Editorial

It appears that *Field Bryology* has had a successful launch. Since the first issue was published in March I have received favourable comments from many members of the BBS. It is a relief to know that all the work that went in to planning and producing the new-look *Bulletin* has not been in vain!

This second issue of *Field Bryology* includes a further selection of new features. An account of *Acaulon triquetrum* by Nick Hodgetts will hopefully be the first in a series of articles on threatened bryophytes, and similarly the profile of H.H. Knight by Jonathan Graham and Mark Lawley introduces the 'Bygone Bryologists' feature. Mark Hill's first compilation of records of rare and interesting bryophytes in Britain and Ireland is also included. I hope that these articles will be of general interest to field bryologists.

Please continue to give me feedback on *Field Bryology* – both positive and negative. Only by receiving feedback will I be able to ensure that *Field Bryology* continues to meet the needs of BBS members. I would also of course welcome any contributions for future issues. These do not need to be lengthy articles; short notes on issues relating to field bryology, comments on previously published articles, photographs – all would be gratefully received.

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An updated list of British and Irish bryophytes from which tubers have been reported

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Introduction

The first modern review of mosses with tubers was written by Harold Whitehouse (1966). Since then, tubers have been detected in many more species, especially by the late Theo Arts who reported them in an excellent series of papers. Risse (1987a) produced an updated list of tuberous species with a thorough bibliography but, as Arts was particularly active at this time, this list soon became outdated. The species accounts in the *Atlas of the bryophytes of Britain and Ireland* (Hill, Preston & Smith, 1991, 1992, 1994) include information on the occurrence of tubers, but as the information is included amongst other ecological and phytogeographical material it is easily overlooked.

The scope of the current list is more modest than that of the lists published by Whitehouse (1966) and Risse (1987a). I have tried to list all the British and Irish mosses from which tubers

are reported (including those from which tubers are known from abroad but have not been found in the British Isles), and have also listed liverworts and hornworts that produce tubers on the thalli, to draw attention to these little-known structures. The main purpose of the list is to highlight the gaps in our knowledge, as British bryologists are in a position to help fill many of them as they go about their normal fieldwork.

The term 'tuber' is used in this account in the sense in which it was defined by Whitehouse (1966) for mosses and Paton (1999) for hornworts and liverworts; some authors refer to moss tubers as rhizoid(al) gemmae. Bulbils in both mosses and liverworts are excluded.

The modern era of 'potato bryology'

Although the tubers of some mosses were described in the 19th century, it was not until the 1950s that their potential taxonomic importance was appreciated. Key early papers resulting from this research were published in the next decade, including Whitehouse's study of *Hennediella stanfordensis* (1961), Crundwell & Nyholm's (1964) revision of the *Bryum erythrocarpum* aggregate, and Whitehouse's (1966) review of tuberous species.

Whitehouse reported 27 British mosses from which tubers had been reliably reported from Britain or abroad, whereas Risse (1987a) listed 68 (including a few species in which the occurrence of tubers cannot be regarded as confirmed). The current list comprises 87 moss species, including 61 in which tubers have been found in the British Isles, 15 additional species in which they are reliably recorded from adjacent countries of western Europe, and 11 species from which tubers have been reported from western Europe but not described in detail, or have been described from further afield. Tubers are known from Britain in one thallose liverwort and one hornwort.

Looking back at the growth of knowledge about tubers, it is clear that at first attention was concentrated on mosses in arable fields or similar disturbed habitats. These tend to have spherical, ellipsoidal or irregular tubers which in many species are present on almost all specimens. Whitehouse (1966) commented on the 'marked tendency for rhizoid gemmae to occur in the mosses of arable fields. About half the tuber-bearing species have been found in this habitat.' However, the systematic surveys of Theo Arts revealed tubers in numerous species of other habitats. Although tubers have been found on several additional species of arable moss since 1966, arable mosses now comprise only 30% of the British species known to have tubers. Many of the tuber-bearing species of non-arable habitats detected since 1966 have uniseriate tubers, a morphological type that is not typically found in arable field mosses (the only species with such tubers that occurs regularly in this habitat is *Pohlia melanodon*). Tubers have also been documented in an increasing number of species on which they appear to be present only occasionally or rarely.

Topics needing further study

As stated above, the main aim of this list is to draw attention to gaps in our knowledge. These can be summarised as three questions.

Do tubers occur in the British Isles?

There are a number of species for which tubers have been reported in mainland Europe, but not from Britain or Ireland. It might seem unnecessary to check for them here, but there are indications of geographical patterns in the occurrence of tuberous populations in some species. Arts (1990b), for example, found tubers in five out of five specimens of *Archidium alternifolium* from the Iberian peninsula but in only one out of five from Belgium and in none of the three specimens he examined from Ireland. Tubers were not produced by plants cultivated from wild-collected tubers on agar, and so Arts suggested that tubers might be induced by drought stress. Another more

striking discrepancy has been noted for *Atrichum tenellum*. Arts (1987a) found that tubers were always present in Belgium but they have not yet been reported from British material.

Tubers have been reported from *Bryoerythrophyllum recurvirostrum* and perhaps *Syntrichia ruralis* outside Europe, but not in Europe.

How frequent are plants with tubers?

In some species, tubers do not occur in all populations; little is known about the geographical range of tuberous populations and the relationship to habitat or other ecological conditions. *Fissidens taxifolius* is a good example. Plants with tubers were found by Whitehouse (1966) in an arable field in Cambridgeshire but not in a woodland population; the difference between the two populations was maintained in cultivation. I have also found tubers in Cambridgeshire arable fields but even in this habitat tuberous populations appear to be uncommon. By contrast, Imura & Iwatsuki (1988) found tubers in 31 of the 81 specimens they examined from Japan, where the species is typically found on 'partially shaded soil, such as trailside banks in mountains … often also found on rocks', and Sam Bosanquet has recently found several tuberous populations in arable fields in south Wales.

Tuberous populations of some species appear to be very rare. Arts & Risse (1991) searched 50 specimens of *Pseudephemerum nitidum* from Belgium and Germany before Risse found a German population with rather abundant tubers; as with *Fissidens taxifolius*, the difference between tuberous and non-tuberous plants was maintained in cultivation.

There are unresolved taxonomic problems associated with *Bryum caespiticium*, which has occasional tuberous populations, and so any tuberous plants should be collected for further study.

At what stage of the life-cycle are tubers produced?

It has been suggested that some species tend to produce tubers on senescent plants (*Dicranella rufescens*) or when conditions are unfavourable for the production of bulbils (*Bryum dichotomum*). It would be interesting to know the relationship between tuber production and fruiting in plants such as *Tortula modica* and *T. truncata*.

There are many more detailed questions about the role of tubers in the life-cycle, but a detailed research study would be needed to tackle these.

British and Irish bryophytes with tubers

The British and Irish bryophytes from which tubers have been reported are listed in Table 1. Species are listed alphabetically with names following Blockeel & Long (1998), with the exception of *Bryum laevifilum*, where I follow Hodgetts (2001), and *B. bicolor* and *B. dunense*, which are treated as synonyms of *B. dichotomum* following Holyoak (2003).

The table includes a brief description of the mature tubers, giving shape, size and colour as seen with transmitted light (i.e. with light passing though the tuber, as under the ordinary compound microscope). Where appropriate, comments on the frequency or geographical distribution of plants with tubers are also included here. Tubers consisting of a single row of cells are described as 'uniseriate' (in the literature, uniseriate tubers with bulging cells are sometimes termed 'moniliform'). Unless stated, sizes refer to the diameters of spherical tubers. In general, I have based the descriptions on accounts of tubers from Britain or from neighbouring countries of western Europe.

References to a published description are given in the third column of the table. I have given references from journal articles rather than the standard Floras, because the illustrations of tubers in specialised papers tend to be more detailed than those in Floras and because most

bryologists will automatically turn to the Floras, but might be unaware of the cited papers. Only a few key references are provided, rather than a comprehensive bibliography.

In the next column, I have summarised the state of knowledge for each species in five categories:

1 Tubers are well-known in the British Isles; further reports of the occurrence of tubers are not needed (although more detailed observations on their role in the life-cycle of the species are usually required).
2 Tubers are known from the British Isles, but there is little knowledge of the frequency with which they occur; further reports of the occurrence of tubers would be valuable.
3 Tubers have not (to my knowledge) been reported from the British Isles, but are described in detail from neighbouring countries of western Europe; these species require investigation in the British Isles to see if they do produce tubers here.
4 Tubers have not (to my knowledge) been reported from the British Isles or neighbouring countries of western Europe, but they are described from further afield; reports of the occurrence of tubers in western Europe are required.
5 Tubers have been reported from the species but have not been described morphologically; confirmation of their occurrence and details of their morphology are required.

Excluded taxa

I have excluded *Gyroweisia tenuis* and *G. reflexa* from Table 1, although Risse (1987a) includes both on his list of tuber-bearing mosses. Risse cites 'Mönkemeyer 1927, Whitehouse 1966, 1980 (protonema gemmae), Landwehr 1984' after *G. tenuis*, and notes that Smith (1978) illustrates its rhizoid gemmae. However, Mönkemeyer (1927) describes only protonemal gemmae for *G. tenuis*, and Whitehouse (1966) explicitly excludes it from his list as he regarded it as a species that has gemmae on the protonema but not on the rhizoids. Smith (1978) mentions rhizoidal gemmae but his description could refer to the protonemal gemmae and the illustrations are too diagrammatic to be identifiable. Landwehr (1984) illustrates structures on the rhizoids of *G. tenuis*, but as they are similar to the protonemal gemmae it is possible that he misinterpreted the material. I therefore conclude that there is no reliable evidence that *G. tenuis* has tubers. The only reference to support the inclusion of *G. reflexa* in Risse's list is a reference to Smith (1978), who says 'Rhizoid gemmae similar to those of *G. tenuis* often present'.

In addition to the species listed in Table 1, tubers similar to those of *Dicranella varia* were described from *D. howei* in Lanzarote by During (1981), and were later found by During *et al.* (1987) in Spain. This species is not included as there are no confirmed records from the British Isles, but intermediates between it and *D. varia* are reported (Smith, 1978).

Further work

The column in Table 1 describing the state of knowledge for each species is designed to encourage further observations. Interesting new records can be submitted for publication in *Field Bryology* (Hill, 2004). I would be happy to act as a repository for other records, which should include details of the habitat as well as the locality of the collection. Negative records are, of course, also worth contributing.

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I am very grateful to Herman Stieperaere, who searched Theo Arts' archive material for references to tuberous mosses and sent me copies of publications that I would otherwise have found it difficult to see, and to Sam Bosanquet for his observations on tubers on British bryophytes. Mark Hill lent me copies of some publications, and Tom Blockeel and David Holyoak commented on a draft of this note.

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Table 1. List of British and Irish bryophytes from which tubers have been reported.

Species	Brief description of tubers, and comments on frequency and geographical distribution of plants with tubers	References (* indicates illustration of tubers)	State of knowledge
Tubers on thalli of liverworts and hornworts			
Conocephalum conicum	Spherical, up to 500 µm, green or brown, with few to numerous rhizoids curved round tubers, sessile. Occasional on senescent thalli.	Paton (1993, 1999*)	2
Phaeoceros laevis	Subspherical, ellipsoidal or reniform, to 1000(-2000) µm, chlorophyllous with ventral rhizoids, within thallus or sessile or shortly stalked. On living and senescent thalli. Well-developed tubers are not known in *P. carolinianus*.	Paton (1999*)	2
Tubers on rhizoids of mosses			
Archidium alternifolium	Uniseriate, rarely branched, up to 3(-4) mm long, greyish brown. Most frequent in southern Europe; not yet found in Britain or Ireland but should be looked for in droughted habitats.	Arts (1990b*)	3
Atrichum angustatum	Spherical, ovoid or irregular, 150-300(-400) µm. Reported from Austria.	Suanjak (1999*)	4
Atrichum crispum	Spherical or subspherical, 130-300 µm, whitish to pale brown.	Arts (1987a*)	2
Atrichum tenellum	Spherical or subspherical, 130-325(-400) µm, pale brown to brown. Always present and often abundant in Belgian material; not yet found in Britain or Ireland.	Arts (1987a*); Hill *et al.* (1992)	3
Atrichum undulatum	Spherical, ovoid, ovoid-oblong or irregular, 150-300(-400) µm, pale yellow. Reported from Austria.	Suanjak (1999*)	4
Barbula convoluta	Spherical or ellipsoidal, 110-140 µm, brown. Frequent in British material, but perhaps not constantly present.	Whitehouse (1966*); Zander (1981*); Arts (1998*)	2
Barbula unguiculata	Ellipsoidal or pyriform, 140-320 µm, brown. Reported without description from Dutch chalk grassland; found on young single plants on arable and waste ground in Ukraine but rare or absent there on crowded or aged plants.	During & Horst (1983); Khorkavtsiv & Ulychna (1995*)	4
Bryoerythrophyllum ferruginascens	Shortly cylindrical, often curved, (100-)150-300(-500) µm, red or reddish-brown, at base of stem as well as underground.	Whitehouse (1966*); Risse (1987b*); Arts (1989b*)	1
Bryoerythrophyllum recurvirostrum	Spherical or pyriform, 25-30 µm, dark reddish-brown. Reported as uncommon in Japan; not known from Britain or Europe.	Saito (1975); Zander (1978b*); Hill *et al.* (1992)	4
Bryum alpinum	Spherical, 120-200(-230) µm, purplish-red to brownish-red.	Whitehouse (1966*); Holyoak (2002)	1
Bryum bornholmense	Spherical, 160-330 µm, amber, orange, orange-red or dark red, becoming browner with age.	Whitehouse (1966*); Crundwell & Whitehouse (2001*)	1
Bryum caespiticium	Spherical or ovoid, 100-200 µm, red or chocolate-brown. Tuberous variants are rare and require study; plants with red tubers occur on calcareous soil in Britain.	During *et al.* (1987); Nyholm (1993); Hill *et al.* (1994)	2
Bryum canariense	Spherical, 180-300 µm, red.	Whitehouse (1966*)	1
Bryum capillare	Spherical, ovoid or irregular, 66-270(-440) µm, brown to red-brown.	Whitehouse (1966*); Syed (1973*)	1
Bryum dichotomum (including *B. bicolor* and *B. dunense*)	At least two sorts: a) spherical, subspherical, ovoid, irregular or complex, multicellular, 110-220 µm or more, pale yellow to red-brown or dark brown; and b) club-shaped, unicellular or few-celled, up to 150-180 µm, brown, at end of rhizoids. Perhaps most frequent when conditions do not favour bulbil production.	Wilczek & Demaret (1976*, 1978*); Risse (1993*); Pedrotti & Aleffi (2001*); Holyoak (2002)	1

Species	Brief description of tubers, and comments on frequency and geographical distribution of plants with tubers	References (* indicates illustration of tubers)	State of knowledge
Bryum dixonii	Spherical or shortly ovoid, up to 280 µm, brown. Only known in culture, not yet found in the wild.	Whitehouse (1992*)	2
Bryum elegans	Spherical, 90-200 µm, brown. Tuberous plants are apparently very rare.	Syed (1973*)	2
Bryum gemmiferum	Spherical or cylindrical, 180-360 µm, brown or reddish-brown; 'juvenile' unicellular or few-celled pyriform tubers also described, perhaps equivalent to club-shaped tubers of *B. dichotomum*.	Wilczek & Demaret (1976*)	3
Bryum gemmiparum	Spherical, 100-160 µm, orange or pink, rarely red. Tubers known from Belgium.	Whitehouse (1966*)	2
Bryum klinggraeffii	More or less spherical, with protuberant cells, 60-115 µm, crimson or brown.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Wilczek & Demaret (1974*); Arts (1985b*)	1
Bryum laevifilum (*B. subelegans* auct.)	Spherical, 65-120 µm, brown.	Syed (1973*)	2
Bryum muehlenbeckii	Spherical, 160-300 µm, orange-red or red.	Whitehouse (1966*); Holyoak (2002)	2
Bryum radiculosum	Spherical, 120-180(-210) µm, red or brown.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Wilczek & Demaret (1974*)	1
Bryum riparium	Pyriform in surface view, with lobed margins, flattened, 130-200 µm, red or brownish-red.	Whitehouse (1963*, 1966*)	1
Bryum rubens	Spherical, with protuberant cells, 180-260(-300) µm, bright crimson, red or dark red.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Wilczek & Demaret (1974*); Crundwell & Whitehouse (2001*)	1
Bryum ruderale	Spherical, 125-180(-200) µm, purplish-red, rarely paler or orange.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Wilczek & Demaret (1974*)	1
Bryum sauteri	Pyriform, 60-100 µm, brown to red-brown.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Arts (1985b*)	1
Bryum subapiculatum	Spherical, 190-260 µm, red.	Crundwell & Nyholm (1964*); Whitehouse (1966*)	1
Bryum tenuisetum	More or less spherical, 120-180(-220) µm, lemon-yellow, rarely orange.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Wilczek & Demaret (1974*)	1
Bryum torquescens	Spherical, 75-255 µm, red or crimson.	Syed (1973*)	1
Bryum violaceum	Spherical, 60-90(-110) µm, purplish-red, sometimes paler or orange.	Crundwell & Nyholm (1964*); Whitehouse (1966*); Wilczek & Demaret (1974*)	1
Campylopus flexuosus	Uniseriate, rarely branched, up to 2 mm long, reddish-brown to dark reddish-brown. Found by Arts on an Irish specimen, and recently reported from material from Pembrokeshire (note 1).	Arts (1989a*)	2
Campylopus fragilis	Uniseriate, sometimes branched, up to at least 1500 µm long, reddish-brown to dark reddish-brown. Found by Arts on an Irish specimen, and recently reported from material from Cornwall (note 2).	Arts (1989a*)	2

Species	Brief description of tubers, and comments on frequency and geographical distribution of plants with tubers	References (* indicates illustration of tubers)	State of knowledge
Campylopus pyriformis	Two sorts, although intermediates are not infrequent: a) subterranean, ovoid to long cylindrical, rarely bifurcated or branched, 300-1300 µm long, white to yellowish; and b) superficial, uniseriate, 250-800 µm long, dark to blackish-red. Found by Arts on an Irish specimen (note 3), and widely reported from European and extra-European material.	Arts (1986b*); Risse (1988); Arts & Frahm (1990*)	2
Chenia leptophylla	Irregular, more or less elongated, 75-135(-175) µm, brown.	Warburg & Crundwell (1965*); Whitehouse (1966*); Arts & Sollman (1991*)	1
Cynodontium bruntonii	Uniseriate, sometimes bifurcated or branched, up to 2 mm long, pale yellowish-brown. Scarce to rather abundant on all specimens examined by Arts from mainland Europe; he did not find them on his single Welsh specimen but they have been found recently in Monmouthshire (note 4).	Arts (1990a*)	2
Dicranella grevilleana	Spherical, 90-140 µm, brown to reddish-brown.	Whitehouse (1966*)	1
Dicranella palustris	Spherical, 200-250 µm, brown to reddish-brown.	Whitehouse (1966*)	1
Dicranella rufescens	Uniseriate with (1-)2-3(-6) cells, 150-200(-300) µm long, pale red to wine-red. Often present, especially on senescing plants.	Whitehouse (1969*); Arts (1985a); Risse (1986*); Hill *et al.* (1992)	1
Dicranella schreberiana	Spherical, 90-140 µm, brown to reddish-brown.	Whitehouse (1966*)	1
Dicranella staphylina	Irregular, 80-100 µm, dark brown.	Whitehouse (1969*); Arts (1985a*)	1
Dicranella subulata	Uniseriate or irregular, 110-170 µm long, dark brown.	Whitehouse (1966*)	1
Dicranella varia	Irregular, 80-200(-250) µm, pale brown. Not always present, and Whitehouse (1969) suggests frequent only on calcareous soils.	Whitehouse (1966*); Arts (1985a, 1987d*)	2
Didymodon cf *fallax*	Very small plants that emerged from soil samples collected in Dutch chalk grassland produced tubers like those of *D. tomaculosus*; the plants were too small to be identified with certainty but were either *D. fallax* or *D. ferrugineus*.	During & Horst (1983)	5
Didymodon insulanus	More or less ovoid-ellipsoid, 87.5-135 µm, dark brown. Tuberous plants are apparently very rare.	Ellis & Smith (1983*)	2
Didymodon nicholsonii	Irregular, 100-500 µm, sometimes coalescing into larger clusters, brown. Tubers reported from Belgium.	Arts (1987c*)	3
Didymodon sinuosus	Plants with many tubers on the rhizoids have been reported from Spain but the tubers were not described.	During *et al.* (1987)	5
Didymodon tomaculosus	Uniseriate, straight, curved or contorted, 40-140 µm long, brown.	Blockeel (1981*)	1
Didymodon tophaceus	Uniseriate, straight or curved, sometimes branched, 25-74 µm long, pale brown.	Joenje & During (1977); Side (1983*); Arts (1998*)	2
Didymodon umbrosus	Irregular, with protuberant cells, 25-200 µm, brown.	Crundwell & Whitehouse (1978*)	1
Didymodon vinealis	Plants with many tubers on the rhizoids were reported from Spain by During *et al.* (1987) but the tubers were not described. Saito (1975) described brown, spherical tubers 25-30 µm in	During *et al.* (1987)	5

Species	Brief description of tubers, and comments on frequency and geographical distribution of plants with tubers	References (* indicates illustration of tubers)	State of knowledge
[*Didymodon vinealis* cont.]	diameter on the rhizoids of Japanese *Didymodon constrictus*, a species reduced to a synonym of *D. vinealis* by Sollman (1983). However, Sollman did not see tubers in the many collections of *D. constrictus* that he examined, and in any event the synonymy he proposed is questioned by Zander (1993).		
Discelium nudum	Unicellular, cells 80-150 μm, rarely uniseriate with 2-3 cells, colourless.	Side & Whitehouse (1987*)	1
Ditrichum cornubicum	Pyriform, ellipsoidal, subspherical or irregular, 65-125 μm, yellowish-brown or reddish-brown.	Paton (1976*); Arts (1994*)	1
Ditrichum cylindricum	Irregular, few-celled or, less frequently, unicellular, 80-110 μm or more, pale brown to reddish-brown.	Whitehouse (1966*); Arts (1987d*, 1994*)	1
Ditrichum heteromallum	Uniseriate, in irregular line, 96-294 μm long, dark reddish-brown. Tubers known from mainland Europe.	Risse (1985b*); Arts (1987d*, 1994*)	3
Ditrichum lineare	Uniseriate, irregularly or helically twisted, 150-275 μm long, dark reddish-brown. Tubers known from mainland Europe and Japan, and recently found in Wales (note 5).	Matsui, Deguchi & Seppelt (1985*); Arts (1987d*, 1994*); Hill *et al.* (1992)	2
Ditrichum plumbicola	Uniseriate, spirally twisted into a subspherical helix, 150-200 μm in diameter, dark reddish-brown.	Arts (1994*)	2
Ditrichum pusillum	Pyriform, rarely irregular or ellipsoidal, 100-175 μm, yellowish-brown.	Whitehouse (1976*); Arts (1987d*, 1994*)	1
Ditrichum subulatum	Uniseriate, twisted into zigzag shape, 200-475 μm long, dark reddish-brown.	Arts (1994*)	2
Ditrichum zonatum	Uniseriate, sometimes twisted into zigzag or helical shape, 125-300 μm long, dark reddish-brown.	Arts (1994*)	2
Epipterygium tozeri	Ellipsoidal, 100-130 μm, pale brown. Tubers have been found on specimens from Essex and Carmarthenshire (note 6).	Arts & Nordhorn-Richter (1986*)	2
Fissidens dubius	Spherical to irregular with rounded protuberances, 100-600(-1600) μm, reddish-brown to nearly black, sometimes brown or pale yellowish-brown. Tubers known from mainland Europe.	Arts (1986a*)	3
Fissidens incurvus	Tubers have been reported (but not described) on wild-collected and cultivated material from Spain.	During *et al.* (1987)	5
Fissidens osmundoides	Irregular, up to 1.5 mm long, pale to dark reddish-brown. Tubers found in an Irish specimen.	Arts (1988b*)	2
Fissidens polyphyllus	Irregular, up to 1.5 mm long, pale to dark reddish-brown. Tubers found in a Welsh specimen.	Arts (1988b*)	2
Fissidens serrulatus	Spherical, or with 2-3(-5) connate spheres, rarely more irregular, up to 800 μm, dark reddish-brown to almost black. Tubers found in a specimen from Devon.	Arts (1988b*)	2
Fissidens taxifolius	Spherical or irregular, 300-700 μm, dark brown or nearly black, rarely pale yellowish. Many populations in Britain lack tubers, but some produce abundant tubers (note 7).	Whitehouse (1966*); During & Horst (1983); Arts (1986a); Imura & Iwatsuki (1988*)	2
Glyphomitrium daviesii	Uniseriate, sometimes branched, 75-170(-370) μm long, brown.	Lewinsky (1987*)	1
Hennediella macrophylla	As *H. stanfordensis*.	Whitehouse & Newton (1988), but not described in detail	1
Hennediella stanfordensis	More or less ovoid or irregular, 50-90(-150) μm, pale brown.	Whitehouse (1961*, 1966*)	1

Species	Brief description of tubers, and comments on frequency and geographical distribution of plants with tubers	References (* indicates illustration of tubers)	State of knowledge
Leptobryum pyriforme	Ellipsoidal, 125-140 µm, dark purplish-brown or black.	Whitehouse (1966*)	1
Pleuridium acuminatum	Spherical, ovoid or cylindrical, rarely bifurcated, 65-120 µm diameter or 120-140 µm long, pale to dark brown. Tuberous plants are frequent in mainland Europe; tubers are usually rather scarce but are abundant in some shade forms.	Arts & Risse (1988*)	3
Pohlia lescuriana	Spherical, ellipsoidal or pyriform, 75-100 µm, pale brown.	Whitehouse (1973*); Arts (1987d*)	1
Pohlia lutescens	Ellipsoidal, knobbly, with 3-6 cells, 50-70 µm, pale yellow.	Whitehouse (1973*); Hart & Whitehouse (1978*); Arts (1987d*)	1
Pohlia melanodon	Uniseriate, occasionally branched, *ca* 75-300 µm long, colourless. Widespread (at least in stubble field populations) in Britain and Ireland (note 8).	Arts (1986c*, 1987d*)	2
Pseudephemerum nitidum	Subspherical, ovoid or cylindrical, 60-160 µm long, bright yellow or pale orange-brown. Tuber-producing populations appear to be very rare and genetically distinct; they have been found in mainland Europe and, when present, tubers are abundant.	Nyholm (1987*); Arts & Risse (1991*)	3
Pseudocrossidium revolutum	Irregular, 300-600 µm long, occasionally coalescing into clusters >1 mm diameter at contact layer with solid substrate. Tubers known from mainland Europe.	Arts (1988a*)	3
Scopelophila cataractae	Uniseriate, sometimes branched, or irregular, 50-400 µm long, pale brown. Tubers known from mainland Europe.	Arts (1988a*)	3
Syntrichia amplexa	Unicellular or uniseriate with 2-3 cells, 20-75 µm, pale brown. Smith's (1978) illustrations are misleading.	Side & Whitehouse (1974*)	1
Syntrichia ruralis	Spherical, 50-60 µm, green, on tomentum of lower stem. It is not clear if the gemmae described by Magill from southern Africa are tubers or if southern African and European taxa are the same; no such structures have been reported from Europe.	Magill (1981*)	5
Tortula lanceola	Usually irregular, ellipsoidal or pyriform, rarely more or less isodiametric, 80-400 µm, pale brown to brown. Tubers rather frequent in mainland Europe.	Arts (1987b*)	3
Tortula modica	Irregular, more or less ellipsoidal or pyriform, 80-422 µm, pale brown to brown. Always present, sometimes in small numbers, in Germany, and rather frequent in Belgium.	Risse (1985a*); Arts (1987b*)	3
Tortula protobryoides	As *T. lanceola*. Tubers known from Belgium.	Arts (1987b*)	3
Tortula truncata	As *T. lanceola*. Tubers known from Belgium.	Arts (1987b*)	3
Trichostomum tenuirostre	Irregularly clavate, sometimes branched, or ellipsoidal, 150-250(-800) µm, brown to red-brown. Tubers are known from mainland Europe and elsewhere, but are apparently rare; they have been looked for by Whitehouse but not yet found in the British Isles.	Zander (1978a*)	3
Weissia brachycarpa	Ovoid, rather few-celled. Tubers are illustrated by Landwehr but are not described in any other source I have traced.	Landwehr (1984*)	5
Weissia condensa	Tubers have been reported (but not described) on wild-collected and cultivated material from Spain.	During *et al.* (1987)	5

Note 1. Tubers on *Campylopus flexuosus* have been found by S.D.S. Bosanquet on a specimen collected at Mynydd Preseli (v.-c. 45) in 2003.
Note 2. The report of tuber-bearing *Campylopus fragilis* in Cornwall is based on a specimen collected by S.D.S. Bosanquet at St Genys (v.-c. 2) in 2000.
Note 3. Arts (1986b) did not publish the details of the Irish specimen of *Campylopus pyriformis* with tubers; it was collected at Letterdyfe, Roundstone (v.-c. H16) in 1986 (Arts 13208) and is now in BR (H. Stieperaere, in litt., 2003).
Note 4. The report of tuber-bearing *Cynodontium bruntonii* from Monmouthshire is based on a specimen collected by S.D.S. Bosanquet on Mynydd Bedwellte (v.-c. 35) in 2001.
Note 5. D.T. Holyoak detected tubers on male plants of *Ditrichum lineare* collected by S.D.S. Bosanquet in Fwng Forest, Carmarthenshire (v.-c. 44) in 2002.
Note 6. The report of tuber-bearing *Epipterygium tozeri* from Carmarthenshire is based on a specimen collected by S.D.S. Bosanquet near Newcastle Emlyn (v.-c. 44) in 2000.
Note 7. Tuber-bearing plants of *Fissidens taxifolius* were illustrated by Whitehouse (1966) from Witchford, Cambridgeshire (v.-c. 29). Since 2001, I have examined material from 10 arable fields in the county and found tuber-bearing plants at only two sites. However, S.D.S. Bosanquet has recently found tubers in three out of four samples from arable fields in Monmouthshire (v.-c. 35), and in one sample from an arable field in Pembrokeshire (v.-c. 45).
Note 8. Since 2001, S.D.S. Bosanquet, J.D. Sleath and I have found tubers on material of *Pohlia melanodon* from arable fields in v.-c. 1, 9, 29, 35, 36, 37, 40, 41, 52, 61, 89, 93, H11, H19, H21, H22, H23 and H31.

Grimmia nutans Bruch: ecology, morphology and distribution

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Original description of *Grimmia nutans*

In 1828, a certain Fleischer botanised in the mountains around Smyrna (present-day Izmir) in Turkey. His moss collections were published by a friend, the pharmacist Fr. A. Müller (1829). Some of these were new to science, among them a *Grimmia*. Müller, who had insufficient knowledge about *Grimmias*, sent the material to a pharmacist colleague, Ph. Bruch, in Zweibrücken, Germany. Bruch, one of the authors of the *Bryologia Europaea*, described the material as *Grimmia nutans* Bruch. After this, the species disappeared from the literature for 160 years.

G. nutans in Greece and the Canary Islands

In 1987, Cliff Townsend collected near the Varlaam monastery of the Meteora at Kalabaka, Greece, a *Grimmia* that was unknown to him. He tried to identify the species but, finding no helpful notes in works such as Loeske (1930), Henderson & Prentice (1969), Savicz-Ljubitskaya & Smirnova (1970) and Cetin (1988), he published his species as *Grimmia meteorae* sp. nov. (Townsend, 1989). Characteristic features of the species included secund leaves with bistratose upper laminas running down the leaf in ridges, 3-4 stratose leaf margins, straight cell walls, cygneous setae and smooth capsules. At almost the same time, the Dutch bryologist Gerard Dirkse found an unknown *Grimmia* on Gran Canaria (Pozo de las Nieves, 1620 m alt.). When he described to me the rather peculiar morphology and ecology of his species, I told him that he had probably found *G. meteorae*. This appeared to be correct, and consequently Dirkse & Greven (1993) published *G. meteorae* as new to the Canary Islands.