Herefordshire Fungus Survey Group

News Sheet N° 27: Spring 2014

Scutellinia setosa - Cwm Farm, Walterstone (4/9/13)

Contents

President:	Ted Blackwell
Recorder:	Jo Weightman
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Secretary:	Mike Stroud
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Welcome to the Spring 2014 News Sheet

Firstly: in case any of you do not already know, it is with great sadness that I have to report the death of Ray Bray, one of the founder members of HFSG. Ray was a man of great kindness and wisdom and, even though he has not forayed with us for some time now, will be very much missed by those who knew him. Jo has written a fitting tribute of her memories of Ray on page 8.

It is really pleasing to find that Debbie's enthusiasm for rusts is now being communicated to a wider readership - the Field Mycologist has started to reprint some of her articles (updated, where necessary) from our News Sheets. It is certainly an opportune time to do so, as the present year seems to be particularly good for rusts! In this issue of the HFSG News Sheet we ourselves are again treated to one of her delightful pieces - this time on the very common and widespread rust, *Coleosporium tusilaginis.*

Jo does some very thoughtful musing on why some fungi 'weep', whereas most do not. Is there some evolutionary advantage, or what? Some interesting thoughts.....! Maybe it will provoke a response from some of our readers? - There's a challenge for you!

Tom Preece has written that he

> 'was very interested to see the foray record of knobbly patches of *Protomyces macrosporus* on the stems of Ground Elder, *Aegopodium podagraria*, at the Hampton Court for*ay* of June 12th 2013 [HFSG News Sheet No. 26, p3]. It is very common indeed on very young (just coming up) roadside plants of Hedge Parsley*, Anthriscus sylvestris*, the distortion of young leaves becoming quite amazing to see. Readers might also like to look in streams, etc. at Fool's Watercress, *Apium nodiflorum,* which develops brown to orange lumps - galls caused by another member of the Protomycetales, *Burenia inundata*.'

It is a long time since we have heard from Tom and we are grateful to the BMS for permission to reprint his article on this (written in association with A.J. Hick) from the August 2001 issue of Mycologist.

Finally, Roger has found a couple of interesting snippets for Fungal Fragments - one on spore dispersal and one on the impact (and importance) of fungal disease on world food production.

As I mentioned in the last News Sheet, from now onwards, as an experiment, there will be a slight change in the format of these issues.

There will be

- just a Recorder's Report (with photos) in Oct./Nov.
- and then a 'normal' one (ie with articles as well) in May/June.

The reason for this is that there really has not been enough material recently for two full issues per year. If the situation changes, however, then we can always run a 'normal' issue whenever necessary.

The next 'normal' issue will, therefore, be for Spring 2015 and the deadline for this will be March 20th. Don't forget that the Editor is always looking for ***your*** contribution(s) to the News Sheet. It is by no means too early to start sending these to me - it does help a great deal if you can send me your articles, photos, etc. as far as possible in advance of the deadline!

Happy reading!

Mike Stroud

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A couple of photos for you:

HFSG members at Moccas Park

Section of a log with *Chlorociboria aeruginascens* - Lower Buckenhill Farm, Fownhope 27/11/13

Jo Weightman, Recorder

While Herefordshire was not blessed with such an abundance of fungi that 2013 would count as a lifetime`s best for foraying, this was a year when the eye was gladdened and the note book filled. I am overwhelmed as I compile this half year`s report by the great length of my ‘short list’ of species worthy of comment. Many will have to go.

THE FORAYS

K ≡ deposited in Kew Herbarium

Cwm Farm, Walterstone 04.09.2013

A new site comprising pasture and a dingle.

The grassland was not yet productive, most of the 66 species recorded being found in the dingle. These included *Boletus appendiculatus*, *Russula chloroides, Helvella* (formerly *Leptopodia*) *atra* and *Lasiosphaeria ovina* or ‘sheeps`eyes’, a pyrenomycete in which the flask is coated with a white, woolly scurf apart from a black peep-hole on the top. An eyelash fungus was determined by Ted Blackwell as *Scutellinia setosa* (see photograph on front cover), a rarely recorded species Of the few (thirty) entries in the FRDBI, seven are from Herefordshire which probably says more for recording enthusiasm than for geographical distribution.

Great Doward - Leeping Stocks and White Rocks Reserves 18.09.2013 - all day

This was a whole day foray so we decided to survey two reserves. It was a good result overall, although there were some unproductive areas. The most rewarding was the wooded part of White Rocks which was reached too late to do it justice. *Cortinarius olivaceofuscus and the* violet-staining *Lactarius flavidus* (K) were new county records and the white, but pink-tipped coralloid fungus *Ramaria botrytis* was found in litter under beech in Leeping Stocks, making a 4th county site for a Red Data List species.

Mains Wood 02.10.2013

The vegetation beside the rides was dauntingly wet but fortunately an occasional gap gave access into the conifer and sweet chestnut plantations where terrestrial agarics afforded most interest. Of the mycorrhizal species *Amanita submembranacea* and *Russula amoenolens* were interesting. The first is in the Section of Amanitas that lack a ring but do still have velar remains on the cap – there have been only five previous records in the county while the *Russula* is in the group around *R. sororia* – this one has very marked, lumpy striations, a nauseating, not fruity smell and an absence of red at the base. *Hypoderma rubi* is a common but overlooked species on dead blackberry stems, forming 2mm long, black, boat-shaped bodies with a slit along the middle. *Pseudohydnum gelatinosum* is always exciting – it is that oddity, a spiny jelly on a conifer stump. But it was on another such stump that one of this year`s excitements was waiting for us, although it remained a puzzle at the time. See on.

***Helvella atra & Lasiosphaeria ovina* - Cwm Farm, Walterstone (4/9/13)**

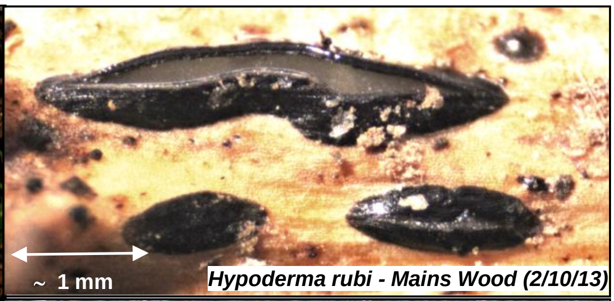
***Lactarius flavidus* - White Rocks,Great Doward (18/9/13) -** rarely recorded nationally

Moccas Park NNR 16.10.2013 – all day

The morning proved very wet – but the forayers proved undaunted and damply gathered a handsome collection of over ninety equally wet specimens. By lunchtime however, we were able to eat our picnics in sunshine and then spend another hour or so in the Park before repairing to our study table to examine and discuss our finds. At this point our brains had dried enough to separate Steve Rolph from his supper - for his *Lepista nuda*, seen in better light, was none other than *Cortinarius purpurascens*! A sobering moment.

Grassland species included several waxcaps among which *Hygrocybe splendidissima* was a new site record and some Entolomas - *Entoloma cf huismannii* a small species with a pale, striate cap, dark `eye` and blue-grey stipe was also new to Moccas. Common litter and dead wood species were plentiful, especially the Mycenas – *M. crocata* evoking the usual cries of admiration. *Calocera pallidospathulata* a new site record, was found on dead oak wood. It forms small

Hyphoderma setigerum - Moccas Park (16/10/13)
a common species, but in an untypical form



***Hypoderma rubi* - Mains Wood (2/10/13)**

***Geoglossum cookeanum* - Kinsham Court (13/11/13)**

The '*Typhula* that got away' - Bacton (30/10/13)

whitish-yellowish gelatinous stubs which are most frequently found on fallen conifer wood but are not unknown on deciduous hosts. *Hyphoderma setigerum* caused much head scratching and was finally identified for us by Alick Henrici who mentions it in the latest (January 2014) issue of Field Mycology. Although a common corticioid fungus, it bore "atypical" spines instead of granules. K

There were examples of several mycorrhizal genera but no one species was abundant. The most interesting were *Amanita echinocephala*, a white agaric with erect pointed veil remains on the cap, otherwise known only in the county from the Doward and *Gyroporus castaneus* a firm brown bolete with a series of cavities in the stipe. This has been recorded in Herefordshire since the mid-nineteenth century but only twelve times in all those years.

We were joined by Greg Hull a new member whom we welcome to the Group.

Upper Grange, Bacton 30.10.2013

Susan and Charles Hunter once again gave us the run of their garden, pastures, dingle and woodland in what proved to be a good garnering of records. Many of the ninety or so finds were new to the site which is still in the early days of recording. Most were of good base line species – alas the two which got away were probably the most notable mycologically – a *Typhula*, attached to a prominent sclerotium, proved immature so unidentifiable. The second, a large, single *Cortinarius* associated with a splendid *Tilia cordata*, lacked identifying characters as it was over-mature.

We surveyed the garden first, finding a number of mycorrhizal species among which *Lactarius glyciosmus* was in good form and surprisingly large - and a good range of litter species. A white woodland waxcap stained golden yellow with KOH , so was *Hygrophorus discoxanthus* and *Baeospora myosura* was found on part of a cone under a cedar. Common waxcaps and clubs were quite frequent in the lawns. Then we divided, the more able-bodied going into some woodland and the others heading across pasture to the dingle. At the end of the foray, we gathered round a table for an ID session. Species of note found included *Eichleriella deglubens*, *Psilocybe inquilina, Orbilia curvatispora* and *Plagiosphaera immersa* - the last rarely recorded anywhere and a first for Herefordshire – we are indebted to Shelly Stroud who investigated a grey patch on a dead nettle stem.

The foray was followed by a magnificent lunch provided by Charles and Susan to whom and their daughter Alice very many thanks for their help and hospitality. We were happy to welcome Brian Davis who has joined the Group.

Kinsham Court 13.11.2013

There had been a heavy frost overnight so the fungi were rather fraught but even under these conditions a good range of grassland species (*Hygrocybe* and *Geoglossum*) were recorded on the lawns, although in low numbers in most cases. Other records derive from log piles and litter under the variety of trees and shrubs. In all 87 species were recorded, the majority being new to the site.

Waxcaps included *Hygrocybe calyptriformis*, *H. irrigata* and H. *fornicata*. There were two earth tongues, *Geoglossum cookeanum* and *G. fallax*.

The earth star *Geastrum fornicatum* was found in the litter under *Thuya plicata* and *Mycena pterigena* - one of the joys of the day – on a rotting fern. This is a delicate white to pale pink species with pink gill edges. A possible

Lepiota cristata that lacked the characteristic rubbery smell was later determined by Shelly Stroud as *L. echinella.*

We are grateful to Peter Roberts who determined two resupinate species both of which are 2nd VC36 records. One was *Exidiopsis calcea* which although a `jelly` fungus is described as looking like old greyed whitewash. The other was *Sistotremastrum niveocremeum,* a rarely recorded species.

Lower Buckenhill Farm, Fownhope 27.11.2013
A new site comprising pasture, associated hedges, scrubby areas, trees and woodland.
We concentrated on the pastures nearest the farm buildings and reserved the woodland for another occasion. In all this is a very promising site. The most interesting species found were:

- *Agaricus phaeolepidotus* 5th Herefordshire site for an Agaricus in the yellow-staining group with fine greyish-brown scales on the cap, weakly staining flesh and only a faint inky smell;
- *Badhamia panicea* 1st county record for a myxo that is common in the south but thins out northwards (Ing)
- *Hygrocybe mucronella,* one of the less frequently recorded fungi in the county, red or orange-red, usually decurrent and bitter tasting;
- *Hygrophorus lindtneri* the 2nd VC 36 record for a viscid, woodland waxcap, white with pale brown to tan tones in the cap centre, often associated with hazel and for which there are few national records;
- *Marasmius epiphylloides* 4th Herefordshire site for this small pure white agaric, which is restricted to ivy leaves and probably under-recorded;
- *Pilaira moreaui* 1st county record for a mould on rabbit pellets, cultured and identified by Ted Blackwell;
  Punctelia jeckeri 2nd VC 36 record for a lichen that is rarely recorded nationally;
- *Ramariopsis kunzei* a branching white coralloid fungus that can occur singly or, as in this instance, gregariously. The stem has distinct fine hairs.

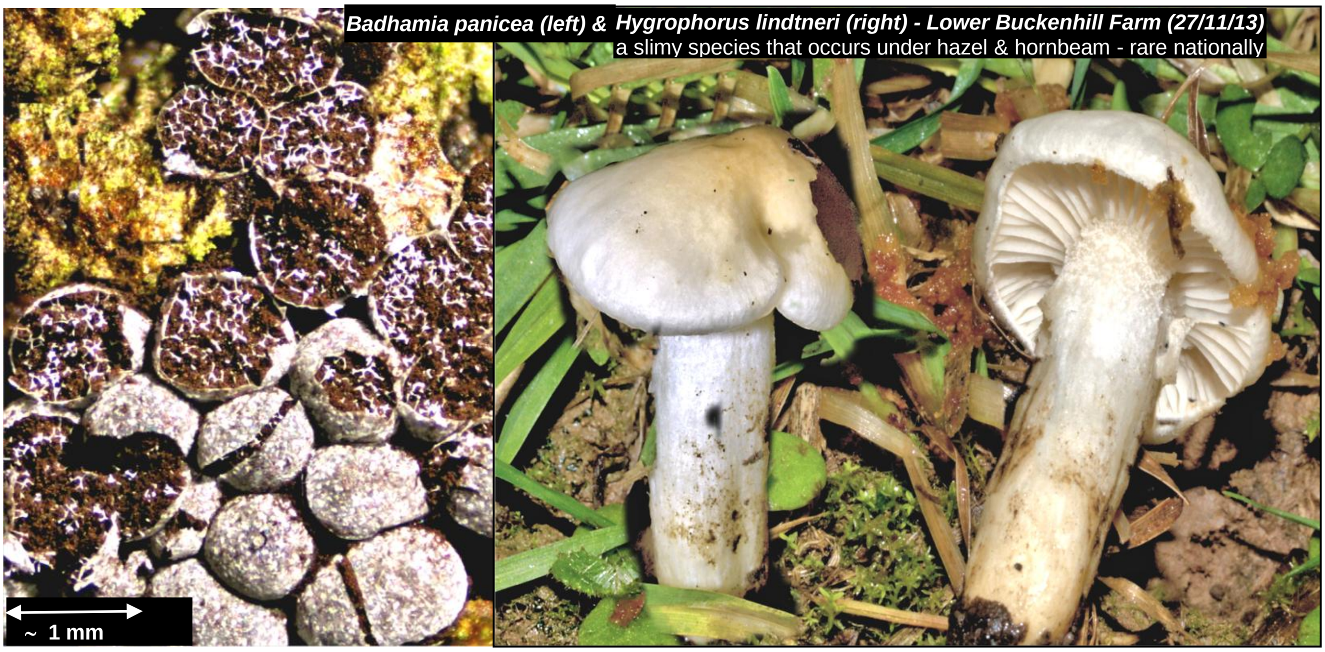
National Fungus Day at Queenswood Arboretum 12.10.2013
Among the fifty or so fungi spotted by visitors to the National Fungus Day event were *Boletus impolitus* which smells of iodine at the base, *Inonotus dryadeus* a perennial bracket with amber droplets when young and the dog stinkhorn *Mutinus caninus*.

Non-Foray Records
Unusually common species
Reports such as this tend to concentrate on the 'specials`. It is also interesting however to take note of species which, though common and well known, are exceptionally abundant. In this category I would place:

August / September:	*Phallus impudicus* and *Russula foetens* in Douglas fir plantations, *Hypholoma fasciculare* in huge troops, *Panaeolus semi-ovatus* on dung and *Bulgaria inquilans* on newly fallen trunks.
October / November:	*Armillaria ostoyae* on both broad-leaved and coniferous stumps, *Baeospora myosura* on fallen cones, *Clavulina rugosa* in litter generally, *Calocera viscosa* on conifer stumps, lighting up the dark plantations.

Records from members and friends
I am delighted to report that a good number of records have been contributed by members. Many of these represent our only record of the species in 2013. To name but a few:

Abortiporus biennis Docklow (Will Watson)
Amanita crocea Bircher Coppice (Steve Rolph)
Crucibulum laeve Stapleton Castle garden (Trefor Griffiths)
Grifola frondosa Docklow (Jean Wynne-Jones)
Lepiota boudieri in her garden at Bodenham Moor (Margaret Hawkins)



***Badhamia panicea* (left) & *Hygrophorus lindtneri* (right) - Lower Buckenhill Farm (27/11/13)**
a slimy species that occurs under hazel & hornbeam - rare nationally

Macrotyphula fistulosa Croft Castle Estate (Greg Hull)
Marasmius setosus Upper Grange Bacton (Charles & Sue Hunter)
Schizophyllum commune recreation ground, Orleton (Ted Blackwell)
Sparassis crispa Bircher Coppice (Annamaria Paterson)
Volvariella bombycina Brockhampton Estate (Sheila Spence)

Notable mycorrhizal species
Naucoria luteolofibrillosa Holywell Dingle 25.09.13. 1st VC36 record.
Suillus tridentinus Wigmore Rolls 10.10 13, a repeat recording at its only site in the county. A rare species nationally. Featured in FM 15 (1). K

Notable grassland species
Pholiotina sulcata (formerly *Conocybe plicatella*) Moccas Park 26.09 13 K 1st VC36 record. Probably under-recorded as seen subsequently at two more Herefordshire sites.

Uromyces pisi-sativae on dyers greenweed *Genista tinctoria*, Birches Farm, Kington, very rarely recorded on this host. K

Notable woodland species
Coprinopsis erythrocephala on decayed brash near streamlet, Haugh Wood 27.09.13. Rare nationally, 1st VC36 record. K

Hydropus subalpinus on fallen wood Haugh Wood 27.09.13, 6th site in ten years for a species which is rapidly becoming a Herefordshire speciality; only a handful of records from other counties.

Lepiota ochraceofulva in litter under a yew in the churchyard at Stretton Sugwas 13 04.11. - warm orange tones on the cap and gills. The 3rd Herefordshire site for a nationally rare species. Confirmed by Alick Henrici.

Lyophyllum infumatum one of the blackening Lyophyllums, in litter under beech, Croft Castle Estate 28.09.13. A repeat fruiting at this its only Herefordshire site. Rare nationally. K

Tephrocybe osmophora in litter under larch and Douglas fir, Mortimer Forest 15.10.13. An undistinguished dark brown agaric with a sensational, aromatic smell. 2nd UK site for a species only otherwise known in Great Britain from Surrey, where it was last recorded in 1986. Listed as Critically Endangered on the Red List (2006) and a BAP species. K

Miscellaneous
Microsphaera baeumleri a powdery mildew on Wood Vetch *Vicia sylvatica*, Haugh Wood 27.09.13 Very rarely recorded nationally. K.

Out of County Records
Clavariadelphus truncatus A large club with a flattened top found by Mike Kemp in October. in mature spruce woodland on Broniarth Hill, Wales. Listed as Extinct in the Red Data List (2006), the last and only British record (from Worcestershire) being dated 1924. So back from over the brink!

Trichoglossum walteri an earth tongue collected at Ty Fri, Llangattock by Mike and Shelly Stroud. Listed as Near Threatened in the Red Data List (2006). Not known in Herefordshire.

Top of the pops
Postia guttulata, Mains Wd, Bircher Coppice and Haugh Wood K
During the Mains Wood foray we found material on a conifer stump of a young, whitish bracket with transparent guttules and a tendency to stain red. This was identical to a collection I had made in September in Haugh Wood (sent to K) and to specimens seen in Bircher Coppice on separate occasions by both myself and Annamaria Paterson. It has been tentatively identified by Dr Martyn Ainsworth at RBG Kew as *Postia guttulata* and represents the second British collection - the first having been made in E. Sussex also in September this year, but some weeks prior to ours. Interestingly, Thomas Laessoe reports a spurt of records for this species in Denmark this year.

We warmly thank Dr Martyn Allison, Alick Henrici, Geoffrey Kibby, Mariko Parsloe and Dr Brian Spooner for their generous assistance with identification.

***Suillus tridentinus* - Wigmore Rolls -** its only Herefordshire site; a rare apricot to orange coloured bolete

***Coprinopsis erythrocephala* - Haugh Wood -** this very uncommon inkcap has fiery squamules when young

***Lepiota ochraceofulva* - Stretton Sugwas -** in the churchyard under yew

***Lyophyllum infumatum* - Fishpool Valley, Croft -** in the beech hanger and showing the blackening reaction when handled

***Tephrocybe osmophora* - Mortimer Forest -** fruiting under larch - an extremely rare fungus

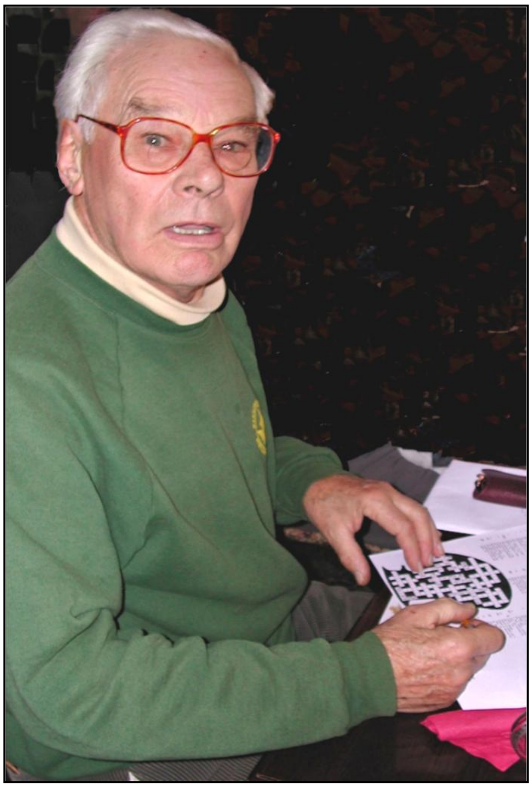
***Trichoglossum walteri* - Llangattock, Powys**

***Postia guttata* - Haugh Wood (also at Mains Wood & Bircher Coppice) -** showing guttules (drops) and reddening of the flesh

MEMORIES OF RAY BRAY

Jo Weightman

Ray was one of the founder members of the HFSG, having been fired with a love of fungi while he lived in Kent. He did sterling work in the Hadlow area, recording two of the earliest finds of *Amanita inopinata* in the churchyard and again near Hadlow College. As Mereworth Wood was a favourite foraying and dog walking spot, he added hugely to the known mycoflora of the wood. Significant finds there included a number of hydnoid species – early records again for the county – and the old man of the woods *Strobilomyces strobilaceus* - (frustratingly, it was many years before I found my own).



Even in those days Ray was fighting a courageous battle with chronic back pain but, on his move to Herefordshire, this did not prevent him from discovering *Geastrum berkeleyi* almost on his doorstep. His identification of this earthstar was confirmed at Kew and his site remains the second of only two in the British Isles where the species has been recorded in recent times. His find of *Sphaeropsis visci* on mistletoe cladodes, a county 'first', was the trigger for subsequent collections of a rarely recorded species.

As his physical condition deteriorated, he turned his attention to what he could find in the hedges and edges of his lane: in this way became interested in and knowledgeable about rusts, especially those on ferns. Roles were reversed when he taught me how to see the nearly invisible bumps betraying their presence. He spent many hours measuring countless spores in order to confirm the determination of his *Milesina whitei* record.

In addition to contributing records, he served the Group for many years as Treasurer, a task impeccably undertaken. Ever resourceful, he set up his own database and, disliking inactivity, researched and produced a booklet on the names of fungi.

When he could no longer see well enough to drive a car, he took to travelling across the fields by cross-country buggy. This miracle of engineering had a fair turn of speed – I recall having to run hard as we raced down the lane.

Ray loved his remote cottage and garden - he was also a plantsman with a special interest in ferns and an eager, and generous, grower of vegetables. But, when the time came, he philosophically adapted to life in Brockhampton Court Care Home. I used to take his last dog, Ben (whom I had adopted), to see him there. He always had a 'treat' ready for his old dog – and the staff were as excited as he was to meet him. Ray was a kind, generous and charming friend and a loving family man. Possessed of a wicked sense of humour, he was invariably great company and always cheerful in increasingly great adversity. He kept himself up-to-date in the affairs of the world, of which he understood much after a lifetime in the diplomatic service. Indomitable comes to mind.

COLEOSPORIUM TUSSILAGINIS – HERE, THERE AND EVERYWHERE……

Debbie Evans

When starting to look for and record rusts it is useful to begin with a species that is not only widespread, but also fairly easy to find and recognise. *Coleosporium tussilaginis* ably fits the bill as it must be one of the commonest species in Britain, appearing from early summer and parasitising a wide range of hosts. It is easy to identify and is the only rust I can confidently record as I drive along in the car!

Coleosporium tussilaginis* on Butterbur *(Petasites hybridus)* & on Coltsfoot *(Tussilago farfara)

C. tussilaginis is a macrocyclic[1], heteroecious[2] species with the pycnidia and aecia being produced on the needles of 2-needled *Pinus* species and the uredinia and telia produced on the leaves and stems of a wide range of annual and perennial hosts, mainly within the Campanulaceae, Compositae and Scrophulariaceae. The uredinial stage on the latter hosts is the most conspicuous stage of the rust and thus the one that is more often recorded. The uredinia are orange and often caemoid, (without a proper structure) and the urediniospores are a bright orange and can cover a leaf surface, so can be highly visible. In contrast the telia, when formed, need to be looked for more closely, as they are sub-epidermal forming small waxy, orange-red crusts and the teliospores are sessile and colourless. The aecial infection on the Pines, the alternate host, is evident as erumpent, yellowish growths on the needles and these contain the aeciospores which can infect the other hosts. It is more difficult to find the rust on Pines and, indeed, many infected perennial plants will probably have over-wintering spores of the rust. These then infect the plants and others in the spring without the need for the Pine host. Annual hosts however, must become infected early in the year from air borne spores. The rust appears to be unable to survive on Pine trees without the presence of the uredinial/telial hosts nearby to complete the life cycle. This has been shown by carrying out effective weed control, which reduces or eliminates the infection on the Pines: it is more important in North America where *Coleosporium* rusts can cause considerable damage to Pine trees (Termorshuizen & Swertz, 2011).

Because the rust attacks so many different hosts it is not surprising that early mycologists thought there were several species involved and a glance at the FRDBI will confirm the large number of synonyms for *C. tussilaginis*; including *C. euphrasiae*, *C. melampyri*, *C. petasitis* and *C. sonchi*. However, when the individual species were examined critically no differences could be found macroscopically and it was concluded that they were all the same rust, but possibly different races or race groups according to the host (Wilson & Henderson, 1966). A specific race may only be able to infect one or a small number of related host species despite appearing identical to another race. This applies to the European species which are now all called *C. tussilaginis,* but probably not to those in North America which do appear to be different.

The most conspicuous host must be Butterbur, *Petasites hybridus,* with its huge leaves that are often completely covered underneath with the orange uredinia and spores, making the infection very obvious. The upper surfaces of infected leaves can look mottled and paler green. This is the rust I regularly see and record from the car on road verges and on river banks. The related plant Coltsfoot, *Tussilago farfara,* is another host and gives the rust its name. The leaves also appear mottled and similar orange uredinia can be found on the undersides.

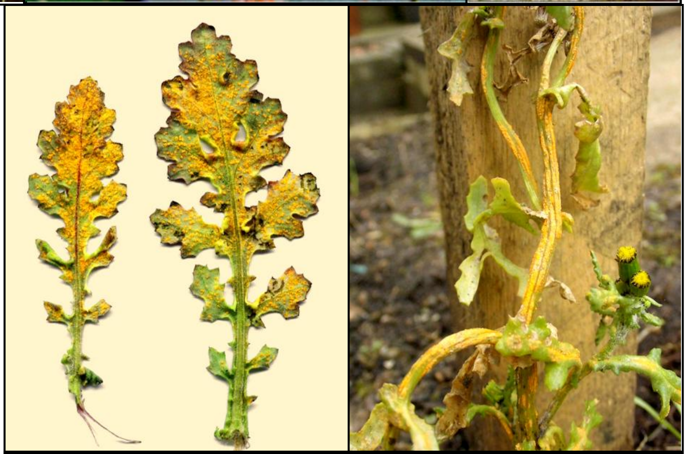
There is a second rust species called *Puccinia poarum* which can infect Coltsfoot leaves and both species may occur together. It can be readily differentiated from *C. tussilaginis* by the little groups of aecial cups which are formed, with white torn peridia and orange coloured spores, thus looking like pretty little flowers especially when viewed with a hand-lens. (All aecial cups should be looked at closely to appreciate their beauty!) They sit on yellow or pinky-purple areas on the leaf, with a corresponding yellow/orange area on the upper surface making them easy to spot. *P. poarum* is a heteroecious rust and alternates with *Poa* species of grass, where the uredinia and telia are formed.

[1] Exhibits all 5 spore stages
[2] Uses 2 hosts to complete its life-cycle

Puccinia poarum on Coltsfoot - upper side of leaf

Puccinia poarum (insert: aecial cups) and small amount of *C. tussilaginis* on Coltsfoot - under side of leaf

Several other plant species in the Compositae can carry the *C. tussilaginis* infection including Sow-thistles, *Sonchus,* species (Evans, 2013) and *Senecio* species, which include Ragworts and Groundsels.



C. tussiaginis (left) & *P. lagenophorae* (right) on Groundsel

C. tussilaginis, infecting Common Groundsel, *S. vulgaris,* used to be a fairly common find, but nowadays it is more usual in my area to find the plants infected instead with the yellow or orange aecial cups of *Puccinia lagenophorae*. These are formed on the leaves and stems and the latter can be swollen and twisted. Gill Brand reports similar observations, (pers. comm.) and it would be interesting to know if other rusters have noticed less *C. tussilaginis* infection on this host.

P. lagenophorae is now very common, especially on *S. vulgaris* and Oxford Ragwort, *S. squalidus*, but only arrived in the UK in 1961, originating from Australasia. Good places to search for all these are waste ground and verges.

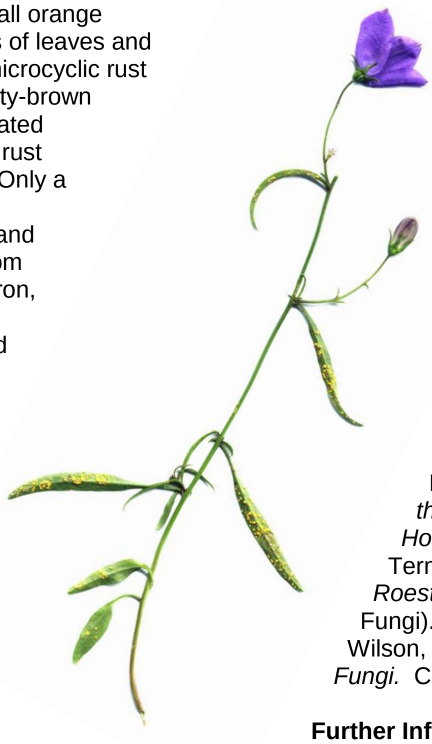
Yellow Bartsia (left) with leaves infected by *C. tussilaginis* (right) - photos by Ian Fraser

A variety of plant species within the Scrophulariaceae are regularly infected in the summer with *C. tussilaginis*, including the semi-parasitic grassland species Yellow Rattle, *Rhinanthus minor*; Red Bartsia, *Odontites vernus*, and Eyebrights, *Euphrasia* species (see photo next page). These plants are common in unimproved grasslands and wildflower meadows. Macroscopically, the plants may look paler and possibly more etiolated: inspection of the undersides of the leaves will reveal the orange uredinia. Telia may also be present, but are not as easy to see. In addition, I have a single record given to me of a heavy infection of the rust on Yellow Bartsia, *Parentucellia viscosa,* which is an uncommon plant locally.

Common Cow-wheat, *Melampyrum pratense,* often found growing in woodland, on heaths and similar habitats can often carry the rust (see photo next page). The orange uredinia easily differentiates it from the very rare heteroecious rust *P. nemoralis*, which produces white aecial cups on the Cow-wheat leaves and alternates with Purple Moor Grass, *Molinia caerulea* (Evans, 2008).

C. tussiaginis on Red Bartsia

Harebell*, Campanula rotundifolia,* and other Bellflower species are further hosts within the Campanulaceae (see photo on right). Despite having very narrow leaves, in complete contrast to the Butterbur, the Harebell can still be infected and small orange uredinia are found on the undersides of leaves and on the stems. There is also a rare microcyclic rust called *P. campanulae,* producing rusty-brown telia on Harebell and a few other related species, but I have yet to record this rust myself despite extensive searches. Only a single recent record exists for Caernarfonshire, VC49 (from 1975) and one record from Anglesey, VC52 (from 1999), both recorded on Harebell (Aron, 2005). It should still be looked for when recording the common rust and is definitely on my 'wish list'!



A scan of the 2 checklists of rust species recorded in the British Isles shows a long list of hosts on which *C. tussilaginis* has been recorded (Henderson, 2000, 2004). These include many wild plants but also several introduced garden plants like cultivated Cinerarias, *Senecio cruentus,* and Marigolds, *Calendula* species. This demonstrates the potential for further new host records in the future. It is thought that these garden plants would have become infected by spores from our native plants (W & H, 1966). All rusters, myself included, like the challenge of finding a new rust species, but almost as satisfying is finding a new host plant for a rust: monitoring garden plants is one possible way. *Coleosporium tussilaginis* - the rust that's 'Here, There and Everywhere' - certainly gives lots of scope for the new (and old) ruster to generate lots of records. Happy Rusting!

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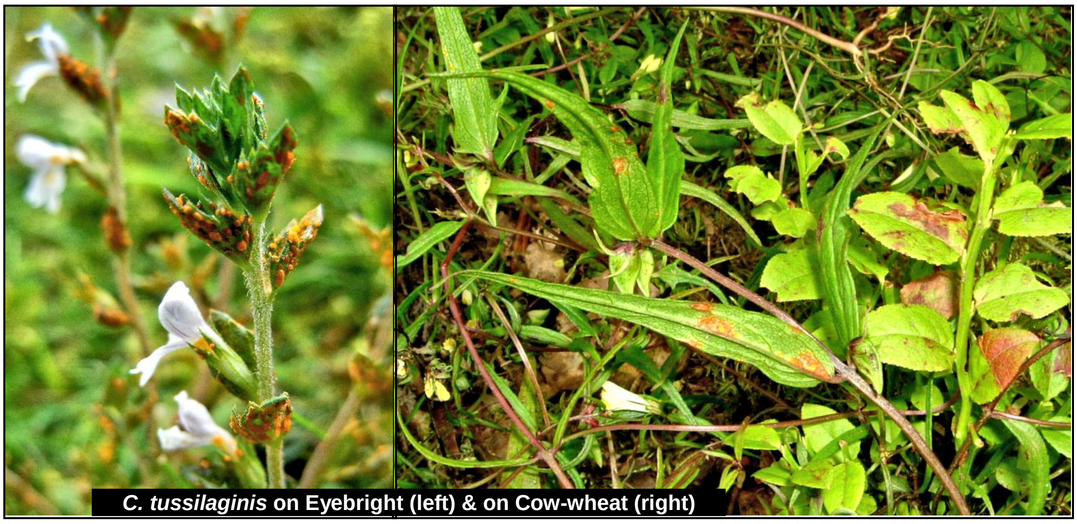

C. tussilaginis **on Eyebright (left) & on Cow-wheat (right)**

OBSERVATIONS AND MUSINGS – A TELLING OF BEADS

Text & photos by Jo Weightman

Some fungi commonly and characteristically 'weep'. Others are tearful only sometimes. The vast majority not at all. Which fungi and where do the beads of moisture arise? When? Why? What?


Abortiporus biennis - Kenchester 2013


Inonotus dryadeus - Shobden Arches 2013


Hydnellum peckii - Culbin 2005


Suillus collinitus - Fowlmead 2010

Which fungi and where?

The first question is fairly straightforward. The Big Four - *Abortiporus biennis*, *Inonotus dryadeus*, *Hydellum peckii* and *Postia guttulata* regularly produce droplets (guttules) on their growing edge, before the pores are formed. In the first three, the droplets are coloured, red in *Abortiporus biennis*, spectacularly blood red in *Hydellum peckii* and amber or tawny in *Inonotus dryadeus*.

Postia guttulata appears to have clear droplets, but young and weeping examples of the 2013 Herefordshire collections reddened on handling. As reported elsewhere in this issue, these were the first GB records so this observation must be treated with due caution especially as this reddening feature has not been observed in continental material.

The boletes *Suillus granulatus* and *S. collinitus* have clear droplets on the upper part of the stipe, the spots drying brown from captured spores; a close, but gilled relative, *Gomphideus maculatus,* occasionally has red ones which leave red-brown to black smudges.

On the other hand, certain species of *Hebeloma* and *Lacrymaria lacrymabunda* weep on the gill edge when the fruit body is fully mature. These gilled species may also have droplets on the upper part of the stipe. In '*The Genus Hebeloma',* Vesterholt almost always mentions whether a species does have, does not have or sometimes has gill - edge droplets, confirming the significance of the phenomenon as a tool to confirm or reach a determination. [*Hebeloma crustuliniforme* and *H. helodes* have conspicuous droplets; in *H. pusillum*, they are small.]

A number of other Hebelomas only weep sometimes, (this 'on-off' group includes the familiar *H. mesophaeum*) and some polypores may produce droplets on the mature pore layer - *Inonotus hispidus,* for example, which I have seen with rusty droplets - coloured by fallen spores - hanging off the pores. In these instances the feature is interesting and has an aesthetic value, but is no use in identification.

So, in some polypore or hydnoid species, droplets occur on a sterile surface; in agarics and boletes on the hymenium, ie the spore-producing surface and sometimes on the upper stipe.

Colour

On the sterile polypore surfaces, does the red colour of the droplets derive from the host?

As *Inonotus dryadeus* occurs on oak, the red might come from the tannin. However, there is no uniformity between hosts - the magnificently be-jewelled *Abortiporus biennis* in the illustration was on either crack willow or Balsam poplar, *Hydnellum peckii* is mycorrhizal with Scots pine and *Postia guttulata* has, thus far, been found only on plantation conifer stumps. Are the droplets chemically the same or are they not?

In *Hebeloma* the droplets may initially be clear or opaque. Some specialists consider this is also a good diagnostic tool, but Vesterholt is not convinced of this. Certainly, the droplets become brown as spores are trapped in them and then leave brown specks on the gills. The tears shed by the Weeping Widow, *Lacrymaria lacrymabunda* become, appropriately, black, again from accumulated spores. The dark smudges on the *Gomphideus* stipe are also probably deposited spores, but I do not know the cause of the bright red of the drops in the first place.

When?
In all instances guttation occurs during active growth – but in the early stages only of the Big Four. Once the agarics and the *Suillus/Gomphideus* species reach their sell-by date, and/or if they become desiccated, guttulation ceases. For identification purposes all is not lost as the captured spores are stranded on the edge of the gills or pores, forming visible brown or black speckles that indicate the site of a dried out droplet.

Why?
While it seems feasible that the function of weeping, as in human sweating, is to remove excess of moisture and/or unwanted substances, there are many further questions and apparently no answers as yet.

Gomphidius maculatus - Curr Wood 2005

Lachrymaria lachrymabunda - Moccas 2013

- Why do some species behave in this way and not others?
- Are they lagging behind or leading the way?
- Is this evolution/experimentation at work?
- Does the discharge confer an advantage on the species or a disadvantage?

I tried seeking an answer online but, although there were sites describing the phenomenon, the only one I found which attempted an answer was one by Parmasto and Voitk, promisingly entitled 'Why do Fungi Weep?' [www.**fungi**mag.com/fall-2010-articles/mushroom-weepLR.pdf]
The authors offer explanations for the physical causes of guttation, but conclude that "a causal relationship has not been proved scienctically'. So the question 'why?' remains.

- Why some parts of the fruit body rather than others?
- As all droplet formation necessarily occurs where the actively growing hyphal tips reach the outer surface of the fungus, why a gill edge, why on the upper stipe?
- Why not on the lower part, or over all the stipe or on the cap or all over the entire gill? (There does, for once, seem to be an answer to this last for, if the faces discharged drops, they would stick together and spore discharge would cease – an evolutionary dead end.)
- So, is there an advantage beyond getting rid of the unwanted?
- Could weeping be a deterrent to the ever present army of munchers when the fungus is at its most vulnerable?
  - offer a wet and slippery barrier to those who might crawl up the stipe and venture into the tubes?
  - Wet and deter those sussing out that here are gills about to discharge their food-rich spores?

Gill edge droplets capture spores and therefore prevent air-borne dispersal, but the number trapped represent such a very small proportion of those that are successfully discharged into the air currents that it is hard to see this as an evolutionary cul de sac. On the other hand, it could be argued that as the fungus decomposes, the stranded spores return to a substrate that has already proved to be a good germination and development site – thus an advantage is gained.

What?
At this point it again became necessary to seek an answer online. An abstract from The Canadian Journal of Microbiology 1978 states:
"Biochemical analyses of the exudates showed that acid phosphatase, beta-glucosidase, acid and alkaline protease. RNase polygalacturonase and cellulase enzymes as well as oxalic acid and ammonia were present."
[www.ncbi.nlm.nih.gov/pubmed/728849]
So, not just water!

Also online, I learnt that the bright red 'juice' on young, moist fruit bodies of *Hydellum peckii* contains a pigment called atromentin which has been discovered as having anticoagulant properties similar to heparin – what a neat coincidence for a species sometimes known as Bleeding Tooth Fungus.

[Just in case it is not immediately obvious, the above ramblings are NOT concerned with the droplets produced by species of *Lactarius* and certain *Mycena,* which arise from damage to gill or flesh; or with captured dewdrops, as in *Hemimycena tortuosa;* or with the dripping of a very viscous coating, as in *Mycena rorida* or *Pholiota aurivella;* or indeed with the pits on the stipe of such as *Lactarius deliciosus* which look like the site of long-gone droplets, but are not so.]

I am conscious I have been vague about which polypores sometimes produce droplets on the pores, giving only one example. This is where members and friends can play a part. In the coming year, please will you make a note of any droplet-bearing polypores you see and let me know. Straightaway is always good, but any time will do!

AN INTRODUCTION TO THE PROTOMYCETALES: *BURENIA INUNDATA* ON *APIUM NODIFLORUM* AND *PROTOMYCES MACROSPORUS* ON *ANTHRISCUS SYLVESTRIS*

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An outline classification of the *Protomycetales* enables clarification of the difference between the *Protomycetaceae* and the *Ustilaginaceae.* Light, electron transmission and scanning electron microscopy of *Burenia inundata* on *Apium nodiflorum* and of *Protomyces macrosporus* on *Anthriscus sylvestris* show the emerging vesicle of *B. inundata* and the relationship of *P. macrosporus* to host vascular tissue. The very early development of *P. macrosporus* galls on *A. sylvestris* is discussed and illustrated.

Keywords: Protomycetales, Protomycetaceae, Ustilaginaceae, *Entyloma* spp., *Burenia inundata, Apium nodiflorum, Protomyces macrosporus, Anthriscus sylvestris.*

Members of the *Protomycetales* are obligate parasites of flowering plants in the *Apiaceae* (formerly the *Umbelliferae)* and *Asteraceae* (formerly the *Compositae).* There is only one family, the *Protomycetaceae,* with five genera: *Protomyces, Burenia, Protomycopsis, Taphridium* and *Volkartia.* Only the first four occur in Britain and of these, *Protomycopsis* and *Taphridium* records are rare. None of them are known on agricultural or horticultural crops except Coriander *(Coriandrum sativum* L.) in India (Gupta & Sinha, 1964). At present the only monographic treatment is that of Reddy & Kramer (1975). The first member of the *Protomycetaceae* to be described and named was *Protomyces macrosporus.* At present, this species is known on 27 genera of *Umbelliferae* and 14 genera of *Compositae* throughout the world. The next in order of importance is *Protomyces pachydermus,* which occurs on *Taraxacum* and seven other genera in the *Asteraceae* only.
+
Other species of the *Protomycetaceae* affect smaller numbers of genera of flowering plants: *Burenia* on four genera of the *Umbelliferae; Protomycopsis* on four genera of the *Compositae; Taphridium* on five genera of the *Umbelliferae;* and *Volkartia* on one genus, *Crepis,* in the *Compositae.* Some are rare on particular hosts, such as *Burenia* on *Berula (vide infra),* or are rare fungi in Britain e.g. *Protomycopsis leucanthemi* on Ox-eye Daisy *(Leucanthemum vulgare)* which was collected by A. Gramshaw in Yorkshire in 1999. (See also Table 1).

Previous confusion of *Protomycetales* and *Ustilaginales*

The taxonomic position of the *Protomycetales* has been much debated. Early mycologists (de Bary, Marshall Ward and Plowright) came to the conclusion that it was a group 'alongside' or the same as, the smut fungi (the *Ustilaginales)* in the *Basidiomycetes.*

However, Savile (1955) suggested that the *Protomycetales* diverged early, in evolutionary terms, from a *Taphrina-like* ancestor. More recent molecular studies have confirmed that the *Protomycetales* are very closely related to the *Taphrinales* (see the reviewby Sugiyama, 1998). A group of Japanese workers, including Sugiyama, have used inferences from 18S rDNA sequence divergence to set up a new group of *Ascomycetes,* the *Archiascomycetes,* containing both species of *Protomyces* and *Taphrina* as well as three other fungi in the genera *Schizosaccharomyces, Saitoella* and *Pneumocystis.* This primitive and early diverging group may have evolved during the coal ages, *ca.* 330-310 million years ago. Large agarics (gilled mushrooms) probably did not arise until *ca.* 130 million years ago. (Nishida *et al., 1993:* Nishida & Sugiyama, 1994; Sugiyama & Nishida, 1995; Sjamsuridzal *et al.,* 1997). Notwithstanding these advances in our understanding, there is a long history of the *Protomycetales* being confused with the smut fungi, especially in the genera *Entyloma, Doassansia* and *Melanotaenium.* The spores of these smuts in leaf tissue are easily confused with those of the *Protomycetales* and it is important to understand the essential difference between the *Protomycetales* and *Ustilaginales.*

Many smut fungi have been previously named as *Protomyces* species. Twelve of these originally misnamed smuts occur on *Sagittaria, Galium, Eryngium, Myosotis, Limosella, Alisma, Arum, Bellis, Calendula* and *Chrysosplenium* in Britain. Illustrations of these may be found in Ellis & Ellis (1985) and in Mordue & Ainsworth (1984).

Table 1 Species in each of the five genera of the *Protomycetaceae* known worldwide according to Reddy & Kramer (1975). The figures indicate the number of different flowering plant genera in which each fungus is reported to occur. In this paper only *Burenia inundata* and *Protomyces macrosporus* are examined.

Burenia	Protomyces	Protomycopsis	Taphridium	Volkartia
cicuta I inundata 3	macrosporus 27 grandisporus 1 gravidus 2 pachydermus 8 andinus 2 inouyeii 1 burenianus 1 lactucae-debilis 1 matricariae 1 sonchi 1	bellidis 1 leucanthemi 2 lyoseridis I leontodontis 1	algeriense 2 umbelliferarum 3	rhateica 1

Recent light microscope and SEM illustrations of the nearly colourless spores of some smuts in leaf tissue may be compared with the illustrations of *Protomycetaceae* in this paper: for example *Melanotaenium* on *Arum* (Preece, *et al.,* 1994); *Entyloma* on *Bellis* and *Calendula* (Preece *et al.,* 1997) and also on *Chrysosplenium* (Preece, Clement & Gramshaw, 1999). These smut fungi in plant tissue do strongly resemble the resting spores of *Protomyces* in their distribution in the tissues, and in appearance.

It is the morphology of the structures produced from spores in the plant tissues, together with their subsequent development, which are critical in the separation of smuts from the *Protomycetales.* The teliospores of smuts, on germination, produce basidia (promycelia), which bear basidiospores. Clear illustrations of this can be seen in Ingold (1998). The work of von Buren (1922) showed that the process in the ascomycete *Protomycetales* is quite different (Fig 1). The resting spores of the *Protomycetales,* often called chlamydospores, but now regarded as ascogenous cells, do not, on 'germination', produce basidia and basidiospores as do the smuts. They produce a single large envelope (a vesicle) containing masses of 'endospores'. This vesicle at first becomes full of wall-less asci (thus it is a *synascus).* Later, the synasci produce masses of ascospores, which are eventually liberated from the extruded vesicle. Using this nomenclature (ascogenous cells, synasci, ascospores), Reddy & Kramer (1975) published the following key to the five genera of the Protomycetaceae:

1 Ascogenous cells formed throughout the tissue of the host ...2
1 Ascogenous cells formed in a single layer beneath the host epidermis 4

2 Ascogenous cells forming ascospores without a rest period; *(vesicle not produced,* but see text) ....**Burenia**
2 Ascogenous cells requiring a rest period before germinating to form a vesicle in which the ascospores are formed 3
3 Ascogenous cells formed intercalarly, smooth walled ....**Protomyces**
3 Ascogenous cells formed terminally, rough walled at least when young ....**Protomycopsis**
4 Ascospores produced within the ascogenous cell, vesicle not produced ....**Taphridium**
4 Ascospores produced within the ascogenous cell or inside the vesicle; vesicle always produced ....**Volkartia**

In the light of the present paper, the three words in italics in choice 2 should be removed; otherwise this is a workable key. Further work may suggest modification, especially as regard the three lesser known genera *Protomycopsis, Taphridium* and *Volkartia.* As regards *Protomyces* and *Burenia,* the important feature is that in *Burenia* the ascospores are very rapidly produced within the ascogenous cells, and freely liberated without a rest period, whereas *Protomyces* requires a rest period (usually until the following spring), its thick-walled ascogenous cell acting as an over-wintering device.

Methods for microscopic study of *Burenia* and *Protomyces*

The microscopic observations of *Burenia* used leaves of *Apium nodiflorum* collected at Sweeney Fen Shropshire Wildlife Trust Reserve, (SJ2725), near Oswestry, Shropshire in May 1992. *Protomyces* was collected on *Anthriscus sylvestris* as described later (and see Fig 12).

Fixation and dehydration. After several hours in 2.5% glutaraldehyde in 0.2M phosphate buffer at pH 6, portions of leaf were washed twice for 30 minutes in O.1M phosphate buffer. They were then post-fixed in 1.0% osmium tetroxide in 0.1% phosphate buffer overnight, followed by washing in buffer twice for 30 minutes, then dehydrated in an ascending ethyl alcohol series, 30 minutes each change.

Scanning electron microscopy. Portions of leaf were critical point dried using liquid CO_2 in a Polaron E3000 apparatus. Specimens were mounted on stubs with carbon cement and coated with 50nm. gold in a Polaron E5300 freeze drier sputter coating unit. Micrographs were taken using a CamScan series 3/30BM S.E.M.

Light and transmission electron microscopy. Following fixation and dehydration, pieces of leaf tissue were twice passed through propylene oxide, 20 minutes each time, followed by an ascending concentration of Araldite for several hours. After full Araldite infiltration, the tissue was kept at 60°C overnight to allow polymerisation. Blocks were cut at 0.5μm using a Reichert Ultracut microtome, and stained in 1.0% toluidine blue in 1.0% borax solution. Micrographs were taken with a Zeiss Ultraphot. For TEM, 90nm gold sections were stained with uranyl acetate and Reynolds lead citrate and viewed with a Jeol 1200 EX electron microscope.

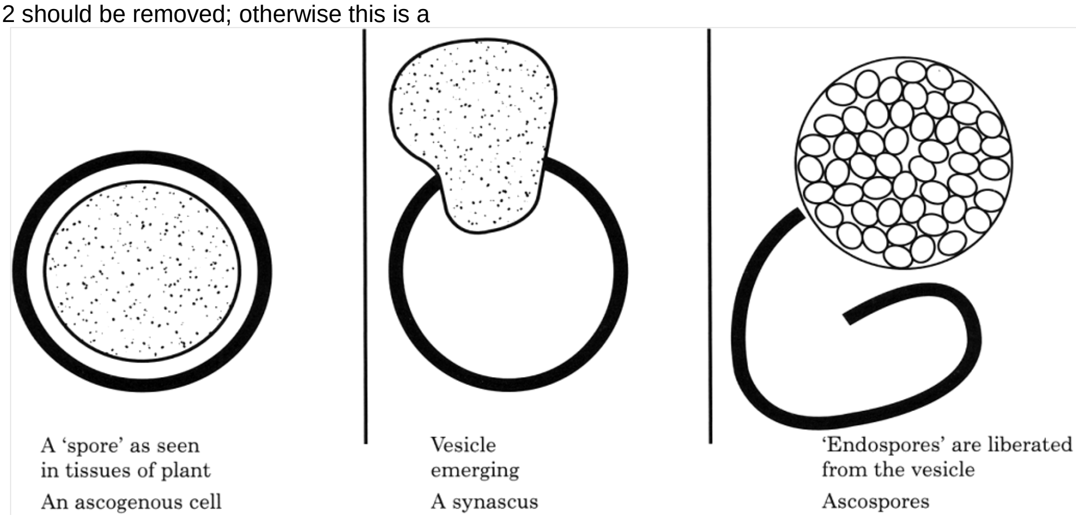


Fig 1 After a drawing by von Buren (1922) showing a thick-walled resting 'chlamydospore' (ascogenous cell) of *Protomyces macrosporus* liberating a vesicle (synascus) packed with 'endospores' (ascospores). In this species of *Protomyces* the process occurs only after a very prolonged resting period. The ascospores are subsequently liberated by the breakdown of the vesicle wall and fuse in pairs before initiating new infections.

Observations on *Burenia inundata* on *Apium nodiflorum* leaves

Of the two known species of *Burenia, B. inundata* occurs on species of *Apium, Daucus* and *Sium* (Reddy & Kramer, 1975). These authors report that *B. inundata* was found for the first time in England, by William Phillips in Shropshire in the summer of 1883. He called it *Protomyces heliosciadii,* since *Apium nodiflorum* was then called *Heliosciadium nodiflorum.* It has been collected in Carmarthenshire in 1998 on *Berula* by N. Stringer (confirmed by B. Spooner), K(M)67008, but there do not appear to be any records on the common *Daucus carota ,* or on the rare Water Parsnip, *Sium latifolium. B. inundata* is probably more common on *Apium nodiflorum,* Fool's Watercress, than the records reveal, but it has not been recorded on *Apium graveolens, A. repens* or *A. inundatum* in Britain.

The second *Burenia* species occurs elsewhere, on *Cicuta. Burenia cicuta* has never been recorded in Britain , but *Cicuta virosa* (Cowbane) is in any case a comparatively rare plant here.

On *Apium nodiflorum,* the characteristic brown-orange areas with swellings caused by *Burenia inundata* probably occur to a much greater extent than is generally realised. *A. nodiflorum* is an exceedingly common plant in lowland Britain and it is difficult to believe that *Burenia inundata* can be rare . Notwithstanding this assumption, the Shropshire Check List (Blackwell *et al.,* 1997) has only two records of the fungus. In Yorkshire Bramley (1985) reported that the fungus was seen "only occasionally" in that huge county. Clark (1980) gave one site for Warwickshire and a recent list of fungi in the New Forest (Dickson & Leonard, 1996) gives only one site. However, we have recorded it since 1992 in Shropshire, Essex, Gloucestershire, Norfolk and Brecon. This may stimulate *Mycologist* readers to look for *Burenia* and other members of the *Protomycetaceae.*

Results of microscopy of *Burenia* in leaves.

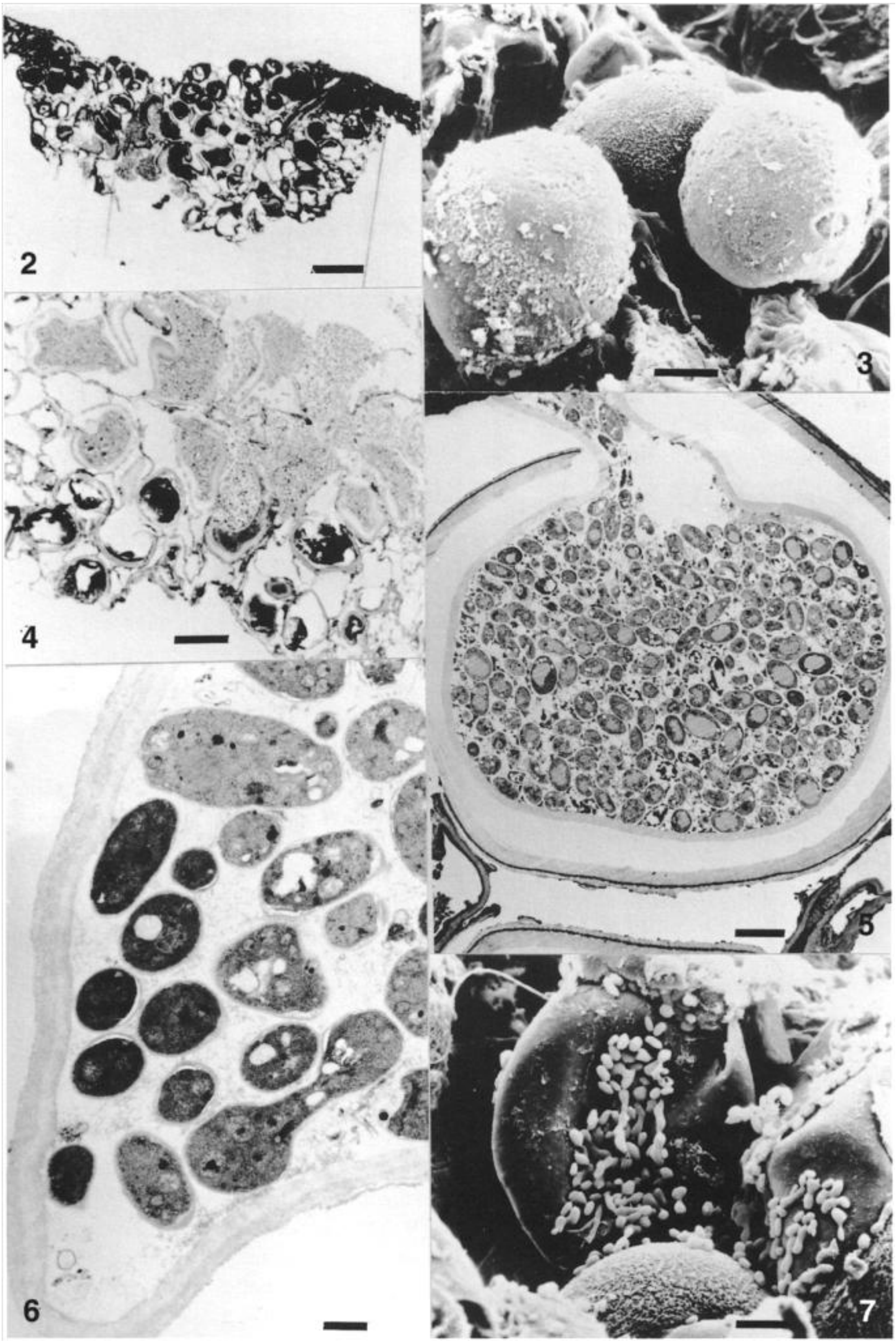
Sections of leaves with brown open galls caused by *B. inundata* show host cells packed with ascogenous cells (Fig 2). Those nearer the surface can be seen to be disintegrating and the contents exuding. At higher magnification (Fig 4) these can be seen to be masses of ascospores. The large *Burenia* ascogenous cells can be seen by SEM (Fig 3) to have a rough scaly exterior. They are approximately 50μm across. Although Reddy & Kramer (1975) considered a vesicle not to be produced by *Burenia* (see key), TEM pictures show that there is indeed a vesicle wall, arising within the ascogenous cell (Fig 5). The vesicle emerges from the thick-walled ascogenous cell via a narrow neck (Fig 5). Thus the *Burenia* synascus is different from that of *Protomyces* in that a vesicle emerges very rapidly without any rest period. This very thin vesicle wall cannot normally be seen by light microscopy. It disappears ('dissolves'?) in the mass of rapidly liberated ascospores (Fig 4).

At higher magnifications (Fig 6) the vesicle wall can be seen to have three layers, the outer and inner ones appearing to be similar in nature. Both within the vesicle, and also as the vesicle contents stream out, nuclei can be seen in groups of four (see Fig 6). It is likely that these are the result of meiotic divisions, the resultant nuclei being haploid, each becoming the nucleus of an ascospore. In transverse sections of the leaf galls (Fig 4) viewed by SEM (Fig 7) the liberated ascospores are seen on the surfaces of the thick walled ascogenous cells. Some are budding, others fusing in pairs as illustrated from artificial cultures of this fungus (Valadon *et al.,* 1962). Ascospore fusions give diploid cells which can re-infect leaves, spreading the fungus to other plants. According to Valadon *et al.* (1962), the fused ascospores form mycelium on the host surface which penetrates the epidermal cells of *Apium,* while unfused spores from budding cells do not have the ability to penetrate the leaf. It seems likely in the case of *Burenia* and *Protomyces* that infection remains localised near the infection site and is not systemic (J. M. Manners, personal communication). As can be seen from Figs 2-7 the ascospores are liberated in enormous numbers in these leaf infections. Nothing is known about the conditions needed for re-infection; this may well differ in *Burenia* and *Protomyces,* related to their very differing habitats.

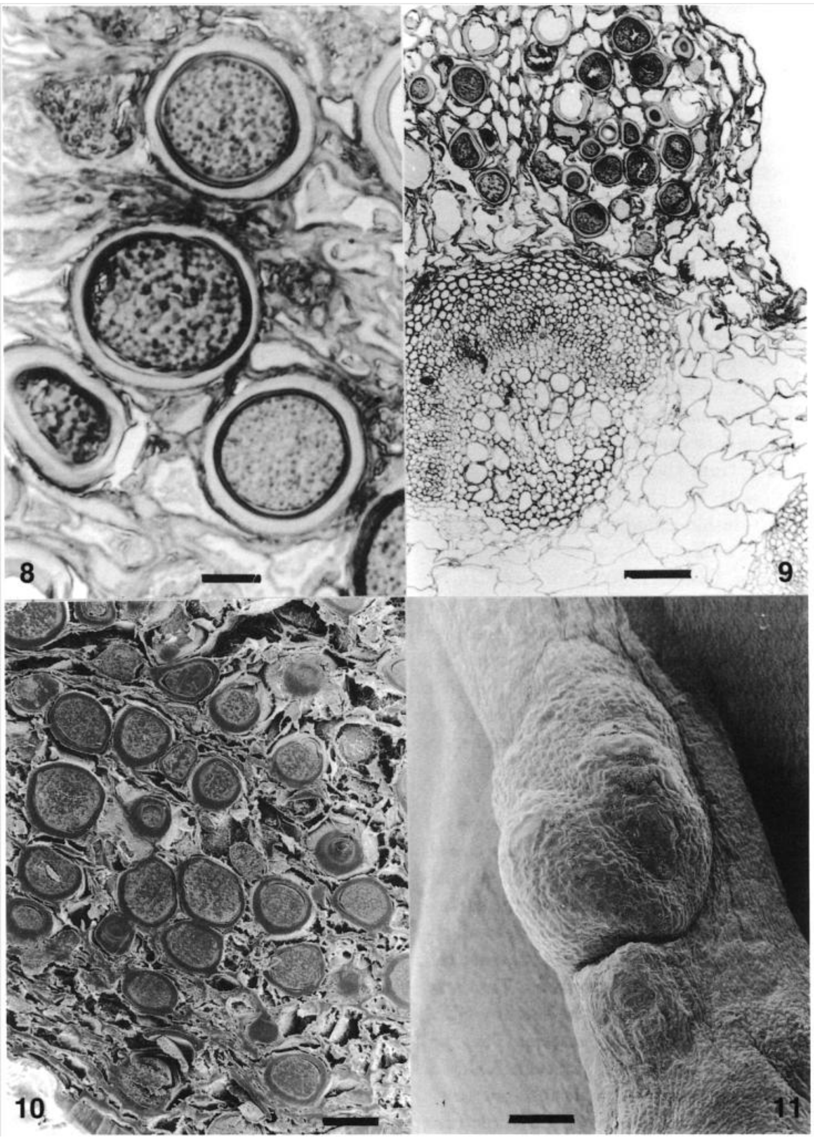
Observations on *Protomyces macrosporus* on *Anthriscus sylvestris*

Protomyces macrosporus accounts for most British records of the Protomycetales. It occurs on 27 host genera. From Britain, there are recent records of *P. macrosporus* on *Oenanthe crocata* (B. Wurzell, Kent 1990 and Surrey 1999) and one on *Torilis japonica* (N. Stringer, Carmarthenshire, 1997). It is, however, usually only recorded on *Aegopodium podograria* (Ellis & Ellis, 1985) presumably because the whitish galls induced by the fungus are easily visible on the very long green petioles of this host plant. It is considered much rarer on Cow Parsley *(Anthriscus sylvestris),* which is one of the most widespread and extensive roadside verge plants in Shropshire. It seems that in agriculture intensive areas, destruction of hedges and herbicide treatment have often left a poor roadside flora now dominated by *A. sylvestris.* Another factor is likely to be the decline in regular cutting or mowing of grass verges which decreases the frequency of *A. sylvestris* (Parr & Way, 1988). This change is also occurring in other European countries. In the Netherlands, research on the biology and control of *A. sylvestris* has been given high priority (Mierlo & Groenendael, 1991). Recent work on the fungal flora of Shropshire (Blackwell *et al.;* 1997) reveals many more records of *Protomyces macrosporus* on *A. sylvestris* than on *Aegopodium podograria.*

Galls of *P. macrosporus* are difficult to find on mature flowering plants of *A. sylvestris,* but from late October to March, young new leaves emerge, often grotesquely distorted by galls of *P. macrosporus.* These can be seen before the young leaves turn green or greenish purple (Fig 12). Scanning electron microscopy shows more clearly entire galls in surface view (Fig 11). Figs 8-10 show that these contain very thick walled ascogenous cells, closely associated with the vascular tissues of the plant (Fig 9). The ascogenous cells are known to produce vesicles and ascospores, but none have been seen germinating in natural material of *A. sylvestris.* Observations at time intervals should reveal the 'germination' of ascogenous cells with vesicle and ascospore production as described by von Buren (1922) for *Aegopodium* galls in detached tissues brought into the laboratory.

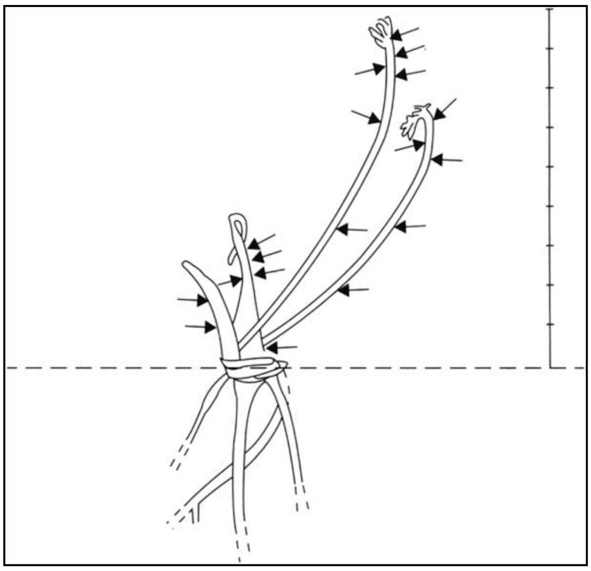


Figs 2-7 *Burenia inundata* within the leaves of *Apium nodiflorum.* Fig 2 T. S., light microscopy, showing gall which is breaking down on the lower leaf surface. Bar = lOO µm. Fig 3 SEM view of ascogenous cells *in situ.* Bar = 15 µm. Fig 4 T.S. higher magnification, light microscopy, showing masses of free ascospores. Bar = 50 µm. Fig 5 TEM of a single ascogenous cell showing burst outer wall at top of picture and the base of the vesicle which is extruding via a narrow neck. Masses of ascospores can be seen within the vesicle. Scale bar 5µm. Fig 6 TEM of structures within the vesicle wall. Four nuclei can be seen at the bottom of the picture (see text) as can the layered nature of the vesicle wall. Scale bar Iµm. Fig 7 SEM view of surfaces of collapsed ascogenous cells at the outer edge of a disintegrating gall. Ascospores fusing in pairs or budding. Scale bar 10 µm.



Figs 8-11 *Protomyces macrosporus* within the leaves of *Anthriscus sylvestris.* Fig 8 T. S., light microscopy, showing ascogenous cells *in situ.* Remains of hyphae can be seen, showing their intercalary position. Bar = 15μm. Fig 9 T. S. as Fig 8, but low power, showing relationship of entire gall, with ascogenous cells, near vascular tissue. Bar = 100μm. Fig 10 T. S. viewed by SEM., which emphasises the thick walls of the synasci, and their dense packing within the gall. Bar = 50μm. Fig 11 SEM view of a single gall, showing position on a leaf vein. Bar = 50μm.

Fig 12 Base of a young plant of *Anthriscus sylvestris,* drawn on 12 February 1998. Natural size. Arrows indicate numbers of white early *Protomyces* galls on the translucent petioles. Nearer the base of the plant the galls are browner and breaking up. Dashed line is soil level. Right hand scale shows cm.
Turner's Lane, Llynclys, Shropshire.



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FUNGAL FRAGMENTS

Contributed by Roger Evans

Mushrooms Can Create Air Currents to Aid Spore Dispersal

For spores to be effectively dispersed they need firstly to pass through a still layer of air which covers surfaces, including the ground. This is known as the 'laminar layer'. Once through, the air is then moving, ie is 'turbulent air'. Generally the laminar layer is just a millimetre or so thick, but spores released into it would soon sediment out onto the ground and thus not be widely dispersed.

Fungi have developed many mechanisms to get their spores through the laminar layer. In Basidiomycetes, the stipes of fruit bodies, or the nature of brackets growing above the ground, appear to have evolved to allow spores to drop into turbulent air.

However, Emilie Dessaire (a professor of experimental fluid mechanics at Trinity College, Hartford, Conecticut) and Marcus Roper (a mathematician from the University of California) have suggested an additional mechanism to aid spore dispersal. They studied this in cultivated Oyster and Shiitake mushrooms using high speed video recording and mathematical analysis and suggest that small water droplets, which appear just before spore release, evaporate, producing water vapour and local cooling. Presumably, this cool air - being denser than surrounding air - sinks; less dense air flows in to replace it and so convection currents are set up. These are easily capable of moving spores into the turbulent air, thus giving them the potential for widespread dispersal. The authors speculate that this mechanism may be widespread amongst mushroom species.

These results were not presented at a meeting of mycologists, but at that of the 66th Annual Meeting of the American Physical Society's Division of Fluid Dynamics. It will be of great interest to see the details of this work when they are published in a science journal

The Fungal Destroyers

Recently a group of scientists, including some from the U.S.A., Imperial College London and the University of Oxford, wrote a paper in which they assessed the threats to animal and plant health.

They suggested that fungi destroy 125 million tonnes (1 tonne ≡ 1000 kg) each year of the World's five most important food crops - namely, wheat, rice, maize, potatotoes and soyabeans.

If

- stem rust on wheat,
- rice blast,
- maize smut,
- late blight of potatoes
- and soya bean rust

were controlled, then 600 million people could be adequately fed each year.