

Common and Occasional Bryophytes of the Virginia Piedmont

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INTRODUCTION¹

With the publication of “Liverworts and hornworts of the Virginia Piedmont” (*Banisteria* 8: 3-28), Dr. David Breil brought to fruition (in part) his years of study of the bryophytes of this central region of Virginia. His stated purpose in the earlier publication is continued here, that is, “to write an illustrated guide to the regional species of these too often ignored plants,” and “to make the citizens of this pygmy plant world understandable and accessible to naturalists who may have been discouraged from their study by the lack of a means of identification” (Breil, 1996).

¹ Prior to his death on March 3, 1997, Dr. David Breil had completed the substance of a manuscript on mosses of the Virginia Piedmont. Illustrations had been contracted to Susan A. Williams of Rowe, Massachusetts, and were approaching completion. As the only resident bryologist in Virginia, Dr. Breil’s work filled a void not only in subject matter, but in its geographic coverage as well. The body of the manuscript is reproduced here essentially without change to preserve Dr. Breil’s taxonomic concepts (minor changes are noted in the manuscript). Dr. Jonathan Shaw of Duke University recommended a few places where a better name might be used. Accessory portions of this paper (Introduction, Glossary, Literature Cited, Checklist, and Plates) were compiled by Thomas F. Wieboldt of Virginia Tech, to provide a similarly formatted companion paper to Dr. Breil’s “Liverworts and hornworts of the Virginia Piedmont”. The Introduction borrows heavily from the earlier paper but is adapted and expanded to address mosses rather than liverworts and hornworts. Definitions in the glossary are adapted slightly from *Glossarium Polyglottum Bryologiae* on the Missouri Botanical Garden’s bryology website. Plates were assembled digitally by Thomas F. Wieboldt.

Despite the moss flora being larger, 158 species, compared with the 67 liverworts and hornworts (hepatics), the level of detail and coverage is similar. To bring this work into an historical perspective, a brief review of bryophyte exploration in Virginia follows.

The bryophyte flora of Virginia is imperfectly known as evidenced by the relatively few publications on Virginia mosses. Little attention was paid to Virginia until the end of the 19th century (Patterson, 1949). An excellent synopsis of early bryological exploration is given by Anderson & Zander (1973), a few highlights of which are reiterated here. The earliest moss collections from Virginia were probably those of John Banister who sent specimens to John Ray in England. Ray published descriptions of Banister’s plants in two publications (Ray, 1686, 1690). The classic work *Historia Muscorum* by Dillenius (1741) acknowledged receiving plants from John Bartram, John Clayton, and John Mitchell. A study of Bartram’s mosses listed 18 of 55 species as being from Virginia (Buck & McLean, 1985), but Bartram traveled through Virginia only briefly. By comparison, Clayton and Mitchell were residents. All 32 mosses listed (as polynomials) by Gronovius in *Flora Virginica* (1762) are credited to Clayton. These were subsequently studied by Patterson (1965), who determined them according to the binomial system. Mitchell, who resided on the Rappahannock River, sent specimens to Dillenius. It was customary to publish only new species, so the number of specimens actually collected by these early botanists is unknown.

Mention of Virginia bryophytes is almost completely lacking for the next century as most plant collectors merely traversed the state enroute westward or to the higher mountains to the south. Such was the case of Asa Gray accompanied by the well-known bryologist William S. Sullivant, who traveled through the mountains of southwestern Virginia in 1845 (Sullivant, 1846). Specific place names were given in

only a few instances, so it is not possible to attribute collections specifically to Virginia in many cases (Patterson, 1949). In 1892, John K. Small and Anna Vail made the first extensive collection of bryophytes in the state in the vicinity of Marion (Small & Vail, 1893). Neither was a bryologist but their numerous collections were identified by Elizabeth Britton whose list of 158 species comprises a significant portion of the report. Britton also assisted Thomas Kearney who included 34 mosses in his botanical survey of the Dismal Swamp region of southeastern Virginia (Kearney, 1901).

During the 1930s and 1940s, M.L. Fernald made nearly annual forays to southeastern Virginia to study the vascular flora. He was accompanied by Bayard Long, who collected 121 specimens of bryophytes, four of which were new to the known flora of Virginia (Patterson, 1951). The eminent bryologist Aaron J. Sharp of the University of Tennessee was the first of several bryologists to conduct field courses in bryology at the Mountain Lake Biological Station. Others to follow him were Paul M. Patterson, Rudolph M. Schuster, David A. Breil, and Susan Studlar. Patterson published several papers compiling the results of his and others' studies (Patterson, 1940a, 1940b, 1943, 1944) which brought to 216 the total number of mosses reported for Giles County, the only reasonably well-studied region in Virginia.

During 1944, the bryophyte flora of Shenandoah National Park was studied by Irma Schnoberger and Frances Wynne (1944) who reported 171 mosses for this relatively large and diverse area. Over a period of several years in the late 1940s, Hugh Iltis made some 400 bryophyte collections in the vicinity of Fredericksburg, comprising parts of Spotsylvania, Caroline, King George, and Stafford counties. Among the 109 mosses reported (Iltis, 1950), nine were recorded for the first time in Virginia. During the summers of 1949 and 1950, Bernard Mikula made about 600 bryophyte collections from 36 counties throughout the state, though mostly from the southeastern Coastal Plain. His specimens, housed at the Ozarks Regional Herbarium at Southwest Missouri State University, tallied 113 species and varieties, the more unusual of which were reported by Patterson (1953).

Over a period of years, Patterson studied over 3,000 unreported collections made mostly by personnel associated with various colleges and universities, as well as the U.S. National Herbarium. These and his own collections (which numbered over 1,500 in 1953-1954 alone) covered much of the state

and resulted in numerous noteworthy records as well as 41 new state records which he published in his Bryophytes of Virginia series (Patterson, 1950, 1955). This brought the total number of mosses known to occur in Virginia to 365 species, yet he points out that the Piedmont is poorly represented (Patterson, 1950).

In the more recent past, Douglas Ogle has collected widely and from diverse habitats across most of southwestern Virginia. His collections were almost entirely determined by David Breil and are now housed at VPI. Between 1989 and 1991, Christopher Clampitt made a concerted effort to insure that the sphagnum mosses were better known, and made hundreds of collections from across the state. All of his collections were determined authoritatively by Lewis Anderson of Duke University to give us a solid foundation for this interesting but complex group.

Following his arrival at Longwood College in 1968 and continuing until his death in 1997, David Breil collected bryophytes throughout Virginia with primary emphasis on the central and southern Piedmont. This accumulated material, now part of the cryptogamic herbarium at Duke University, forms the basis for the following treatment.

THE VIRGINIA PIEDMONT

The Piedmont physiographic province extends in a NE - SW direction throughout the length of Virginia and is about 60 miles (96 km) wide at the northern end, broadening to about 120 miles (192 km) wide along the North Carolina border. The eastern edge of the Piedmont is formed by the Fall Line (at 30 m elevation), a series of rapids occurring in rivers (James, Rappahannock, Potomac, Appomattox, and Roanoke) draining to the east. The western boundary of the Piedmont is marked by the base of the Blue Ridge Mountain escarpment, about 300 m elevation. The Piedmont is underlain by ancient crystalline rocks mainly covered by residual, red clay soils which are somewhat acidic (pH 5.0 - 6.0). The area is hilly, with elevational differences not usually exceeding 15 m. Occasional resistant ridges or monadnocks occur as solitary outliers of the Blue Ridge Mountains. Precipitation averages about 45 inches (114 cm) per year occurring throughout the year except during the drought season during late summer, usually August.

Braun (1950) described the outer Piedmont as occurring in the pine-oak region of the Eastern Deciduous Forest. Mature upland deciduous forests are composed of populations of oaks (white, red, post, Spanish, chestnut, scarlet), hickories (sweet pignut,

pignut, shagbark, mockernut), and mixtures of other hardwood species (red maple, sweetgum, tulip poplar, ironwood, beech, black gum, dogwood, sourwood), often with old successional pines scattered throughout. North slope forests are dominated by American beech with white oak, red or Florida maples, tulip poplars, and ironwood. Successional community stages range from old fields to conifer forests (loblolly pine, Virginia pine, red cedar), and some hardwood types (including sweetgum and tulip poplar). Wetland communities include small streams (with hazel alder, sycamore), rocky river shorelines, floodplain forests (with river birch, sycamore, willow oak, American elm, box elder), and grassland marshes. Most reservoirs, lakes, and ponds were created in the last hundred years but strongly influence the vegetation of this region. Microhabitats of soil hummocks, rock ledges, rocky ravines, logs, stumps, tree trunks, and roots are especially important to the mosses, with the greatest diversity always being found in the more moist shaded areas.

STUDY AREA

The Virginia Piedmont has been virtually unsurveyed for the presence of bryophytes prior to this study. The central and southern part of the Virginia Piedmont was utilized, from Louisa County in the northern part to the North Carolina border on the south. A buffer zone of about one Piedmont county to the east and west was maintained in order to diminish the direct influence of plants from the mountains and the Coastal Plain. The counties included in this study were Amelia, Appomattox, Buckingham, Campbell, Charlotte, Cumberland, Fluvanna, Goochland, Halifax, Louisa, Lunenburg, Mecklenburg, Nottoway, Pittsylvania, Powhatan, and Prince Edward (Figure 3).

BRYOPHYTE CHARACTERISTICS

Bryophytes consist of hornworts, liverworts, and mosses, all of which are small (normally less than 2 inches [5 cm] long) and have similar life cycles. A key to subdivisions will serve to distinguish these major groups. Mosses are small leafy plants which have leaves in more than three rows. Moss leaves are singly pointed, unlobed, and have a midrib (although it can be short and inconspicuous). Leafy liverworts may be confused with mosses but differ from them in leaf and sporophyte structure. Leafy liverworts have leaves in two or three distinct rows, each leaf possessing two or more lobes that lack midribs. In

both mosses and liverworts, the sporophyte grows epiphytically upon the gametophyte plant and is produced seasonally. Mosses usually develop persistent green to brown sporophytes with sporangia that are ovate, cylindrical, spherical, or oblong and allow the escape of spores through the release of a terminal cap. The sporophytes of liverworts are short-lived and produce black cylindrical or ovate sporangia (capsules) which split into four valves to release the spores.

ILLUSTRATIONS

One species in each genus is illustrated. Numbers correspond to the number of the genus in the text. The following conventions are used: abbreviations - br. = branch, c. = capsule, l. = leaf, p. = plant, sp. = sporophyte; scale lines - single = 1 mm, double = 0.5 mm.

KEY TO SUBDIVISIONS

- 1a. Plants with stem and leaves 2.
- 1b. Plants thallose, consisting of a flat, elongated, round, or heart-shaped body, sometimes branched (never with leaves) 3.
- 2a. Leaves singly pointed and/or possessing a single midrib; leaves attached spirally around stem (except *Fissidens*) **Mosses** (Musci)
- 2b. Leaves forming 2 or more lobes or conspicuous teeth at tips and lacking a central midrib, or formed of multicellular hairs; leaves occurring in 2 (sometimes 3) distinct rows on stem.
..... **Liverworts** (Hepaticae)
- 3a. Sporophytes linear, horn-like; thallus with 1-2 large chloroplasts filling each cell
..... **Hornworts** (Anthocerotae)
- 3b. Sporophytes with a spherical or ovate terminal capsule; thallus with several small chloroplasts in each cell **Liverworts** (Hepaticae)

MOSESSES

KEY TO GENERA

- 1a. Leaf cells arranged in a network of narrow green cells enclosing large colorless cells, no midrib; large mosses of wet areas, branches clumped at tips of stems *Sphagnum*
- 1b. Leaf cells not arranged in a network..... 2.
- 2a. Upper leaf surface possessing erect, parallel green ridges (lamellae) extending lengthwise over midrib 3.
- 2b. Leaf surface lacking lamellae 5.
- 3a. Leaves shriveled or contorted when dry; leaf lamellae 2-6; calyptra smooth, capsules elongated, cylindrical *Atrichum*
- 3b. Leaves rigid and not contorted wet or dry; leaf lamellae 16-60; calyptra hairy 4.
- 4a. Plants developing singly from a felty green mat (protonema) on soil; capsules cylindrical *Pogonatum*
- 4b. Plants not developing from a green protonema; capsules 4 angled, inclined *Polytrichum*
- 5a. Stems erect, simple or sparingly branched; sporophytes, when present, produced at tips of erect stems (acrocarpous mosses) 6.
- 5b. Stems creeping (often with ascending branches), freely or pinnately branched, usually in interwoven mats; sporophytes lateral or at ends of branches (pleurocarpous mosses) 47.
- acrocarpous mosses**
- 6a. Leaves several layers thick, consisting mostly of midrib which is 1/2 to 2/3 the width of leaf base..... 7.
- 6b. Leaves a single layer in thickness; midrib narrower or lacking 8.
- 7a. Plants whitish-green; leaf tips straight; on soil or rotten wood *Leucobryum*
- 7b. Plants gray-green or yellow; leaf tips all bending sideways; on rock or tree base *Paraleucobryum*
- 8a. Plants blackish to dark reddish-brown; relatively short (about 13 mm) 9.
- 8b. Plants green to yellow, not particularly dark or brittle 11.
- 9a. On trees in small rounded cushions; capsules usually with 8 distinct longitudinal ridges *Orthotrichum*
- 9b. On granite rocks; capsules lacking ridges 10.
- 10a. Leaves with clear hair points; capsules opening by operculum *Grimmia*
- 10b. Leaves lacking clear hair points; capsules opening by 4 longitudinal slits *Andreaea*
- 11a. Leaves inserted on the stem in 2 rows, double bladed, split at base and clasping stem *Fissidens*
- 11b. Leaves in more than 2 rows (though sometimes strongly flattened)..... 12.
- 12a. Capsules tilted sideways, immersed in bristle-tipped leaves; small plant with a very short stem *Diphyscium*
- 12b. Capsules not as above 13.
- 13a. Plants very tiny, normally with capsules, ephemeral (lasting only a few weeks, usually between November and May); stemless or with very short stems 14.
- 13b. Plants small to large (rarely minute), not ephemeral..... 19.
- 14a. Capsules immersed in leaves 15.
- 14b. Capsules emerging above leaves or clearly extended on a seta 18.
- 15a. Leaf margins rolled inwards *Astomum*
- 15b. Leaf margins not inrolled 16.
- 16a. Capsule with operculum (lid), leaf tips coarsely toothed *Aphanorrhagma*
- 16b. Capsules spherical, lacking opercula, releasing spores through decay 17.
- 17a. Plants attached to a green felty protonema on soil; leaves linear to lanceolate ... *Ephemerum*
- 17b. Plants not having a persistent green protonema at base; leaves hairlike *Pleuridium*

- 18a. Capsules barely emerging beyond leaves, each resembling a hot-air balloon *Bruchia*
- 18b. Capsules extended on a long seta, ovoid in shape *Physcomitrium*
- 19a. Leaf cells papillose (with projections or bumps over cells) 20.
- 19b. Leaf cells smooth 32.
- 20a. Basal leaf cells golden, square, somewhat enlarged or inflated; upper cells coarsely and irregularly papillose at back *Dicranum*
- 20b. Basal leaf cells not golden, square and enlarged 21.
- 21a. Stems repeatedly branched; leaf tips colorless; capsules immersed in leaves along branches; green plants on rock *Hedwigia*
- 21b. Stems simple or scarcely branched; sporophytes at tips of stems 22.
- 22a. Plants in small cushion-like tufts on trees and rocks 23.
- 22b. Plants generally in more extensive clusters or tufts, nearly always on soil, rock, or tree roots (rarely, concrete) 27.
- 23a. Plants on rocks 24.
- 23b. Plants on trees 25.
- 24a. Leaves contorted and crisped when dry *Ptychomitrium*
- 24b. Leaves not contorted or only slightly so when dry *Ulota*
- 25a. Capsules exerted on long setae *Ptychomitrium*
- 25b. Capsules immersed to shortly exerted 26.
- 26a. Capsules generally immersed; leaves erect, appressed when dry *Orthotrichum*
- 26b. Capsules shortly exerted; leaves crisped and contorted when dry *Ulota*
- 27a. Leaves broad, strap-shaped, widest at middle or above; cells of lower 1/4 of leaf colorless (usually on concrete walls or abutments) *Tortula*
- 27b. Leaves considerably longer than broad, lanceolate or linear, tapering to a slender tip from a broad base 28.
- 28a. Leaf margins inrolled; capsule exerted beyond leaves *Weissia*
- 28b. Leaf margins not inrolled 29.
- 29a. Stems of sterile plants producing leaf-like gemmae at their extended tips; leaf midrib often gently S-shaped above; cells of equal diameters, centrally papillose *Aulacomnium*
- 29b. Stems of sterile plants not ending in gemmae-bearing tips; midrib straight 30.
- 30a. Leaf cells papillose over the cell cavity; capsules elongate, cylindric, erect; leaf base composed of clear cells extending beyond shoulders of leaf as a V-shaped border; on tree roots *Tortella*
- 30b. Leaf cells papillose at 1 or both ends from projecting angles; capsules spherical when fresh 31.
- 31a. Leaves lanceolate, not sheathing the reddish stems; plants of wet seepage places *Philonotis*
- 31b. Leaves linear, not exposing stem; lower 2/3 of stem clothed in brownish hairs; on drier soil banks *Bartramia*
- 32a. Leaves more than 5 times as long as wide, tapering to a slender tip from a broad base 33.
- 32b. Leaves less than 5 times as long as wide; mostly broadly ovate 39.
- 33a. Basal cells of leaf differentiated in golden brown groups *Dicranum*
- 33b. Basal cells not especially differentiated 34.
- 34a. Leaf cells long, rhombic to linear, 6 to 12 times as long as wide; capsules pear-shaped, inclined to nodding 35.
- 34b. Leaf cells shorter, 2 to 5 times as long as broad; capsules erect or inclined, not pear-shaped; leaves linear to lanceolate 36.
- 35a. Leaves linear, midrib filling about 1/2 the base and most of the long tip *Leptobryum*
- 35b. Leaves lanceolate (broader), midrib narrow *Pohlia*

- 36a. Capsules cylindric and long-necked, the neck as long or longer than the urn (main capsule) *Trematodon*
- 36b. Capsules lacking a neck or neck very short 37.
- 37a. Sporophytes (capsules and seta) purple; capsule inclined at right angle to seta, resembling an upside-down golf putter; leaves shortly lanceolate *Ceratodon*
- 37b. Sporophytes green to brown, erect, cylindric; leaves linear 38.
- 38a. Teeth of capsule 16, composed of triangular segments, each split 1/2 way down into 2 papillose forks *Dicranella*
- 38b. Teeth of capsule mostly 32, composed of hair-like segments *Ditrichum*
- 39a. Leaves bordered by narrow or linear cells ... 40.
- 39b. Leaves lacking a border 43.
- 40a. Leaf cells rhombic (diamond-shaped) 41.
- 40b. Leaf cells isodiametric, mostly hexagonal, rarely somewhat elongate 42.
- 41a. Stems connected by dark underground cords (stems); leaves clumped in dense terminal rosettes *Rhodobryum*
- 41b. Stems not connected by underground cords; leaves not clumped in rosettes *Bryum*
- 42a. Capsules erect, cylindric; leaf midrib bearing a few short, barely discernible lines of cells (lamellae) on upper surface *Atrichum*
- 42b. Capsules nodding, broadly oblong-cylindric; leaf midrib lacking lamellae *Mnium*
- 43a. Leaf cells of equal diameters 44.
- 43b. Leaf cells somewhat elongate and rectangular to short rhombic 45.
- 44a. Leaves deeply concave, broadly ovate, strongly toothed; capsules curved and inclined, strongly ribbed *Aulacomnium*
- 44b. Leaves plane, remotely toothed; capsules nodding *Mnium*
- 45a. Plants silvery green, cylindric, upper leaf cells short rhombic, clear; lower cells squarish, green *Bryum*
- 45b. Plants green or yellow, not cylindric; upper leaf cells large and pale, oblong, hexagonal or short rhombic, not paler than lower cells 46.
- 46a. Capsules erect and symmetric *Physcomitrium*
- 46b. Capsules inclined to horizontal, asymmetric, the capsule mouth skewed to one side *Funaria*
- pleurocarpous mosses**
- 47a. Leaf cells papillose (with bumps or projections from the cell surfaces) 48.
- 47b. Leaf cells smooth 59.
- leaf cells papillose**
- 48a. Leaf cells papillose as a result of cell angles projecting toward adjacent cell 49.
- 48b. Papillae (1 or more bumps) located over the cell cavity 50.
- 49a. Midrib single, extending beyond the leaf middle *Bryhnia*
- 49b. Midrib short and double or none; plants pinnately branched, forming a triangular frond *Ctenidium*
- 50a. Midrib short and double or none; leaves minutely toothed *Schwetschkeopsis*
- 50b. Midrib single, ending at or above the leaf middle 51.
- 51a. Plants with numerous capsules immersed in leaves; midrib protruding on lower surface of leaf; leaf cells narrowly oval or elliptic with very thick walls; square basal cells numerous *Cryphaea*
- 51b. Capsules, when present, exerted beyond the leaves; midrib and leaf cells not as above ... 52.
- 52a. Leaf margins with sharp marginal teeth or long hairs, cells with large papillae; leaves deeply concave *Thelia*
- 52b. Leaves lacking large teeth or marginal hairs; papillae lower and short; leaves moderately concave 53.
- 53a. Leaves ending in a short yellowish to clear hairpoint 54.
- 53b. Leaves not ending in a hairpoint 55.

- 54a. Plants occurring as scattered strands on trunks of trees; leaves recurving when moist, abruptly narrowed to a short, yellowish hairpoint; cells coarsely unipapillose (brood branchlets common in leaf axils) *Lindbergia*
- 54b. Plants in dense mats on rock or base of trees; leaves not recurving when moist, gradually narrowed to a clear hairpoint; cells multipapillose *Anomodon*
- 55a. Plants pinnately branched, resembling fern fronds; paraphyllia (filaments or minute scales) numerous, thickly covering stems and branches 56.
- 55b. Plants irregularly branched; paraphyllia none or few 57.
- 56a. Apical cell of branch leaves crowned with 2-4 papillae; plants 1 to 3 pinnate *Thuidium*
- 56b. Apical cell of branch leaves with a single terminal papilla *Bryohaplocladium*
- 57a. Leaf cells singly papillose, papillae often broad, blunt and indistinct; on trees and logs *Leskea*
- 57b. Leaf cells with 2 or more papillae 58.
- 58a. Leaf tips usually broken off; plants in patches on bark *Haplohymenium*
- 58b. Leaves not broken at tips; large matted or tangled mosses *Anomodon*
- leaf cells smooth**
- 59a. Paraphyllia (filaments or minute scales) abundant on stems and branches; plants tree-like with spreading leafy branches; plants connected by a creeping underground stem *Climacium*
- 59b. Paraphyllia none, or if present, plants usually flattened 60.
- 60a. Midrib single, reaching the middle of the leaf or beyond 61.
- 60b. Midrib short and double or none 77.
- midrib single**
- 61a. Plants aquatic, normally submerged 62.
- 61b. Plants terrestrial, on dry or wet substrates, not normally submerged 64.
- 62a. Leaves bordered by several rows of thick-walled cells in 2 or more layers *Sciaronium*
- 62b. Leaves not bordered 63.
- 63a. Plants flattened with leaves lying in 2 opposite rows and widely spread *Leptodictyum*
- 63b. Plants not flattened, leaves erect or spreading, lanceolate, thick and opaque; midrib stout, extending beyond leaf apex *Hygroamblystegium*
- 64a. Plants on tree trunks; stems long, creeping, somewhat solitary; branches crowded, erect, bearing sporophytes at their tips *Drummondia*
- 64b. Plants on various substrates; stems creeping to erect-ascending; sporophytes from lateral buds, not at tips of well-formed branches; upper cells diamond-shaped to linear 65.
- 65a. Leaves nearly circular, overlapping, deeply concave with abrupt slender tips; shoots fat and cylindric *Bryoandersonia*
- 65b. Leaves lanceolate to ovate, moderately concave to flat 66.
- 66a. Median leaf cells short, not more than 5 times as long as wide 67.
- 66b. Median leaf cells elongated, 6 to 12 times longer than wide 72.
- 67a. Leaves widely spreading from their attachment to stem *Leptodictyum*
- 67b. Leaves erect or appressed to stem 68.
- 68a. Midrib variable in length, often double or nearly lacking; capsules immersed to shortly exerted *Forsstroemia*
- 68b. Midrib single, not variable; capsules, when present, extended on a long seta 69.
- 69a. Mosses growing on trees (woody plants) 70.
- 69b. Mosses not on trees; capsules horizontally inclined, curved and asymmetric 71.
- 70a. Plants in sheltered places in trees, especially high up, in knot holes and branch crotches; leaves 1 mm long; basal leaf cells not or barely differentiated; capsules with teeth recurved *Anacamptodon*

70b. Plants on exposed bark on trees; leaves 0.4 - 0.7 mm long, basal cells squarish, in several rows along margins; teeth of capsule inconspicuous, never recurved ... *Clasmatodon*

71a. Midrib strong, ending in or extending beyond leaf tip; plants relatively coarse; on wet rocks in or beside streams *Hygroamblystegium*

71b. Midrib slender, ending in or below leaf tip; plants small and slender; swampy habitats *Amblystegium*

72a. Shoots somewhat flattened (as though stepped on) 73.

72b. Shoots not flattened 74.

73a. Leaf margins sharply toothed, the leaf apex twisted; midrib projecting as a tooth at back; woodlands or open habitats *Steerecleus*

73b. Leaves entire, not twisted at tips; midrib not projecting at back; in swampy habitats *Leptodictyum*

74a. Basal cells of leaf thin-walled, clear, inflated; plants often in dense tufted mats *Brachythecium*

74b. Basal leaf cells little or not at all enlarged; leaves somewhat pleated lengthwise 75.

75a. Leaves clasping stem and wide spreading to spreading at right angles to stem, the tips curved downward and V-channeled *Campyllum*

75b. Leaves erect or erect spreading, not V-channeled 76.

76a. Leaves acute or obtuse at tips; apical cells conspicuously shorter than the middle cells; operculum beak as long as urn of capsule *Eurhynchium*

76b. Leaves with slender tips; apical cells similar to middle cells; operculum merely sharp-pointed *Brachythecium*

midrib short & double or none

77a. Plants aquatic; stems long and trailing from point of attachment; in flowing water (rarely stranded) *Fontinalis*

77b. Plants terrestrial; a few occurring in wet areas but not inundated for long periods of time ... 78.

78a. Median leaf cells short, not more than 5 times longer than wide 79.

78b. Median leaf cells elongate, 6 to 20 times longer than wide 83.

median leaf cells short

79a. Leaves clasping stems and spreading at right angles to stems with tips V-channeled *Campyllum*

79b. Leaves not spreading or V-channeled 80.

80a. Leaf cells thick-walled, the cell cavity elliptic to linear; plants coarse, relatively robust; capsules emergent to exerted 81.

80b. Cell walls thin; plants small or minute; capsules exerted well beyond leaves 82.

81a. Secondary stems little branched; capsules exerted, calyptra smooth *Leucodon*

81b. Secondary stems freely and frequently branched, capsules exerted to immersed *Forsstroemia*

82a. Leaf margins coarsely toothed, blades 0.3 to 0.8 mm long *Fabronia*

82b. Leaves entire or nearly so, 0.2 to 0.5 mm long *Platydictya*

median leaf cells elongate

83a. Plants producing clusters of bud-like brood bodies at tips of branches *Platygyrium*

83b. Plants without brood branchlets, or brood branchlets produced in clumps along stems rather than at tips 84.

84a. Plants distinctly flattened 85.

84b. Plants not at all or only loosely and indistinctly flattened 89.

85a. Leaves secund; alar cells inflated in a group of 3-4 across insertion *Brotherella*

85b. Leaves not as above 86.

86a. Leaf bases extending down stems (decurrent) *Plagiothecium*

86b. Leaf bases attached abruptly to stem 87.

87a. Leaves broadly ovate, erect-spreading, entire; cells at leaf base loosely squared; capsules erect and symmetric *Entodon*

- 87b. Leaves lanceolate, widely spreading, usually finely toothed; cells at leaf base not differentiated; capsules mostly inclined and asymmetric 88.
- 88a. Leaves finely toothed, apical cells shorter than middle cells *Taxiphyllum*
- 88b. Leaves entire or finely toothed only near the apex; apical cells not differentiated
..... *Isopterygium*
- 89a. Leaf tips strongly curved and turned to one side (falcate-secund) 90.
- 89b. Leaves not falcate-secund 92.
- 90a. Epidermal cells of stems and branches large and clear, stripping off with leaves on removal from stems; cells at leaf bases large, clear
..... *Hypnum*
- 90b. Epidermal cells not large and clear; basal leaf cells various 91.
- 91a. Plants irregularly branched; on wet rocks in or near streams; leaves broad, hooded at apex; midrib variable, single or double, often well-developed *Hygrohypnum*
- 91b. Plants usually pinnately branched; in moist woodlands; leaves lanceolate or ovate with narrowed tips, not hood-shaped at apex; midrib short and double or none *Hypnum*
- 92a. Basal leaf cells inflated, often bubble-like 93.
- 92b. Basal leaf cells not inflated 94.
- 93a. Basal leaf cells inflated in narrow strips on the stem (decurent) *Plagiothecium*
- 93b. Basal leaf cells inflated (and often yellow) in an abruptly conspicuous row of 3 to 4 cells at leaf attachment, leaf bases not decurent
..... *Sematophyllum*
- 94a. Plants on wet rocks in or near streams; leaves broadly pointed to rounded at apex, concave and often hooded *Hygrohypnum*
- 94b. Plants of drier habitats; leaves acute or narrowed to long tips, scarcely to distinctly concave basal angle cells tending to be differentiated (either lax or quadrate) 95.

- 95a. Plants on tree trunks; leaves curved in same direction when dry; branches short, crowded and conspicuously hooked at tips when dry *Pylaisiella*
- 95b. Plants on soil, base of trees (rarely limbs); leaves not turned in same direction; branch tips not hooked 96.
- 96a. Plants somewhat erect, pinnately branched; stems orange; branches cylindric, not flattened *Pleurozium*
- 96b. Plants creeping, irregularly branched; branches cylindric or slightly flattened, stems not orange *Entodon*

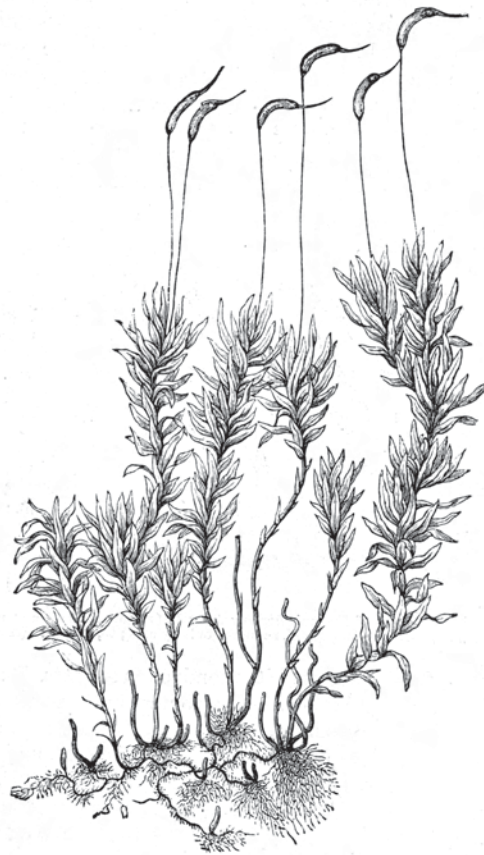
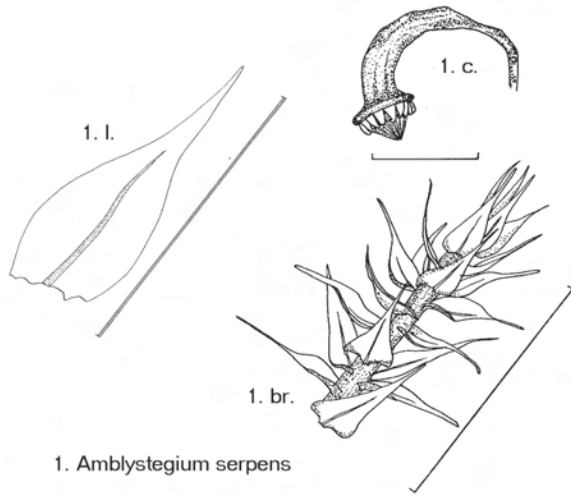
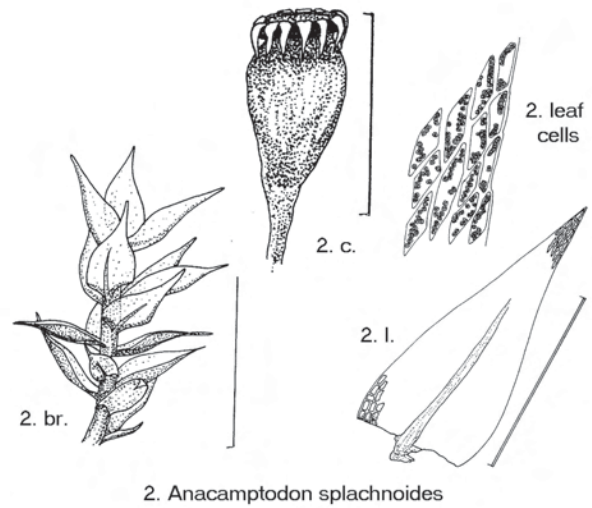


Fig. 1. *Atrichum undulatum*. [from A Handbook of Cryptogamic Botany by Alfred W. Bennett and George Murray, 1889. Longman's, Green, and Co. London. (as *Catharinea undulata*)]

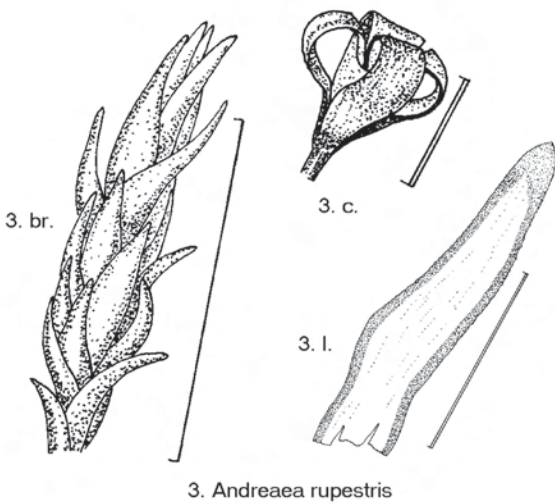
PLATE 1



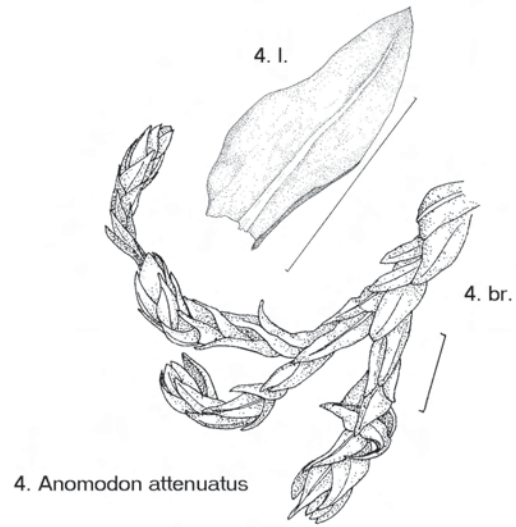
1. *Amblystegium serpens*



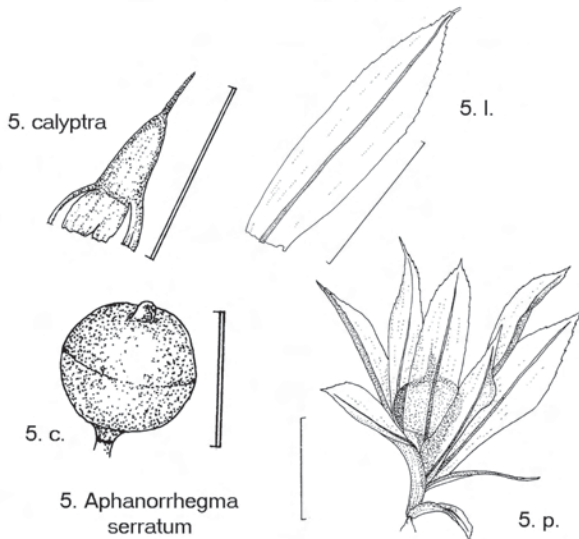
2. *Anacamptodon splachnoides*



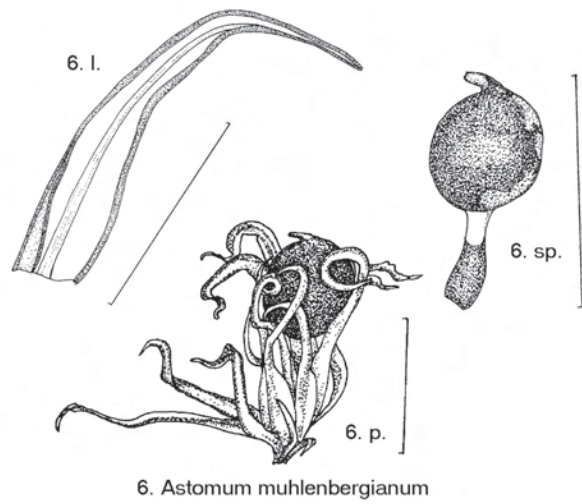
3. *Andreaea rupestris*



4. *Anomodon attenuatus*



5. *Aphanorhagma serratum*



6. *Astomum muhlenbergianum*

Moss Species and Ecology

1. *Amblystegium* BSG

Small creeping plants in loose mats, green to yellowish or brownish, irregularly to pinnately branched; in soft to somewhat rigid tufts, usually in wet places. Leaves small, ovate or lanceolate; midrib ending at or above leaf middle; cells smooth, rhombic to hexagonal above, longer and broader at base. Setae elongate, reddish; capsules strongly curved and inclined.

Only *Amblystegium* sensu stricto is treated here. Crum & Anderson (1981) also include the genera *Leptodictyum* and *Hygroamblystegium*. I follow Crum (1983: 270) when he states "It is convenient to separate the genera, though reasonable to combine them."

- 1a. Midrib ending in the leaf tip; upper leaf cells
2-3:1 *A. varium*
1b. Midrib 1/2 to 2/3 the leaf length; upper cells
3-5:1 *A. serpens*

1. *Amblystegium serpens* (Hedw.) BSG

Common on wet soil, humus, or rotten wood in swamps; often in drier conditions than the next species. Fluvanna, Prince Edward counties. Plate 1.

2. *Amblystegium varium* (Hedw.) Lindb.

On wet rocks in streams, soil or humus in wet shady places. Amelia, Appomattox, Prince Edward counties.

2. *Anacamptodon* Brid.

Small creeping plants with ascending branches in dense, dark-green or yellowish mats. Leaves erect and curving when dry, spreading when moist, ovate; cells rhombic above and rectangular below. Setae elongate, capsules erect and symmetric, cylindric, strongly contracted beneath mouth when dry.

Anacamptodon splachnoides (Brid.) Brid.

On bark of trees, particularly high up, in the protection of crotches, fissures, or knotholes. Prince Edward County. Plate 1.

3. *Andreaea* Hedw.

Small erect plants in dark, brittle tufts on granite rock, irregularly branched. Leaves mostly oblong ovate, concave; midribs lacking. Capsules shortly extended beyond leaves, spindle-shaped, splitting open to

release spores from base to apex, forming 4 valves.

Andreaea rupestris Hedw.

On granite rocks, especially rocky hemlock bluffs on N-facing slopes above rivers nearer to mountains. Campbell County (hemlock bluff). Plate 1.

4. *Anomodon* Hook & Tayl.

Fairly robust to large pleurocarpous plants in loose or dense, dull, rigid, dark green, yellowish, or brownish mats or cushions. Primary stems with small leaves, secondary stems ascending, branched; leaves dense, crowded, tongue-shaped, or lanceolate from a broad base; midrib strong, curving, ending below apex; cells small, hexagonal, densely multipapillose. Sporophytes, when produced, with wavy setae, the capsules symmetric, erect, ovoid or cylindric.

- 1a. Leaves ending in a short or long, clear hair-point; margins of leaf recurving ... *A. rostratus*
1b. Leaves not ending in a slender hair point; margins plane 2.
2a. Secondary stems highly branched, many branches narrowed and tapering to a slender tip; leaves with an abrupt point and finely toothed near apex..... *A. attenuatus*
2b. Secondary stems sparingly branched; leaves usually ending in a single pointed cell or else entire 3.
3a. Leaf apex broad, rounded; on trees, stumps, logs *A. minor*
3b. Leaf apex usually with a single abrupt point; on rocks..... *A. viticulosus*

1. *Anomodon attenuatus* (Hedw.) Hub.

On bases of trees, rocks, or soil; frequently in swamps; very common. Appomattox, Campbell, Prince Edward counties. Plate 1.

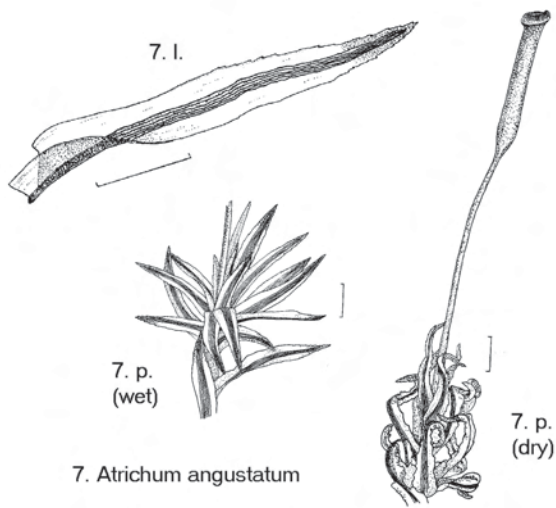
2. *Anomodon minor* (Hedw.) Furnr.

On trees in moist areas, sometimes on logs, rocks, or stumps. Prince Edward County.

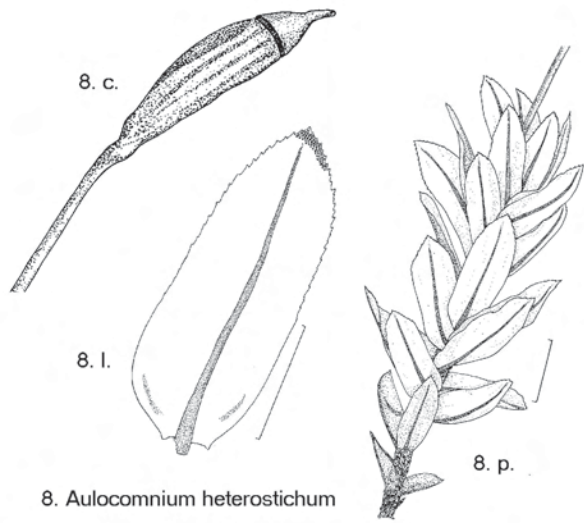
3. *Anomodon rostratus* (Hedw.) Schimp.

On rock, soil, bases of trees, especially in mixed oak forests, beech-oak, or hemlock bluff forests. Appomattox, Buckingham, Fluvanna, Prince Edward counties.

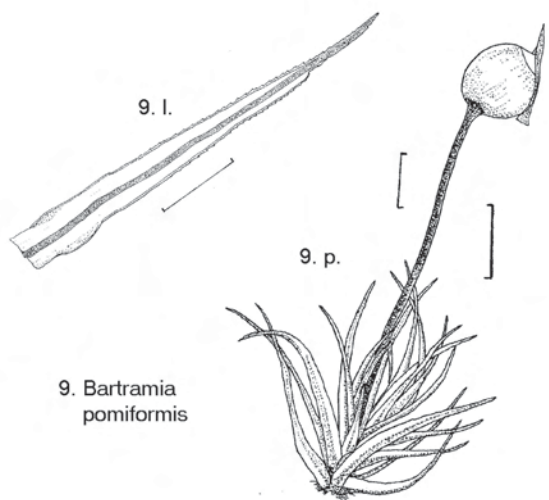
PLATE 2



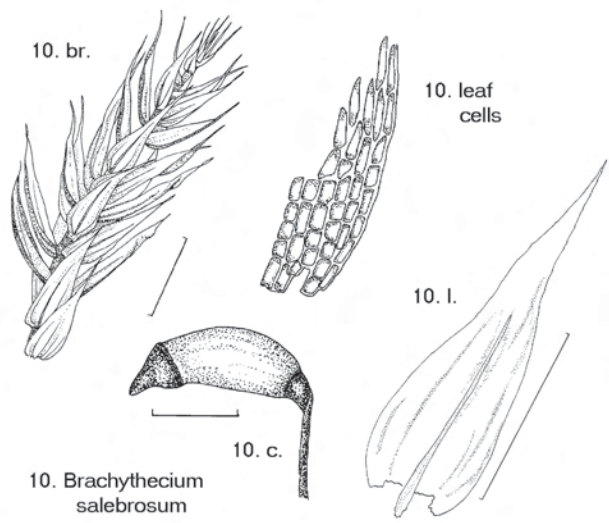
7. *Atrichum angustatum*



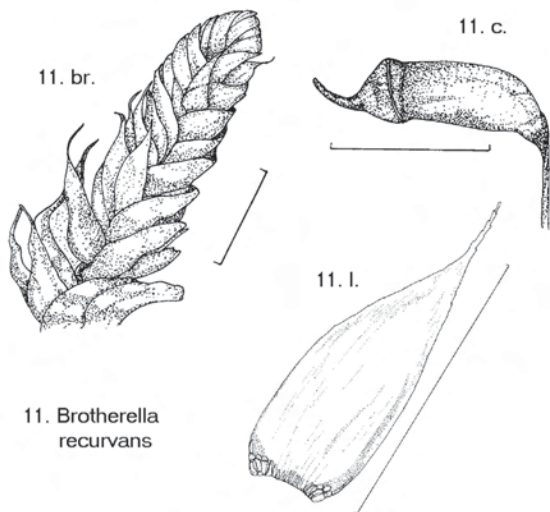
8. *Aulacomnium heterostichum*



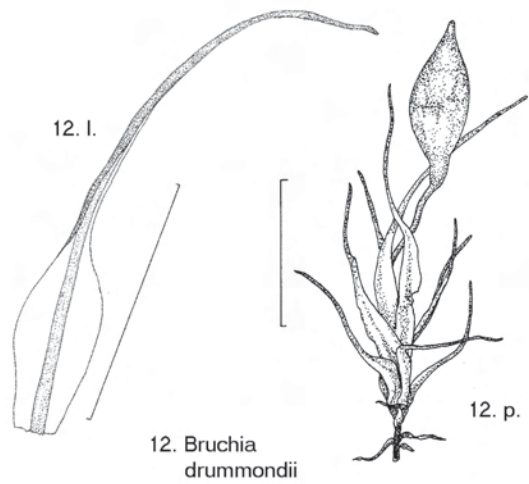
9. *Bartramia pomiformis*



10. *Brachythecium salebrosum*



11. *Brotherella recurvans*



12. *Bruchia drummondii*

4. *Anomodon viticulosus* (Hedw.) Hook. & Tayl.
On rock along streams, occasionally on the base of trees. Spotsylvania County.

5. *Aphanorrhagma* Sull.

Very small, erect, scattered or gregarious plants, the stems often forked. Leaves spreading, oblong to obovate, tapering to a short point, unbordered, margins small-toothed above middle; midrib ending below apex; cells laxly oblong above, rectangular below. Capsules immersed in leaves, spherical, opening along the equator.

Aphanorrhagma serratum (W.J. Hook. & Wils. ex Drumm.) Sull. - On soil of stream banks, floodplains, car ruts, fields; December to February. Prince Edward County. Plate 1.

6. *Astomum* Hampe

Small erect plants, gregarious or loosely tufted on soil; leaves contorted when dry, spreading when moist, narrowly lanceolate from a broader base, tips acute, clear, margins often curled inward; midrib ending below apex or extending into it; cells small, hexagonal, densely papillose. Capsules immersed in leaves, spherical to elliptical.

Astomum muhlenbergianum (Sw.) Grout

On soil in lawns, pastures, floodplain sloughs, burned over areas; fruiting from late fall to early spring. Appomattox, Buckingham, Prince Edward counties. Plate 1.

7. *Atrichum* P. Beauv.

Erect plants, medium-sized to robust, in loose, dark-green tufts (becoming brown with age), rarely branched. Leaves strongly contorted when dry, spreading when moist, usually toothed at back of blade and midrib, tongue-shaped to lanceolate, concave toward apex, bordered by elongate cells and toothed on margins; midrib narrow, long, ending below apex, covered on upper side by few, long, somewhat wavy, green lamellae. Setae elongate, capsules cylindrical slightly inclined to somewhat curved, smooth.

1a. Plants usually 1-2 cm tall; leaves somewhat concave toward apex; lamellae wavy, obscuring 1/4 to 1/2 of leaf in upper third
..... *A. angustatum*

1b. Plants typically more than 2 cm tall; leaves usually keeled toward the apex; lamellae straight, obscuring less than 1/4 of leaf in upper third *A. undulatum*

1. *Atrichum angustatum* (Brid.) BSG

On light, often sandy soil in dry open woods, often in lawns, roadbanks, or bare mounds in woods. Buckingham, Fluvanna, Lunenburg, Prince Edward counties. Plate 2.

2. *Atrichum undulatum* (Hedw.) P. Beauv.

On rich, humic soil in moist woods and shady ravines, also on clay or mud especially along streams. Mecklenberg, Prince Edward counties. Figure 1.

8. *Aulacomnium* Schwaegr.

Erect (to pendulous), robust plants in dull green or yellow-brown tufts. Leaves crowded, erect to spreading, lanceolate to ovate or elliptic, acute to obtuse or rounded, margins entire to toothed above; midrib tapered, wavy, ending below apex; cells rounded to oblong or elliptic, smooth or singly papillose on both surfaces. Setae, elongate, erect to inclined; capsules cylindrical and somewhat curved, ribbed when dry.

1a. Leaves broad, apex rounded or acute, strongly toothed, cells smooth; sterile stems not producing gemmae-bearing stalks
..... *A. heterostichum*

1b. Leaves lanceolate, acute, finely toothed at apex; cells unipapillose; sterile stems stalked, producing cluster of minute, leaf-like gemmae at tips *A. palustre*

1. *Aulacomnium heterostichum* (Hedw.) BSG

On soil of ravine banks in mixed oak woods, often associated with *Bartramia pomiformis*. Amelia, Buckingham, Cumberland, Prince Edward counties. Plate 2.

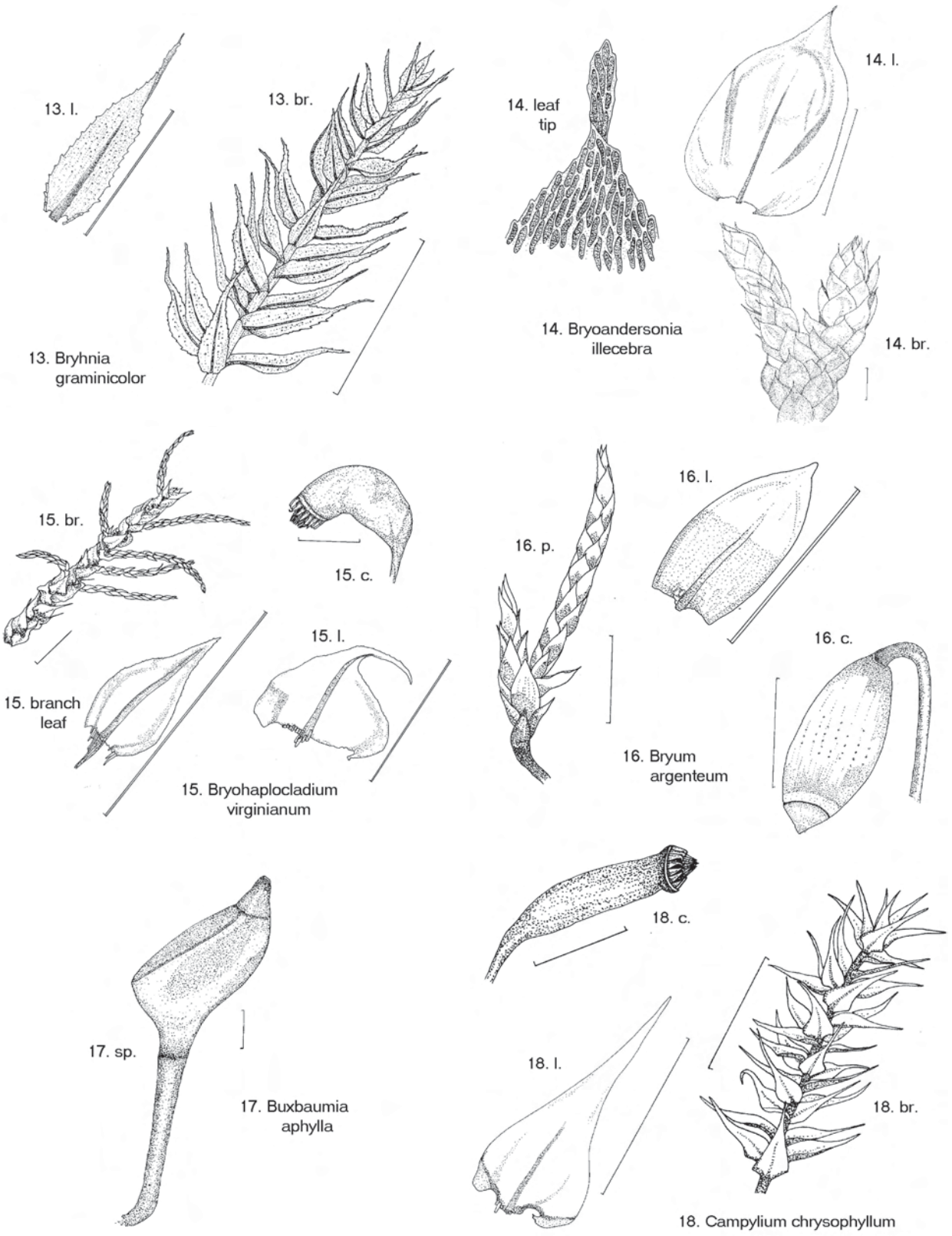
2. *Aulacomnium palustre* (Hedw.) Schwaegr.

On moist or wet soil in pastures, mixed oak woods, or along stream banks. Amelia, Buckingham, Cumberland, Prince Edward counties.

9. *Bartramia* Hedw.

Erect, small to rather robust moss, in loose to dense, often soft tufts, dull, green, yellowish above, yellow

PLATE 3



brown and covered with brown hairs below. Leaves sometimes crisped when dry, long, gradually or abruptly narrowed from a sheathing base to a linear lanceolate point; midrib prominent at back, ending below apex to extending beyond; upper cells small, quadrate to elongate, papillose at the ends; lower cells rectangular to linear, smooth. Setae elongate, capsules spherical, collapsed and deeply furrowed when dry.

Bartramia pomiformis Hedw.

A common moss of ravine embankments on soil, in crevices of rocky bluffs or along wooded creeks; frequently with *Aulacomnium heterostichum*. Appomattox, Buckingham, Campbell, Charlotte, Fluvanna, Mecklenberg, Nottoway counties. Plate 2.

10. ***Brachythecium*** BSG

Plants creeping, slender to moderately robust, branches sometimes ascending, subpinnately to irregularly branched, often shiny. Leaves crowded, erect-spreading, somewhat concave, often pleated longitudinally, ovate to lanceolate, usually long-tapered to apex, the margins finely toothed to entire; midrib single, usually extending about 3/4 of leaf; cells smooth, elongate, often subquadrate at basal angles. Branch leaves smaller and narrower, with a shorter midrib. Setae elongate, capsules inclined to horizontal, ovoid to cylindrical, rather short and broad, curved.

- 1a. Stems dendroid (tree-like); leaf alar cells enlarged and inflated, the bases decurrent (extending down the stem) ***B. rivulare***
- 1b. Stems spreading and irregularly to subpinnately branched; alar cells not inflated, leaves not or little decurrent on stems 2.
- 2a. Leaves plicate (folded or pleated longitudinally) 3.
- 2b. Leaves smooth or faintly plicate; plants medium to large; setae rough, at least in upper half 5.
- 3a. Cells of basal angles relatively large and laxly squared, transparent; capsules relatively short and broad ***B. salebrosum***
- 3b. Cells of basal angles of leaves rather small and dense; capsules oblong-cylindrical 4.

- 4a. Plants small and shiny; branches somewhat cylindrical when dry; branch leaves finely toothed in upper 1/2; cells across leaf base uniform in size; capsules symmetric ***B. acuminatum***
- 4b. Plants robust, dull to somewhat shiny; branches loosely cylindrical; branch leaves finely toothed to base; cells across the base smaller and denser near the margin than near the midrib; capsules mostly asymmetric ***B. oxycladon***
- 5a. Branch leaves concave and pointing in the same direction, 1.3 to 2 mm long; setae rough above ***B. plumosum***
- 5b. Branch leaves not especially concave or all pointing in same direction (homomallous); 2 - 2.5 mm long; setae rough throughout ***B. rutabulum***

1. ***Brachythecium acuminatum*** (Hedw.) Aust.
On bark at base of trees and, less frequently, on rock or soil. Buckingham County.

2. ***Brachythecium oxycladon*** (Brid.) Jaeg. & Sauerb.
In disturbed places, commonly in lawns, on roadbanks and along woodland trails; on soil, rocks, and logs. Lunenburg County.

3. ***Brachythecium plumosum*** (Hedw.) BSG
On moist rocks, in or near streams. Expected but not yet collected.

4. ***Brachythecium rivulare*** BSG
On shaded soil and rocks, in seepy places around springs and in the overflow of streams in woods. Expected but not yet collected.

5. ***Brachythecium rutabulum*** (Hedw.) BSG
On soil, rocks, logs, and bark at base of trees in moist, shady places. Charlotte, Prince Edward counties.

6. ***Brachythecium salebrosum*** (Web. & Mohr.) BSG
On shaded soil, stones, bases of trees, and logs, usually in rather dry, disturbed places (such as lawns and bare mounds in hardwood forests). Plate 2.

11. ***Brotherella*** Loeske ex Fl.

Plants creeping, freely branched, in slender to moderately robust, green, yellowish or brownish green mats, very shiny. Setae elongate, capsules ovoid to cylindrical, asymmetric, inclined, operculum short to long

beaked.

Brotherella recurvans (Michx.) Fleisch.

On soil, humus, bases of trees in moist woods. Campbell, Chesterfield counties. Plate 2.

12. ***Bruchia*** Schwaegr.

Small to very small mosses, erect, gregarious, yellowish or brownish; leaves elongate lanceolate, clasping. Capsules mostly immersed in leaves, pear-shaped. Ephemeral pygmy mosses.

- 1a. Spores densely spiculose (with many pointed projections), sometimes formed into a net-like pattern; neck of capsule tapered at base
..... ***B. flexuosa***
- 1b. Spores with net-like ridges (reticulate), not spiculose; neck of capsule truncate (abruptly at right angles to seta) at base ***B. drummondii***

1. ***Bruchia drummondii*** Hampe ex Britt.

In old fields, burned over areas, disturbed sites, winter to spring. Buckingham County (on soil in burned pinelands). Plate 2.

2. ***Bruchia flexuosa*** (Sw. ex Schwaegr.) C. Muell. (includes *B. sullivantii*) - On soil in old fields, burned areas, floodplain soil; from late fall to late spring. Appomattox, Buckingham counties.

13. ***Bryhnia*** Kaur.

Plants creeping, slender to medium-sized, subpinnately branched, in loose or dense, green, yellowish or brownish, somewhat shiny mats; leaves ovate to lanceolate, acuminate. Setae elongate, red; capsules inclined to horizontal, cylindrical, somewhat curved.

- 1a. Leaves + spreading, ovate or ovate-lanceolate, acute or broadly acuminate, twisted at apex (especially at branch tips), plane-margined; midrib smooth at back, upper cells 3-4: 1, minutely papillose at back .. ***B. novae-angliae***
- 1b. Leaves loosely erect, lanceolate, acuminate, flexing but not twisted at apex; margins narrowly recurved; midrib toothed at back and ending in a sharp spine; upper cells oblong-linear, strongly papillose at back.....
..... ***B. graminicolor***

1. ***Bryhnia graminicolor*** (Brid.) Grout
On moist soil or rock on banks of roads or streams. Prince Edward County. Plate 3.

2. ***Bryhnia novae-angliae*** (Sull. & Lesq. ex Sull.) Grout - On soil, humus, logs or rocks in wet, shady places, particularly in seepage near brooks. Mecklenburg, Prince Edward counties.

14. ***Bryoandersonia*** Robins.

Moderately robust, creeping mosses, with crowded ascending stems in dense, soft, green, yellow-green, or yellow-brown somewhat shiny tufts; leaves spoon-shaped, abruptly acuminate, apex twisted. Setae elongate, red-orange; capsules strongly inclined, curved and asymmetric, subcylindric, rarely seen.

Bryoandersonia illecebra (Hedw.) Robins.

On soil, over bases of trees, and over rock of ravines in mixed oak forests, beech-oak slopes, hemlock bluffs. Buckingham, Campbell, Charlotte, Fluvanna, Nottoway, Prince Edward, Spotsylvania counties. Plate 3.

15. ***Bryohaplocladium*** Wat. & Iwats.

Medium-sized creeping mosses in loose, dull, yellowish-brown or light green mats. Stems mostly pinnately branched, branches spreading to ascending; stem leaves ovate to lanceolate, acuminate; leaf cells quadrate to rhombic, singly papillose; paraphyllia few to abundant on stems. Setae elongate, becoming reddish; capsules inclined to horizontal and cylindrical, constricted below mouth when dry. (Treated as *Haplocladium* by Crum & Anderson, 1981)

- 1a. Stem leaves gradually or abruptly with long tapering tips, pleated longitudinally, wavy and fine-toothed above ***B. microphyllum***
- 1b. Stem leaves abruptly short pointed, not pleated, flat, irregularly toothed above
..... ***B. virginianum***

1. ***Bryohaplocladium microphyllum*** (Hedw.) Wat. & Iwats. - On old logs in swampy places, also on soil, rock, or bark at base of trees, occasionally on brick walls. Prince Edward County.

2. ***Bryohaplocladium virginianum*** (Brid.) Wat. & Iwats. - On soil, rotten wood, rocks, or bark at the

base of trees, usually in rather dry places and often in burned-over areas. Prince Edward County. Plate 3.

16. *Bryum* Hedw.

Small to robust erect plants, gregarious to densely tufted, stems usually forked, often with brownish hairs; leaves ovate to lanceolate; cells smooth, large, rhombic to rectangular to quadrate. Setae elongate; capsules mostly nodding or hanging down, subcylindric.

- 1a. Small silvery cylindrical plants; upper leaf cells transparent, conspicuously differentiated from lower cells..... *B. argenteum*
- 1b. Larger plants, not silvery or cylindrical; upper leaf cells not transparent or conspicuously different from lower cells..... 2.
- 2a. Midrib not or rarely extending beyond leaf tip 3.
- 2b. Midrib regularly and distinctly extending beyond leaf tip..... 4.
- 3a. Stems red; leaf bases extending down (decurent) stems (especially when sterile); never producing axillary brood bodies in leaves *B. pseudotriquetrum*
- 3b. Stems green to brownish; leaf bases not decurrent; leaves often producing linear, brown, brood bodies in leaf axils *B. capillare*
- 4a. Upper leaf cells 3-4:1 *B. creberrimum*
- 4b. Upper leaf cells about 7:1 *B. caespiticium*

1. *Bryum argenteum* Hedw.

A small weedy plant on bare places in disturbed soil, in cracks of sidewalks, paths, old fields, along roads. Appomattox, Prince Edward counties. Plate 3.

2. *Bryum caespiticium* Hedw.

A weedy species growing on soil in open, disturbed places. Expected, but not yet collected.

3. *Bryum capillare* Hedw.

On rock, soil, or humus, especially on roadbanks, and also on bark at the base of trees or in crotches or drainage channels in tree trunks, less commonly on old logs or fence rails.

4. *Bryum creberrimum* Tayl. (*B. cuspidatum*)

A weed on sandy or rocky soil in disturbed places, especially on roadbanks or sides of ditches, sometimes

also on rock humus, or rotten wood. Appomattox County.

5. *Bryum pseudotriquetrum* (Hedw.) Gaertn., Meyer & Scherb. - On wet soil or humus, sometimes on rock or decayed wood, common in swamps and near streams and ponds. Amelia, Prince Edward counties.

17. *Buxbaumia* Hedw.

Small mosses, scattered, stems short, leaves few and inconspicuous, disappearing; recognized primarily from the large erect sporophyte. Sporophytes chestnut brown; setae erect, long; capsules strongly inclined, broadly ovoid, flattened on the upper side, with a small, erect operculum.

Buxbaumia aphylla Hedw.

On sandy soil embankments intermixed with lichens and other mosses in partial shade. Goochland County (February). Plate 3.

18. *Campyllum* (Sull.) Mitt.

Plants creeping, small and slender to moderately robust, in green to yellow or golden-brown, often shiny tufts or mats; leaves lanceolate to ovate, apex long acuminate, V-shaped; branching irregular to subpinnate. Setae elongate; capsules curved, subcylindric.

- 1a. Midrib single, ending at or somewhat above the leaf middle *C. chrysophyllum*
- 1b. Midrib none or very short and double *C. hispidulum*

1. *Campyllum chrysophyllum* (Brid.) J. Lange

On rocks, soil, rotten wood, and bases of trees in moist to wet woods. Nottoway, Prince Edward counties. Plate 3.

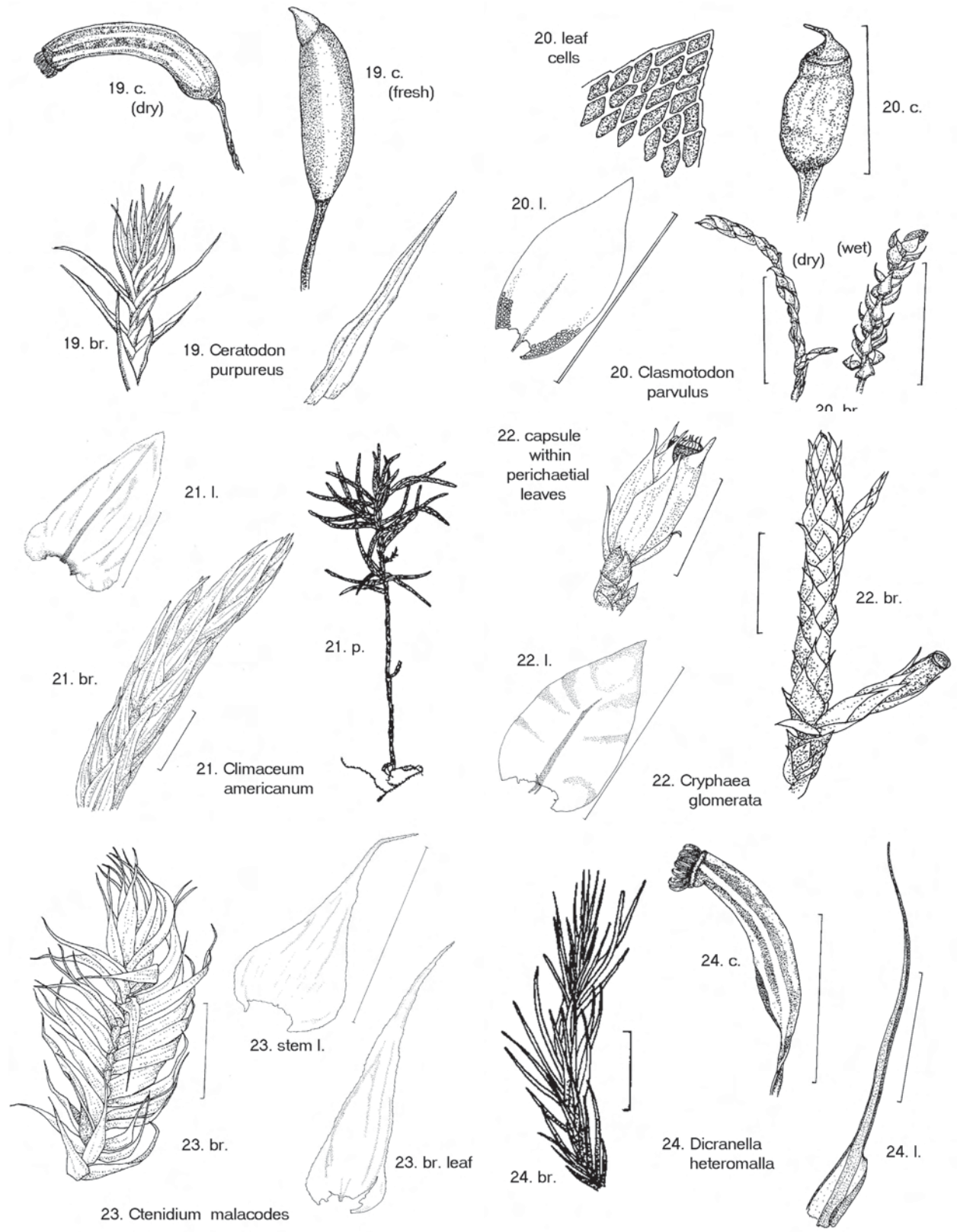
2. *Campyllum hispidulum* (Brid.) Mitt.

On soil, rocks, logs, and bases of trees in moist forests. Appomattox, Buckingham, Prince Edward counties.

19. *Ceratodon* Brid.

Small erect mosses in dense, dull tufts, often forked; leaves lanceolate, midrib strong; leaf cells quadrate to rectangular, thick-walled. Setae elongate; capsules long, dark, purplish-red, inclined to mostly horizontal, deeply furrowed when dry.

PLATE 4



Ceratodon purpureus (Hedw.) Brid.

A weedy species, exceedingly common on sterile soil and sometimes rock or old wood, usually in dry open disturbed places. Appomattox, Buckingham, Prince Edward counties. Plate 4.

20. ***Clasmatodon*** Hook. & Wils. ex Wils.

Small and slender creeping mosses in dull, green mats, freely and irregularly branched, branches usually short and erect; leaves small (less than 1 mm), ovate; cells quadrate to hexagonal. Capsules erect and symmetric, ovoid.

Clasmatodon parvulus (Hampe) Hook. & Wils. ex Sull. - On the bark of hardwood trees in swamps. Cumberland, Halifax, Prince Edward counties. Plate 4.

21. ***Climacium*** Web. & Mohr

A coarse and robust moss, resembling a conifer tree arising from an underground stem; leaves broadly lanceolate, with lobes at base; leaf cells rhombic to hexagonal, short 2-5:1, in loose or dense, dark green to yellowish tufts in swampy places. Sporophytes exceedingly rare.

Climacium americanum Brid.

On wet soil or humus in shady swampy habitats. Buckingham, Cumberland, Mecklenburg, Prince Edward counties. Plate 4.

22. ***Cryphaea*** Mohr ex Web.

Moderately-sized, pleurocarpous, dark green to yellowish, somewhat rigid plants in loose tufts; branching irregularly to pinnately, the branches often curved upward. Capsules immersed in leaves, erect, oblong to ovoid.

Cryphaea glomerata BSG ex Sull.

On trunks and branches of hardwood trees in swamps or along streams. Mecklenburg, Prince Edward counties. Plate 4.

23. ***Ctenidium*** (Schimp.) Mitt.

Medium-sized, creeping mosses, pinnately branched, in soft green to golden-brown, shiny mats. Setae

elongate; capsules strongly inclined to horizontal, oblong cylindrical and somewhat curved.

Ctenidium malacodes Mitt. [*Ctenidium molluscum* (Hedw.) Mitt.] - On wet soil, decayed wood, rocky soil of steep, wooded slopes or ravines in pine-oak or hemlock formations. Buckingham, Mecklenburg, Prince Edward counties. Plate 4.

24. ***Dicranella*** (C. Muell.) Schimp.

Small erect mosses in loose, green, or yellowish tufts, occasionally forking. Setae erect, elongate, straight or flexuous; capsules erect or inclined, smooth or furrowed, symmetric or somewhat asymmetric, rounded to symmetric.

- 1a. Setae (stalks of capsules) yellow; midrib of leaf occupying 1/3 or more of width of leaf base; capsules suberect ***D. heteromalla***
- 1b. Setae reddish (especially with age); midrib of leaf occupying 1/5 to 1/4 of leaf base; capsules curved and inclined ***D. varia***

1. ***Dicranella heteromalla*** (Hedw.) Schimp.

On soil of shaded banks, especially along woodland trails or on soil of upturned tree roots; common. Buckingham, Fluvanna, Prince Edward counties. Plate 4.

2. ***Dicranella varia*** (Hedw.) Schimp.

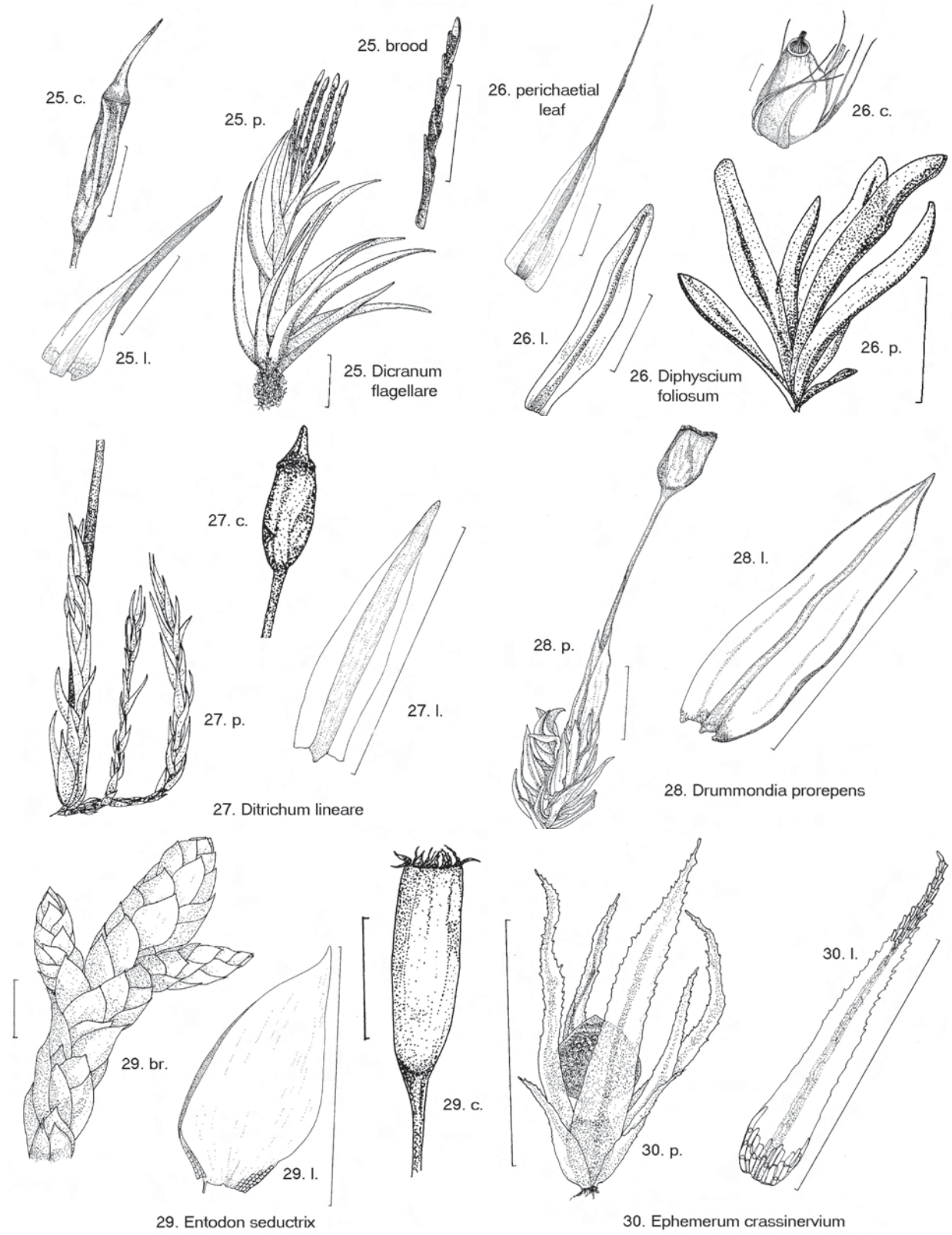
On wet or moist soil in open, disturbed places, on banks of roadside ditches. Prince Edward County.

25. ***Dicranum*** Hedw.

Erect, small to large mosses in dense tufts; stems simple or forked, hairy. Setae elongate, erect; capsules cylindrical, somewhat asymmetric, nearly straight to curved and inclined or horizontal, furrowed when dry and empty.

- 1a. Plants bearing slender brood branches with reduced leaves in axils of upper leaves
..... ***D. flagellare***
- 1b. Plants lacking slender brood branches in axils of upper leaves 2.

PLATE 5



- 2a. Upper cells elongate, the walls pitted; leaves erect or strongly curved, usually toothed at the margins *D. scoparium*
- 2b. Upper leaf cells short, not or indistinctly pitted 3.
- 3a. Leaves double-layered above; midrib about 1/3 the width of leaf base; on rock *D. fulvum*
- 3b. Leaves single-layered, concave or tubular above 4.
- 4a. Leaves somewhat wavy, broadly tapered from an ovate base, coarsely papillose at back *D. spurium*
- 4b. Leaves not wavy, but long and narrow, gradually tapering to the tip *D. flagellare*

1. *Dicranum flagellare* Hedw.

Common mosses of logs and stumps, occasionally on humus, tree bases, or rock. Prince Edward County. Plate 5.

2. *Dicranum fulvum* Hook.

On shaded acid rocks in deciduous woods, rarely on soil or bark at the base of trees. Amherst, Lunenburg counties.

3. *Dicranum scoparium* Hedw.

Our commonest *Dicranum*, in large bright green tufts on soil and humus, in open pine, mixed oak woods, and dense, moist forests; also on rock, the base of trees, and rotten wood. Buckingham, Campbell, Charlotte, Nottoway, Spotsylvania counties.

4. *Dicranum spurium* Hedw.

On dry acid sand or rock in exposed places such as rock ledges, scrubby oak or pine woods. Amelia, Amherst, Buckingham, Lunenburg, Spotsylvania counties.

26. *Diphyscium* (Hedw.) Mohr

Short, small mosses in stiff, dark green or brown to blackish, extensive tufts. Stems very short. Capsules immersed in midst of leaves, brownish-yellow becoming brown, asymmetric, oblique and mostly ovoid, swollen on one side.

Diphyscium foliosum (Hedw.) Mohr

Moist hardwood forests, especially mixed oak, on soil

or humus of shaded banks in late stages of moss-lichen succession. Amherst, Buckingham, Campbell, Fluvanna, Prince Edward, Spotsylvania counties. Plate 5.

27. *Ditrichum* Hampe

Small, erect, loosely tufted plants, simple or forked. Setae elongate; capsules cylindric or elliptic, suberect or inclined, often curved and asymmetric, furrowed when dry .

1a. Setae (stalks of capsule) bright yellow; capsules wrinkled when dry *D. pallidum*

1b. Setae red to brown; capsules rarely wrinkled 2.

2a. Plants producing branchlets with short, blunt leaves; leaf margins entire, plane *D. lineare*

2b. Plants unbranched or producing a normal branch with regular leaves; leaf margins minutely toothed, often recurved *D. pusillum*

1. *Ditrichum lineare* (Sw.) Lindb.

A pioneer on banks of sand or clay, especially in steep roadcuts; uncommon. Prince Edward County. Plate 5.

2. *Ditrichum pallidum* (Hedw.) Hampe

A common springtime moss in dry, open or partly shaded habitats on soil in fields, along roadsides (especially), and in mixed oak woods. Appomattox, Buckingham, Nottoway, Prince Edward counties.

3. *Ditrichum pusillum* (Hedw.) Hampe

On bare, disturbed soil of roadbanks, sometimes in crevices between rocks. Prince Edward County.

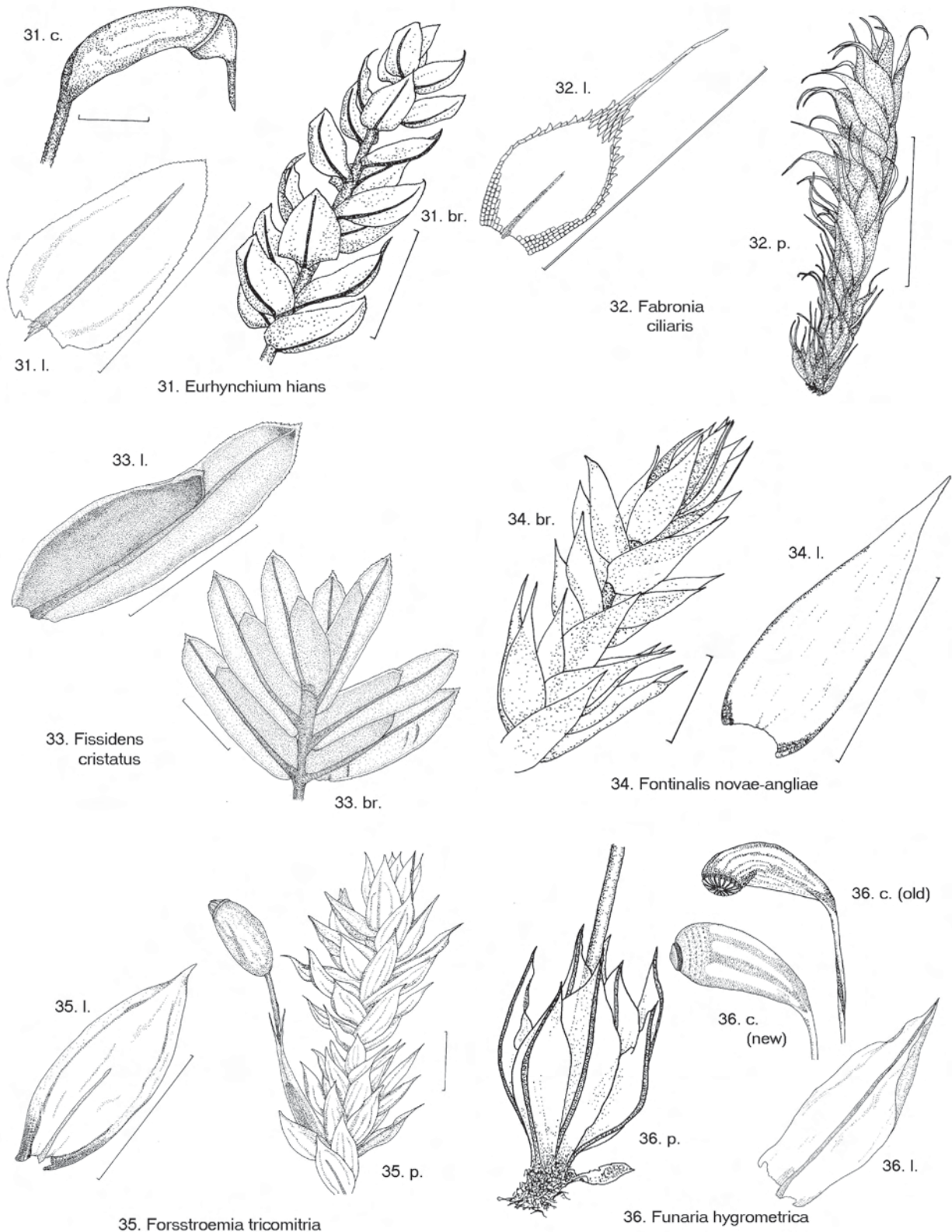
28. *Drummondia* Hook ex Drumm.

Plants of medium size, in low dense, rigid, dull, dark-green or blackish mats. Stems long and creeping, densely branched; branches short, simple or forked, ascending. Setae produced at ends of branches, elongate; capsules erect, ovoid, becoming somewhat wrinkled when dry.

Drummondia prorepens (Hedw.) E. G. Britt.

On the trunks and branches of hardwoods, especially oaks, hickories, occasionally red cedar. Lunenburg, Prince Edward counties. Plate 5.

PLATE 6



31. c.

31. l.

31. *Eurhynchium hians*

31. br.

32. l.

32. p.

32. *Fabronia ciliaris*

33. l.

33. *Fissidens cristatus*

33. br.

34. br.

34. l.

34. *Fontinalis novae-angliae*

35. l.

35. *Forstroemia tricomitria*

35. p.

36. c. (old)

36. c. (new)

36. p.

36. l.

36. *Funaria hygrometrica*

29. *Entodon* C. Muell.

Plants creeping, irregularly to somewhat pinnately branched, green, yellow or golden-brown, in more-or-less shiny mats or tufts. Setae short to elongate, reddish; capsules erect and symmetric, cylindric, brown.

- 1a. Stems and branches rounded, leaves not flattened *E. seductrix*
 1b. Stems and branches distinctly flattened; leaves flattened 2.
 2a. Teeth and segments of the peristome densely papillose; leaves entire or nearly so
 *E. compressus*
 2b. Teeth finely papillose, segments smooth; leaves toothed at the apex *E. cladorrhizans*

1. *Entodon cladorrhizans* (Hedw.) C. Muell.

On rotten wood and bark at the base of trees, also on tops of horizontal branches, also on soil humus, and rocks in dry deciduous forests but also on drier surfaces in swamps. Charlotte, Prince Edward counties.

2. *Entodon compressus* C. Muell.

On bark at the base of trees, also on logs or stumps and soil or rock; uncommon. Buckingham, Prince Edward counties.

3. *Entodon seductrix* (Hedw.) C. Muell.

On rotten wood, bark at the base of trees, rocks, and soil among hardwoods, in rather dry open woodlands, occasionally in pastures and lawns. Fluvanna, Prince Edward counties. Plate 5.

30. *Ephemerum* Hampe

Tiny, delicate mosses growing from a shiny protonema, scattered to clustered; leaves lanceolate, few; capsules sessile, ovoid to spherical, without opercula.

- 1a. Leaves lacking a midrib, margins strongly toothed *E. serratum*
 1b. Leaves with a midrib (although sometimes weak) 2.
 2a. Leaves linear-lanceolate, the margins spinose toothed, the teeth recurving *E. spinulosum*

- 2b. Leaves lanceolate to ovate lanceolate, toothed but lacking strongly recurving teeth; cells papillose *E. crassinervium*

1. *Ephemerum crassinervium* (Schwaegr.) Hampe
 On moist soil in disturbed places, particularly in old fields, also on riverbanks in late summer to early spring. Prince Edward County. Plate 5.

2. *Ephemerum serratum* (Hedw.) Hampe
 On moist soil in old fields, in floodplains, along riverbanks; fall to spring. Prince Edward County.

3. *Ephemerum spinulosum* Bruch & Schimp. ex Schimp. - On moist soil in disturbed places, including river banks, old fields; fall through spring. Buckingham, Prince Edward counties.

31. *Eurhynchium* BSG

Plants small, dark to shiny green or brownish, in loose to dense mats of tufts. Stems creeping or ascending, irregularly to pinnately branched, sometimes tree-like. Setae elongate, rough or smooth; capsules inclined to horizontal, subcylindric and somewhat asymmetric; the operculum with a long beak.

- 1a. Branch leaves broadly ovate, acute; setae rough *E. hians*
 1b. Branch leaves narrowly oblong-ovate, bluntly acute to rounded obtuse; setae smooth
 *E. pulchellum*

1. *Eurhynchium hians* (Hedw.) Sande-Lac.
 On soil, occasionally other substrates, in damp, shady places. Buckingham, Campbell, Mecklenburg, Prince Edward, Spotsylvania counties. Plate 6.

2. *Eurhynchium pulchellum* (Hedw.) Jenn.
 On soil or humus, particularly on low mounds in woods, or on rotten logs or stumps, bark at base of trees or rocks. Buckingham, Prince Edward counties.

32. *Fabronia* Raddi

Plants small, silky, creeping, deep to moderately green in mats, irregularly and closely branched, the branches short, ascending. Leaves crowded, ovate and gradually drawn out into a long slender tip, the tip formed of a long, almost clear cell; margins conspicuously and

irregularly toothed; midrib extending to midleaf; median cells rhombic, short, basal cells quadrate. Setae short; capsules erect, pear-shaped to ovoid.

Fabronia ciliaris (Brid.) Brid.

On trunks of hardwood trees, often along streets in towns (less commonly on rocks of various kinds). Farmville, Prince Edward County (courthouse, on elm). Plate 6.

33. ***Fissidens*** Hedw.

Erect, large to small, clustered, simple or sparsely branched mosses, attached at base. Leaves sticking out from stem in two distinct rows, split on lower side from the midrib, forming 2 plates (laminae) which clasp the stem at base. Setae terminal or lateral, elongate; capsules erect to inclined, symmetric to curved, operculum usually beaked; sporophytes not common.

- 1a. Plants aquatic, submerged, or attached to trees below the high water line in swamps ***F. fontanus***
 1b. Plants on soil, logs, trees or rocks 2.
 2a. Leaves bordered, at least in part with long narrow cells ***F. bryoides***
 2b. Leaves not bordered by linear cells 3.
 3a. Midrib covered by short, green cells toward leaf tip, thus appearing obscure ***F. subbasilaris***
 3b. Midrib not covered by short green cells 4.
 4a. Leaves coarsely and unevenly toothed toward tip, bordered by 3-5 rows of pale cells 5.
 4b. Leaves entire or evenly and finely toothed; not or indistinctly paler at margins 6.
 5a. Leaf cells rounded, bulging, dark green and obscure; pale margin distinct ***F. cristatus***
 5b. Leaf cells hexagonal, flat or somewhat convex; pale margin somewhat indistinct ***F. adiantoides***
 6a. Midrib ending 4-11 cells below toothed leaf tips ***F. osmundoides***
 6b. Midrib ending in or very near pointed leaf tip 7.

- 7a. Midrib brown, ending in a stout point ***F. taxifolius***
 7b. Midrib colorless, ending in or near a minute point ***F. bushii***

1. ***Fissidens adianthoides*** Hedw.

On damp soil or humus, rocks, logs, stumps, or bark of exposed roots or tree bases, in woods.

2. ***Fissidens bryoides*** Hedw.

On wet rocks or soil, often in or along brooks. Amelia, Prince Edward counties.

3. ***Fissidens bushii*** (Card. & Ther.) Card. & Ther.

On soil and occasionally on rocks, in open woods or in exposed, disturbed places. Buckingham, Prince Edward counties.

4. ***Fissidens cristatus*** Wils. ex Mitt.

On soil or humus, bark of exposed roots at bases of trees, rotten wood, and rocks in woods. Buckingham, Prince Edward counties. Plate 6.

5. ***Fissidens fontanus*** (B. Pyl.) Steud.

Submerged in flowing water or in swamps, often attached to trees below the high water line. Prince Edward County.

6. ***Fissidens osmundoides*** Hedw.

On soil, humus, rocks, or logs, in woods. Nottoway, Prince Edward counties.

7. ***Fissidens subbasilaris*** Hedw.

On bark at the base of trees or rock. Fluvanna County.

8. ***Fissidens taxifolius*** Hedw.

On damp, clayey soil and rock. Buckingham County.

34. ***Fontinalis*** Hedw.

Plants aquatic, submerged and trailing, freely and irregularly branched above a naked base, slender to robust, usually dark and dull colored. Not often with capsules, but capsules on short setae, immersed to emergent, operculum conic.

- 1a. Plants exceedingly slender and thread-like, up to 10 to 15 cm long; leaves slenderly lanceolate ***F. filiformis***
 1b. Plants of moderate to large size 2.

- 2a. Stem and branch leaves intergrading in size and shape 3.
- 2b. Stem and branch leaves differing in size, sometimes also in shape; plants slender, stems rigid; leaves firm and narrowly lanceolate, well spaced..... *F. sullivanii*
- 3a. Branches ending in a conspicuous, slender, elongate cylindrical tip; leaves rather crowded, mostly erect, acute, with margins reflexed when dry *F. dalecarlica*
- 3b. Branches ending in a shorter, less conspicuous cylindrical tip; leaves less crowded and mostly spreading (except at branch tips), acute to blunt or obtuse, with margins plane when dry
..... *F. novae-angliae*

1. *Fontinalis dalecarlica* BSG

Attached to rocks and submerged in swiftly running water. Cumberland, Prince Edward counties.

2. *Fontinalis filiformis* Sull. & Lesq. ex Aust.

Attached to logs, stumps, roots, and bases of bushes submerged in streams and stagnant water. Chesterfield County.

3. *Fontinalis novae-angliae* Sull.

Attached to various substrates, submerged in shallow, flowing water. Amherst, Buckingham, Powhatan, Prince Edward counties. Plate 6.

4. *Fontinalis sullivanii* Lindb.

On rocks, bases of trees and shrubs, or roots, in pools or streams, often in stagnant water. Prince Edward County.

35. *Forsstroemia* Lindb.

Moderately robust creeping plants in loose, yellowish green to brownish tufts; secondary stems erect, sparsely to freely branched. Capsules immersed to shortly exserted, ovoid. Resembling a *Leucodon* in many respects but according to Crum & Anderson (1981: 757) "... softer and paler, with secondary stems straight, spreading from the substrate, and subpinnately branched."

Forsstroemia trichomitria (Hedw.) Lindb.

On the bark of trees, on trunks, branches and twigs, mostly in swamps. Buckingham County. Plate 6.

36. *Funaria* Hedw.

Small to medium-sized, erect mosses, in clusters or in bright green or yellowish, loose tufts. Stems usually unbranched. Setae elongate, capsules inclined to drooping, asymmetric, usually curved, broadly pear-shaped, usually furrowed when dry and empty. Although not ephemeral mosses, they are seldom collected or recognized without sporophytes which are produced in springtime.

- 1a. Leaves slender, tapering to a pointed tip, upper cells not differentiated at margins; sporophyte setae not flexed and twisting from humidity; capsule mouth slightly asymmetric
..... *F. flavicans*
- 1b. Leaves acute or shortly tapering to tip; upper cells slightly narrower at margins; setae flexed and twisting from humidity; capsule mouth very asymmetric, almost paralleling one side of capsule *F. hygrometrica*

1. *Funaria flavicans* Michx.

On soil or among rocks in disturbed places, such as burned-over woods, gardens, and roadsides. Prince Edward County.

2. *Funaria hygrometrica* Hedw.

A weed of disturbed habitats, usually on soil but sometimes wood or rock; common in poor lawns, old campfire sites or burned areas; a springtime plant. Appomattox, Buckingham, Prince Edward counties. Plate 6.

37. *Grimmia* Hedw.

Plants erect, small to medium-sized, in dull, rigid, dark green, brown or blackish tufts or mats, mostly on dry, exposed rocks. Stems erect, forked. Leaves frequently with clear, whitish hair points. Capsules immersed in leaves to exserted, globose to ovoid; calyptra not hairy.

- 1a. Upper leaves without white or clear hair-points except for an occasional clear terminal cell; capsules emergent or slightly exserted
..... *G. alpicola*
- 1b. Upper leaves ending in clear or whitish hair-points 2.