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**THE LIVERWORTS AND HORNWORTS OF COLORADO**

By

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(A WORK IN PROGRESS)

This portion of the Bryophytes of Colorado is dedicated to

Won Shic Hong  
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who has contributed mightily to our knowledge of the Colorado Flora

Our Hepatics, usually called liverworts, are small in numbers of species. So many of the genera have only one species, which is wonderful news for amateurs. The larger genera, especially *Lophozia*, present difficult problems in recognition and dissection. However, with field experience many *Lophozia* species may be recognized on sight! By far the best source of information with hints on field recognition is Schuster, *Boreal Hepaticae* (1953). The illustrations are really useful. It is sad that such books are no longer easy to find. We really need a clearing house for good illustrations of hepatics!

\*\*\* introductory morphological material, terminology (spores, elaters, pseudoperianth, etc.)

## ***THE THALLOID LIVERWORTS***

**A note about the families:** In a local flora, especially one in which the number of genera and species is very low, as here in the Rocky Mountains, it makes little sense to try to think of families. Learning the liverworts begins with recognizing a species, then a few more, getting the feel for a genus. This is often as far as the non-specialist wants or needs to go. Too many families are controversial. Genera are less so. So pardon us if we slight the family characteristics.

**Microscopic characters:** For field botanists it will be impossible to follow some generic keys that deal with cell sizes and other microscopic characters. Until you have the necessary experience with the genus that you feel you need to do microscopic work, you may have to be satisfied with recognizing the genus.

## ANEURACEAE

- 1a. Thallus large, unbranched or nearly so; thallus thick, bright green and greasy in appearance, 10-15 cells thick and 4-10 mm wide; oil bodies absent; calyptra hairy.  
**Aneura**
- 1b. Thallus small and rather delicate, thin, dull, 4-9 cells thick, less than 2 mm wide, regularly pinnately branched, the ultimate branches thin-edged about 2-3 cells wide and 1 cell thick. **Riccardia**

### **Aneura**

*Aneura pinguis*, our only species, consists of a very simple, usually unbranched thallus up to 6 mm wide, opaque green, rather rigid and thickish, with a greasy appearance. There is no mid-rib. It is closest in appearance to *Pellia*, but that is thinner and has a mid-rib. Female plants have erect, club-shaped green calyptras. The fragile seta and black, oblong capsule stick up through the top of the calyptra.

**Aneura pinguis** (L.) Dum. We have one record: Chaffee Co.: Wet ground, St. Elmo, 10,000 ft., Kiener 6695 (with fruit!) (*Riccardia pinguis* (L.) S. F. Gray, *Trichostylium pinguis* Schuster, *Bryologist* 61:53. 1958).

### **Riccardia**

**Riccardia multifida** (L.) S.Gray. We have only one record, Larimer Co.: On soil, Chiquita Creek, Rocky Mountain National Park, *Hong 78-921* (Hong 1980). We have no specimens in the COLO herbarium.

## ANTHELIACEAE

### **Anthelia**

*Anthelia* is an exceedingly common plant of melting snow-beds in the alpine tundra. However, it is rarely recognized as a plant because it forms black, more or less amorphous patches. It is only upon very close examination that it is seen to consist of minute stems. In the field *Anthelia* usually has a grayish color because of a covering of either fungal hyphae or terpenoid chemical compounds.

***Anthelia juratzkana*** (Limpr.) Trevis. There are two species of *Anthelia*. The second one, *A. julacea*, occurs in areas with a more oceanic climate than Colorado. Fortunately we do not need to distinguish them here, since technically they differ in spore size (*A. julacea* having spores 14-15 microns, *A. juratzkana* 17-20 microns). I have not seen *Anthelia* fruiting here. We have specimens from Boulder, Grand, Larimer, Park, Pitkin, and San Juan counties. It can be found in most snow-melt basins.

## ANTHOCEROTACEAE

The hornworts, as these are called, form a separate class from other liverworts: The Anthocerotae. They are different in all respects from other hepatics. The sporophyte, rather than having an ephemeral seta, is green and persists until the death of the thallus. The capsule is long and cylindrical instead of round or oval. The capsule is two-valved rather than four. The cells of the thallus are thin-walled, never with corner thickenings (trigones), and they have a single, large saucer-like chloroplast.

- 1a. Sporophytes small, nearly horizontal, surrounded until maturity by the perichaetia.  
**Carpobrotus**
- 1b. Sporophytes tall, erect, cylindrical, projecting far beyond the perichaetia at maturity.  
**Phaeoceros**

### **Carpobrotus**

**C. orbicularis** Schwein. Our only collection is from Alamosa Co.: East edge of Alamosa, on alluvial deposit, bank of Rio Grande River; very scattered, with *Riccia frostii*, *McGregor* 7465. There has not been an attempt to rediscover this, and the town of Alamosa probably has grown to encompass and destroy the locality. The species forms small rosettes similar to those of *Riccia*, but the thallus is clear green and not appressed to the ground.

### **Phaeoceros**

**P. laevis** (L.) Prosk. Our only collection is from Boulder Co.: Boulder [presumably on the White Rocks], 1908, *Bethel*. If it still persists, it should be sought on moist underhangs of the Fox Hills Formation at the White Rocks Preserve, 8 mi NE of Boulder. In *Phaeoceros* the spores are yellow. In **Anthoceros**, for which we have no reports, the spores are black.

May 8, 2003

## AYTONIACEAE

In this family, a critical character is the structure of the pores that open into the air-spaces of the thallus. Making thin sections showing the surface view or the cross-section of these is not an easy task, but it is worth while to explain what the architecture of the surrounding tissue is like. Many times the determination of the genus depends on our knowledge of the pores. Also, sporophytes are usually necessary for identification. Count yourself very lucky to find specimens with well-developed female receptacles. These are beautiful structures and vital in distinguishing the genera. Treat them gently so that they are not damaged by pressing.

- 1a. Plants with female receptacles .....(2)
- 1b. Plants lacking female receptacles .....(4)
  
- 2a. Female receptacles (carpocephala) with a white pseudoperianth surrounding the capsule; stalk lacking scales at the base..... **Asterella**
- 2b. Female receptacles lacking a pseudoperianth.....(3)
  
- 3a. Stalk very short (3 mm or less), arising from the thallus surface, lacking a rhizoid furrow; the receptacle cap smooth; involucre 2-lipped (lengthwise). **Plagiochasma**
- 3b. Stalk elongate, arising from the thallus notch, with a rhizoid furrow; receptacle cap with low coarse tubercles, not lipped. *Mannia*
  
- 4a. Thallus pores bounded by 4-6 cells, not in several radial rows. **Plagiochasma**
- 4b. Thallus pores bounded by several radial rows of cells .....(5)
  
- 5a. Subalpine species. **Asterella**
- 5b. Foothills species. **Mannia**

### **Asterella**

*Asterella* is a thalloid liverwort with a bluish-green color. It is easily recognized when fruiting because it produces a stalked umbrella that is simply hemispherical, not lobed, and under the umbrella four sessile sporophytes that are enveloped by a hyaline pseudoperianth. This splits into a fringe of linear white segments or remains attached at the end, forming a “Chinese lantern” cage. In *Mannia fragrans* there are white scales, but these are on the upper end of the stalk, not around the sporophytes. The thallus surface has small hexagonal markings (these lines indicate the places where the air chambers are separated). The ventral scales are small and do not protrude as a tuft at the thallus tip as in the similar *Mannia fragrans*.

- 1a. Thallus about 2 mm wide. **A. gracilis**
- 1b. Thallus 4-6 mm wide. **A. lindenberiana**

**A. gracilis** (F. Web.) Underw. is our only species. Evans (1915) reported it from Boulder, Bethel 4; Gilpin Co.: near Tolland, Young. We have specimens from Gunnison,

Larimer, and San Juan counties. All of our specimens are from the subalpine, 10,000-12,000 ft.

**A. lindenberiana** (Corda) Lindenb. Infrequent or rare, wet subalpine spruce forests. Por specimens from Summit Co.: mouth of Monte Cristo Creek, 2 mi N of Hoosier Pass, 11,000 ft., *Weber & Holmen B-4428*, !M. Hicks; Boulder Co.: trail from 4<sup>th</sup> of July Canyon to Arapahos Glacier, 10-11,000 ft., *Shushan B-15728*.

### **Mannia**

- 1a. Stalk of sporophyte with very slender, white “bracts” along its length. **M. pilosa**
- 1b. Stalk of sporophyte naked.....(2)
  
- 2a. Thallus 2-4 mm wide, 1.5-2.0 cm long; appendages of ventral scales very large, 2-3 in number, hyaline and forming a conspicuous cluster at the thallus apex; epidermis firm, not becoming lacunose; plants strongly aromatic. **M. fragrans**
- 2b. Thallus 1.5-3.0 mm wide, 0.8-1.5 cm long; fertile plants with appendages of ventral scales 1-2, not forming a “beard” at apex of thallus; epidermis fragile, becoming lacunose in age; plants without odor. **M. rupestris**

**M. fragrans** (Balb.) Frye & Clark. Evans (1915) reports this from Grand and Larimer counties. Our specimens are from Boulder, Gunnison, La Plata, Larimer, and Montezuma counties.

**M. pilosa** (Hornem.) Frye & Clark. Known from two collections: Baca Co.: Rin rock, Big Hole Canyon, Carrizo Creek drainage, *Weber & Wittmann B-100956*; Teller Co.: Twin Trocms Valey, Florissant Fossil Beds, 12 Aug. 1985, *Edwards et al. B-89815*.

**M. rupestris** (Nees) Frye & Clark. Our collections are from Boulder Co.: 4 mi NW of Lyons, 6,500 ft. alt; on north-facing ledges, *Weber B-27931*; Larimer Co.: Moss-covered ledges of N-facing wall of Little Thompson Canyon 10 mi NW of Lyons, 7,500 ft. alt., *Weber B-6092*.

### **Plagiochasma**

*Plagiochasma* is a southern genus, appearing in only the southernmost counties, on protected ledges of sandstone rim rock. Unlike *Mannia*, which grows mostly as solitary thalli, *Plagiochasma* forms large colonies. The species are very easy to distinguish when they are fresh. *Plagiochasma* shares with *Athalamia* (Cleveaceae) the character of the sporangiophore being produced on the surface of the thallus, in this instance with a fringe of white scales surrounding its base. The thallus rolls up to show a purple underside.

- 1a. Thallus green; epidermal hexagons inconspicuous, not easily made out with the hand lens; pores usually surrounded by six radial rows of 2-3 cells. **P. wrightii**
- 1b. Thallus glaucous, blue-green; epidermal hexagons easily visible with a hand lens; pores usually surrounded by one circle of 4-6 cells with no further radiate layers. **P. rupestre**

**P. rupestre** (Forst.) Steph. Common on bases of rim rock cliffs of the southern mesas. Our collections are from Baca and Las Animas counties.

**P. wrightii** Sull. We have one collection from Baca Co: Canyonside, NE-exposure, Dodge Ranch SW of Utleyville, 4,500 ft. alt., *Shushan 166*.

## BLASIACEAE

We have the single genus, *Blasia*. This is a rather small, thin, green thalloid liverwort with distinctly crenate and ruffled margins. Scattered over the thallus are dark purplish, swollen spots which are actually symbiotic colonies of *Nostoc* living in the *Blasia* thallus. The plants commonly form rosettes. The branches have a more or less distinct mid-vein. The most outstanding feature is the production of gemmae in flask-shaped organs on the upper distal surface of the thallus. The flasks point forward in the direction of growth and are abruptly narrowed to an elongate neck through which the oval gemmae are discharged a few at a time. *Blasia* may also produce star-shaped gemmae directly on the thallus surface.

### **Blasia**

**B. pusilla** (L.) Micheli. *Blasia* occurs typically on raised grassy hummocks in wet grasslands. Our only collection to date is the following: Larimer Co.: heavy soil on knoll in swale at base of bluff near Little South Cache La Poudre River, ca. 9,000 ft., 28 mi. W of Fort Collins, 11 Aug. 1961, *Hermann 16,980* (COLO B-9120).

## CLEVEACEAE

We have the single monotypic genus, *Athalamia*. The thallus has hyaline or pale violet scales with very large cells, tapering appendages protruding beyond the thallus margins (see also *Mannia fragrans*); thallus color is pale crystalline green, margins not very purplish; carpocephala are dorsal on the thallus (as in *Plagiochasma*), not from an apical notch; pit-like depressions fringed with white scales mark where the carpocephala will arise; pores have thickened radial (stellate) cell walls.

### **Athalamia**

***Athalamia hyalina*** (Somm.) Hatt. A common thalloid liverwort of the alpine and subalpine. We have collections from Boulder, Gunnison, Huerfano, Larimer, Park, and Saguache counties. See *Preissia* for discussion of differences.

## CONOCEPHALACEAE

Our only genus, *Conocephalum*, is the giant among Colorado liverworts. It is larger than *Marchantia*, more yellow-green in color, more flabby than stiff, and has very coarse polygonal areoles, each with an obvious white pore. It is said to have a fragrant odor (I find it more peppery). There are no gemma cups. The carpocephala are rarely produced in Colorado, but when present the stalked ones are only female and conical (whence the name *Conocephalum*!) (antheridial receptacles are sessile on the thallus surface).

### **Conocephalum**

**C. conicum** (L.) Dum. A very common species along small streams in the foothills and montane zones.

## LUNULARIACEAE

In Colorado we have only the genus *Lunularia*. This is a greenhouse weed and unlikely to be found in nature in Colorado. It looks like a small *Marchantia*, but the gemma cups are crescentic, and the thallus has a glistening appearance.

### **Lunularia**

**L. cruciata** (L.) Dum. We have found it on the soil on greenhouse benches in Boulder, *Weber B-7287*.

## MARCHANTIACEAE

### Key to the Genera

- 1a. Ventral scales deep purplish, in two rows; gemmae absent; female receptacles shallowly 4-5-lobed on the margins, or hardly lobed; ventral scales without oil cells (or at most with only one or two). **Preissia**
- 1b. Ventral scales colorless or pinkish, in 4 to 6 rows; gemmae in distinct, cup-like receptacles, female receptacles very deeply divided into 5-9 lobes or segments; ventral scales with oil cells. **Marchantia**

### Marchantia

- 1a. Common plants from the plains to the montane. **M. polymorpha**
- 1b. Restricted to the subalpine and alpine. **M. alpestris**

**M. alpestris** Nees. Very common on the edges of streamlets and rills in the subalpine and alpine. See table below for distinctions between this and the next.

**M. polymorpha** L. Very common along streamsides from the plains to the montane. Replaced at higher altitudes by *M. alpestris*.

Table of characters, *Marchantia alpestris* vs. *polymorpha*, based on Warncke (1968)

#### Thallus:

- (M.a.): Broad, thick, leathery; (M. p.) smaller, thinner, and linear
- (M.a.): Short-branched, branches very often equally developed; (M.p.) Long branched, one branch “suppressing the other”
- (M.a.): Middle line never developed; (M.p.) Middle line always present in adult thalli, Depressed and more or less dark (to grooved and black in var. *aquatica*)
- (M.a.): Middle path distinct; (M.p.) Middle path seldom developed
- (M.a.): Bluish green, waxy; margins of older thallus rust-red; (M.p.) Gray-green to yellowish (in var. *aquatica*)
- (M.a.): Gemma cups not rare; (M.p.) Gemmae cups nearly always present (very rare in var. *aquatica*)
- (M.a.): Prostrate in dense, compact patches (M.p.) Prostrate (to suberect in tufts in var. *aquatica*)

#### Archegoniophore:

- (M.a.): stalk short, stout, square; (M. p.) Stalk longer, slender, rounded
- Rays oval to flat, strong; (M.p.) Rays longer, slender, rounded
- Perichaetium very well developed, covering more than half of the rays; (M.p.): Perichaetium only slightly developed, covering a third of the rays.

## Preissia

One species, **P. quadrata** (Scop.) Nees. Frequent on packed moist soil, especially along seeping cliffs. Much smaller than *Marchantia*, not forming an elongated and branched thallus. If one has difficulty in distinguishing between these fairly similar genera, no one has given us better advice than Schuster (1953):

“The moderate size (usually between 6-10 mm wide and 2-4 cm long), and the dull green color, with the lateral thallus margins somewhat purplish, and the ventral scales always blackish-purple, give the species a rather characteristic appearance, even when sterile. Confusion is possible only with *Reboulia* and *Athalamia* (which are similar in size), while the smaller size (of *Mannia*) at once eliminates that genus. From all of these genera, and all other genera except *Marchantia*, *Preissia* differs at once in its elevated, whitish, rather prominent compound [barrel-shaped] pores. In *Reboulia* the pores are simple (that is, flanked by a single layer of cells), and the epidermal cells are distinctly collenchymatous (in *Preissia* always very thin-walled and lacking trigones). In *Athalamia* the pores are stellate and simple, and very different from those of *Preissia*. *Reboulia*, with which *Preissia* frequently occurs, can usually be separated from *Preissia* in the field by the smooth and often slightly more yellow-green thallus, with the pores extremely inconspicuous, while the thalli of *Preissia* are a little rough because of the many elevated, whitish pores, and usually of a duller green color. The margins of the thalli of *Preissia* are also usually bleached and decolorate—never in *Reboulia*.”

## METZGERIACEAE

This family is characterized by its thin, ribbon-like thallus one cell thick and only a few millimeters wide, with a distinct midrib of several cell layers; the thallus margin has marginal hairs. Our single genus, *Apometzgeria*, is sometimes included in *Metzgeria* proper, is characterized by having a dense cover of hairs above and below.

### **Apometzgeria**

**A. pubescens** (Schrank) Kuw. This is a flat, branched, one-cell thick thallus with a thickened midrib. In contrast with *Aneura pinguis*, it is very thin and delicate and grows on relatively dry forest floors with other liverworts. We only have one member of the family in Colorado, and this is instantly distinguishable from the genus *Metzgeria*, one or two of which might be expected here, because the thallus is densely pilose on the surface. The species is characteristic of mature, well-vegetated forest floors in the subalpine zone.

## REBOULIACEAE

### Reboulia

The salient features of *Reboulia* are: Larger than *Mannia* or *Asterella* (about the size of *Preissia*); relatively smooth and yellow-green upper surface with inconspicuous pores (*Preissia* is rough, bluish-green, with elevated pores; the older thallus portions never become bleached or white (*Preissia* does); the carpocephala are moderately 5-7-lobed; the pores are surrounded by 4-5 concentric rings of cells; the epidermal cells have distinct trigones; the stalk of the carpocephalum has a cluster of very narrow filamentous scales (in *Mannia* these are lanceolate-linear).

**R. hemispherica** (L.) Raddi. Evans (1915) reports a Brandege specimen, and from Grand Co.: Granby, *Bethel* 3. We have no recent collections.

## RICCIACEAE

- 1a. Plants forming neat rosettes not more than 1 cm diameter; on ground. **Riccia**
- 1b. Plants submerged or floating. **Ricciocarpus**

### **Riccia**

- 1a. Thallus with photosynthetic, internal tissue loose, forming large air-chambers (in cross section the thallus is not compact in structure; surface of terrestrial forms often lacunose and spongy with age; mostly aquatic or mud-inhabiting species of the plains.....(2)
- 1b. Thallus with compact photosynthetic tissue; mostly mountain or desert-steppe .....(4)
- 2a. Thallus with the segments narrowly linear, mostly less than 0.7 mm wide; occurring free-floating under the water surface, or stranded. **R. fluitans**
- 2b. Thalli with segments relatively broad, usually over 0.7 mm wide, always terrestrial .....(3)
- 3a. Thallus glaucous; dorsal epidermis becoming spongy. **R. frostii**
- 3b. Thallus bright green; dorsal epidermis actually degenerating and disappearing. **R. cavernosa**
- 4a. Thallus with either white ventral scales or marginal cilia .....(5)
- 4b. Thallus lacking white scales or marginal cilia. **R. sorocarpa**
- 5a. Thallus with conspicuous white ventral scales visible on margins of dried thalli; desert-steppe species. **R. austinii**
- 5b. Thallus margins with distinct cilia, stout, usually numerous, 75-300 microns long. **R. beyrichiana**

**R. austinii** Steph. A desert-steppe species occurring on sandstone-derived soils on the Western Slope. It is easily recognized because of the conspicuous white ventral scales that become visible when the thallus dries and curls up. Our single collection is from Moffat Co.: North base of Douglas Mountain 6 mi W of Greystone, 2,300 m; in soil accumulating in depressions at the base of shelving sandstone rim rock, 27 Aug. 1975, *Weber B-49823*.

**R. beyrichiana** Hampe. We have a single specimen: Jackson Co.: morainal pond between Jack Creek ranch and Teller City, 12 mi E of Rand, in muck at edge of pond, 9,300 ft., *Douglass 61-580*. Evans (1915) cited a specimen from Lake Eldora, Boulder Co., as *R. lescuriana* Austin.

**R. cavernosa** Hoffm. emend. Raddi. A fairly common species on very wet streambanks and pond borders, low and middle altitudes. Evans (1915) reports this as *R. crystallina*. We have collections from Boulder, El Paso, and Grand Counties (*R. crystallina* of authors, not L.).

**R. fluitans** L. This is a low altitude species. We have one verified collection, from the

eastern plains: Morgan Co.: with *Ricciocarpus natans* in small side stream out of the main current, South Platte River 8 mi W of Fort Morgan, *Mattoon 7978*. It is probably frequent and widespread in the irrigated areas of eastern Colorado.

**R. frostii** Aust. We have collections from Boulder, Jefferson, Gunnison, Mesa, and Moffat counties. A representative collection is Boulder Co.: Bed of pond at Nine mile Corner 9 mi E of Boulder, *Weber & Shushan 7980*. This pond has filled with cat-tails and no longer supports any liverworts; and Jefferson Co.: just W of Church's lake, on drying mud flat around small pond 1 mi S of Broomfield, 5,500 ft., *Weber 8659*. No liverworts have been found in recent years in the ponds of the Colorado Piedmont. Their margins have been dredged to prevent the formation of mud flats, and the margins of the larger lakes like Boulder Reservoir have been heavily polluted by Canada Goose droppings and do not support any vegetation.

**R. sorocarpa** Bisch. A common species in protected places on well-vegetated tundra slopes, generally on the sides and bases of overhanging tussocks of *Kobresia*. We have collections from Boulder, Clear Creek, Moffat, Park, and Pitkin counties.

## **Ricciocarpus**

**R. natans** (L.) Corda. This species is aquatic, found floating on the surface of slow streams. The plants consist of whole or partial rosettes especially where flooding prevents the development of competitive vegetation. It is probably common throughout the irrigated areas at low altitudes. We have collections, from Chaffee, La Plata, Morgan, and Montezuma counties. A representative collection is Morgan Co.: South Platte River, with *Riccia fluitans*, in small side stream outside of main current 8 mi W of Fort Morgan, *Mattoon 7979*.

## ***LEAFY LIVERWORTS***

### **BLEPHAROSTOMACEAE**

The family is monotypic. It is distinguished by the leaves, which are normally four-lobed to the base, with each lobe one cell wide; the underleaves are similarly three-lobed. Technical differences in the sporophyte serve to separate it from superficially similar families.

#### **Blepharostoma**

We have a single species, **B. trichophyllum** (L.) Dum. *Trichophylla* is an apt epithet, because the leaves are divided into four one-cell thick “fingers”. The slender, yellowish-green plants are very small, delicate, and easily overlooked among other liverwort clumps, but sometimes they occur in large, pure stands, as we found them under dwarf birches at Blue Lake. The underleaves are similar but only trifid. There are other liverworts with leaves that are variously dissected, but in Colorado there is nothing like *Blepharostoma*. It is generally restricted to the subalpine zone and lower alpine ecotone, where it is very common.

## CALYPOGEIACEAE

Ref.: Hong (1990)

### Calypogeia

*Calypogeia*, our only genus, is characterized by having entire. Simple leaves that are distinctly incubously inserted. The underleaves are large and either bilobed or virtually entire. At their base is a distinct cushioned area formed of smaller cells, the rhizoid-initial region. There is no perianth, but a fleshy, subterranean hairy perigynium arises from a very short branchlet coming from the axil of an underleaf. The plants are pale, rather transparent, bluish-green in color.

- 1a. Underleaves deeply divided (over half of their length) into two lobes .....(2)
- 1b. Underleaves undivided, or shallowly (less than 1/4 of their length, into two lobes.....(4)
  
- 2a. Leaf cells small (less than 30 microns in the apex, 25-35 x 30-45 microns in middle); underleaves more than 2x (3.2-3.5) wider than the stem. **C. suecica**
- 2b. Leaf cells large (over 30 microns in apex, 35-50 x 45-70 microns in middle); underleaves less than 2x (1-2) wider than the stem .....(4)
  
- 3a. Leaves bidentate or sharply pointed at apex; underleaves ca. 1.5-2x wider than long, 1.5-2x wider than stem. **C. fissa**
- 3b. Leaves entire or narrowly rounded at apex; underleaves 1-1.5x wider than long, 2-2.5x wider than stem. **C. muelleriana**
  
- 4a. Leaf cells 35-45 x 40-60 microns in mid-leaf; underleaves broadly orbicular, ca 1.2-1.5 x as wide as long, 2-3x wider than stem; rhizoid initial area distinct; border of elongate cells indistinct. **C. integristipula**
- 4b. Leaf cells 30-40 x 35-45 microns in mid-leaf; underleaves orbicular, almost as long as wide, 2-2.5x wider than stem; rhizoidal initial area indistinct; border of elongate cells very distinct. **C. neesiana**

**C. fissa** (L.) Raddi. It is really questionable whether this occurs in Colorado. Hong's map shows the distribution as being confined to the Pacific coast states. Hong did not cite any specimens, nor does he show the position of any Colorado stations on his map, p. 315. Nevertheless he states its range as including Colorado.

**C. integristipula** Steph. Hong cites collections from Boulder, Grand, Gunnison, and Larimer counties.

Leaves incubous, not lobed; obtuse, a little less wide than long; leaf border not apparent; leaf cells lacking trigones, 40-50  $\mu$ ; oil bodies oblong, 3-4 per cell, lumpy, not colored; underleaves 2-3-times wider than stem, wider than long, very shallowly lobed. the rhizoidal initial layer with debris clinging to it, hence very distinct (B-112439).

**C. muelleriana** (Schiffn.) Müll. Hong did not cite any specimens, but has two stations

marked on his map, p. 325, evidently from Routt and Jackson counties.

**C. neesiana** (Mass. & Car.) Müller. Hong does not cite specimens, but indicates two Colorado localities on the map, p. 327, evidently from Grand and Larimer counties.

**C. suecica** (Arn. & Perss.) Müll. Hong does not cite any specimens, but indicates a single station, probably in Rocky Mountain National Park, on the map, p. 317.

## CEPHALOZIACEAE

Ref.: Hong (1988)

*Cephalozia* is our only genus. In this genus the plants are very tiny, creeping or prostrate. The stems have large, pellucid, thin-walled cortical cells. The leaves are obliquely inserted, bilobed, with the lobes often pointing toward each other, without cell wall thickening. There are no underleaves. The plants occur on peat, humus, or decaying logs. They are usually somewhat larger than *Cephaloziella*, which has almost transversely inserted leaves.

### Cephalozia

- 1a. Leaves slightly decurrent, orbicular, horizontally or obliquely inserted, bilobed 0.2-0.5 their length, the lobes somewhat connivent. **C. pleniceps**
- 1b. Leaves never distinctly decurrent, ovate (longer than wide, 1.1-1.4 times as long as broad), almost transversely inserted, bilobed for 0.5-0.7 their length; lobes never connivent.....(2)
- 2a. Leaves bilobed for 0.5-0.6 of their length, cells 30-40 x 40-50 microns in leaf base, with thin, non-pigmented walls; mouth of perianth denticulate (with minute teeth); gemmae rare. **C. bicuspidata**
- 2b. Leaves bilobed for 0.4-0.5 their length, cells 20-25 x 20-35 microns in leaf base, with thick brownish-golden walls; mouth of perianth crenulate (with rounded teeth); gemmae frequent. **C. ambigua**

**C. ambigua** Mass.. Hong cited a single collection: Boulder Co.: North Fork [of Boulder Creek?], *Hong 78-953*; Jackson Co.: Michigan River, *Hong 78-807*; Larimer Co.: Sheep Creek, *Hong 67-783*.

**C. bicuspidata** (L.) Dum. Representative collections: Boulder Co.: spruce-fir woods below Ouzel Falls, Rocky Mountain National Park, 9,400 ft. alt., *Hermann 27787* (who called it *C. pleniceps*); Gunnison Co.: Iron fen. Mt. Emmons, 9600 ft., *Weber B-92630* !Hong.

**C. pleniceps** (Aust.) Lindb. Hong (1980) cites one collection: Larimer Co.: Rocky Mountain National Park; Roaring River, *Hong 78-885*.

## CEPHALOZIELLACEAE

Ref.: Hong (2986)

### Cephaloziella

These are the smallest known liverworts. If you thought *Cephalozia* was small! The plants are only 1-8 mm long, filiform, with the leaves only a little wider than the stems. The leaves are distant and transversely inserted, bilobed for  $\frac{1}{2}$ - $\frac{3}{4}$  their length, with the lobes only 2-9 cells broad at base. The leaf cells never have trigones. Our species are found on moist rotten wood and among mosses in high subalpine or alpine situations. They are usually discovered while one is dissecting a larger bryophyte.

- 1a. Leaves often dentate; underleaves present and distinct. **C. divaricata**
- 1b. Leaves edentate; underleaves absent or minute if present.....(2)
  
- 2a. Leaf lobes oval-lanceolate, 3-8 cells wide at base; cells strongly thick-walled; plants red-brown. **C. rubella**
- 2b. Leaf lobes ovate-triangular, 5-15 cells wide at the base; cells thin-walled.....(3)
  
- 3a. Plants purple-black; leaves erect or suberect; leaf lobes blunt or rounded, 6-12 cells wide at base; gemmae absent; calciphile. **C. arctica**
- 3b. Plants green-brown; leaves distantly strongly spreading; leaf lobes acute, 5-8 cells wide at base; gemmae pale green; non-calciphile. **C. hampeana**

**C. arctica** Bryhn & Douin. A distinctive black species of the upper subalpine or alpine. Hong cited a specimen from Larimer Co.: Rocky Mountain park, Trail Ridge, *Hultén s.n.* (S). We have excellent new collections from Summit Co.: Blue Lake, on seeping limestone ledges, 11,000 ft. alt., where it occurs with the equally black *Didymodon subandreaeoides*. *Weber & Wittmann 111181* (!Hong).

**C. divaricata** (J. E. Sm.) Schiffn. A fairly common green species from the foothills to alpine. Boulder Co.: Boulder Canyon, *Weber B-10554* is representative.

**C. hampeana** (Nees) Schiffn. Especially common on burned stumps. Hong cited specimens from Boulder, El Paso, and Larimer counties. A fine representative collection is Boulder Co.: Rocky Mountain Nat. Park, Bear Lake tourist trail; forming a continuous carpet on soggy ground of inlet area, *Weber & Wittmann B-111256*.

**C. rubella** (Nees) Warnst. Easily recognized by its reddish brown color, this species seems to be common in the foothill canyons on north-facing cliffs.

## FRULLANIACEAE

Our members of the family have complicate-bilobed leaves, one lobe dorsal, the other ventral, but quite different from that of *Scapania*. The dorsal lobe is typically round, and the insertion incubous. A curious ventral lobe is seen underneath, which is smaller and most often three-dimensional, helmet-shaped like an upside-down cup, connected by a small stalk to the upper lobe. In some species the cup is only imperfectly cup-shaped and not closed along the side (explanate). The stem also has underleaves, in our species always bifid. All of the species are pioneer types rarely mixed with other mosses except where they occur as thin colonies on cliffs. In Colorado all of our species tend to be cliff-dwellers, while in more humid climates they are most common on tree-trunks.

### **Frullania**

Ref.: Hong (1989)

- 1a. Ventral lobes very small (less than half the size of the dorsal lobes), strongly explanate (evidently with no helmet-shaped lobules), lanceolate; perianth with five keels; underleaves bifid to a third their length. **F. inflata**
- 1b. Ventral lobes strongly inflated (helmet-shaped), rarely weakly explanate, especially near the stem apex; perianth with 3-9 keels..... 2)
- 2a. Ventral lobes mixed, helmet shaped on more mature stems, explanate on the younger ones; underleaves large (3/4 as wide as the stem), wider than long. **F. riparia**
- 2b. Ventral lobes inflated uniformly, never explanate; underleaves large (3-4 times as wide as the stem. **F. brittoniae**

**F. brittoniae** Evans. Frequent in seepage zones on vertical cliffs. We have collections from Boulder, Clear Creek, Grand, Hinsdale, Montrose, and Rio Grande counties.

**F. inflata** Gott. This species is usually found on bark. It has not yet been found in Colorado, but should be expected in the southern counties, since it comes as far north as Las Vegas, New Mexico. There may be small pockets of canyons where the humidity is high enough to support the species.

**F. riparia** Hampe. Our only collection is from Las Animas Co.: Carrizo Creek, *Shush an B-6903*.

## GEOCALYCACEAE

Ref.: Hong (1993), Engel & Schuster (1984). Engel & Schuster (1984) reduced *Lophocolea* to synonymy under *Chiloscyphus*, but Hong rejects this merger because of differences in the perianth, male inflorescence, leaves, underleaves, and bracts. We feel that it is justifiable for us to follow Hong in the long-standing treatment.

This family contains genera that are not obviously alike. The leaves are succubous or obliquely inserted; the underleaves are bilobed; rhizoids are restricted to the bases of the underleaves or scattered over the underside of the stem; fertile branches are lateral or ventral; androecia branches are spicate, and many other contrasting characters. Best to learn *Geocalyx*, *Lophocolea*, and *Chiloscyphus* in the field and forget about the family!

- 1a. Perianth present, elongate, exerted, trigonous; perigynium or marsupium lacking; capsule oblong-ovoid, the wall 4-5-stratose; rhizoids restricted to the bases of the underleaves. ....(2)
- 1b. Perianth absent, more or less spicate; female inflorescence terminal; leaves bilobed; rhizoids scattered over the ventral part of the stem .....(3)
- 2a. Male inflorescence more or less spicate; female inflorescence terminal; leaves bilobed; underleaves with a subulate-acuminate tooth on each side. **Lophocolea**
- 2b. Male inflorescence undifferentiated; female inflorescence on short lateral branches; underleaves with a spinose tooth on each side. **Chiloscyphus**
- 3a. Autoicous; perianth absent, replaced by a subterranean rhizoidous perigynium (marsupium); underleaves deeply bilobed, with entire margins; gemmae absent; male bracts in 4-8 pairs. **Harpanthus**
- 3b. Dioicous; perianth present, fused with shoot-calyptra; underleaves divided, subulate; gemmae present; male bracts in 2-5 pairs. **Geocalyx**

### Chiloscyphus

- 1a. Plant body transparent, pale whitish- to yellowish-green; sells at mid-leaf 35-40 x 45-60 microns; perianth lobes spinose-dentate. **C. pallescens**
- 1b. Plant body dull to deep green or often blackish; cells at mid-leaf 25-30 microns; perianth lobes entire or undulate. **C. polyanthus**

**C. pallescens** (Ehrh.) Dum. Common throughout the montane and subalpine forested areas. This is a close relative of the next, with 18 chromosomes.

**C. polyanthus** (L.) Corda. Common through the montane and subalpine forested areas. This species has 9 chromosomes. A variant occurring in swift-flowing streams is very dark green (var. *rivularis*).

## Geocalyx

**Geocalyx graveolens** (Schrad.) Nees. We have one Colorado record: Larimer Co.: Rocky Mountain National Park, 1.2 mi N of Deer Creek junction on Hwy 34 to Estes Park. On ground, tree bases, and rotting wood in mesic *Abies-Populus-Alnus* woodland with abundant dead-fall and extensive seepy areas, also along the roadside, 5 June 1976, *Vitt 15255* (cited by Hong). This collection represents the southernmost station for the species in North America.

Schuster says this is one of the easiest bilobed species to identify. Under the microscope, the bifid, rather large, underleaves, with the linear-lanceolate divisions nearly parallel, entirely unarmed on the outer side, are absolutely characteristic. *Lophocolea* may have similarly divided underleaves, but the lobes usually bear a sharp tooth on the outer side; in *Geocalyx*, also, rhizoids occur not only on the bases of the underleaves, but some occur scattered over the rest of the ventral side of the stem. In *Lophocolea* they are limited to a small area at the bases of the underleaves. . . On the postical side of the stem the fleshy perigynia are usually evident; when young they are small, spherical, and look like small tubers; when mature they are cylindrical and very prominent. No other species with bilobed leaves has such perigynia.

## Lophocolea

- 1a. Plants pale whitish-green; leaves entire or subentire to bilobed; gemmae rarely developed. **L. heterophylla**
- 1b. Plants greenish-yellow; leaves bilobed 0.2-0.35 of leaf length; gemmae always abundantly developed along leaf margins. sometimes making the leaf ragged. **L. minor**

**L. minor** Nees. Abundant in moist forests throughout the mountains. Probably much more abundant the next.

**L. heterophylla** (Schrad.) Dum. Abundant in moist forests throughout the mountains.

## HAPLOMITRIACEAE

We have the single genus and species. *Haplomitrium hookeri* is known from Mount Katahdin, Maine; Mount Washington, New Hampshire, and West Greenland. The single Colorado collection is the only one known in America south of the area of Continental Pleistocene glaciation. The discovery of this species by Norton Miller on an excursion of the American Bryological and Lichenological Society in 1973 was a cause of great celebration. Miller was already acquainted with it in the field in Greenland and knew where to look.

### Haplomitrium

**H. hookeri** (J. E. Sm.) Nees. One collection, Boulder Co.: Green Lakes Valley, on "*Haplomitrium* Hill," \*\*\*

*Haplomitrium* is a very strange hepatic, consisting vegetatively only of a slender stem no more than a centimeter long, the lower part of which is white and tender succulent rhizome. The leaves are remotely scattered along the stem, and are somewhat diamond-shaped, and somewhat shallowly and unequally lobed or completely entire. The cells are thin-walled, 25-40 x 30-50 microns. There is no asexual reproduction. For those who would like information about the sexuality, see the very detailed treatment of Schuster.

Schuster writes: "The chief problem with *H. hookeri* is not to identify it but to be able to locate it. It is a difficult plant to find in the field. The plant will not under any condition be confused with any other hepatic. It is quite likely, however, to be mistaken for a moss because of the erect growth, the lack of differentiation between lateral and dorsal leaves, and the form of the leaves." The plant hardly appears more than a few millimeters above the ground and is lost among the welter of other low-growing plants. At Green lakes Valley it was accidentally found when Miller dug up a patch of soil and found the white, coralloid basal portion of the shoot system. Everyone who has had the joy of collecting this plant has never found more than one or a very few plants. Schuster continues: "The plant is exceedingly sensitive to drying, apparently lacking all toleration for intermittent moisture conditions."

## JUNGERMANNIACEAE

### Jungermannia

“The genus is characterized by its dioicous or paroicous gametangia, prostrate to erect stems, lateral branching, abundant rhizoids, succubous, obliquely inserted marginal leaves, absence of underleaves, well-developed perianth (fusiform, pyriform, and cylindrical) usually with an abruptly constricted mouth and oval capsule with bistratose spiral elaters.”

*Plectocolea* and *Solenostoma* are now regarded as subgenera of *Jungermannia*.

#### Key to the species

- 1a. Perianth abruptly narrowed distally in a beaked mouth .....(2)
- 1b. Perianth gradually narrowed, not beaked .....(4)
  
- 2a. Perianth tubular, smooth; leaves ovate-oblong, parallel-sided. **J. leiantha**
- 2b. Perianth cylindrical, ovoid to clavate; leaves reniform-orbicular to slightly ovate, erecto-patent (subgenus *Solenostoma*) .....(3)
  
- 3a. Paroicous; plants green; leaves orbicular to orbicular-cordate; leaf cells 25-30x35-50 $\mu$ m in mid-leaf. Rhizoids arising almost exclusively from ventral side of stem, not forming a bundle. **J. sphaerocarpa**
- 3b. Dioicous; plants red-purple, 1.0-1.5 mm wide, 0.8-2.0 cm long; leaf with a distinct border; cells 20-25x25-35 $\mu$ m in mid-leaf, with small trigones, more than one oil body per cell. **J. rubra**
  
- 4a. Perianth plicate above only, with elongated cells; perigynium present; rhizoids sometimes reddish-purple (Subgenus *Plectocolea*) .....(5)
- 4b. Perianth plicate for almost the entire length, with isodiametric cells, perigynium lacking; rhizoids usually colorless (Subgenus *Jungermannia*) .....(6)
  
- 5a. Plants usually dark green to purple; leaves oval-ovoid; oil bodies 1-4 per cell, mostly small, smooth; female bracts reflexed; rhizoids purplish or not; cuticle striate; paroicous. **J. obovata**
- 5b. Plants pale green to brownish-red; leaves circular, trigones distinct; rhizoids mostly colorless; oil bodies 4-5 per cell, verrucose, oval; cuticle smooth; Dioicous. **J. hyalina**
  
- 6a. Paroicous; perianth fusiform; leaves broadly elliptical, cells 20-25x25-30  $\mu$ m in mid-leaf. **J. pumila**
- 6b. Dioicous .....(7)
  
- 7a. Plants 0.8-1.0 mm wide, 0.2-3.0 cm long; perianth ovoid or oblong-ovoid; androecia

terminal; male bracts in 4-12 pairs. **J. atrovirens**  
7b. Plants 0.5-4 mm wide, 0.3-12 cm long; perianth slender fusiform. **J. exsertifolia**

**J. atrovirens** Dum. There is one record, not verified: San Juan Co.: Silverton, 1931, reported by Frye (1937). Nomenclature from Damsholt & Vana (1977 [1978]).

**J. exsertifolia** Steph. var. **cordifolia** (Dum.) Vana. In general aspect, this elongate, black liverwort resembles *Scapania irrigua*. It is very common in montane and subalpine forests in wet areas. We have collections from Boulder, Clear Creek, Douglas, El Paso, Gilpin, Jackson, Larimer, Montrose, Park, Pitkin, and Summit counties

**J. hyalina** Lyell. This species grows “on moist sandy or clayey soil, such as the sides of ditches and forest paths, more rarely on moist, siliceous rocks (Arnell 1956). \*\*\* collections?”

**J. leiantha** Grolle. Common on streamsides in spruce-fir forests. We have collections from Grand, Gunnison, and Larimer counties.

**J. obovata** Nees. This always grows on wet rocks and with us it is alpine. The dark color, purple rhizoids, reflexed female bracts, striate cuticle and paroicous inflorescence are diagnostic. We have one collection: Summit Co.: Blue Lake Dam area, Monte Cristo Creek Valley, 3,000 msm, on limestone terraces irrigated with snow melt; in tufts of *Distichium capillaceum*, Weber & Wittmann B-111214, !Hong, 2000.

**J. pumila** With. We have specimens from Boulder, Chaffee, Grand, Larimer, and Mineral counties.

**J. rubra** Underw. Dominant in fens in the San Juan Mountains, disjunct from California. We have collections from Hinsdale, Mineral, San Miguel, and San Juan counties.

**J. sphaerocarpa** Hook. We have collections from Archuleta, Boulder, Chaffee, Clear Creek, Grand, Larimer, Park, and Routt counties.

## Nardia

Ref.: Hong & Vana (2000)

*Nardia* is characterized by its entire (in our species), succubous orbicular-reniform leaves; underleaves distinct, lanceolate to triangular; lack of gemmae; female bracts similar to the leaves; perianth very short, within bracts, with crenulate mouth and oval-globose capsule with bistratose walls. Very rare in Colorado.

- 1a. Plants large, 1.0-2.5 mm wide, 1.0-5.0 cm long, pale green; cells large, 25-30 x 30-40 microns in mid-leaf; oil bodies glistening and homogeneous; dioicous. **N. scalaris**
- 1b. Plants small, 0.8-1.5 mm wide, 5-10 mm long, brownish; cells small, 20-25 x 25-30 microns in mid-leaf; oil bodies granular and opaque. **N. geoscyphus**

**Nardia geoscyphus** (Trevis.) Vana. Two collections known: Boulder Co.: Green Lakes Valley, Indian Peaks, *Gritstone 2263* (COLO). !Vana, Hong; *Kiener 3377* (YU), !Hong. Both of our species have entire, emarginate leaves).

**N. scalaris** S. Gray. One collection known: "Colorado", *Roll* (BM).

## LEPICOLEACEAE

### **Gymnocolea**

**G. inflata** (Huds. Dum. There is only this one species, and it is probably the most common, even dominant hepatic in subalpine fens, especially in shallows or around the edges of rock pools. It is a tiny dark brownish or blackish thing producing simple, unbranched stems. The colonies are usually very dense. The leaves are incubous but hardly overlapping, almost round, shallowly two-lobed above the middle and the leaf lobes curve in, cup-like. There are no underleaves. The perianth is an inflated football with several short broad teeth around the narrow mouth. The leaf cells are uniformly thick-walled, without trigones.

## LEPIDOZIACEAE

Ref.: Hong (1988b)

The Lepidoziaceae is a family notable for having genera with variously terminally toothed or multi-cleft leaves, some having the leaves so deeply and narrowly divided that they look like cottony ropes! The simplest type in the West is *Basinet*, which has the leaves with three terminal teeth, and variously toothed underleaves. *Basinet* does not come into our range.

### **Lepidozia**

**L. reptans** (L.) Dum. Schuster says: “The incubous leaves, with the apices decurved and 3-4-lobed, giving them the appearance of a cupped hand (when seen ventrally), at once identifies this species. This, together with the frequent presence of terminal flagella-like branches and the regularly pinnate branching, serve to characterize this species in the field.

This is an uncommon plant, but possibly it is overlooked because it is so small and tends to grow on rotting logs. We have two specimens: Boulder Co.: Sandbeach Lake trail, 2 mi W of Copeland Lake, Rocky Mountain National Park, *Hermann B-27389*; Larimer Co.: on rotting wood in the stream, Hidden Valley, *Weber B36502, 56609*.

## LOPHOZIACEAE

- 1a. Leaves all or largely 3-4-lobed, at least on well-developed shoots, underleaves sometimes present; perianths plicate ..... (2)
- 1b. Leaves all or nearly all bilobed on sterile shoots; underleaves lacking..... (3)
  
- 2a. Leaves all or mostly 4-lobed, nearly flat; plants growing horizontally, with the leaves at about a 15-30° angle with stem, nearly horizontally spreading.  
**Barbilophozia**
- 2b. Leaves 3- or 2-lobed (a least in part 3-lobed), concave; plants erect or nearly so with the leaves inserted at a 40-60° angle with the stem; leaf lobes usually incurved. **Tritomaria**
  
- 3a. Perianth cylindric, with the apex suddenly and abruptly truncated into a short beak. (See **Leiocolea**)
- 3b. Perianth distinctly plicate, gradually narrowed, never beaked. **Lophozia**

### Barbilophozia

The most easily recognized group of species in the family is *Barbilophozia*. The plants are fairly large, that is, they are elongate creeping plants with leaves that are not densely crowded into heads. Their leaf arrangement is succubous, and the leaves are large enough and spreading enough to tell with a hand lens that they are distinctly 4-lobed. *L. hatcheri* is the species most frequently encountered from the foothills up into the montane. Unless you are very myopic, the leaves need to be examined with a microscope (see the key). With experience some of them can be recognized on sight.

- 1a. Leaves concave, obliquely inserted ..... (2)
- 1b. Leaves nearly flat, horizontally inserted..... (4)
  
- 2a. Leaves mostly 2-3-lobed, the sinus descending 1/4-1/3 of their length; plants with attenuated erect shoots whose leaves are smaller and appressed. **B. attenuata**
- 2b. Leaves mostly 2 (rarely 3,4)-lobed, the sinus descending 1/2-3/5 of their length..... (3)
  
- 3a. Leaves divided into two (occasionally 3, 4) lobes; sinus descending about 1/2 of their length; lobes blunt to sub-acute. **B. kunzeana**
- 3b. Leaves divided into three lobes, the sinus descending less than 1/3 of their length; lobes sharply acute. **B. floerkei**
  
- 4a. Postical leaf bases lacking cilia; underleaves rare or none and little or not ciliate; leaves never mucronate-tipped or apiculate; gemmae absent; leaves symmetrical, with more or less triangular lobes. **L. barbata**
- 4b. Postical leaf bases with a few distinct cilia, formed by several cells 3-10 times as long as wide; underleaves present, ciliate; at least some leaves mucronate-tipped ..... (5)

- 5a. Leafy shoots normally 1.5-2.7 mm wide; brown gemmae very common on the proximal leaves; leaves flat, the lobes ovate-triangular, usually mucronate. **L. hatcheri**
- 5b. Leafy shoots normally 4-5 mm wide and 4-8 cm. long; gemmae very rarely present; leaves undulate-crispate. **B. lycopodioides**

**B. attenuata** (Mart.) Loeske. Frye & Clark cite specimens (as *Orthocaulis gracilis*) from “Silverton, 1931, *Frye*”, and “Longs Peak, *Kiener*.” This needs to be verified. Hong does not mention the species.

**B. barbata** (Schreb.) Loeske. Frequent in the subalpine and upper montane forests. The least common of the three species.

**B. floerkei** (Web. & Mohr) Loeske. Evans (1915) reports this from “Pikes Peak, 1896, *Holzinger*.”

**B. hatcheri** (Evans) Loeske. By far the most common species in the foothills and montane zone. In the mature subalpine spruce forests it is largely replaced by *L. lycopodioides*, a very handsome and conspicuous species in comparison.

**B. kunzeana** (Hüb.) Müll. Evans (1915), reported a collection: El Paso Co.: Minnehaha, 1913, *G. E. Nichols*.

**B. lycopodioides** (Wallr.) Loeske. A beautiful, large species characteristic of forest floors in mature, relatively undisturbed moist subalpine spruce forests. It is like a large edition of *L. hatcheri* but differs in its undulate leaves and lack of gemmae.

**May 8, 2003**

**Leiocolea**

Ref.: Hong (2002b). We have no first-hand knowledge of the genus and are paraphrasing material from the cited reference.

Fertile plants of this genus are very easy to recognize in the field. It is the only bilobed group of liverworts having smooth, cylindrical perianths whose apices are suddenly constricted into a distinct, short beak. A similar beak occurs in *Jungermannia*, but in that genus the leaves are entire.

- 1a. Plants small (less than 1.0 mm wide and 12 mm long); underleaves absent. **L. badensis**
- 1b. Plants large (over 1.0-5.0 mm wide and 1.0-8.0 cm long); underleaves present.....(2)
- 2a. Gemmae present. **L. heterocolpos**
- 2b. Gemmae absent.....(3)
- 3a. Leaves bilobed up to 25 per cent; cells large, 35-40 x 40-55µm in mid-leaf. **L.**

**bantriensis**

3b. Leaves bilobed more deeply; cells small, ca. 25-30 x 25-35µm in mid-leaf. **L. collaris**

**L. badensis** (Gott.) Jörg. One collection was cited by Hong: Chaffee Co.: [Buena] Vista, Conard, 40-870 (G). Our collection from San Juan Co.: Weminuche Wilderness, NE flank of Mt. Silex, just above confluence of Vallecito and Trinity Creeks, 10,600 ft., with *Buxbaumia indusiata*, Jamieson 11490 It is known otherwise in western North America from northern Montana to Alaska. This tiny species is characterized by its translucent, slender stems, leaves uniformly and shallowly bilobed, almost circular, with lobes many cells wide at their bases, large leaf cells (20-30 microns) in proportion to plant size, short-beaked perianth and general absence of underleaves (which rarely occur as slime papillae). The species occurs among mosses on damp rotten wood in spruce forests. Even sterile plants can be recognized by their small size, pale translucent, shallowly and broadly bilobed leaves. At first one thinks of *Cephalozia*, but the lobes are broad and not connivent; then perhaps a minute *Lophozia*.

**L. bantriensis** (Hook.) Jörg. Hong reports this, without citations, from what appears on his dot map to be Larimer and Montezuma Counties. Our specimen is from Larimer Co.: Trail ridge, 10,800 ft., Kiener 7120 (COLO B-21846, 50498)., “This green to reddish brown, large species is characterized by its scarce rhizoids, shallowly bilobed leaves with large cells, distinct linear-subulate to lanceolate underleaves, large, pale brownish oil-bodies (2-8 per cell) and emergent cylindrical perianth with a short beak. This species occurs on moist sandy soil and rocks near streams.”

**L. collaris** (Nees) Schjl. Hong reported this from Larimer Co.: Poudre Lake and Timber Creek Trail, Hermann 78-843 and 79-934. “This green to brown species is characterized by the lack of a mycorrhizal band in the stem, broadly ovate to rotund-quadrate leaves, small cells, bulging trigones, grayish, finely granular-papillose oil bodies (2-6 per cell) , and distinct lanceolate to subulate underleaves. It occurs on humus in woods, in litter over limestone, and on moist boulders beside streams.”

**L. heterocolpos** (The. ex Hartm.) Buch. Hong reports this, without citations, from four localities in western Colorado. We have the following collections: Gunnison Co.: Gothic Natural Area, 10,000 ft., Weber 9127, and San Juan Co.: trail from South Mineral campground to Ice Lake Basin, 11,000-11,800 ft., Weber 9541a !Persson in 1958; Chaffee Co.: Osburne Cr., San Isabel Nat. For., Hong 79-1012. It appears to be the most common and widespread species in western North America. “This green to golden-brown to reddish-brown species is characterized by its abundantly occurring gemmiparous shoots with brownish 2-celled oblong to ovoid gemmae, leaves slightly longer than wide, strongly collenchymatous small cells with bulging and often contiguous trigones, grayish ovoid to ellipsoid oil bodies (2-5 per cell) and distinct ovate-lanceolate to lanceolate underleaves.

**Lophozia**

Ref.: Hong (2002a)

*Lophozia* is our largest and most difficult genus. It is also one of the most commonly collected groups. A few of the species are very easy to recognize, and Schuster (1953) has given us a great deal of information from his unique knowledge of the genus in the field. First of all, authorities disagree as to whether *Lophozia* is one genus or many (including *Barbilophozia*, *Dilophozia*, *Leiocolea*, *Massula*, and a few others.)

- 1a. Leaves opaque, densely chlorophyllose and a peculiar pale bluish-green, 2-3-lobed, the lobes acute to acuminate, often provided with supplementary teeth; cells thin-walled, with about 50 minute oil bodies; apical leaves imbricate and forming a crispate head; plants less than 1 cm long with thick, fleshy stems; gemmae green. **L. incisa**
- 1b. Not as above.....(2)
- 2a. Leaf cells thin-walled, never with trigones. **L. obtusa**
- 2b. Leaf cells thickened (with trigones) at the corners, but these sometimes very weakly defined .....(3)
- 3a. Paroicous species, fruiting abundantly, with concave, dentate male bracts below the perianth; small, less than 1 cm long; leaves as wide or wider than long, suborbicular, with a broad, shallow sinus; gemmae reddish-brown or purple; cells lacking obvious trigones. **L. excisa**
- 3b. Dioicous species; male and female plants often in separate patches; margins of male bracts not dentate (except for an occasional basal tooth) .....(4)
- 4a. Shoots ascending or sub-erect, with the leaves nearly transversely inserted and mostly erect-spreading, the leaves much longer than wide, narrowly ovate; perianth mouth ciliate-dentate.....(5)
- 4b. Shoots creeping or decumbent, only the very tips slightly ascending; leaves more or less spreading, never erect, suborbicular to broadly ovate-rectangular, as wide or nearly as wide as long; perianth with teeth 0-4 cells long (Section *Ventricosae*; *these are the toughest ones to distinguish!*) .....(6)
- 5a. Gemmae greenish-yellow, 10-14 x 16-22  $\mu\text{m}$ ; plants usually 3-10 mm high; oil bodies nearly smooth; plants pale yellow-green; on decaying logs. **L. ascendens**
- 5b. Gemmae reddish-brown or reddish-yellow, 14-18 x 20-28  $\mu\text{m}$ ; shoots 0.8-2.5 mm high; oil bodies appearing coarsely papillose; plants deep or pure green. **L. longidens**
- 6a. Leaves with more or less incurved lobes, more or less strongly cupped, concave or canaliculate-convex; perianth mouth with teeth 1 (or at most 2) cells long; leaves 0.9-1.2 as wide as long. **L. wenzelii** (see also **L. sudetica**)
- 6a. Leaves with more or less spreading lobes, not strongly canaliculate-concave; leaf sinuses descending 1/4-1/3 the leaf height, generally obtusely to acutely angular.....(7)
- 7a. Leaves 0.75-0.95 as wide as long, clearly, even if slightly, elongate; perianth mouth with

teeth 2-4 cells long; trigones very strongly bulging; oil bodies 6-10 per cell. **L.**

**longiflora**

- 7b. Leaves 0.95-1.10 as wide as long (at least on mature robust shoots); perianth mouth with teeth 1-2 cells long; trigones moderately to slightly bulging; oil bodies 10-15 per cell. **L. ventricosa**

**L. ascendens** (Warnst.) Schust. We have collections from Larimer Co.: Rocky Mountain National Park; on decayed wood, Timber Lake trail, *Hermann 79-934*, cited by Hong (1980), Grand Co., *Hermann 25473 (B-57202)*, and Boulder Co.: Niwot Ridge, *Hermann 27425*. A small, pale yellowish-green plant 0.8-1.3 mm wide, 0.3-1.5 cm long, with strongly ascending growth form, narrowly triangular leaf-lobes with scarcely bulging trigones, abundant 1-2-celled yellowish-green gemmae, the cylindric perianth with a laciniate-lobulate mouth with 10-15 lobes and teeth 5-10 cells long and 3-5 cells wide at the base.

**L. excisa** (Dicks.) Dum. We have a specimen so named, from Custer Co.: South Colony Creek basin, 11,700 ft., *Kiener 10238*. Hong characterizes this as being abundantly fertile, green or tinged above with red, large and thin-walled leaf cells (28-30 x 30-40  $\mu\text{m}$ , with minute trigones, 1-2-celled vinaceous to purplish gemmae and strongly plicate perianth with a crenulate mouth. Hong separates this from the other species by the fact that the medulla of the stem is differentiated dorsiventrally and contains mycorrhizal fungi,

**L. incisa** (Schrad.) Dum. A very common species in the subalpine coniferous forests. Very easily recognized with just a hand lens by the pale green color and the shoots that are shaped like loose lettuce heads; the leaves are variously incised with sharp pointed lobes. Under the microscope the leaf cells are filled with masses of chloroplasts and the tiny oil bodies (about 1  $\mu\text{m}$  diameter may be found among them.

**L. longidens** (Lindb.) Mitt. We have one collection: *Hermann 27611*: Larimer Co.: Rocky Mountain National Park; infrequent on rotten logs, moist banks and rocks in the subalpine, Hidden Valley, !Hong. Frye & Clark reported this from Independence Pass, *Rakestraw* in 1938. A strongly ascending species with ovate-rectangular, longer than wide, leaves with straight, elongate, hornlike lobes, masses of red-brown 12-celled gemmae at the lobe apices, an a long-exserted perianth with a ciliate or ciliate-dentate mouth.

**L. longiflora** (Nees) Schiffn. Evans (1915) cited the following specimens: [Archuleta Co.]: near Pagosa Peak, *C. F. Baker*; [Gilpin Co.]: Rollins Pass, *Bethel*. We have a recent collection allegedly this: Boulder Co.: Lake Eldora, *Weber B22082*. Hong accepted the species but cited no specimens.

**L. obtusa** (Lindb.) Evans. Hong (1980) reported this from Larimer Co.: Rocky Mountain National Park; Poudre Lake, *Hong 78-848*. This is characterized, according to Hong, by the frequent presence of underleaves, uniformly bilobed (to 1.4 their length) leaves with rounded or obtuse lobes, almost isodiametric, thin-walled cells (30-35  $\mu\text{m}$  in mid-leaf) and slenderly cylindric perianth with a dentate mouth.

**L. opacifolia** (Culm.) ex Meyl. Hong reported this from Larimer Co.: On rocks, Poudre River, was identified by Hong, who cited his own collection from the same area (*Hong 78-851*). He has verified specimens from Boulder Co.: S. St. Vrain Canyon, 190 mi SW of Lyons, in tufts of *Dicranum rhabdocarpum*, *Weber & Wittmann B-103511*, and Summit Co.: Blue Lake, 11,700 ft., *Weber & Anderson B-34257*. The plant is distinctly opaque, bluish-green, characterized by its 3-5-lobed leaves with acute or obtuse apices, numerous (30-45 per cell) pellucid oil bodies and perianth mouth with 1-celled teeth.

**L. sudetica** (Nees ex Hüb.) Grolle. Hong says that this species differs from *L. wenzelii* by having flat leaves and reddish gemmae. One collection, verified by Hong, is from Boulder C.: S. St. Vrain canyon 10 mi SW of Lyons, in tufts of *Dicranum rhabdocarpum* (in packet with *Weber & Wittmann B-103511*, *L. opacifolia*); another is from Larimer Co.: Longs Peak, 11,800 ft., *Kiener 9164 (COLO B-21819)*, *Kiener 5671 (B-85265)*.

**L. ventricosa** (Dicks.) Dum. Evans (1915) cited, “without locality”, 1873, *J. Wolf*. Recent collections are from Gunnison Co.: We have numerous collections belonging to this or the next. A prostrate or creeping plant 0.8-2.5 mm wide, 1.0-2.5 cm long, with ovate, quadrately-bilobed leaves with bluntly acute lobes, lack of coarse trigones, abundant greenish, angular, 2-celled gemmae and long emergent perianth with pluriplicate mouth and 1-2-celled teeth. Evans (1915) cited a specimen from Palmer Lake, 1913, *G. E. Nichols*. Hong identified a Hermann collection: Larimer Co.: Rocky Mt. Nat. Park, Roaring River, Timber Creek. Other collections are Boulder Co.: Green Lakes Valley, *Shushan & Johnson*; Larimer Co.: *Weber 9686*; Summit Co.: Monte Cristo Creek, *Weber 6599*; Gothic, *Weber 8869*, and Larimer Co.: east slope Long’s Peak, *Kiener 8026*. This is a very small species, generally not lying flat; rather, the stems are very short and erect and tightly packed; the leaves, seen from the top, are distinctly cupped, the lobes not turning outward.

**L. wenzelii** (Nees) Steph. Hong cites no collections and presents no map, but lists this from Colorado. He describes it as follows: “This large species (1.2-1.6 mm wide, 1.0-8.0 cm long) is characterized by its prostrate growth form, sub-vertically inserted broadly orbicular leaves with strongly arched margins, and broad crescent-shaped sinus, homogeneous ellipsoidal oil-bodies (4-10 per cell), angular, 2-celled, pale green gemmae and deeply plicate obpyriform one-celled perianth teeth.” It is likely that what we have been calling *L. wenzelii* is actually *L. sudetica*.

### Tritomaria

Ref.: Hong (1994)

- 1a. Leaves symmetrical, equally trilobed with blunt or rounded apices; perianth mouth entire or subentire. **T. polita**
- 1b. Leaves asymmetrical, unequally 2-3-lobed with acute or acuminate apices; perianth mouth strongly dentate.....(2)

- 2a. Leaves plane, wider than long; gemmae rare, yellowish to yellowish-brown. **T. quinque-dentata**
- 2b. Leaves canaliculate-complanate, longer than wide; gemmae abundant, reddish-brown to rust-red .....(3)
- 3a. Gemmae smooth, ovoid-ellipsoidal; leaf cells 10-15 x 15-25  $\mu\text{m}$  in mid-leaf; cell walls thick, trigones not bulging. **T. exsecta**
- 3b. Gemmae angular, polygonal; leaf cells 15-20 x 20-40  $\mu\text{m}$  in mid-leaf; cell walls thin, trigones bulging. **T. exsectiformis**

**T. exsecta** (Schmid.) Schiffn. Clear Creek Co.: wet tundra, Summit Lake, Mt. Evans, 3900 m, *Weber & Anderson B-10878*.

**T. exsectiformis** (Breidl.) Loeske. Boulder Co.: Vertical sandstone cliff, White Rocks, 5500 ft. alt., 8 km NE of Boulder, *Weber B-5588* \*\*\*needs checking again). Larimer Co.: Rocky Mountain National Park; matting vertical soil bank of Alpine Brook, 3020 m, *Hermann B-25995*; on decayed wood, Chiquita Creek, Roaring River, Hermann \*\*\*, !Hong.

**T. polita** (Nees) Jörg. Infrequent in wet places along rills in the subalpine-alpine ecotone. Our specimens are from Clear Creek, Grand, Park, and Pitkin counties.

**T. quinquedentata** (Huds.) Buch. Boulder Co.: “*Haplomitrium* Hill”, Green Lake Valley, Indian Peaks, 3,400-3,700 m, *Weber B-44150*; Pawnee Lake cirque, 3,300-3,500 m, *Komarkova B-41952*. We also have collections from Gilpin, Grand, and summit counties.

## MARSUPELLACEAE

This family consists of plant with very tiny bilobed, transversely attached. non-decurrent leaves. They are not fen plants but usually are either in forests on rotting wood (*Marsupella*), or on cliffs or rocks (*Gymnomitrium*). In our experience they are very rare. *Gymnomitrium* (original spelling *Gymnomitrium*) (cf. Hong 1983).

- 1a. Leaves very densely imbricate, grayish-white or grayish green to very pale green. The texture is very like coral. **Gymnomitrium**
- 1b. Leaves spreading from the stem, distant in sterile shoots, mostly forming dark green or black tufts. **Marsupella**

### Gymnomitrium

- 1a. Plants silvery-gray; leaves bilobed to 0.05-0.15 their length; leaf lobes rounded; cuticle smooth; marginal cells thin-walled, sloughing off and making the leaf erose. **G. corallioides**
- 1b. Plants greenish to reddish brown; leaves bilobed to 0.15-0.35 their length; leaf lobes apiculate to acute; cuticle smooth to papillate; marginal cells thick-walled. **G. concinnatum**

**G. concinnatum** (Lightf.) Corda. Hong cites a specimen: Boulder Co.: Long's Peak, *Kiener 8971* (F). See discussion below. Kiener gave his two specimens different numbers, so perhaps he recognized that they did look different in the field.

**G. corallioides** Nees. A very rare plant of very high altitudes, 13,000 feet or higher. We have two collections: Boulder Co.: Longs Peak, on siliceous rock ledges, 13,500 ft., *Kiener 8970*. Clear Creek Co.: 1/4 mi N of shore of Summit Lake, Mt. Evans, with *Stereocaulon sp.* 12,500 ft., *Weber B-9014*. Both of our collections appear to be the same species, and were verified by Evans in 1955 and by Steere in 1956. Neither collection is silvery gray, but brown. The marginal cells are fragile and their degeneration makes the leaf erose. I believe it is entirely possible that we have only one species and that it is *G. corallioides*. However, since Hong claims they often grow together, perhaps the Kiener specimen that Hong examined at Field Museum is actually *G. concinnatum*, so I cannot rule it out. We really need more collections of a very rare genus.

### Marsupella

- 1a. Cortical of the stem (in cross-section) resembling the inner ones; usually on moist cliffs. **M. emarginata**
- 1b. Cortical cells of the stem thin-walled and twice as large as the inner ones; forest plants. **M. sphacelata**

**M. emarginata** (Ehrh.) Dum. Our only report is Evans (1915), who cited this from Pikes

Peak, 1896, *Holzinger*.

**M. sphacelata** (Gies.) Dum. We have two collections: Custer Co.: on ground and over rotting wood under spruces, South Colony Creek, 9,500 ft., 2 July 1941, *Kiener B-10218*.

Larimer Co.: Rocky Mountain National Park, on soil SE of Haynach Lake, *Willard B-62167*, !Hong.

## PELLIACEAE

The thallus in *Pellia* is broad (4-8 mm wide), thinner than in *Aneura pinguis* and not fleshy nor greasy, dull green, flat, thin, more so on the margins. There is a faint suggestion of a mid-vein (absent in *Aneura*). It rarely is found fruiting here. The antheridia are minute pimple-like elevations on the surface. The pseudoperianth is a low flap or a low tube beyond which the calyptra may protrude. The seta and capsule are fragile and similar to those of leafy liverworts and grow erect.

### **Pellia**

**P. endiviifolia** (Dicks.) Dum.. The critical distinction of this species is the fringed border of the involucre, which in this species is not a simply low flap but a more or less erect short tube. All fertile specimens we have seen have this character. We have collections from Boulder, Gunnison, and Park counties. It occurs in a variety of wet sites, including streamsides, willow carrs, and edges of pools in the subalpine. A specimen from Buford, Garfield Co. (*Hermann 24235*), labeled *P. epiphylla*, has no pseudoperianths and cannot be validated.

## PLAGIOCHILACEAE

### Plagiochila

This is a fairly common leafy liverwort occurring on moist forest floors and streamsides from the foothills to the subalpine. It is very easily recognized because the leaves are attached obliquely to the stem, alternate, and strongly *succubous*, with the antical (upside) base of the leaf strongly decurrent, and the lamina recurved and overlapping the leaf postical (downside) of it. Think of a Venetian blind: If you pull the cord so that the slat has its upper edge overlapping the one above it, that is what we usually call overlapping (in botanical terms *incubous*); if you pull the cord so that the slat is reversed, with the upper edge of the slat facing backward and overlapping the slat below it, it is succubous; if you were a bug, you would easily slide forward along an incubous leaf arrangement; you would get stuck if you try it with a succubous one. Unless leaves are inserted on the stem transversely, they will be either incubous or succubous.

**P. porelloides** (Torr. ex Nees) Lindb. Common in the montane and subalpine zones. We have collections from \*\*\* counties. The report of *P. asplenoides* (L.) Dum. from Rocky Mountain National Park (*Hermann 2987*) apply to *P. porelloides*. \*\*\* (*asplenoides* European?)

## PORELLACEAE

Ref.: Hong (1983)

This is our largest leafy liverwort. It has long branches (several inches) and forms mats of creeping stems 2-4 mm wide and up to 10 cm long, on moist cliff sides, at fairly low altitudes, especially in the outer foothills of the Front Range. The color is a dark dull green. The leaves are incubous, closely overlapping and forming a rather smooth surface. The underside is a different matter altogether. There are large underleaves, which tend to be ruffled on the lower margins, which also curve outward. The leaf is two-lobed. Instead of the smaller lobe lying flat upon the much larger lobe as it would be in *Scapania*, it is tucked in underneath, narrow, and is oriented parallel to the stem, so altogether the underside of a *Porella* looks like it is filled with odds and ends of leaf-like things. The genus does not produce gemmae. Short side shoots with crowded overlapping leaves produce androecia. The perianth is near the shoot apex and is inflated, narrowed to a small mouth.

### Porella

- 1a. Ventral lobes long-decurrent; margins strongly reflexed; underleaves twice as long as the ventral lobes. **P. cordaeana**
- 1b. Ventral lobes not or only short-decurrent; margins plane or weakly reflexed; underleaves 1-2 times as wide as the ventral lobes. **P. platyphylla**

**P. cordaeana** (Hüb.) Moore. Hong cited the following collections. Boulder Co.: Bluebell canyon, Weber B-9021; Larimer Co.: Little Thompson Canyon, *Hermann 27055*; Park Co.: Estabrook (report by Evans, 1915). They evidently grow together in the Front Range foothills.

**P. platyphylla** (L.) Pfeiff. Hong stated that "*P. platyphylla* is easily distinguished from *P. cordaeana* by its regular 2-3-pinnate branching, underleaves that are slightly wider than the ventral lobes, and a ciliate perianth mouth." Hong cited the following collections. Boulder Co.: Bluebell canyon, *Weber B-9021*; Clear Creek Co.: Clear Creek canyon, *Weber B-40723*; Fremont Co.: Phantom Canyon, *Weber B-37547*; Larimer Co.: Drake, *Hermann 25760*; Little Thompson Canyon, *Hermann 27055*; Jefferson Co.: Platte Canyon, *Holzinger s.n.*

## RADULACEAE

This family has only one genus, *Radula*, which is distinguished by having a rectangular lower “lobule”, which is not seen from above because it is hidden by the larger ovate or orbicular dorsal lobe. There are no underleaves. Otherwise *Radula* looks very much like a very small *Porella*. It is light green as opposed to the dull, dark green of *Porella*, which also differs by having underleaves. Fertile specimens have a narrow, flattened perianth with a wide, truncate, flat mouth. There are no rhizoids whatever on the stem.

### Radula

The genus *Radula* is mostly tropical. We have only one species, ***R. complanata*** (L.) Dum. It is a plant of cliffs, often growing over imperfect lichens. One conspicuous feature is that each leaf cell has one large football-shaped brownish oil body. Usually oil bodies disappear soon after the plants die, but in one of our collections, they are still obvious in specimens a year old. We have specimens from Boulder and Gunnison counties.

## SCAPANIACEAE

### Scapania

Ref.: Hong (1980b)

- 1a. Minute species, 2-6 mm long, 0.5-2.25 mm wide; gemmae reddish-brown, often at the ends of erect, slender shoots with more or less reduced leaves; leaf margins usually entire, both lobes ovate-pointed (less than 0.7 as wide as long and non-decurrent. **S. glaucocephala**
- 1b. Larger species, 8-80 mm long; gemmae always on normal, unmodified, large-leaved shoots with spreading leaves.....(2)
- 2a. Ventral leaf lobe distinctly (often conspicuously) decurrent, the decurrent strip several cells broad, gradually tapered (this is difficult to see in stems in which the leaves are closely overlapping, but diligence usually gets results) .....(3)
- 2b. Leaves not decurrent ventrally or rarely with a 1-seriate line of cells below the keel insertion .....(6)
- 3a. Mature leaves not sharply keeled, the keel rounded; dorsal lobe squarrose; minute plants 1.0-2.2 mm wide x 5-12 mm long; ventral lobes one half to two-thirds as wide as long; gemmae deep reddish brown, 2-celled. **S. cuspiduligera**
- 2b. Mature leaves with a sharply folded keel; dorsal lobe flattened against the ventral or variously spreading, not strongly squarrose; plants usually robust, 2-5 mm wide x 20 mm long; ventral lobes broadly ovate to rotund .....(4)
- 4a. Dorsal lobe with an arcuate insertion, distinctly (usually long-) decurrent.....(5)
- 4B. Dorsal lobe transversely inserted, indistinctly decurrent.....(6)
- 5a. Leaf margins almost entire; dorsal lobes almost reniform; gemmae very rare, 1-celled, greenish to reddish. **S. uliginosa**
- 5B. Leaf margins slightly dentate; dorsal lobes broadly cordate; gemmae never produced. **S. paludosa**
- 6a. Dorsal lobe not more than 2/3 the ventral lobe in size, the keel less than half the length of the ventral lobe; marginal leaf cells (in ours) not incrassate. **S. undulata**
- 6b. Dorsal lobe 0.7-0.8 times the ventral in size; keel 0.5-0.65 the length of the ventral lobe; marginal rows of leaf cells incrassate. **S. subalpina**
- 7a. Ventral lobe broadly ovate to suborbicular, width mostly 0.85-1.25 times the length; plants robust, 2.1-5.0 mm wide x 2-10 cm long .....(8)
- 7b. Ventral lobe narrow, 0.45-0.8 times the length; plants small, 0.5-2.2 mm wide x 2-18 mm long. ....(10)
- 8a. Gemmae greenish at maturity, 2-celled; leaf lobes mostly acute to subacute; submerged

- in subalpine slow streams and pools; color dark green or black. **S. irrigua**
- 8b. Gemmae reddish to brown at maturity; leaf lobes mostly rounded; in fens and moist tundra; color usually brownish-green to brown.....(9)
- 9a. Leaves with highly arched, often semicircular keel; dorsal and ventral lobes obtusely pointed, more or less denticulate; gemmae brown, narrowly elliptical, one-celled; oil bodies very large, persistent; plants mostly 2.4-3.5 mm wide. **S. degenii**
- 9b. Leaves with keel more or less concave or almost straight; dorsal and ventral lobes obtuse to broadly rounded, always entire; gemmae reddish-brown, 2-celled, very broad; oil bodies mostly small, disappearing soon after death; plants usually 1.9-2.8 mm wide. **S. hyperborea**
- 10a. Leaves with the marginal cell rows of non-gemmiparous lobes uniformly thick-walled (usually strongly so), forming a distinct border; subalpine, forested areas. **S. curta**
- 10b. Leaves with marginal cells with trigones as large as those in the inner cells, the lobes thus not distinctly bordered; alpine tundra. **S. mucronata** (see also *S. fulfordiae*)

**S. curta** (Mart.) Dum. A small species fairly common in forested areas. The best distinguishing feature is the one or two rows of smaller, thick-walled cells bordering the leaf. The dorsal lobe is broader than high, distinctly pointed. In the field this is a very light green plant more or less erect with the lobes not strongly flattened against each other. The dorsal lobe may have some small teeth near the apex. I have not seen gemmae in our material. We have specimens from Boulder, Chaffee, Clear Creek, Larimer, and Summit counties.

**S. cuspiduligera** (Nees) Müll. Uncommon along streamlets, from upper foothills to subalpine, We have collections from Boulder, Gilpin, Larimer, and Summit Counties. The small size and spreading, almost reflexed, dorsal lobes are distinctive field characters.

**S. degenii** Schiff. ex Müll. A rare subalpine species. Collections cited by Hong : Boulder Co.: Left Hand peat fen, 10,600 ft., *Weber & Dahl B-6982*; Isabelle Glacier, *Komarkova B-42040*. "Easily distinguished by its cordate-reniform dorsal lobes, yellow-brown 1-celled gemmae and large oil bodies" (Hong 1980). Compare with *S. hyperborea*.

**S. fulfordiae** Hong. Known from one collection from near Centennial, Wyoming, and two Colorado collections: Grand Co.: Lulu City Trail, Rocky Mt. National Park, *Hong 79-895, 79-903*. This is said to be similar to *S. mucronata*, but "distinguished from that species by its rather broadly rounded ventral lobes, large dorsal lobes (ca. 0.65-0.8 the ventral in size in contrast to ca. 0.5-0.6 the ventral in *S. mucronata* ), small marginal cells which average 10-14 microns, fewer oil bodies (2-4 per cell), exclusively green 1-celled, small gemmae and strongly developed keel (0.5-0.75 the length of the ventral lobe)." It is a small plant, about the size of *S. curta*.

**S. glaucocephala** (Tayl.) Evans. One collection known: San Juan Co.: Coal Bank Hill, 6 Aug. 1979, *Hong 79-1061* (COLO B-71209).

**S. hyperborea** Jörg. Probably the most common species on the tundra along rocky snow-melt rills. Clear Creek Co.: Gray's Peak, *Nelson & Weber B-41681*; slopes around S shore of Summit Lake, Mt. Evans, 12,800 ft., *Weber B-8909*, !Schuster. "Characterized by the consistently rounded apices of the dorsal lobes, entire margins of the ventral and dorsal lobes, and the 2-celled, broadly ovoid, brownish-red gemmae" (Hong 1980).

**S. irrigua** (Nees) Dum.. Very common in subalpine forests where water spreads from snow-melt streamlets. A very dark species with rather remotely spaced leaves. We have specimens from Boulder, Clear Creek, Grand, and Larimer counties.

**S. mucronata** Buch. We have collections from Chaffee and Clear Creek counties. Schuster (vol. 3, p. 435) cites a specimen collected by Holzinger, Pikes Peak, 7,000-10,000 ft., 1896 (NY). "Another specimen with the same data is *S. cuspiduligera*." See also *S. fulfordiae*.

**S. paludosa** (Müll.) Müll. We have one collection from Grand Co.: West St. Louis Creek, 9,000 ft., ca. 6 mi W of Fraser, *Weber et al. B-11092*, !Hong, 1978.

**S. subalpina** (Nees) Dum. A species of the subalpine. We have collections from Boulder, Clear Creek, Grand, and San Juan counties.

**S. uliginosa** (Sw.) Dum. Our only record is one cited by Evans (1915): Lake Co.: Twin Lakes, 1873, *Wolf & Rothrock*.

**S. undulata** (L.) Dum. Probably the most common species of montane and subalpine forest floors. We have collections from Boulder, Gilpin, Grand, Larimer, Pitkin, Routt, and Summit counties.

## INDEX AND CATALOG OF COLORADO HEPATICS

This list should account for all names used in publications on the Colorado liverwort flora, and their present dispositions. Names in italics represent synonyms that may be used in other or earlier works, or if noted, erroneous reports.

### **ANEURA (ANEURACEAE)**

**A. pinguis** (L.) Dumortier

### **ANTHELIA (ANTHELIACEAE)**

**Anthelia juratzkana** (Limpricht) Trevisan

### *ANTHOCEROS (ANTHOCEROTACEAE)*

*A. laevis* = *Phaeoceros laevis*

### **APOMETZGERIA (METZGERIACEAE)**

**A. pubescens** (Schrader) Kuwahara

### **ASTERELLA (AYTONIACEAE)**

**A. gracilis** (F. Weber) Underwood

**A. lindenbergiana** (Corda) Lindenberg\*\*\* check Lindberg/Lindenberg

*A. ludwigii*: erroneous name for *A. gracilis*

### **ATHALAMIA (CLEVEACEAE)**

**A. hyalina** (Sommerfelt) Hattori

### **BARBILOPHOZIA (LOPHOZIACEAE)**

**B. attenuata** (Martius) Loeske

**B. barbata** (Schreber) Loeske

**B. floerkei** (Weber & Mohr) Loeske

**B. hatcheri** (Evans) Loeske

**B. kunzeana** (Hübener) Müller Frib.

**B. lycopodioides** (Wallroth) Loeske

### **BLASIA (BLASIACEAE)**

**B. pusilla** (L.) Micheli

### **BLEPHAROSTOMA (BLEPHAROSTOMACEAE)**

**B. trichophyllum** (L.) Dumortier

### **CALYPOGEIA (CALYPOGEIACEAE)**

**C. fissa** (L.) Raddi

**C. integristipula** Stephani

**C. muelleriana** (Schiffner) K. Müller

**C. neesiana** (Massalongo & Carestia) K. Müller  
**C. suecica** (Arnell & Persson) K. Müller

**CARPOBROTUS (ANTHOCEROTACEAE)**

**C. orbicularis** Schweinitz

**CEPHALOZIA (CEPHALOZIACEAE)**

**C. ambigua** Jörgensen  
**C. bicuspidata** (L.) Dumortier  
*C. binsteadii* = *C. ambigua*  
**C. pleniceps** (Austin) Lindberg

**CEPHALOZIELLA (CEPHALOZIELLACEAE)**

**C. arctica** Bryhn & Douin  
*C. byssacea* = *C. divaricata*  
**C. divaricata** (Smith) Schiffner  
**C. hampeana** (Nees) Schiffner  
**C. rubella** (Nees) Douin

**CHILOSCYPHUS (GEOCALYCACEAE)**

**C. pallescens** (Ehrhart) Dumortier  
*C. fragilis* = *C. pallescens*  
**C. polyanthus** (L.) Corda

*CLEVEA (CLEVEACEAE)*

*C. hyalina* = *Athalamia hyalina*

**CONOCEPHALUM (CONOCEPHALACEAE)**

**C. conicum** (L.) Dumortier

**FRULLANIA (FRULLANIACEAE)**

**F. brittoniae** Evans  
**F. inflata** Gottsche  
**F. riparia** Hampe

**GEOCALYX (GEOCALYCACEAE)**

**G. graveolens** (Schrader) Nee

*GRIMALDIA (AYTONIACEAE)*

*G. fragrans* = *Mannia fragrans*

**GYMNOCOLEA (LEPICOLEACEAE)**

**G. inflata** (Hudson) Dumortier

**GYMNOMITRIUM (MARSUPELLACEAE)**

**G. concinnatum** (Lightfoot) Corda

**G. corallioides** Nees

**HAPLOMITRIUM (HAPLOMITRIACEAE)**

**H. hookeri** (J. E. Smith) Nees

**HARPANTHUS (GEOCALYCACEAE)**

**H. flotovianus** (Nees) Nees [to be expected]

**JUNGERMANNIA (JUNGERMANNIACEAE)**

**J. atrovirens** Dumortier

*J. cordifolia* = *J. exsertifolia*

**J. exsertifolia** Stephani var. **cordifolia** (Dumortier) Vana

**J. hyalina** Lyell

*J. lanceolata* = *J. leiantha*

**J. leiantha** Grolle

**J. obovata** Nees

**J. pumila** Withering

**J. rubra** Underwood

**J. sphaerocarpa** Hooker

**LEIOCOLEA (LOPHOZIACEAE)**

**L. badensis** (Gotttsche) Joergensen

**L. bantriensis** (Hooker) Joergensen

**L. collaris** (Nees) Schljakov

**L. heterocolpos** (Thedin ex Hartman) Buch

*L. muelleri* = *Lophozia collaris*

**LEPIDOZIA (LEPIDOZIACEAE)**

**L. reptans** (L.) Dumortier

**LOPHOCOLEA (GEOCALYCACEAE)**

**L. heterophylla** Nees

**L. minor** Nees

**LOPHOZIA (LOPHOZIACEAE)**

*L. alpestris*: Erroneous reports of *L. sudetica*

**L. ascendens** (Warnstorf) Schuster

*L. attenuata* = *Barbilophozia attenuata*

*L. badensis* = *Leiocolea badensis*

*L. bantriensis* = *Leiocolea bantriensis*

*L. barbata* = *Barbilophozia barbata*

*L. collaris* = *Leiocolea collaris*

**L. excisa** (Dickson) Dumortier  
*L. guttulata* = *L. longiflora*  
*L. hatcheri* = *Barbilophozia hatcheri*  
*L. heterocolpa* = *Leiocolea heterocolpa*  
**L. incisa** (Schrader) Dumortier  
**L. longidens** (Lindberg) Macoun  
**L. longiflora** (Nees) Schiffner  
*L. lycopodioides* = *Barbilophozia lycopodioides*  
*L. muelleri* = *L. collaris*  
**L. opacifolia** Culmann ex Meylan  
**L. obtusa** (Lindberg) Evans  
*L. porphyroleuca* = *L. longiflora*  
**L. sudetica** (Nees ex Hübener) Grolle  
**L. ventricosa** (Dickson) Dumortier  
**L. wenzelii** (Nees) Stephani

#### **LUNULARIA (LUNULARIACEAE)**

**L. cruciata** (L.) Dumortier

#### **MANNIA (AYTONIACEAE)**

**M. fragrans** (Balbis) Frye & Clark  
**M. pilosa** (Horneman) Frye & Clark  
**M. rupestris** (Nees) Frye & Clark

#### **MARCHANTIA (MARCHANTIACEAE)**

**M. alpestris** Nees  
**M. polymorpha** L.

#### **MARSUPELLA (MARSUPELLACEAE)**

**M. emarginata** (Ehrhart) Dumortier  
**M. sphacelata** (Giesecke) Dumortier

#### *MASSULA (LOPHOZIACEAE)*

*M. incisa* = *Lophozia incisa*

#### **NARDIA (JUNGERMANNIACEAE)**

**N. geoscyphus** (De Notaris) Lindberg  
**N. scalaris** (Schrader) Dumortier

#### *NOTOTHYLAS (ANTHOCEROTACEAE)*

*Notothylas orbicularis* = *Carpobolus orbicularis*

#### *ORTHOCAULIS (LOPHOZIACEAE)*

*O. gracilis* = *Barbilophozia attenuata*

*O. kunzeana* = *Barbilophozia kunzeana*

**PELLIA (PELLIACEAE)**

**P. endiviifolia** (Dickson) Dumortier

*P. fabbroniana* = *P. endiviifolia*

*P. epiphylla*: Unsubstantiated report.

**PHAEOCEROS (ANTHOCEROTACEAE)**

**P. laevis** (L.) Proskauer

**PLAGIOCHASMA (AYTONIACEAE)**

**P. rupestre** (Forster) Stephani

**P. wrightii** Sullivant

**PLAGIOCHILA (PLAGIOCHILACEAE)**

*P. asplenoides*: erroneous report.

**B. porelloides** (Nees) Lindenberg

**PLECTOCOLEA (JUNGERMANNIACEAE)**

*P. hyalina* = *Jungermannia hyalina*

*P. obovata* = *Jungermannia obovata*

**PORELLA (PORELLACEAE)**

**P. cordaeana** (Hübener) Moore

**P. platyphylla** (L.) Pfeiffer

**PREISSIA (MARCHANTIACEAE)**

**P. quadrata** (Scopoli) Nees

**RADULA (RADULACEAE)**

**R. complanata** (L.) Dumortier

**REBOULIA (REBOULIACEAE)**

**R. hemispherica** (L.) Raddi

**RICCARDIA (ANEURACAE)**

**R. multifida** (L.) S. F. Gray

*R. pinguis* L. = *Aneura pinguis*

**RICCIA (RICCIACEAE)**

**R. austinii** Stephani

**R. beyrichiana** Hampe

**R. cavernosa** Hoffmann emend. Raddi

**R. fluitans** L.  
**R. frostii** Austin  
*R. lescuriana* = *R. beyrichiana*  
**R. sorocarpa** Bischoff

**RICCIOCARPUS (RICCIACEAE)**

**R. natans** (L.) Corda

*SACCOBASIS (LOPHOZIACEAE)*

*S. polita* = *Tritomaria polita*

**SCAPANIA (SCAPANIACEAE)**

**S. curta** (Martius) Dumortier  
**S. cuspiduligera** (Nees) K. Müller  
**S. degenii** Schiffner  
**S. fulfordiae** Hong  
**S. glaucocephala** (Taylor) Evans  
**S. hyperborea** Joergensen  
**S. irrigua** (Nees) Dumortier  
**S. mucronata** Buch  
**S. paludosa** (K. Müller) K. Müller  
**S. subalpina** (Nees) Dumortier  
**S. uliginosa** (Swartz) Dumortier  
**S. undulata** (L.) Dumortier

*SOLENOSTOMA (JUNGERMANNIACEAE)*

*S. cordifolium* = *J. exsertifolia* var. *cordifolia*  
*S. pumilum* = *Jungermannia pumila*  
*S. sphaerocarpa* = *Jungermannia sphaerocarpa*

*TRICHOSTYLIUM (ANEURACEAE)*

*Trichostylium pinguis* = *Aneura pinguis*

**TRITOMARIA (LOPHOZIACEAE)**

**T. exsecta** (Schmidel) Schiffner  
**T. exsectiformis** (Breidler) Loeske  
**T. polita** (Nees) Joergensen  
**T. quinquedentata** (Hudson) Buch

## GLOSSARY OF TERMS

\*\*\* in progress

Air chambers: cavities within the thallus, usually opening to the dorsal surface by a pore

Antical: Referring to the upper surface or margin (as of a leaf as opposed to postical).

Areoles:

Bracteole:

Carpocephalum: the elevated female “receptacle” of certain Marchantiaceae, consisting of a disk and stalk issuing from the thallus

Calyptra:

Underleaves: The reduced (often vestigial) lower row of leaves, often hidden amongst rhizoids

## **BIBLIOGRAPHY**

Note: The combined bibliography of mosses and hepatics is to be found in Part I: Mosses.