

Studies in Indiana Bryophytes VII

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The mosses used in this study are Indiana collections in herbaria in the following institutions: Butler University, Chicago Natural History Museum, Carnegie Museum, DePauw University, University of Michigan, University of Minnesota, New York Botanical Garden, Laboratoire de Cryptogamie, Muséum d'Histoire Naturelle, Paris, France, and University of California, Berkeley.

The asterisk following the name of the plant indicates that this is the first known published record of this species or variety in Indiana.

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FONTINALACEAE (WATER MOSSES)

Plants normally submerged but frequently exposed by recession of the water, attached at base of stems by rhizoids; stems flaccid to rigid, short to much elongated, up to 150 cm. in length, 0.2-0.75 mm. in diameter, often denuded at or near the base with age, regularly or irregularly branched; branches erect-ascending to spreading, ends of foliated stems and branches acuminate to obtuse, in some species conspicuously three-angled, frequently curved to uncinate in *Dichelyma*; leaves tristichous, flaccid to firm, erect to spreading, often secund, subfalcate to falcate, or uncinate in *Dichelyma*, plane, subconcave to concave, subcanaliculate to canaliculate, irregularly longitudinally folded, faintly keeled, subcarinate, or carinate-conduplicate, keel straight to strongly curved, ecostate in *Fontinalis*, costate in *Dichelyma* and *Brachelyma* with the single midrib supercurrent to long excurrent, plane or unfolded blades subulate, lanceolate-subulate, sublanceolate, lanceolate, oblong-, ovate-, oval, or subelliptic-lanceolate, subovate to ovate, suboval to oval, suborbicular, or subrhomboidal to rhomboidal, apices subulate, short to long acuminate, subacute to acute, subobtuse to obtuse, sometimes subcucullate to cucullate, occasionally subcymbiform, entire to serrulate, margins of apices sometimes narrowly to broadly involute, blades 2-10 mm. long, 0.35-8.5 mm. wide; median cells of leaves subrhombic, subrhomboidal, subhexagonal, linear-rhomboidal, linear-rhombic, or linear, ends obtuse or attenuate, frequently cells subflexuous to flexuous; marginal cells occasionally forming a border; alar cells not enlarged to much enlarged, subquadrate to subhexagonal; auricles

distinct to none; leaf bases not decurrent to long decurrent; dioecious usually; sporophytes on upper portion of stem in *Brachelyma* and *Dichelyma* and on the lower part in *Fontinalis*; perichaetium suboval to cylindrical; calyptra long conical or mitriform, dimidiate in *Dichelyma* and *Brachelyma*; capsule sessile, subsessile, or on short to moderately long seta; operculum obtuse conical in *Fontinalis*, rostrate in *Dichelyma* and *Brachelyma*; seta 0.1-1.5 mm. long in *Fontinalis* and *Brachelyma*, 3-21.5 mm. in length in *Dichelyma*; urn suboval to cylindrical, 0.65-3 mm. long, 0.35-2 mm. in diameter; peristome double, teeth 16, free or united in pairs at apices, cilia 16, free or incompletely to completely united by transverse strands into a conical trellis; spores 10-35 μ in diameter, ripe in summer.

Since *Dichelyma* and *Fontinalis* are known to occur in Wisconsin, Michigan, and Ohio, and *Brachelyma* and *Fontinalis* in Illinois, the key includes the three genera of Fontinalaceae although at present only *Fontinalis* has been recorded from Indiana. It seems probable that many of the species in the states bordering Indiana may be found, sometime, in Indiana. These species have been included in the keys in addition to those known to occur in the state.

Key to the Genera of Fontinalaceae

1. Leaves ecostate, from plane to concave, tubular, or carinate-conduplicate; perichaetium oval, oblong, or cylindrical; perichaetial leaves oblong, ovate, oval, oval-lanceolate, or orbicular; calyptra conical; capsule immersed in perichaetial leaves or emergent.....
..... *Fontinalis*.
1. Leaves costate, always carinate-conduplicate; perichaetium always cylindrical; perichaetial leaves ovate-lanceolate, elliptic-lanceolate, or linear-lanceolate; calyptra dimidiate.
 2. Ends of foliated stems and branches conspicuously three-angled, not curved or uncinat; leaves not secund; keel straight to moderately curved, frequently abruptly curved near apex; calyptra covering operculum only; capsule completely immersed; seta 0.75-1.5 mm. long..... *Brachelyma*.¹
 2. Ends of foliated stems and branches not conspicuously three-angled, commonly slightly to distinctly curved, frequently uncinat; leaves often secund and falcate; calyptra enveloping capsule; capsule emergent to surpassing perichaetium; seta 3-21.5 mm. long..... *Dichelyma*.

Key to Species of Fontinalis²

1. Leaves usually carinate or carinate-conduplicate.
2. Leaves with keels or median lines predominantly curved above basal curve.

¹ *Brachelyma subulatum* has been collected in Illinois.

² All references concerning leaves are applicable to the majority of median cauline blades unless otherwise stated. The leaf shapes are those of unfolded blades. The ratios recorded are to be interpreted as length to width.

3. Leaves broadly ovate or ovate-lanceolate, oval, or suborbicular, 4-8 mm. long, 3-6.5 mm. wide, 1-1.6:1; keels moderately curved to almost semicircular; plants robust..... *F. antipyretica* var. *gigantea*.
3. Leaves ovate- to oval-lanceolate, 3-8.5 mm. long, 2-4 mm. wide, 1.5-3.5:1; keels slightly to moderately curved; plants medium in size..... *F. antipyretica*.
2. Leaves with keels or median lines predominantly straight above basal curve, frequently abruptly curved at apex; apices briefly and broadly acuminate, often subconcave to plane; blades ovate- to broadly ovate-lanceolate, 4-6 mm. long, 1.5-2.5 mm. wide, 1.5-3:1; plants medium to robust..... *F. patula*.
1. Leaves usually concave.
 2. Leaves erect to slightly erect-spreading, appearing to be appressed; apices of perichaetial leaves acute or apiculate..... *F. dalecarlica*.
 2. Leaves erect-spreading to spreading, not appearing to be appressed; apices of perichaetial leaves usually broadly obtuse or rounded.
 3. Margins frequently involute.
 4. Margins in apical portions commonly narrowly involute.
 5. Blades usually firm, ovate-lanceolate, and 2.5-4 mm. long, 1-2 mm. wide..... *F. novae-angliae*
 5. Blades usually flaccid, broadly ovate-lanceolate, and 4-7.5 mm. long, 1.5-3.5 mm. wide..... *F. novae-angliae* var. *latifolia*.
 4. Margins in apical portions frequently broadly involute, the broad involution sometimes extending to base of blade, occasionally margins convolute and blades subtubular to tubular.
 5. Apices long acuminate; apical cells rhombic, rhomboidal, quadrat, rectangular, or hexagonal; blades narrowly ovate-lanceolate..... (aestival leaves) *F. biformis*.
 5. Apices generally obtuse to truncate, margins gradually narrowing to tips; apical cells linear or linear-rhomboidal; blades ovate- or oblong-lanceolate or lanceolate..... *F. novae-angliae* var. *cymbifolia*.
 3. Margins not involute.
 4. Apical cells rhomboidal, rhombic, quadrate, rectangular, or hexagonal; apices narrowly to broadly obtuse; blades broadly ovate-lanceolate or lanceolate..... (vernal leaves) *F. biformis*.
 4. Apical cells linear or linear-rhomboidal; apices acuminate, frequently serrulate.

5. Stems flaccid; leaves usually subflaccid, lanceolate to ovate-lanceolate..... *F. missourica*.
5. Stems rigid; leaves firm, narrowly lanceolate.
 6. Blades concave throughout or subconcave at base and plane above, occasionally canaliculate to sub-tubular; apices narrowly acuminate; leaves 0.75-1.5 mm. wide *F. disticha*.
 6. Blades concave or deeply concave to convolute tubulose; apices long acuminate or subulate; leaves 0.35-0.5 mm. wide..... *F. filiformis*.
1. Leaves usually plane.
 2. Leaves generally broadly ovate-lanceolate or oval-lanceolate, 1-2.5 mm. wide; margins tapering from approximate middle into apex; apices short and broadly acuminate; auricles frequent..... *F. Duriaei*.
 2. Leaves generally narrowly ovate-lanceolate or lanceolate, 0.5-1.75 mm. wide; margins tapering from basal fourth or half into apex; apices long acuminate.
 3. Apices gradually narrowed; tips commonly acute and entire; auricles usually none, occasionally very slight... *F. hypnoides*.
 3. Apices frequently abruptly narrowed; tips commonly obtuse to truncate and serrulate; auricles very conspicuous... *F. flaccida*.

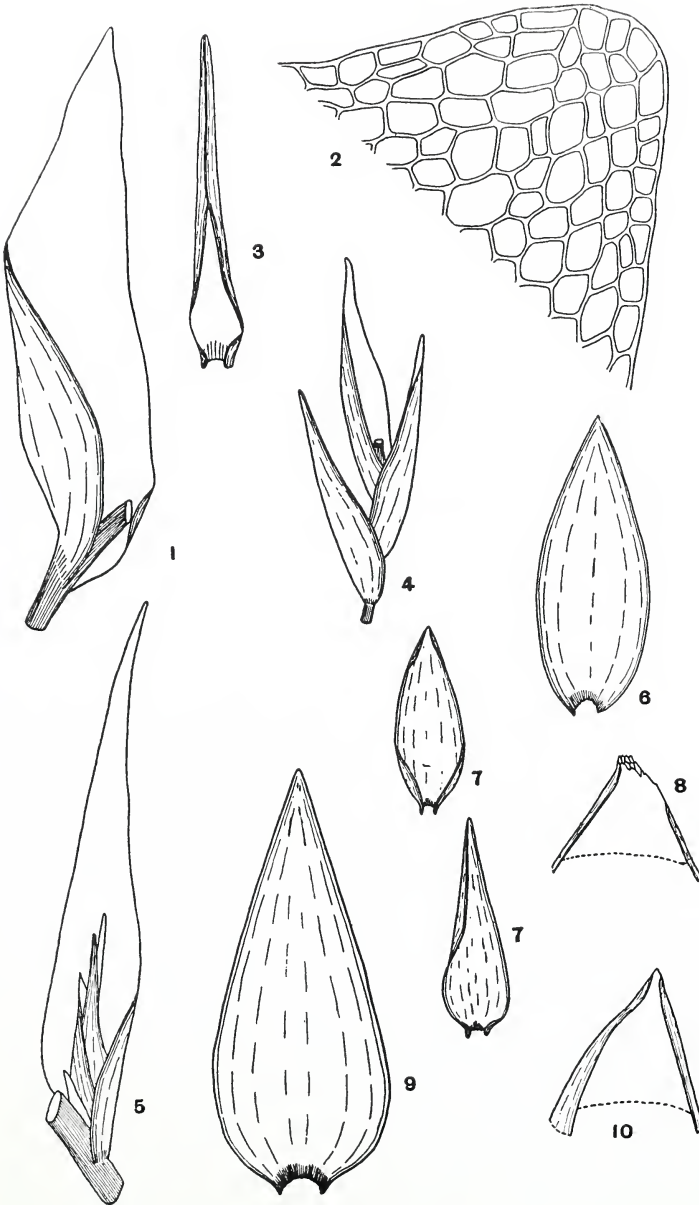
Key to Species of *Dichelyma*

1. Costa subpercurrent to briefly excurrent.
 2. Costa frequently briefly excurrent; leaf apices subulate or acuminate *D. falcatum*.
 2. Costa not excurrent; leaf apices often subobtuse or obtuse *D. pallescens*.
1. Costa long excurrent *D. capillaceum*.

Indiana Species of *Fontinalis*

F. biformis Sull.* (Figs. 1-3.) Plants medium in size in spring and approaching slender in summer and autumn, up to 67.5 cm. in length, with two distinct kinds of leaves during one growing period, vernal stage yellowish green, green or brownish green, aestival phase brownish green or blackish; vernal median cauline leaves with bases up to 1.5 mm. apart, blades flaccid, erect-spreading, concave to plane, usually broadly ovate-lanceolate, sometimes lanceolate; apices broadly acuminate, leaf tips usually narrowly to broadly obtuse, sometimes subobtuse to acute, commonly subserrulate to serrulate, sometimes entire; median cauline leaves 4-7.5 mm. long, 1.25-3.5 mm. wide, 2.5-4:1; median cells of leaves linear; apical cells rhomboidal, rhombic, subquadrate, subrectangular, or subhexagonal, somewhat sphagniform; auricles distinct; aestival median cauline leaves very different in appearance from the former, occurring

with the vernal and eventually composing the dominant foliage of the plants for a period, occasional young or vernal leaves sometimes present, bases of blades up to 1.5 mm. apart, leaves firm, erect-spreading, usually concave, canaliculate or subtubular, sometimes subconcave to plane,



margins involute to convolute, blades narrowly ovate-lanceolate; apices long acuminate, leaf tips acute, generally serrulate, sometimes entire; median cauline leaves 2-3.5 mm. long, 0.4-0.8 mm. wide, 3-7.5:1; median cells of leaves linear; apical cells rhombic, rhomboidal, subquadrate, subrectangular, or subhexagonal, somewhat sphagniform; auricles distinct. Specimens studied from Owen and Putnam counties.

F. dalecarlica Br. and Schimp.* (Fig. 4.) Plants slender, up to 90 cm. in length; branches numerous, frequently appearing fasciculate, ends of foliated stems and branches attenuate; median cauline leaves subimbricate to imbricate, bases up to 1 mm. apart, blades firm, erect to slightly erect-spreading, concave, ovate-lanceolate, narrowly ovate-lanceolate, or narrowly lanceolate, margins occasionally slightly involute in apical portions; apices usually acute or acuminate, leaf tips entire or serrulate; blades 2-4.75 mm. long, 0.5-1.5 mm. wide, 3-4.5:1; median cells of leaves linear with ends attenuate; auricles usually distinct. Specimens studied from Lawrence and White counties.

F. disticha Hook. and Wils.* (Fig. 5.) Plants slender in size; stems subrigid to rigid, up to 25 cm. in length; branches generally somewhat rigid, spreading or erect-spreading, usually close, appearing to be distichous in herbarium specimens although tristichous, short, up to 5 cm. long, ends of foliated stems and branches attenuate; leaves distant, bases up to 2 mm. apart, blades generally firm, erect to spreading, commonly concave, occasionally canaliculate to subtubular, narrowly lanceolate; apices long and narrowly acuminate, leaf tips usually acute to subacute, generally serrulate or subserrulate, occasionally entire; median cauline leaves commonly 4-6.5 mm. long, sometimes up to 9 mm. in length, 0.75-1.5 mm. wide, 3.7-8:1; median cells of leaves linear with ends attenuate; auricles usually distinct. Specimens studied from Knox county.

F. Duriaei Schimp.* (Fig. 6.) Plants slender to medium in size, sometimes rather delicate; stems flaccid, up to 30 cm. in length; branches few to numerous, up to 12 cm. in length, ends of foliated stems and branches attenuate; median cauline leaves usually distant, bases 2-2.5 mm. apart, blades flaccid to somewhat firm, erect-spreading to spreading, usually plane, sometimes with one to two slight longitudinal folds, generally broadly ovate-lanceolate or oval-lanceolate, sometimes oblong-lanceolate, width decreasing either gradually or somewhat abruptly from the approximate middle into the apex; majority of apices short and broadly acuminate, leaf tips usually acute, occasionally subobtuse, commonly serrulate, often entire; median cauline blades 3-7 mm. long, 1-2.5 mm. wide, 2-5.5:1; median cells of leaves usually linear with ends attenuate, sometimes narrowly rhomboidal; auricles distinct to none. Specimens examined from Elkhart, Fulton, Lake, and Pulaski counties.

F. novae-angliae Sull.* (Figs. 7-8.) Plants commonly medium in size; stems up to 40 cm. in length; branches numerous, up to 11 cm. in length, ends of foliated stems and branches usually attenuate; median cauline leaves with bases 0.5-2 mm. apart, blades usually firm, erect to erect-spreading, concave, commonly ovate-lanceolate, sometimes oblong-

lanceolate or narrowly ovate-lanceolate, margins in apical portions of blade generally narrowly involute, occasionally plane; apices commonly subtruncate, truncate, subobtusate, or obtuse, sometimes subacute to acute, at times almost cucullate, leaf tips usually distinctly serrulate, occasionally entire; median cauline blades 2.5-6 mm. long, 0.75-2.5 mm. wide, 1.75-5:1; median cells of leaves linear with ends attenuate or narrowly rhomboidal, cells above basal area commonly subflexuous or flexuous; auricles distinct, leaf bases occasionally subclasping. Specimens studied from Crawford and Perry counties.

F. novae-angliae Sull. var. *latifolia* Card.* (Figs. 9-10.) Median cauline leaves with bases 1-2 mm. apart, blades subflaccid to flaccid, broadly ovate-lanceolate, 4-7.5 mm. long, 1.5-3.5 mm. wide, 2-3:1; otherwise plants similar to those of *F. novae-angliae*. Specimens studied from Putnam county.

The drawings, made by William D. Gray, are those used by the author in the treatise on the Fontinalaceae in Grout, Moss Flora of North America North of Mexico 3: pls. 73-79. 1934.

Fontinalis biformis. Fig. 1. Median cauline leaf (vernal stage), enlarged, (Sullivant, Icon. Musc. pl. 60). Fig. 2. Apical cells of same, X 255. Fig. 3. Median cauline leaf (aestival stage), enlarged, (Sullivant, Icon. Musc. pl. 60). *Fontinalis dalecarlica*. Fig. 4. Portion of stem with median cauline leaves, enlarged, (Bruch and Schimper, Bry. Eur. pl. 431). *Fontinalis disticha*. Fig. 5. Median cauline leaf, enlarged, (Sullivant, Icon. Musc. pl. 63). *Fontinalis Duriaei*. Fig. 6. Median cauline leaf, X 8.5. *Fontinalis novae-angliae*. Fig. 7. Median cauline leaves, X 8.5. Fig. 8. Leaf apex, enlarged. *Fontinalis novae-angliae* var. *latifolia*. Fig. 9. Median cauline leaf, X 8.5. Fig. 10. Leaf apex, X 59.