STUDIES OF COLORADO BRYOPHYTES[1]

By William A. Weber[2]

The bryophyte flora of the Southern Rocky Mountains and Colorado Plateaus region is both rich in species and interesting from a phytogeographical standpoint. It draws from the arctic or boreal flora, from the disjunct floras of the isolated mountain masses of the northern continents, and from an ancient semi-desert flora which is now highly disjunct and limited to the major desert areas of the world. Thus the great majority of our species in Colorado are also found in Eurasia.

The bryophyte flora may be said to be distinctly "continental" in composition because our climate is generally one of extremes in which the mesic habitat is uncommon. Thus, our flora lacks many of the species which are characteristic, on the one hand, of the eastern deciduous forest and, on the other, of the western Coastal elements of the Cascade region. Nevertheless, a few of these species do occur along the east flank of the Front Range adjacent to the Great Plains because of local topography and weather conditions combining to produce an unusually cool, moist climatic regime in the foothill canyons. Much of the excitement of bryological work in Colorado comes in the discovery of these unexpected rare species inhabiting the foothill canyons.

The alpine areas are also of great bryological interest. In those choice localities above timberline where moisture levels remain continuously high throughout the year and a well-developed "moss-tundra" exists, several characteristic Arctic-alpine species occur at their only stations in the contiguous United States. When one does field work in the Colorado alpine he enjoys a vicarious experience with the moss flora of Scandinavia, the Swiss Alps and the Arctic regions of either hemisphere, for most of the species he encounters are found in all of these regions.

The bryophytes of the drier, semi-desert areas of our southwestern section, while fewer in numbers of species, nevertheless have their special interest. Only a token number are actually restricted to the American Southwest, while the great majority occur in other desert regions, particularly the area of the Mediterranean Sea, the Near and Middle East.

This interesting combination of geographical elements in the Colorado bryophyte flora suggests that the student of these plants must try to acquire a working knowledge of the world's literature and species. Here is no room for narrow provincialism.

[1] Andreaeaceae, Aulacomniaceae, Cryphaeaceae, Fabroniaceae, Fissidentaceae, Meesiaceae, Neckeraceae, Orthotrichaceae, Polytrichaceae, Splachnaceae, Tetraphidaceae.

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Dr. Geneva Sayre, now a professor at Russell Sage College, Troy, New York, devoted a great deal of time and effort to a study of the Colorado Moss Flora. Her Ph.D. thesis (1938) brought together all that was then known on the subject. Dr. Sayre also was instrumental in establishing the bryophyte herbarium at the University of Colorado. Her work was a pioneering effort, undertaken at a time when collections of Colorado mosses were very meagre. The thesis preceded by several years the publication of certain portions of A. J. Grout's great work on American mosses (1928–1939) so that her treatments of the Bryaceae and Pottiaceae, for example, could not take advantage of his later findings. Nevertheless, it has been immeasurably useful to have her thesis before me in my studies of the moss flora inasmuch as Dr. Sayre did bring together the known records of the species, both published and unpublished.

Our knowledge of the other great group of bryophytes, the Hepaticae or Liverworts, is extremely fragmentary. Aside from a few lists published in papers growing out of the Hayden and other historic surveys the only paper dealing with a survey of Colorado hepatics is that of Dr. Alexander W. Evans (1915) which listed only 41 species, most of them from only one or two collections.

I have planned for some years to prepare a revision which would bring up-to-date the work of Dr. Sayre on the mosses and of Dr. Evans on the hepatics. But publication of the entire group at this time would be highly premature. Several reasons argue for piecemeal treatment. First, those genera which contain only a few easily recognized species whose distribution is already well understood can be disposed of without delay. Many of these species are of interest to ecologists, who have an immediate need for information on their identification and habits. Second, with more active collection going on, our knowledge of some of the rare alpine and desert species literally grows day by day; these groups may reach the stage of publication within a very few years. But the more difficult or critical groups, such as *Bryum, Hypnum, Barbula,* and the like, require intensive monographic study, very thorough collection, and field observation as well as the co-operation of specialists. These groups may face a long delay in publication.

I therefore balance between the desire to fulfill Dr. Sayre's intention to publish a complete Colorado Moss Flora and the need to make available as soon as possible whatever I can of this flora to those amateur and professional botanists who need to know the bryophytes. In choosing the second course we stand to gain the interest and enthusiasm of new students of bryology, who will, in the long run, contribute significantly to the final result.

The present series of papers will employ keys, citations of specimens for the record, and brief discussions pertinent to recognition of the species and their

habitats. Excellent technical descriptions and illustrations of all of the North American mosses are now generally available in the works of Grout (1903–1939), and the work of Schuster (1953) provides adequate technical aid for the liverworts. The student should have in his working library the excellent guides of Conard (1956) and Watson (1955). A variety of source-books is indispensable for the beginner as well as the professional in the field of bryology.

I gratefully acknowledge the generous help and advice of all of my bryological colleagues. Individual credit is given under the citation of specimens. Unless otherwise specified, the collections cited are in the University of Colorado Herbarium. For convenience of reference, the families are arranged in alphabetical rather than phylogenetic sequence.

In the interest of brevity of citation, I am adopting code initials for the counties of Colorado, after those of the Smithsonian Institution River Basin Surveys. The key to the code initials is as follows:

Adams	AM	Fremont	FN	Montrose	MN
Alamosa	AL	Garfield	GF	Morgan	MR
Arapahoe	AH	Gilpin	GL	Otero	OT
Archuleta	AA	Grand	GA	Ouray	OR
Baca	BA	Gunnison	GN	Park	PA
Bent	BN	Hinsdale	HN	Phillips	PL
Boulder	BL	Huerfano	HF	Pitkin	PT
Chaffee	CF	Jackson	JA	Prowers	PW
Cheyenne	CH	Jefferson	JF	Pueblo	PE
Clear Creek	CC	Kiowa	KW	Rio Blanco	RB
Conejos	CN	Kit Carson	KC	Rio Grande	RN
Costilla	CT	Lake	LK	Routt	RT
Crowley	CW	La Plata	LP	Saguache	SH
Custer	CR	Larimer	LR	San Juan	SA
Delta	DT	Las Animas	LA	San Miguel	SM
Denver	DV	Lincoln	LN	Sedgwick	SW
Dolores	DL	Logan	LO	Summit	ST
Douglas	DA	Mesa	ME	Teller	TL
Eagle	EA	Mineral	ML	Washington	WN
Elbert	EL	Moffat	MF	Weld	WL
El Paso	EP	Montezuma	MT	Yuma	YM

ANDREAEACEAE

This entire family is characterized by the peculiar dehiscence of the capsule, which splits into four valves with the valves remaining attached at top and

bottom, making a sort of paper-lantern structure unique in the mosses. Our species is strictly alpine, forming tufts, looser than those of most *Grimmia* species, on siliceous rocks above timberline. The tufts resemble those of *Grimmia,* but the individual stems are very slender, totally black with sometimes a brownish tinge, and the leaves lack hair-points. The leaves of our only species, *A. rupestris,* lack a costa.

ANDREAEA RUPESTRIS Hedw.—Black Moss; Soot Moss

BL: on large boulder, west end of the uppermost of the Green Lakes, T. 1 N., R. 74 W., Boulder Watershed, north of Kiowa Peak, 12,000 ft., *Weber 8596.* CC: base of large boulder, near the water, inlet of Summit Lake, 12,700 ft., Mt. Evans, *Weber & Jones 8534.* EP: Pikes Peak, along the Cog Railway, above 13,000 ft., *Holzinger s.n.* LR: Rocky Mt. Nat. Park, on vertical wall of cirque below Lake of Glass, very abundant, 10,000–11,000 ft., *Weber & Pontecorvo 9692, Krypt. Exs. Vindob. No. 4153.*

AULACOMNIACEAE

We have the single genus, *Aulacomnium.* In Scandinavia these plants are called "Reffelmossor", the term 'reffel' = rifling, possibly alluding to the capsule which is grooved or longitudinally striate. *Aulacommium* is an acrocarpous moss with lanceolate or lance-ovate, decurrent leaves; the midrib is prominent and ends just below the leaf-tip; the margins of the leaves are narrowly revolute at least below the apex, and the leaf-cells are small (5–15u), isodiametric and papillose, mostly with one papilla over the cell cavity. The leaves may be entire or irregularly denticulate.

Aulacomnium is rarely found fruiting in our area. Instead, the vegetative stems often bear stalks (pseudopodia) which bear clusters of gemmae. The seta is elongate and the capsule is slightly curved, ascending or almost horizontal, with a striate or furrowed wall.

KEY TO THE SPECIES

1a. Leaves small, mostly less than 1.5 mm. long; basal leaf cells green, not distinctly different from the upper, unistratose; stems characteristically with a terminal pseudopodium bearing a ball-like cluster of few-celled, fusiform gemmae; habitat on rotting wood ..... *Aulacomnium androgynum*

1b. Leaves larger, from 2 to 4 mm. long; basal leaf-cells yellow-brown, thick-walled, often enlarged, bistratose; pseudopodia when present naked or bearing relatively few green, minute but leaf-like ecostate gemmae in an erect cluster; habitat bogs and slow streams ..... *Aulacomnium palustre*

AULACOMNIUM

AULACOMNIUM ANDROGYNUM (Hedw.) Schwaegr.

BL: on decaying wood of cut stumps of *Pseudotsuga*, trail between Scout Cabin and Kossler's Lake, west base of Green Mountain, S.W. of Boulder, 7,000 ft., *Weber 4511*.

Aulacomnium androgynum must be more abundant than our single record would suggest. Watson (1955) states that although its typical habitat is rotten wood, it also may occur on humus-rich soil of banks and occasionally on sandstone rocks. In our area it would be most unusual to expect the species to occur on rock because of the arid climatic regime.

AULACOMNIUM PALUSTRE (Hedw.) Schwaegr.

BL: 11 mi. N. of Nederland, 9,500 ft., *Pursell 3134*; University Camp, 9,900 ft., *Livingston 108*. CF: St. Elmo, 10,000 ft., *Kiener 6738*. DA: Devil's Head Mt., 8,000 ft., *Weber 7754*. GF: Trappers Lake to Coffin Lake, 9,700 ft., *Shushan B-302*. GA: South Fork Columbine Cr., 5 mi. S.E. of Grand Lake, 9,500 ft., *Douglass B-621*. GL: near Tolland, *Grout s.n.* GN: Elko Basin to Mexican Cut, 10,000 ft., *Weber 9228*; Gothic, 9,800 ft., *Sayre 589*; Mt. Carbon, *Tidestrom 3485*. JA: 3 mi. N. of Willow Cr. Pass, 9,000 ft., *Shushan 193*; Big Creek Lake, 9,200 ft., *Shushan 28*. LK: Twin Lakes, *Conard 451*. LR: Moons Ranch, *Baker 34* (as *A. androgynum*); Chambers Lake, *Crandall 36*. PA: 11.3 mi. E. of Jefferson on road to Lost Creek Park, 10,000 ft., *Shushan 83*. ST: Monte Cristo Creek, N. of Hoosier Pass, 10,800 ft., *Weber s.n.*; Breckenridge, 10,000 ft., *Holzinger 35*.

This species is one of our most abundant mosses, occurring in almost every bog area in the middle altitudes of the mountains. In its typical form, *Aulacomnium palustre* is very easily recognized by its yellow-green, loosely spreading upper leaf-growth and very densely shaggy-brown-tomentose lower stems. In the alpine, however, an unusual type occurs which merits further detailed discussion below.

AULACOMNIUM PALUSTRE var. IMBRICATUM B.S.G.

CC: shore of Summit Lake, Mt. Evans, 12,800 ft., *Weber B-1401* (Crypt. Exsic. Vindobonensis No. 4160), *Weber & Jones 8527, 8541, Weber B-218, 9267*; 12,500 foot level along trail from Stevens Mine, 11,200 ft., to summit of Gray's Peak, 14,250 ft., *Weber 5642*.

Some time ago I reported this (Weber 1952) as the Arctic and eastern American alpine *Aulacomnium turgidum* (Wahl.) Schwaegr. Morphologically

our material stands nearer *A. turgidum* than *A. palustre,* but the leaf-shape varies in the direction of *palustre* to such an extent that one would hesitate to assign the plants unequivocally to *turgidum.*

The general aspect of var. *imbricatum* is like that of *A. turgidum.* The stems are stout and loosely adherent to each other because of the densely crowded imbricate leaves and a general absence of long-protruding stem tomentum. The stem tomentum is present, but is mostly hidden in the leaf-axils. In fact, the tomentum is hardly apparent even on the older growth. The stems form erect sods on wet hummocks which may be saturated with moisture through most of the growing season. For the most part the leaves are broad, blunt, rounded at the apex, not at all denticulate, cucullate, and hardly crispate. However, on some of the stems the terminal growth has more attenuate leaves which are slightly crisped as in *A. palustre.*

Wallace (1950) commented on the difficulty of distinguishing *A. turgidum* from *A. palustre* var. *imbricatum* in Great Britain. After considering the published descriptions and specimens he came to the conclusion that the material which he found passing under var. *imbricatum* was identical to *A. turgidum* in growth habit and tomentum, but could be separated because of the occurence of pointed and rounded leaves near together on the same stem. He pointed out that the stem tomentum alone was not a valid distinction.

Considering the Colorado alpine material, we reach the same conclusion. The stem tomentum is inconspicuous and hidden in the leaf-axils. The stems are stout and do not hold together; the leaves are erect-imbricate and many of them are entire, cucullate, and rounded at the tip. In other words, if it were not for the fact that some narrower leaves are formed, which become slightly crisped at the apex, we would not hesitate to call this plant *A. turgidum.* The question is, can we disregard the majority of characters pointing to relationship with *turgidum* and on the basis of the leaf-variation submerge this population within our concept of *A. palustre*?

As I examine the series of specimens collected in the Mount Evans area over a period of eight years, I find that many plants within a sod show no divergence from the *turgidum* type, other stems have acuminate leaves only in the upper portion, some have acuminate leaves more or less throughout, and a few seem to have acuminate leaves in the older growth and *turgidum*-type leaves above. It would appear that there is a complex correlation here and that the leaf-shape may vary with the position of the individual stem in the sod or with the seasonal inundation levels of the sod or its parts or both.

Because of the general resemblance of our plants to *A. turgidum* and their tendency to produce narrower leaves, I considered the possibility that they might be related to *A. acuminatum* (Lindb. & Arn.) Paris, another Arctic

species combining the coarse habit of *A. turgidum* with an acuminate leaf-shape. I submitted specimens to Dr. Howard Crum, who has considerable experience with the group. He wrote: "Your specimen certainly comes close to *A. acuminatum* in gross appearance, but I think that it is a form of *A. palustre,* probably the var. *imbricatum,* although I doubt that the variety can really be pinned down as anything more than an ecological expression of considerable variability. *Aulacomnium acuminatum* has more ovate leaves ending in finer tips, the margins are more clearly revolute and the leaves are not at all crisped. The tips of the stems in your specimen show the leaves somewhat crisped in the manner typical of *A. palustre*; I would guess that the plants were growing greatly compacted and therefore the leaves did not have a chance to become very crisped (?)."

Dr. Herman Persson, the renowned Swedish bryologist, has also given his opinion that the Colorado alpine plants belong to *A. palustre* var. *imbricatum.*

I have dwelt on this question at length because to me the foregoing resolution is still not entirely satisfactory. The plants of the alpine region are always recognizable at a glance by their *turgidum* characteristics and are never to be confused with *A. palustre* from lower altitudes. Likewise, the middle altitude *A. palustre* never varies in the direction of *A. turgidum.* Ecologically, these plants grow where one would expect *A. turgidum* to grow, associated with an elite Arctic-Alpine flora including *Campylopus schimperi, Entodon orthocarpus, Cirriphyllum cirrosum, Grimmia mollis, Paraleucobryum enerve, Oreas martiana, Calliergon stramineum* and *C. sarmentosum, Phippsia algida, Saxifraga foliolosa,* and *Koenigia islandica.* In other words, it might be more reasonable to allow some leaf-variation in *A. turgidum* and consider our material a disjunct race of that species. However, since the plants connect in some degree *A. turgidum* and *A. acuminatum,* I hesitate to make any taxonomic proposal at this time, anticipating that a serious and thorough monographic study reinforced by cytology may bring a fuller understanding of relationships.

It is interesting to discover that the status of *A. palustre* var. *imbricatum* is doubtful also in the European flora. Mårtensson (1956, II, p. 202), in his extremely valuable floristic study on the bryophytes of Swedish Lapland, writes: "Möller has referred one of his collections from Vassitjåkko to var. *imbricatum.* This type with its imbricate, rather broad, and obtuse leaves is similar to *A. turgidum* in its general appearance, but some leaves, however, are like those of the main species. According to M. (1939) var. *imbricatum* occurs in the alpine belt in habitats which are exposed to the sun. I have not studied it in the field and know very little about it. Bruch and Schimper

give very little information about it when describing it in Bryologia Europaee."

CRYPHAEACEAE

ANTITRICHIA

Sayre reported *Antitrichia californica* Sull., a Pacific Coast and Mediterranean species, on the basis of the distribution statement in Grout (1934, Vol. 3, p. 225): "on rocks, soil and trees; Los Angeles Co., California, to British Columbia, east to Colorado". Study of the literature fails to uncover the source or herbarium record for this statement, and no specimens have been seen from Colorado. Until a definite record is found, this species (and family) must be excluded from the Colorado flora.

FABRONIACEAE

We have the single genus and species, *Fabronia pusilla* Raddi. *Fabronia* is the tiniest and most delicate of our pleurocarpous mosses. The creeping stems, leaves and all, are only about 0.3 mm. wide when dry (to about 0.5 mm. when wet). The plants can be recognized very easily under the microscope, however, because of the large teeth which project outward from the margins of the leaves. These teeth are commonly hyaline, contrasting with the green cells of the leaf-lamina. The leaf-tip is also hyaline, abruptly long-attenuate from the ovate blade, and frequently forked at the apex. This very unusual serrate or even fimbriate condition is unique among our mosses. Because of the ciliate margins and the long, slender, often colorless leaf-tips, the branches of *Fabronia* often appear fuzzy under the hand-lens.

Fabronia almost always grows in the innermost recesses of rock crevices of cliffs in the foothill canyons. Our collections are all from siliceous rocks. The tufts are loosely attached to the substrate, sometimes almost lying free, and they range in color from bright green to pale yellowish-green.

The species of *Fabronia* are differentiated by the admittedly variable characters of leaf-shape, cell-size, and especially as to whether the teeth of the leaf are composed of single cells or of several cells. All of our Colorado material is alike characteristically with leaves having mostly single-celled teeth. These teeth range from shortly triangular to long and finger-like. On most leaves one or more of the teeth near the middle of the leaf-margin are larger than the others and are composed of a pyramid of from three to five cells, the terminal one the largest. The capsule of *Fabronia* is goblet-shaped on a well-exserted seta; the peristome is like that of *Orthotrichum*. All of our Colorado collections thus far have been without capsules.

Grout (1934, Vol. 3, pp. 227–230) regarded *Fabronia pusilla* as a sub-

species of *F. ciliaris* (Brid.) Brid. However, *F. pusilla* Raddi, published in 1808, is the type species of the genus and has nomenclatural priority, while *F. ciliaris* stems from *Hypnum ciliare* Brid. of 1812.

It is interesting to note under *Fabronia pusilla* an ecological situation somewhat analogous to that discussed under *Orthotrichum obtusifolium*. *Fabronia pusilla* in Colorado is found exclusively in rock crevices, while to the north and south of our area it occurs commonly on the bark of trees. I suspect that this is because our humidity is generally too low to support the plant on corticolous substrates.

FABRONIA PUSILLA Raddi

BL: in recesses of overhang in granite cliff, base of "The Crags", Gregory Canyon west of Boulder, 6,200 ft., *Weber 4645*; locally abundant on north face of overhanging cliff, Four-Mile Canyon below Salina, 6,000 ft., *Weber 4499, 9011*; on granite ledges, usually in deep crevices, Boulder Falls, foothills west of Boulder, 7,000 ft., *Weber 10,485*. LR: Log Canyon and Rist Canyon, 6,000–7,000 ft., *Baker & Holzinger 44*; canyon of Little Thompson River 10 mi. N. W. of Lyons, 8,000 ft., *Weber s.n.*

FISSIDENTACEAE — The Pocket Mosses

The leaves of the Fissidentaceae are in two ranks, lying in a single plane and thus giving the shoot a frond-like appearance. The leaves are unique among our mosses. The lower half of the leaf has a large, single lamella extending from the costa toward the stem, forming in effect a second leaf-blade lying over and partly covering the inside half of the lamina. This smaller 'half-leaf' is called the *dorsal lamina*.

The species of *Fissidens*, our only genus, are limited to wet ground, dripping cliffs, and shelving streambanks. A few species even live submerged in pools and streams.

KEY TO THE SPECIES

1a. Plants slender, with long narrow, rather distant leaves, completely submerged in pools; mesa country, not yet reported for Colorado but found in northern New Mexico ..... *Fissidens debilis.*

1b. Plants terrestrial but often in very wet places; leaves not as above, usually touching each other and forming a flat frond-like shoot ..... (2)

2a. Leaves wholly or in part bordered by a band of narrow elongated and colorless cells ..... (3)

2b. Leaves not bordered by narrower elongated cells ..... *Fissidens osmundoides.*

3a. Border extending nearly to the leaf apex on both sides; leaves acute ..... *Fissidens viridulus.*

3b. Border mostly confined to the sheathing laminae; leaves obtuse ..... *Fissidens obtusifolius.*

FISSIDENS DEBILIS Schwaegr.

Fissidens julianus (Mont.) Schimp.

Not yet reported from Colorado, but surely present in the southern tier of counties. We have a collection from adjacent New Mexico; MORA CO: attached to rocky bottom of water hole in an intermittent stream, in gully ca. 3 mi. W. of Canadian River Bridge on State Road No. 120, 5,900 ft., *R. A. Pursell 2997.*

FISSIDENS OBTUSIFOLIUS Wils.

Fissidens obtusifolius is frequent on moist overhanging cliff faces on the Mesa Verde and elsewhere in southwestern Colorado. It is extremely small and easily overlooked. The report (Brandegee 1896) of *Fissidens exiguus* Sull. probably refers to a specimen of *F. obtusifolius.*

MT: moist shaded recesses in sandstone (containing calcium carbonate) cliff 10 mi. N.W. of Dolores along Beaver Creek, 7,500 ft., *R. A. Pursell 3247*; cool recess behind overhanging cliff near head of Spruce Canyon, Mesa Verde Nat. Park, *Weber 4820, 8917.*

FISSIDENS OSMUNDOIDES Hedw.

Fissidens osmundoides is a boreal species occurring rarely in mesic alpine sites. On Loveland Pass it grows on vertical sides of cut-banks of streamlets in wet willow-hummock tundra below late-snow patches. Its characteristic associates were *Meesia uliginosa, Tayloria lingulata* and *Distichium capillaceum.* This is one of the larger species in the genus, easily recognized in the field by its rather large fronds with apple-green upper leaves closely arranged, and the lower, older blackened leaves.

CF: below Cottonwood Pass, Buena Vista, 11,500 ft., *H. S. Conard 415* (IA, *teste* Crum & Anderson). ST: Loveland Pass, northwest side of summit, 12,000 ft., *Weber B-4604.*

FISSIDENS VIRIDULUS (Web. & Mohr) Wahlenb.

Fissidens viridulus is the most frequent species in our area, occurring on moist streamside cut-banks throughout the middle altitudes of the mountains. It often grows in the protection of exposed rocks or tree-roots on substrates which are inundated during high-water periods.

BL: on earth banks of Boulder Creek, Boulder Canyon at Castle Rock, 14 mi. W. of Boulder, 7,500 ft., *Weber 8784*; Boulder Canyon, 6,800 ft., *Sayre*

224, 212a; south shore of Lake Eldora, 9,000 ft., *Weber 7982*; streamside west of Hessie, 9,500 ft., *Weber 9677*.

MEESIACEAE — The Swan-neck Mosses

The Meesiaceae are bog mosses with tall slender seta bearing an erect but curved sporangium upon a narrowed elongate neck. The plants are usually tufted, with brown tomentum on the stems. The distinguishing features are chiefly in the leaf characters. The leaves are prominently costate, with the costa ending just below the apex. We have two genera, *Ambylodon* and *Meesia*.

Key to the Species

1a. Leaf-margins plane; leaves lanceolate or broader, acute, the cells large, thin-walled, visible under the hand-lens; capsule pale olive-brown..... *Amblyodon dealbatus*.

1b. Leaf-margins revolute; leaves linear-lanceolate, the apex lingulate; leaf-cells small, thick-walled, not visible with hand-lens; capsule pale when young, reddish-brown and quite dark when old and empty..... *Meesia uliginosa*.

AMBLYODON

AMBLYODON DEALBATUS (Hedw.) B.S.G.

Amblyodon is a monotypic genus. Its single species belongs to the circumboreal element and is one of Colorado's real rarities, being known from only a few collections.

CF: hanging bog 1 mile W. of Fox Lake, Buena Vista, 10,500 ft., *Conard 41–109*. Also reported by Porter (1874) and Rothrock (1878).

MEESIA

MEESIA ULIGINOSA Hedw.

After one has learned to recognize *Meesia* by the peculiarly shaped capsule and elongate seta, it becomes easy to recognize the sterile plant by the leaves. These are narrowly oblong, with a disproportionately broad and prominent convex costa. The laminae are hardly wider than the costa and much thinner in comparison. The leaf-tip is blunt and the leaves themselves have a metallic sheen. *Meesia uliginosa* is probably quite common on streamsides in the alpine and subalpine although it has not been collected very often.

GN: Gothic Natural Area, base of Bald Mt., along Quigley Creek 4 mi. N. of Gothic, 10,000 ft., *Weber 9128*. PA: wet ground at timberline, Hoosier Pass, 11,000 ft., *Kiener 6705* (with *Tortella fragilis*). ST: willow-sedge-hummock area at run-off of late snow patch, summit of Loveland Pass, 12,000 ft., *Weber B-4602*.

NECKERACEAE

We have the single species, *Neckera pennata* Hedw. This moss is one of the easiest to recognize. It has wiry, creeping stems which are almost leafless, and erect, frond-like leafy stems which may be simple or somewhat pinnately branched. Young stems are particularly fragile-looking and pale glossy green. The leaves are diagnostic. They are oblong, ecostate, are abruptly narrowed to a short denticulate tip, and are transversely corrugated or wavy. The capsules, which are borne on the older growth, are immersed in the tips of short branches arising on the main stems.

In our region *Neckera pennata* is characteristically found in dark crevices of overhanging cliffs and ledges, always in more or less deeply shaded sites. It is most common in the foothill canyons, but occurs in similar sites in the lower subalpine. The Colorado material belongs to the variety *oligocarpa* (Bruch) Grout.

NECKERA

NECKERA PENNATA Hedw.

BL: granite ledges, Boulder Falls, foothills west of Boulder, 7,000 ft., *Weber 10,490*; mossy shaded ledge, "Little Royal Gorge" of Como Creek 2 mi. S. of University Camp, 9,000 ft., *Weber s.n.* GL: near trestle, Tolland, 9–10,000 ft., *Grout s.n.* GN: narrows of Cement Creek above Yarnell Ranch, 8,500 ft., *Weber & Langenheim 9498.* PA: Estabrook, Platte Canyon, 7,500 ft., *Holzinger 43.* RN: hillside N. of Beaver Creek Campground, Rio Grande River west of South Fork, 8,200 ft., *Weber & Livingston 6193.*

REJECTED SPECIES

NECKERA DOUGLASII Hook.

Sayre reported this species for Colorado on the basis of Grout's statement (1934, Vol. 3 p. 210): "on rocks and trunks of trees, San Mateo, California to Alaska, east to Colorado and Idaho". I am unable to find any specimen or report to verify this and must exclude the species from the Colorado flora.

ORTHOTRICHACEAE

The Orthotrichaceae are tuft-forming mosses occurring on rocks and trees. Our genera characteristically have a capsule which is cylindrical or oval, in most species ornamented with eight prominent longitudinally thickened lines or ribs. Our two genera, *Amphidium* and *Orthotrichum* are distinguished easily by the characters listed below.

AMPHIDIUM

This genus is boreal and is represented in Colorado by the single species, *Amphidium lapponicum* (Hedw.) Schimp., a small mat-forming moss found on dripping cliffs of siliceous rock. In fruiting condition it resembles a tiny *Orthotrichum,* having a cylindrical capsule on a short seta; the capsule wall is 8-ribbed and furrowed and strongly constricted below the mouth; there is no peristome, and, in contrast to *Orthotrichum,* the calyptra is cucullate and smooth. The leaves are strongly curled when dry, with margins plane or involute. The perichaetial leaves are much broader than the stem leaves and pale in color; in *Orthotrichum* these are not differentiated. *Amphidium* forms tight mats covering considerable surface; *Orthotrichum* forms discrete loose clumps.

AMPHIDIUM LAPPONICUM (Hedw.) Schimp.

BL: on granite ledges just below head wall of gully on northwest-facing slope, Four-Mile Canyon, 4 mi. N. W. of Boulder, 6,500 ft., *Weber 4496*; north-facing slope of ravine, Upper Gregory Canyon, 6,800 ft., *Weber 4533*; CR: siliceous rock ledge, South Colony Creek, *Kiener 10,317.* EP: Pike's Peak, along the cog railway, *Holzinger 20.* GN: on west-facing dripping cliffs, East River Valley just below Emerald Lake, north of Gothic, 10,500 ft., *Weber 9552, Krypt. Exsic. Vindob. No. 4032.*

ORTHOTRICHUM

Orthotrichum is a genus of tuft-forming mosses resembling *Grimmia* but with a looser habit and almost never having hair-pointed leaves. The only such species, *O. diaphanum,* grows on oak and juniper trees (*Grimmia* never occurs on trees). The leaves of *Orthotrichum* are bright green (lower ones blackish) and widely spreading when moist. In all of our local species they are imbricate when dried naturally. The leaves range from very obtuse to narrowly acute. The leaf-cells are papillose except at the base of the leaf.

The capsules are either immersed (not projecting beyond the tips of the upper leaves), emergent (slightly exceeding the leaves) or exserted (with the seta long enough to elevate the capsule beyond the leaves). The shape of the capsule is usually oblong, often sharply constricted below the mouth, and with eight usually prominent ribs (sometimes these only run part way down from the mouth).

The stomata on the capsule wall and their location on this wall are important diagnostic characters. The stomata are not at all numerous; in fact, there are usually only three or four visible. To observe them, one should

thoroughly soften the capsule by a wetting agent or by heating gently in water over a low flame. Slit the capsule with a needle and open it so that the outer wall is face-upwards on the slide. In order to obtain an unobstructed view, the spores and shriveled columella should be removed or washed away from the capsule. Addition of KOH tends to clear the cells and make the stomata more easily visible. Air bubbles should be avoided. Older or empty capsules are best for study of stomata.

The stomata are of two types, superficial (phaneropore) and immersed (cryptopore). If the stomata are superficial, the guard cells will be fully visible in the same plane as the adjacent cells. The two guard cells form almost a perfect circle bisected by a narrow slit swollen at the middle. If the stomata are immersed, the guard cells are partly hidden from view by the overlapping edges of seven or eight of the cells immediately adjacent them. The cell corners point toward the pore of the stomate and give the capsule a puckered appearance wherever they occur.

The peristome consists of 16 broadly lanceolate teeth often united in pairs. On the truly tree-inhabiting species, the teeth are usually tightly reflexed and appressed against the outside of the capsule when dry; in the rock-inhabiting forms, the teeth are usually spread more or less widely but are not strongly reflexed.

The teeth of the peristome are ornamented by papillae and/or striae. The striae appear to be low papillae which run together forming curved or vermiform markings on the teeth. Striae and papillae intergrade; some species have papillae at the base of the teeth and striae above, others are wholly striate or completely smooth.

The leaves of *Orthotrichum* are typically unistratose, but in *O. hallii* they are bistratose in the upper portion. It is usually not necessary to make sections of the leaves in order to see this; merely a careful manipulation of the fine adjustment of the microscope will show a sheet of cells at one level and then another sheet of cells in a slightly different horizontal position when one focuses up and down. The revolute edges of the leaves can be seen, preferably in dry material, with high magnification of the dissecting microscope. With practice a hand-lens is sufficient.

The calyptra is usually hairy and is mitrate (covering the capsule completely, as a thimble. *Grimmia calyptrata* has a sub-mitrate calyptra, but this never covers the capsule so perfectly as in *Orthotrichum. Encalypta* has a mitrate calyptra, but this is naked and drawn out suddenly at the apex into a slender rod-like point.

The only genus likely to be confused with *Orthotrichum* in Colorado is the genus *Grimmia. Grimmia* usually can be separated by its hair-pointed leaves

and rock habitat. However, those species of *Grimmia* centering about *G. apocarpa* form loose tufts, they have sessile capsules, and the leaves commonly lack hair-points. *Grimmia apocarpa*, when fertile, can be recognized by its bright red operculum and peristome. In our species of *Orthotrichum* the lid and peristome are not brightly colored. The median and upper leaf cells in *Orthotrichum* are round and often thick-walled but nevertheless clearly defined. In *Grimmia* these cells are often so papillose, opaque, or bistratose, that they are not easily distinguished. The tufts of *Grimmia* are usually very dense and blackish.

With the exception of *O. alpestre*, which occurs with equal frequency on rocks and on trees, the species are quite constant in their choice of substrate. *O. anomalum* occurs on limestone or calcareous sandstone, *O. diaphanum* on oaks and junipers, *O. obtusifolium* on *Populus balsamifera* and *P. tremuloides*, *O. rupestre* and *O. hallii* on acid rocks.

KEY TO THE SPECIES

1a. Upper leaves with long serrate hair-points; rarely fruiting; usually on oak and juniper in the southern part of Colorado ..... *Orthotrichum diaphanum.*
1b. Leaves lacking hyaline points ..... (2)
2a. Leaf-margins plane or involute throughout; leaves with gemmae scattered on the surface; tiny plants, peristome lacking, capsule immersed; on *Populus* at high altitudes ..... *Orthotrichum obtusifolium.*
2b. Leaf-margins revolute for at least a portion of their length ..... (3)
3a. Stomata superficial (phaneropore) ..... *Orthotrichum rupestre.*
3b. Stomata immersed (cryptopore) ..... (4)
4a. Capsules plainly exserted, wet or dry, the seta evident beyond the subtending leaves; on limestone or calcareous sandstones ..... *Orthotrichum anomalum.*
4b. Capsules immersed or emergent; on various rocks, or on trees ..... (5)
5a. Leaves obtuse or rounded; plants with bluish and reddish-purple tints; on calcareous sandstones or limestones ..... *Orthotrichum jamesianum.*
5b. Leaves acute, tapering to the tip; plants with green young tips, blackish in the older parts; on siliceous rocks or on trees ..... (6)
6a. Peristome teeth papillose at the base, striate above; leaves unistratose ..... *Orthotrichum alpestre.*
6b. Peristome teeth striate throughout; leaves bistratose in the apical part ..... *Orthotrichum hallii.*

ORTHOTRICHUM

ORTHOTRICHUM ALPESTRE Hornsch.

On siliceous rocks and infrequent also on deciduous trees in the outer foothill valleys. See discussion under *O. hallii.*

AL: in sandy area on dead juniper wood, campground, Great Sand Dunes Nat. Mon., *Maslin s.n.* BL: boulders, Green Mountain, 7,000–8,000 ft., *Weber 3250, 4528, 4662, 9597*; granite boulder, Middle Boulder Creek near Eldora,

9,000 ft., *Livingston 163*; on bark of base of *Betula papyrifera*, Green Mt., 7,000 ft., *Weber s.n.*; on *Acer negundo*, Bluebell Canyon, 6,000 ft., *Weber 10475*; on *Populus*, University of Colorado campus, *Weber B-687*.

ORTHOTRICHUM ANOMALUM Hedw.

Orthotrichum anomalum has not yet been reported for Colorado, but it is to be expected in the mesa country of southeastern Colorado. We have four records of the species from adjacent New Mexico, in Harding, Mora, San Miguel and Union Counties. The species is said to prefer calcareous substrates, and is easily recognized by the exserted capsule.

ORTHOTRICHUM DIAPHANUM (Schrad.) Brid.

The only species of *Orthotrichum* with hair-pointed leaves, *O. diaphanum* occurs on the bark of oaks and junipers in the southern portion of Colorado and southwestward.

MT: bark crevices, *Juniperus osteosperma*, top of Chapin Mesa along Ruins Road, vicinity of Cliff Palace, Mesa Verde Nat. Park, *Weber B-1989*.

ORTHOTRICHUM HALLII Sull. & Lesq.

This taxon may bear the same relationship to *O. alpestre* as do *O. texanum* and *O. macounii* to *O. rupestre*. *Orthotrichum hallii* and *O. alpestre* are found in the same habitats and range and differ by the same kinds of variable characters. If *O. hallii* can be included in *O. alpestre*, then there are only two species to be found on our acid rocks. According to this key the only way to distinguish them is by the immersed *versus* superficial stomata. If we can simplify the taxonomy in the way indicated above, it should be possible to distinguish *alpestre* from *rupestre* in the field as follows: the capsules of *rupestre* are variable as to length of seta, sometimes being almost exserted; those of *alpestre* are immersed; the capsules of *rupestre* are smooth or only weakly ribbed near the mouth and are not strongly constricted below the mouth; those of *alpestre* are strongly ribbed throughout the whole length and strongly constricted below the mouth (urn-shaped).

BL: north slope, "narrows" of Boulder Canyon at Castle Rock, 11 mi. W. of Boulder, 7,500 ft., *Weber 9656*. EP: North Cheyenne Canyon on road to Bruin Inn at foot of Palmer's Trail to Mt. Cutler, 6,900 ft., *Jewett* (Holzinger, Musc. Acro. Bor.-Amer. No. 90A). MT: under ledge of west pour-off at the head of Bobcat Canyon, 6,900 ft., Mesa Verde Nat. Park, *Erdman B-3686*.

ORTHOTRICHUM JAMESIANUM Sull. & Lesq.

This is probably the rarest of our species of *Orthotrichum*, only recently discovered (1959) on calcareous cliffs in the southwest corner of Colorado. The

blunt rounded leaves, often encrusted with lime, and the peculiar reddish-purplish hues of the leaves are characteristic.

MT: growing on ceiling of an overhang below the west pour-off of Bobcat Canyon, Wetherill Mesa, 6,900 ft., Mesa Verde Nat. Park, *Erdman B-3687.*

ORTHOTRICHUM OBTUSIFOLIUM (Schrad.) Brid.

Stroemia obtusifolia Hagen

Orthotrichum obtusifolium is a boreal species commonly occurring on *Populus* in the far north. In Colorado very few epiphytes occur on aspen, possibly because of the very low humidity in the mountains. As one goes south, however, into New Mexico and Arizona, there is a rich development of epiphytic lichens on the trees of the upper montane and subalpine forests, probably because of the greater influence of moisture-laden gulf air. At least the summits of these mountains are more frequently enveloped by fog than the Colorado Rockies, even though the southern mountains are more isolated and more obviously desert ranges at their lower levels.

In the Sandia Mountains east of Albuquerque, *Orthotrichum obtusifolium* grows commonly on *Abies lasiocarpa* near the summit of the range (*Weber 102,259*). Therefore, it might be expected that this species will be found in the forests of the Culebra, Sangre de Cristo, or San Juan mountains in southern Colorado, where there is some greater moisture than exists to the north.

The species is easily recognized by the small, obtuse leaves with prominent papillae showing along the margins, and the brownish, oblong, several-celled gemmae scattered over the surface.

ORTHOTRICHUM RUPESTRE Schleich.

In my present imperfect understanding of the group I am tentatively including *O. texanum* Sull. and *O. macounii* Aust. within a broad interpretation of *Orthotrichum rupestre. O. rupestre* has the peristome smooth to faintly papillose, sometimes with faint sinuous lines; *O. texanum* has teeth roughened with coarse irregular projections which are neither papillae nor striae, and *O. macounii* has teeth coarsely papillose, sometimes striate at the base. Since I find all three forms occupying the same range and habitat, I am inclined to allow considerable variability within *rupestre* and not to recognize three species here. Local populations should be studied carefully in order to determine whether all three peristome types are found within an otherwise homogeneous population. There seems to be no vegetative difference separating the forms.

BL: Gregory Canyon, Green Mountain, 6,000–8,000 ft., *Weber 3251, B-3671, 4527, 4651, Pursell 3028*; base of "Flatirons", 6,000 ft., *Shushan & Weber,*

Crypt. Exsicc. Vindob. No. 4185 sub *O. macounii*; Boulder Creek at Castle Rock, 7,500 ft., *Weber 8792*; Horseshoe Cirque, Bald Mt., 11,000 ft., *Weber 4969*. CC: south shore Summit Lake, Mt. Evans, 12,700 ft., *Weber & Jones 8545*. CR: siliceous rock ledge, South Colony Creek, 11,500 ft., *Kiener 10,319*. EP: Dark Canyon, 2,700 m., *Clements & Clements* Crypt. Format. Coloradensium No. 395. GL: Tolland, *Grout s.n.* GN: granite cliffs, Cement Creek narrows, 8,500 ft., *Weber & Langenheim 9497*. LR: rocky tundra slope, summit of Trail Ridge, Rocky Mt. Nat. Park, 12,000 ft., *Weber 9645*. RN: hillside south of Beaver Creek Campground west of South Fork, 8,200 ft., *Weber & Livingston 6167, 6194*. RT: Little South Fork of Elk River 2 mi. S. of Seedhouse Guard Sta., 28 mi. N. of Steamboat Springs, 8,400 ft., *Weber 7107*. ST: Monte Cristo Creek, between Breckinridge and Hoosier Pass, 11,000 ft., *Weber 6597*.

DOUBTFUL REPORTS

Several species listed by Sayre on the basis of old reports (Brandegee, Rothrock, Grout, and others) have not been found in the herbarium. Several of these are likely to be incorrectly determined. Thorough checking of all the records is being pursued and will be reflected in later revisions. The species reported by Sayre in addition to the above are the following: *Orthotrichum elegans* Hook. & Grev. (Grout, 1935, considered this a subspecies of *O. speciosum*), *O. lyellii* Hook., a characteristic species of the Pacific coast, *O. pumilum* Dicks., credited by Grout (*ibid.*) to "... eastern U. S., east of the Rocky Mts., Idaho, Utah, south to Tennessee", *O. speciosum* Nees, a northwestern species, and *O. tenellum* Bruch, "California and Rocky Mt. Region, New Mexico to Alberta" (Grout, *ibid.*). Under *O. elegans*, Grout comments that "this eastern form is distinctly different from the western form which the author collected several times in the Colorado mountains". By the "western form" he presumably means *O. speciosum*.

POLYTRICHACEAE — The Hair-Cap Mosses

This family is recognized by the combination of simple erect stems, robust habit, the large leaves always with lamellae on the upper surface, all but the single species *Atrichum undulatum* having thick, opaque leaves resembling spruce needles. In fact, the uninitiated might even mistake these mosses for seedlings of conifers. The capsules are usually large and cylindric, being either terete (*Pogonatum, Atrichum,* and *Polytrichum alpinum*) or four-angled (*Polytrichum* and *Polytrichadelphus*). A broad membranous disk serves to close the capsule mouth even after the dehiscence of the operculum, and the peristome consists of 32 or 64 very low teeth composed of whole cells. The calyptra is often covered with hairs.

The genera are somewhat artificial and not easily separated on vegetative characters alone. Too much reliance on sporophytic characters alone probably contributes to the artificiality of the classification. Thus, *Polytrichum alpinum* is usually placed in the genus *Pogonatum* on the basis of the terete capsule, although on most other grounds it is best placed in *Polytrichum*. In view of this difficulty, the key below does not attempt to give clear-cut characters for the genera, but keys the species directly.

Whenever possible, these plants should be collected with sporophytes because the diagnostic characters largely reside in the capsules and calyptra. Indeed, *Polytrichum alpinum, Pogonatum urnigerum*, and *Polytrichadelphus lyallii* differ so little vegetatively that it is only with experience that they can be easily recognized.

In addition to the species treated here, Sayre reported *Pogonatum contortum* Lesq., a plant of the Pacific Northwest. The specimen (*L. Nagel s.n.*) actually belongs to *Polytrichadelphus lyallii*. *Polytrichum gracile* Sm. has also been reported by Sayre and by numerous collectors. All of these specimens examined to date also turn out to be *P. lyallii*. Frye (in Grout 1937) believed that one specimen (Tolland, *Grout* in 1914) actually was *P. gracile*, but I have been unable to verify this.

It is very curious that the role of *Polytrichum commune*, which is so abundant across northern North America, is taken over in Colorado by *Polytrichadelphus lyallii*. *P. commune* is apparently absent from the southern Rocky Mountains. Frye (in Grout 1937) listed Arizona as being in its range, but Haring (1947) does not include it in her check list of Arizona mosses.

Key to the Species

1a. Lamellae few (only 2 to 6), much of the leaf-lamina naked and the lamellae easily visible with a hand-lens; leaves thin, undulate, crisped when dry ..... *Atrichum undulatum.*

1b. Lamellae numerous (25–75), covering most of the face of the lamina; leaves thick, awl-shaped, like spruce needles ..... (2)

2a. Margins of the leaf thin, folded in over the lamellae ..... (3)

2b. Margins of the leaf plane, not infolded, the margins commonly serrulate .... (4)

3a. Leaf with a long hyaline awn ..... *Polytrichum piliferum.*

3b. Leaf with a short reddish awn ..... *Polytrichum juniperinum.*

4a. Capsule with four longitudinal ridges but these in pairs so that the capsule is unequally four-sided; leaves long and spreading-recurved when moist, the sheath to 2 mm. and blade to 10 mm. long; plants of subalpine forests and protected sites above timberline ..... *Polytrichadelphus lyallii.*

4b. Capsule terete, without ridges; leaves usually shorter and more erect, often stiffly so, the blades up to 6–8 mm. long ..... (5)

5a. Leaves short and broad, glaucous or brownish; capsule nearly erect, yellowish or reddish-brown; rare, alpine screes; plants rarely in large clumps ..... *Pogonatum urnigerum.*

5b. Leaves slender, green; capsule inclined, yellowish-green; common in wet alpine and subalpine sites..... *Polytrichum alpinum.*

ATRICHUM

ATRICHUM UNDULATUM (Hedw.) Beauv. var. SELWYNI (Austin) Frye

Catharinea selwyni (Austin) E. G. Britton
Atrichum selwyni Austin

Atrichum undulatum has a very wide altitudinal amplitude, occurring in the cool foothill ravines, the deep spruce forests of the subalpine, and sparingly in the moister alpine areas. The variety *selwyni* has the lamellae slightly higher (6–13 cells high) than in the species proper.

BL: sandy soil of undercut streambank, west base of Green Mt., S. W. of Boulder, 7,000 ft., *Weber 4513, 4509.* CC: Summit Lake, Mt. Evans, 12,800 ft., *Weber & Holmen 4359.* GL: moist north-facing slope 1 mi. below Tolland, 9,000–10,000 ft., *Grout* in 1914. GN: steep bank, spruce-fir forest north of Gothic, 10,000 ft., *Weber 8866.*

POGONATUM

POGONATUM URNIGERUM (Hedw.) PB.

Thus far, all Colorado specimens of this species have been sterile and the plants have occurred intermixed with *P. alpinum,* from which *Pogonatum urnigerum* is easily separated out by the broad, boat-shaped, glaucous leaves. Whereas *Polytrichum alpinum* forms dense sods on peaty soil, *Pogonatum urnigerum* grows scattered, only a few stems together, on more sandy substrates.

CC: west shore, Summit Lake, Mt. Evans, on slope to ice lake, 13,500 ft., *Weber, Porsild & Holmen B-4357, 4342A.*

POLYTRICHADELPHUS

POLYTRICHADELPHUS LYALLII Mitt.

Sterile material of this species is often mistaken for *Polytrichum,* especially *P. gracile.* The large size of the plant, the leaves long and widely spreading when moist, and peculiarly ridged capsules make for easy recognition.

BL: east edge of Lake Isabelle, 11,000 ft., *Weber 4282*; Lake Albion, 11,000 ft., *Nagel s.n.*; Science Lodge, *Gambill s.n.*; Thunder Lake, Rocky Mt. Nat. Park, 11,000 ft., *Kiener 5621.* CC: Summit Lake, Mt. Evans, 12,800 ft., *Weber & Holmen B-4466.* GF: trail from Trappers Lake to Coffin Lake 30 mi. E. of

Buford, 9,700 ft., *Shushan B-297*. GA: North Inlet, 5 mi. N. E. of Grand Lake, 9,000 ft., *Douglass B-2923*; Flat-Top Mt., 12,000 ft., *Drew 259*. GN: Gothic Natural Area, 10,000 ft., *Weber 8855, 9117, 8854*. PA: 11 mi. E. of Jefferson on road to Lost Creek Park, 10,000 ft., *Shushan 87*. RT: Anita Peak, *Holzinger 1751*.

POLYTRICHUM

POLYTRICHUM ALPINUM Hedw.

Pogonatum alpinum (Hedw.) Röhl.

I am following Holmen (1960) in retaining this species in *Polytrichum*. *Polytrichum alpinum* is a characteristic plant of the wet tundra, especially around alpine snow-melt ponds and on frost-push hummocks. It is found commonly in fruiting condition with short, broad, light-colored capsules. Leaf-length is quite variable, much of our material being assignable to the variety *brevifolium* Brid. with leaves only 5–8 mm. long.

BL: Baldy Ridge, 11,500 ft., *Sayre 361*. CC: Summit Lake, Mt. Evans, 12,700 ft., *Weber 8537, 7773, 9261*; Stevens Mine Trail, Gray's Peak, 13,700 ft., *Weber 5646*. GF: Trappers Lake, *Johnson 681*. GL: James Peak, 13,000 ft., *Grout s.n.* LR: Cameron Pass, *Baker 38*; Long's Peak, *Kiener 4872, 8002 pro parte* (N. Amer. Musc. Perf. No. 441).

POLYTRICHUM JUNIPERINUM Hedw.

Polytrichum juniperinum is very abundant and widely distributed from the foothills through the subalpine. In contrast to the next species, which is equally abundant, it tends to avoid excessively dry or exposed sites and tolerates more shade. With a hand-lens, the infolded margin of the leaf and the reddish leaf-tip are diagnostic.

BL: Long Mesa, S. of Boulder, 5,300 ft., *Sayre 314*; Fourth of July Mine, *Ramaley & Robbins 2444*; Bear Creek near Kossler Ranch, 7,000 ft., *Weber 4670*; between Silver and Albion Lakes, 10,500 ft., *Shushan & Johnson B-3992*. CF: Hancock, 11,000 ft., *Kiener 6718*. CC: Grizzly Gulch, S. of Bakersville, 11,000 ft., *Weber 7880*. GL: Teller Lake, Tolland, *Robbins 7562*. GA: Lost Lake, 8 mi. W. of Grand Lake, 9,500 ft., *Douglass 60–219*. GN: North Italian Mt., 11,000 ft., *Weber & Langenheim 9297*. JF: Genessee Mt., 7,400 ft., *Sayre 141*. LR: Long's Peak, 11,100 ft., *Kiener 7306*; Ethel Peak, *Goodding 1899*; Chambers Lake, 10,000 ft., *Baker 518*. PA: Breckinridge, *Holzinger 39*; Platte Gulch, N. of Mount Lincoln, 12,300 ft., *Weber 8841*. RT: Slavonia to Gilpin Lake, *Weber 7114*.

POLYTRICHUM PILIFERUM Hedw.

Abundant and ubiquitous on gravelly open ridges and wind-swept summits, *Polytrichum piliferum* is easily recognized by the thick lamellate leaves with infolded margins and long white hair-points. When forming dense sods it mimics to some extent *Selaginella densa*, which is also abundant in the same areas.

BL: Rainbow Falls, *Livingston 165*; 4 mi. N. E. of Ward, 8,900 ft., *Livingston 78*; Gregory Canyon, 6,000 ft., *Pursell 3023*; Horseshoe Cirque, Bald Mt., 10,000 ft., *Weber 4968*; summit Green Mt., 8,000 ft., *Weber 3252*. DA: Devils Head Mt., 8,000 ft., *Sayre 237*. LR: west of Fort Collins, 5–7,000 ft., *Baker s.n.*; timberline, Long's Peak, 11,000 ft., *Kiener 7305*; N. W. of Lyons, 6,000 ft., *Weber 3898*; Trail Ridge Road, 11–12,000 ft., *Sayre 87*; summit of North Park Range, *Goodding 1835*. RT: Slavonia to Gilpin Lake, *Weber 7124*.

SPLACHNACEAE — The Dung Mosses

The Splachnaceae are a peculiar group of mosses, most of the species occurring on dung, decaying animal remains, or other highly organic substrates. Several species have a highly swollen hypophysis or basal part of the capsule; at the same time this structure may be colored pink, white, or yellow. Such species are commonly called "parasol-mosses". In the Colorado species the hypophysis is usually merely differentiated in some minor way from the capsule proper, being either broader or narrower than the urn.

The leaves of Splachnaceae are usually very loosely areolate; that is, the cells are large and easily visible, suggestive of casement windows. The species are for the most part rare alpine or subalpine mosses growing in moist situations, especially willow-bogs and snow-melt basins. Vegetatively they remind one of *Mnium*, but the leaves are usually narrower and lingulate and are never bordered.

KEY TO THE SPECIES

1a. Peristome absent; capsule long and narrow, tapering to the apex..*Voitia nivalis.*
1b. Peristome present; capsule with an evident hypophysis.....(2)
2a. Calyptra constricted below; hypophysis narrower than the urn (genus *Tayloria*) .....(3)
2b. Calyptra not constricted below; hypophysis widened, but at maturity often narrower than the urn; peristome teeth reflexed; hypophysis dark purple..... .....*Tetraplodon mnioides.*
3a. Leaves acuminate, serrate; spores less than 20 microns diameter; peristome teeth divided into 32 prongs.....*Tayloria acuminata.*
3b. Leaves obtuse, more or less entire; spores more than 20 microns in diameter...(4)
4a. Peristome teeth at maturity in pairs; seta stout, ca. 1 cm. tall; spores brown, densely papillose.....(5)

4b. Peristome teeth at maturity 16, single; seta slender, 3–4 cm. tall; spores yellowish-green, granulate or smooth ..... *Tayloria lingulata.*

5a. Operculum not deciduous, remaining attached to the exserted columella; leaves clustered at the tip of the stem and branches ..... *Tayloria hornschuchii.*

5b. Operculum deciduous; columella not protruding; leaves more or less uniformly distributed down the stem ..... *Tayloria froelichiana.*

TAYLORIA

TAYLORIA ACUMINATA Hornsch.

Tayloria splachnoides var. *acuminata* (Schleich.) Hueben.

"Southern Colorado, collected within 100 miles of Canyon City", *T. S. Brandegee 78*, 1874–78 (NY, as *T. splachnoides*); "Colorado", *T. P. James*, 1872 (NY). Both specimens have been verified by Dr. Howard Crum.

TAYLORIA FROELICHIANA (Hedw.) Lindb.

This species is rather critically close to *T. lingulata.* Crum (correspondence) points out that in *T. froelichiana* the peristome has paired teeth and rather erect, appressed leaves (conspicuously contorted in *T. lingulata* when dry).

GN: wet seepage area below quartzite cliffs above East River and below Emerald Lake, 10,500 ft., north of Gothic, *Weber 9556*, verified by H. Crum and H. Persson. "Colorado", *leg. Brandegee, ex herb. E. A. Rau* (NY), as *Dissodon splachnoides*; "Southern Colorado, collected mostly within 100 miles of Canyon City", 1874–78, *T. S. Brandegee* (NY), both specimens verified by H. Crum.

TAYLORIA HORNSCHUCHII (Grev. & Arn.) Broth.

Tayloria hornschuchii grows on vertical sides of frost-push hummocks on the mossy outlet area of Summit Lake on Mount Evans. It is nowhere abundant, occurring in small patches with *Distichium capillaceum, Entodon orthocarpus, Cirriphyllum cirrosum, Oreas martiana,* and *Campylopus schimperi.* Even when sterile, it is conspicuous by its very broad, obtuse, loosely areolate leaves.

CC: Summit Lake, Mt. Evans, west shore, slope to ice lake, 13,500 ft., *Weber, Porsild & Holmen B-4355.*

TAYLORIA LINGULATA (Dicks.) Lindb.

Tayloria lingulata occurs abundantly in a willow-sedge hummock area of a snow-melt basin on the summit of Loveland Pass, where I have found it in association with *Drepanocladus revolvens.* It does not seem to be associated

with animal droppings but forms close mats in depressions between the hummocks. The hypophysis is narrow and the urn short and broad (wine-glass-shaped), with erect, gray-white peristome teeth.

CC: Grizzly Gulch, S. of Bakersville, 11,000 ft., *Weber 7883a.* HN: wet alpine meadow, basin on west side of Handies Peak, 12,000 ft., *R. B. Livingston s.n.* (DUKE), verified by Crum. ST: Loveland Pass, 12,000 ft., *Weber B-4601.*

TETRAPLODON

TETRAPLODON MNIOIDES (Hedw.) B. S. G.

Tetraplodon mnioides is recognized by its stout reddish or yellowish seta and usually deep purple hypophysis and paler urn with reddish reflexed peristome teeth. The height of the seta is very variable; plants with short seta are called *T. urceolatus*, but this character is probably merely environmentally induced.

BL: on humus soil, west side Lily Lake, Science Lodge area on the moraine, 10,500 ft., *Sayre 666*, verified by H. Crum.

VOITIA

VOITIA NIVALIS Hornsch.

Voitia nivalis is one of the rarest of North American mosses. Except for Alaskan records, the specimen cited below is the first known from the United States. Arctic collections cited as this species belong mostly to *V. hyperborea* Grev. & Arn., in which the capsule is truncate below and squarish in cross-section.

The existence of the Colorado collection was brought to my attention by Dr. Henry S. Conard, who had seen it in the Missouri Botanical Garden herbarium. I am very grateful to that institution for their kindness in donating the specimen to the University of Colorado Museum.

CC: Argentine Pass, 18 July 1886, *William Trelease s. n.*

REJECTED SPECIES

SPLACHNOBRYUM KIENERI R. S. Williams in Bryologist 38: 92. 1935.

Andrews (1949) has shown that this plant is in reality *Bryum turbinatum* (Hedw.) Schwaegr. Andrews further suggests that the genus *Splachnobryum* should be placed in the Pottiaceae rather than with the Splachnaceae.

TETRAPHIDACEAE

Our single species, *Tetraphis pellucida*, is immediately recognized by one unique characteristic: the slender, tubular, erect capsule is terminated by a

peristome consisting of only four narrowly triangular teeth. No other moss has this number of peristome teeth; they can easily be seen and counted under the hand lens. Since the sporophytes endure for several seasons, this moss is usually found and recognized by the unique capsule. Vegetative shoots frequently develop elongate, almost leafless shoots terminated by a shallow cup of short, broad leaves in the center of which is a cluster of gemmae. Without sporophytes or gemmae, the species may be recognized with experience by the rather distantly arranged, almost perfectly elliptical leaves which are somewhat prominently keeled and which turn a beautiful reddish color when dry.

Tetraphis pellucida is probably more common than our few collections indicate, and its chief habitat is on decaying wood, frequently the cut ends of stumps in the deep shade of the subalpine forests.

TETRAPHIS PELLUCIDA Hedw.—Four-toothed Moss

GN: on wood, moist *Picea engelmannii* forest, Gothic Natural Area, 10,000 ft., *Sayre 634*. LR: on rotting wood in moist gully, Long's Peak, 9,700 ft., *Kiener 8987*.

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