ENCALYPTACEAE

Diana G. Horton[1]

Encalyptaceae Schimp., *Coroll. Bryol. Eur.* 38 (‘1855’) [1856].

Type: *Encalypta* Hedw.

Goniautoicous, occasionally dioicous. Plants erect, in loose or dense turfs or tufts. Stems simple or branched; central strand usually undifferentiated; axillary hairs usually sparse, short, with few cells, or abundant, elongate and multicellular. Leaves ±twisted and contorted when dry, the laminae generally inflexed to conduplicate, otherwise involute; moist leaves erect-spreading to reflexed, the laminae inflexed to plane; most leaves ±oblong or lanceolate-oblong; apex ±rounded, usually ±broadly obtuse or acute, otherwise narrowly acute, muticous, mucronate, apiculate or hair-pointed; margins mostly plane, or recurved, usually distally minutely (microscopically) crenulate, or minutely bluntly serrulate. Costa strong, ±prominently keeled on the abaxial surface, smooth to ±prorulose or papillose; adaxial surface (T.S.) with a single layer of laminal cells, 1–3 rows of cells with ±large lumina and strongly thickened walls; central strand distinct or undifferentiated, a small cluster of minute thin-walled cells; stereids in a single abaxial band, 2–8 cell rows with heavily thickened walls and minute lumina; abaxial epidermis ±undifferentiated. Distal medial laminal cells chlorophyllose, quadrate to subquadrate or short-oblong, their walls evenly thickened, usually bulging equally and papillose on both surfaces; papillae 2–8 over the lumina, ±C-shaped, or bulging more on the adaxial surface and bulging less and mammillose on the abaxial; distal marginal cells differentiated in 1 row, usually ovate, the narrow end projecting marginally, papillose or ±rhomboidal; upper corner projecting marginally; basal cells ±differentiated, ±rectangular, usually non-chlorophyllose, their transverse walls ±thickened, orange to yellow; longitudinal walls thin, hyaline to orange; surface walls usually smooth or papillose on the abaxial, as a group extending higher marginally or medially or not, or ±chlorophyllose, with the transverse and longitudinal walls thin or somewhat thickened, hyaline to pale orange or brownish; basal marginal cells undifferentiated or differentiated in a broad greenish band 2–20 narrow ±elongate cells. Specialised asexual reproduction usually lacking, alternatively as ±dense, filamentous, richly branched, dark brown brood bodies on stems.

Perichaetia terminal, the leaves ±sheathing or undifferentiated. Perigonia usually lateral, minute, bud-like, the leaves ±sheathing and paraphyses with undifferentiated distal cells; terminal perigonia with leaves differentiated or not, the paraphyses with enlarged distal cells. Calyptra persistent, mitrate, elongate-cylindrical, generally extending well below the capsule, smooth to ±prorulose or papillose, basally ±entire or fringed, distally narrowed to a ±elongate beak. Seta erect, short to elongate, straight to ±flexuose, ±twisted. Capsules stegocarpous, erect, the theca cylindrical, occasionally furrowed longitudinally or spirally; neck usually indistinct; annulus usually undifferentiated, massive, glossy, crimson-red, deciduous in large fragments; operculum conical, convex or concave-plane and short- to long-rostrate. Peristome absent or highly variable and with teeth in 1 or 2 concentric layers, ±lanceolate to ±linear and elongate. Spores highly variable in size, shape, polarity and ornamentation.

The Encalyptaceae comprises two genera, *Encalypta* and *Bryobrittonia* Hedw., and perhaps 25 species, mostly in tundra and boreal and temperate regions of the Northern Hemisphere. A few species are found south of the Equator in mountainous regions and other areas where there are rock outcrops. The family is known from all Southern Hemisphere continents,

[1] Department of Biology, University of Iowa, Iowa City, IA 52242, U.S.A.

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including Antarctica, and two species are endemic to South America. In Australia, it is represented by a single species. All taxa occur in ±dense turfs or tufts on disturbed soil or on soil on rock ledges and in crevices. Some are ±restricted either to calcareous or siliceous substrata, while others are tolerant of a broader pH range (Horton, 1988).

While the two genera of Encalyptaceae are differentiated solely by gametophytic features, remarkably there is convergence in sporophytic structure. This has led some to treat the monotypic *Bryobrittonia* as a species of *Encalypta*. Williams (1901) described *Bryobrittonia* on the basis of sterile plants, whereas Mitten (1864) had described fruiting plants as *E. longipes* Mitt. and erroneously reported the upper laminal cells to be papillose. This was a critical error, because the absence of papillae is one of the most distinctive features of *Bryobrittonia*. Nyholm (1998) noted that *Bryobrittonia* is indistinguishable from *Encalypta* sporophytically and concluded that Mitten's treatment was correct. However, Steere (1953) felt that the distinctive gametophytic features "more than adequately" justify generic segregation, and Horton (1983) later concurred with his assessment. *Bryobrittonia* is restricted to tundra and montane boreal regions of North America and Eurasia.

Detailed developmental and structural analyses were the basis for Stone's (1977) suggestion that a third genus, the monotypic *Bryobartramia* Sainsbury, might belong in the Encalyptaceae. However, she concluded that detailed studies of Pottiaceae, in particular, are necessary "before any valid assessment can be made". Zander (1993) placed *Bryobartramia* in the Encalyptaceae based on shared characteristics of a large calyptra and large, coarsely papillose upper laminal cells that have a yellow KOH reaction. In contrast, Buck & Goffinet (2000) included only *Encalypta* and *Bryobrittonia* in the Encalyptaceae in the monotypic order Encalyptales and placed the monotypic Bryobartramiaceae in the Pottiales. The Encalyptaceae and *Bryobartramia* were among the outgroups included by Hedderson *et al.* (2004) in a phylogenetic analysis of haplolepideous mosses based on the chloroplast-encoded *rps*4 gene, and their data indicated that *Bryobartramia* is closely related to the Encalyptaceae. At the same time, Goffinet & Buck (2004) included *Bryobartramia* within the Encalyptaceae; however, more recently, Goffinet *et al.* (2008, 2012) treated *Bryobartramia* as a monotypic family in the Encalyptales.

The diversity of peristome structure among species of *Encalypta*, which Philibert (1884–90) interpreted as representing nematodontous and arthrodontous, diplolepideous and haplolepideous peristomes, led him to treat the Encalyptaceae as a basal group from which other mosses had diverged. Philibert suggested closest relationships with Polytrichaceae-Tetraphidaceae-*Buxbaumia*-*Diphyscium*, *Orthotrichum* and Pottioideae. Subsequently, the Encalyptaceae generally were placed close to Pottiaceae-Calymperaceae or Orthotrichaceae-Grimmiaceae until Edwards (1979, 1984) reported that the 2:3 pattern characteristic of haplolepideous mosses is not present in the *Encalypta* species he examined and that the *Encalypta* species Philibert considered nematodontous actually are arthrodontous. In 1984, Vitt proposed a new classification of Bryopsida in which he recognised two fundamental lineages of arthrodontous mosses with the link between the two being groups with diplolepideous peristomes in which the segments are opposite the teeth, including Funariineae, Buxbaumiineae and Encalyptineae. He placed the Encalyptineae just above the Buxbamiineae, the base of the otherwise haplolepideous lineage, and Funariineae at the base of the diplolepideous lineage. Subsequent studies have borne out Vitt's (1984) recognition of close relationships among Encalyptaceae, Funariaceae and Buxbaumiaceae/Diphysciaceae, and a near-basal phylogenetic position of Encalyptaceae among Bryopsida. Newton *et al.*'s (2000) analyses of combined morphological and molecular data placed *Encalypta* and *Bryobrittonia* as a sister group to the haplolepideous mosses in an arthrodontous clade derived from three taxa (*Diphyscium* basal, with *Funaria* and then *Timmia* above) with diplolepideous, opposite peristomes. Analyses of nucleotide sequences from one nuclear and two chloroplast loci by Goffinet & Cox (2000) placed Encalyptineae as a sister group to Funariaceae in the lineage of arthrodontous mosses with opposite peristomes. Buck & Goffinet (2000) placed Encalyptales within the Funariidae beside Timmiales and Funariales. Later, Goffinet & Buck (2004) similarly included Encalyptales in the Funariidae, but next to Gigaspermales and Funariales and placed Timmiaceae in the Timiidae. They noted the general incongruence of gametophytic and sporophytic structure between Encalyptales and Funariales, but suggested that the latter might be most closely related to Encalyptales and the

evidence for this could lie in development of the amphithecium. The Encalyptales are treated similarly by Goffinet *et al.* (2008, 2012). Further molecular support for the placement of *Encalypta*, *Bryobrittonia* and *Bryobartramia* in the Funariidae and Encalyptales is that these three taxa share with eight genera of Funariaceae and *Discelium* the 71-kb inversion in the large single copy of the plastid genome (Goffinet *et al.*, 2007).

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ENCALYPTA

Encalypta Hedw., *Sp. Musc. Frond.* 60 (1801); from the Latin prefix *en-* (with or in) and *calyptus* (covered or enveloping), in reference to the calyptra that completely covers the capsule.

Lecto: *E. ciliata* Hedw.

Leersia Hedw. ex Batsch, *Tab. Afd.* 264 (1802), *nom. illeg. incl. gen. prior* (*Leersia* Sw.).

Leaves with inflexed to conduplicate laminae when dry; margins minutely crenulate distally; distal medial leaf cells bulging equally and papillose on both surfaces; distal marginal cells ovate, their narrow ends projecting marginally, papillose; basal cells ±markedly differentiated, non-chlorophyllose, their transverse walls orange to dark orange or yellow, their longitudinal walls hyaline to dark orange.

Perigonial paraphyses with undifferentiated distal cells.

Encalypta vulgaris Hedw., *Sp. Musc. Frond.* 60 (1801)

T: "Bryum *extinctorium* anther erecta oblonga minori, calyptras laxis aequalibus. Linn. Sp. pl. 2. P. 1581. 5. Bryum calyptras extinctorii forma minus Dill. Musc. 349. T. 45. F. 8. Enc. vulgaris Hedw. St. Crypt. p. 46. t. 18."; lecto: G-Hedw.-Schwägr., *fide* Horton (1983).

Encalypta tasmanica Müll.Hal. & Hampe, *Linnaea* 26: 491 (1853). T: "Tasmania, Van Diemansland leg. C.Stuart"; lecto: BM-Hampe (*here chosen*); syn: "*Encalypta vulgaris* Hedw. Van Diemensland. (moist places). C.Stuart 1850. Sonder 34/146 1106. *E. tasmanica* C. Mull. *E. australis* Mitt." (MEL); "*Encalypta tasmanica* nsp. *Encalypta vulgaris* Hedwig [Hedwig's name is crossed out] prius VDL 1106 Moist places" (MEL).

Encalypta vulgaris Hedw. var. *tasmanica* Hampe, *Linnaea* 26: 491 (1853), *nom. inval. in synon.* [= *E. tasmanica* Müll.Hal. & Hampe].

Encalypta australis Mitt., *Fl. Tasman*. 2: 182 (1859). T: near the Cataract, Launceston, Tas., and on the fossiliferous limestone near Cheshunt, *W.Archer*; lecto: BM-Hooker (*here chosen*): "*Encalypta australis* M. Near the Cataract Launceston Tasmania 1 Aug. Mr. Archer" (BM-Hooker); isolecto: "*Encalypta australis* Mitten Tasmania Mr. Archer" (BM-Hooker).

Encalypta novae-valesiae Hampe, *Linnaea* 37: 513 (1872), as *novae-valisiae*; *Pyramitrium novae-valesiae* (Hampe) Mitt., *Trans. & Proc. Roy. Soc. Victoria* 19: 61 (1882). T: Blue Mountains, N.S.W.; holo: BM-Hampe.

Illustrations: J.Beever, K.W.Allison & J.Child, *The Mosses of New Zealand*, 2nd edn 78, fig. 33a–h (1992); G.A.M.Scott, I.G.Stone & C.Rosser, *The Mosses of Southern Australia* 223, pl. 41 (1976).

Goniautoicous. Stems with an undifferentiated central strand; axillary hairs sparse. Leaves oblong to narrowly obovate, 2.2–3.1 (–4.0) mm long, 0.9–1.2 mm wide; apex broad, ±rounded, muticous; margins plane; abaxial surface of costa prominently keeled even near apex, sparsely prorulose, glossy, yellow to brown. Distal medial laminal cells 11–18 (–21) × (9–) 13–18 (–21) µm wide, with 3–7 papillae; basal cells 22–80 × 9–18 µm [L:W 2.5–4.5:1], as a group extending higher marginally or medially or not; transverse walls pale orange; longitudinal walls hyaline; surface walls smooth; basal marginal cells in a band 4–6 cells wide. Specialised asexual reproduction absent.

Perichaetia terminal. Perigonia lateral. Calyptra 3–6 mm long, extending well below capsule, glossy, golden, faintly translucent, smooth to ±papillose, basally ±erose; beak 0.9–1.8 mm long, narrow. Seta 2–11 mm long, untwisted or with 1 or 2 dextrorse twists at the capsule base, dull to ±glossy, red below, orange to yellow near the capsule. Capsules 1–4 mm long, golden with a narrow bright red rim; theca occasionally slightly narrowed at the mouth, delicately puckered, sometimes delicately longitudinally striate; neck indistinct; annulus undifferentiated; operculum concave-plane and rostrate. Peristome usually absent, or with teeth poorly developed, evanescent, white. Spores 35–40 µm diam., brown, heteropolar; proximal face ±smooth centrally or with low gemmae, ±radially plicate; distal face with large hollow gemmae 5–6 µm diam.

Occurs on soil and on soil over rock in S.A., N.S.W., A.C.T., Vic. and Tas.; also in North America, Eurasia, Africa and New Zealand.

S.A.: Wilpena Pound, Central Flinders Ra., 31 Aug. 1952, *R.G.Gray* (MEL). N.S.W.: Near Armidale, 26 Oct. 1903, *W.W.Watts* (NSW). A.C.T.: Molongo River Gorge, c. 2 miles [c. 3.2 km] NE of Queanbeyan, 1 July 1963, *L.D.Pryor* (MEL). Vic.: Euroa, near Strathbogie, 21 Sept. 1971, *G.A.M.Scott* (MELU). Tas.: Snowy Knob, Central Highlands, *A.Moscal 18844* (HO).

The most obvious, immediately recognisable, diagnostic character is the persistent, mitrate, elongate-cylindrical and rostrate calyptra. All Australian specimens seen by me have sporophytes, and calyptrae are absent from only two or three. Vegetatively, *E. vulgaris* is most likely to be confused with members of the Pottiaceae, particularly species of *Tortula* and *Syntrichia*. The most obvious feature that differentiates *E. vulgaris* is the pale orange transverse walls of the basal laminal cells, whereas those of Pottiaceae lack orange colouration.

Doubtful Names

Encalypta aristata Hampe, *Linnaea* 37: 513 (1872)

T: "Priori intermixta [a reference to the preceding species, *E. novae-valisiae* (as *E. novae-valisiae*)], specimen parvulum inveni, ab ea differ:" *n.v.*

According to *Index Muscorum* 2: 197 (1962) and 5: 584 (1969), *E. aristata* is nomenclaturally synonymous with *Barbula aristatula* and taxonomically synonymous with *Tortella calycina* (Schwägr.) Dixon [= *Barbula calycina* Schwägr.] (*cf.* Brotherus, *in* Paris, *Index Bryol*., 2nd edn, 1: 78 (1904).

Encalypta ciliata Hedw., *Spec. Musc.* 61 (1801)

According to Mitten (*in* Paris, *Index Bryol.*, 2nd edn, 2: 120, 1904), *E. ciliata* is known from eastern Australia, and this is the likely basis for the record in *Index Muscorum* 2: 198 (1962). However, I have seen no Australian specimens of *E. ciliata*.

Encalypta vulgaris Hedw. var. *mutica* Brid., *Mant. Musc.* 28 (1819)

Wilson's (1859) treatment of the Musci in Hooker's *Flora Tasmaniae* included Mitten's description of *E. australis*, while Wilson also reported *E. vulgaris* var. *obtusa* Nees, Hornsch. & Sturm. However, when Nees *et al.* (*Bryologia Germanica*, 1827) described the latter taxon, they listed *E. vulgaris* var. *mutica* Brid. as a synonym. Since Bridel's name was described earlier (Bridel, *Muscologiae Recentiorum Supplementum, Mantissa*, 1819), it has priority, so

Wilson's record is the likely source of later reports of *E. vulgaris* var. *mutica* from Tasmania and Australia in Paris (*Index Bryol.*, 2nd edn, 2: 125, 1904), *Index Muscorum* 5: 587 (1969), Streimann & Curnow (*Catalogue of Mosses of Australia*, 1989), Dalton *et al.* (Checklist of Tasmanian mosses, 1991), Streimann & Klazenga (*Catalogue of Australian Mosses*, 2002) and Klazenga (http://www.rbg.vic.gov.au/dbpages/cat/index.php/mosscatalogue/name/844, 2012). In any event, it is doubtful that this variety warrants taxonomic recognition; it likely represents part of the variation of *E. vulgaris* var. *vulgaris*.