
Nodose	With knots or swellings.
Obconic	Inversely conic.
Obcordate	Inversely cordate.
Obovate	Inversely ovate, narrowed below.
Ovate	Egg-shaped, broader below.
Papillae	Minute protuberances of various forms.
Papillose	Covered with papillae.
Paraphyllia	Minute leaf-like or branched organs scattered among the leaves.
Paraphyses	Jointed hyaline hairs associated with the reproductive organs.
Parenchymatous	Composed of broad cells joined end to end, not dovetailed.
Paroicous	Having the antheridia and archegonia in the same cluster but not mixed, the antheridia axillary below the archegonia.
Pellucid	Translucent but not hyaline.
Pendulous	Loosely pendent or hanging.
Percurrent	Ending in the apex, applied to the costa.
Perichaetium	The leaves surrounding the female flower.
Perigonium	The leaves surrounding the male flower.
Peristome	The fringe of teeth surrounding the mouth of the capsule.
Piliferous	With a long hair-like point.
Plane	Flat.

Pleurocarpous	With the fruit axillary and lateral on the stem or branch.
Plicate	With longitudinal folds or plaits.
Plumose	Like a plume, feathery.
Porose	Perforated with small holes or pores.
Procumbent	Trailing or prostrate.
Prosenchymatous	Composed of narrow cells with the ends dovetailed.
Pseudopodium	A false seta.
Punctate	Dotted.
Pyriform	Shaped like a pear.
Quadrate	Square.
Radicles	Rootlets growing from the stem.
Radiculose	With radicles.
Retuse	Obtuse and slightly indented.
Revolute	Rolled backward, as of the leaf margin.
Rostellate	With a short beak.
Rostrate	With a long beak.
Rosulate	Like a rosette.
Rugose	Wrinkled.
Rupestrine	Growing on rocks.
Scabrous	Rough.
Scarious	Thin and dry.
Secund	Turned to one side.
Segments	The divisions of the inner peristome.
Serrate	With saw-like teeth.
Serrulate	Finely serrate.
Sessile	Not stalked.
Seta	The stalk supporting the capsule.
Setaceous	Like a bristle.
Sheathing	Partly clasping, as of the leaf base.
Sinuose	Wavy.
Spatulate	Like a spatula, narrowly obovate, tapering downwards.
Spinulose	With small spines.
Sporophyte	The spore-bearing organs, including all the parts produced by the fertilization of the archegonium.
Squarrose	Widely and abruptly spreading.
Stoloniferous	With slender, creeping, microphyllous stems.
Stomata	Openings in the capsule wall surrounded by special guard cells.
Striate	With fine, longitudinal lines or ridges.
Strumose	With a goiter-like swelling at the base of the capsule.
Sub	A prefix denoting almost, nearly, or slightly.
Subulate	With an awl-like point or subula.
Sulcate	Longitudinally furrowed.
Synoicous	Having the antheridia and archegonia mixed together in the same cluster.

Teniolae	The intra-marginal border of differentiated leaf cells in Calymperes.
Terete	Smoothly cylindrical.
Terrestrial	Growing on earth.
Tomentose	Covered with a thick felt of soft matted hairs or tomentum.
Trabeculate	With prominent transverse ridges on the inner side of the peristome teeth.
Truncate	Abruptly cut off at the apex.
Tubulose	Like a tube.
Tumid	Swollen or turgid.
Turbinate	Shaped like a top.
Unistratose	With the cells in one layer.
Urceolate	Like an urn, contracted below the mouth.
Vaginula	The minute sheath surrounding the base of the seta.
Ventral	Relating to the front, the surface of the leaf facing the stem.
Ventricose	Swollen on one side.
Vermicular	Curved like a worm.
Vesiculose	Inflated like a bladder.

ADDITIONS

Trematodon latinervis C. Müller.

Oahu: Punaluu Mountains, C. N. Forbes and C. M. Cooke, Jr.

Dicranodontium falcatum Brotherus.

Oahu: Kipapa Gulch, elevation 2800 feet, Hosaka.

Island of Hawaii: upper Hamakua ditch trail, Waipio, Kohala Mountains, elevation 3200 feet, St. John.

Leucoloma molle (C. Müller) Mitten.

Oahu: Kipapa Gulch, elevation 2500 feet, Hosaka.

Webera cruda (Hedwig) Bruch, manuscript., Hubener, Muscologia Germanica, p. 425, 1833, (fig. 195).

Mnium crudum Hedwig Sp. Musc. p. 189, 1801.

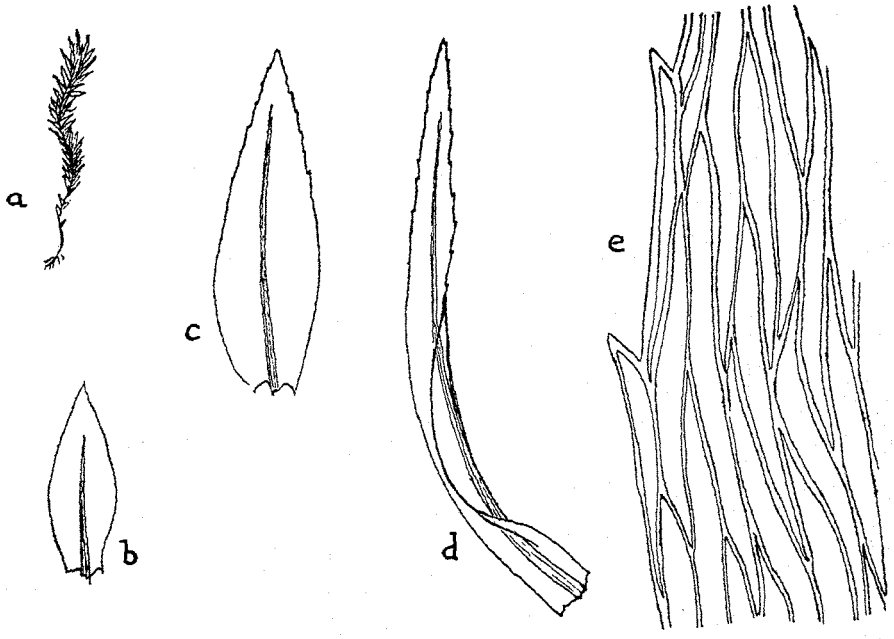

FIGURE 195.—*Webera cruda* (Hedwig) Bruch: *a*, sterile stem, × 1½; *b*, lower stem leaf, × 20; *c*, middle stem leaf, × 20; d, comal leaf, × 20; *e*, upper leaf cells and margin, × 500.

Autoicous, sometimes synoicous or dioicous. Rather robust, loosely tufted plants, pale green and very lustrous above, reddish brown below. Stems red, flexuose, about 2 cm. long but often longer in the more robust forms. Lower leaves small, distant, broadly oval, more crowded and larger above, ovate-lanceolate, 2-3 mm. long by 0.8 mm.

wide, the comal leaves longer and narrower, all reddish at the base; margin plane, distantly denticulate toward the apex in all but the lower leaves which are nearly entire; costa ending well below the apex; cells linear with acute ends and thin walls, about 10 μ wide by 15-18 times as long, a trifle more lax but hardly altered toward the base. Seta long and flexuose; capsule subcylindrical, curved, reddish brown, neck short and indistinct; lid conical apiculate. (Sporophyte not yet known in Hawaii.)

Almost cosmopolitan. Type locality, Europe.

Maui: Haleakala, elevation 9200-9700 feet, Donald Anderson.

This well known species has a wide distribution and it is not surprising to find it growing in Hawaii. The leaf cells are relatively longer than usual but otherwise the plants are typical in every respect. The red stems and glossy leaves with a characteristic metallic lustre will identify it easily.

Rhodobryum giganteum (Hooker) Schimper.

Oahu: Kipapa Gulch, elevation 2800 feet, Hosaka.

Breutelia arundinifolia (Duby) Fleischer.

Oahu: Kipapa Gulch, elevation 2800 feet, Hosaka.

Hookeria acutifolia Hooker.

Oahu: south ridge of Kipapa Gulch, Waipio, Koolau Range, elevation 1200 feet, E. H. Bryan, Jr., Amy Suehiro, M. Fukuda.

Hookeriopsis purpurea (C. Müller) Brotherus variety **ligulacea** (C. Müller) Bartram.

Oahu: south ridge of Kipapa Gulch, Waipio, Koolau Range, elevation 1200 feet, E. H. Bryan, Jr., Amy Suehiro, M. Fukuda.

INDEX TO GENERA AND SPECIES