

Helen Beatrix Potter

Beatrix Potter is well known for her children's books and in Linnean Society corridors by the supposed confrontation between male dominated science and herself, or could it have been a confrontation between personalities? W. Phillip Findlay in his volume on fungi in the Wayside and Woodland series, illustrated with Potter's paintings, said

".....But Beatrix Potter was more than an enthusiastic amateur collector and artist. She had the mind of a professional scientist and biologist –"

What reasons induced him to say that? This thesis will be addressed below.

Last year the Linnean Society and the British Mycological Society joined forces and presented a contribution on fungi to the Edinburgh Science Festival. The theme traced aspects of mycology from Beatrix Potter's time to the present with Dr. Mary Noble presenting a paper on Beatrix as a woman and her connections with the Dunkeld postman and naturalist Charles McIntosh; Professor A.J.S. Whalley, John Moore's University, Liverpool showed how fungi effect all aspects of every day life and Dr. S. Moss, Portsmouth University demonstrated modern techniques in studying fungi which we all know Beatrix Potter would have wondered at, especially the electron microscopy as she was among other things a very competent microscopist, and no doubt all these ideas would have stimulated questions in her mind!

After sifting through her folios of coloured illustrations and line-drawings, and through translations of her journal, the present author presented information on how she developed such a deep interest in mycology both at the Science Festival and, in April 1997, at a Linnean Society meeting. In her time the study of fungi was, as now, a "cinderella" subject and for a woman to study these organisms was even more unusual. But why should it be so? Alas, the great interest that my colleagues and myself have in these organisms has been overshadowed for centuries by the study of plants and of the larger animals. This is truly unfortunate as fungi now form the basis of much industry and commerce and studying them *in situ*, as shown by Beatrix Potter, is open to everyone from child to pensioner.

So what was Beatrix Potter's contribution? She undoubtedly had a sharp brain and asked questions, the answers to which have come to light only latterly. I can categorize the various threads of her activities into five main topics; (1) biorecording, (2) germination of fungal and lichen spores, (3) the role of algae in the lichenized fungi, (4) asexual stages in the life-cycle of macromycetes and (5) questioning whether there were such things as hybrids in this last group.

With Beatrix Potter's accurate documentation of all the fungi she illustrated there is no doubt she was aware of the differences in habitat of different fungi, their fickle appearance and, for many, their rarity. Although like most good naturalists she took these factors as a natural extension of her illustration, today such activities have become very fashionable. It is through examination of field data such as these that we begin to unravel the mysteries of our natural world. Two case studies can be extracted from the considerable bulk of Potter's notes. In 1889 a collection of the 'Old Man of the Woods', *Strobilomyces floccopus*, then unknown in Scotland, was found at Crieff on a

foray of the Cryptogamic Society of Scotland. Although Beatrix did not take part herself she knew one of the Perth Drummond Hay family who did, and who brought the specimen to her to paint. In this way, by chance, *Strobilomyces floccopus* came to Beatrix's hands; the actual illustration is in the Perth Museum and Art gallery having been presented as part of a collection of Potter papers from Troutbeck, Ambleside. Potter later realised how rare this fungus was when she collected another specimen in the grounds of the most famous of her family's holiday residences, Eastwood, on the side of the Tay. She painted this collection three times and on the back of the one in the Perth museum there is a map of the locality, the site sadly now having been replaced by a lawn. The specimens were sent to the Rev. John Stevenson, an expert at that time who made an entry of the find in his working copy of *British Hymenomyces*. This fungus, while rare in Scotland, is a feature of the area of Perthshire frequented by the Potter family whilst on holiday. It has been found in the last twenty years at Blackspout Wood Pitlochry, Blair Atholl, Killiecrankie and Faskally; these areas all represent fingers of oakwood which push up into Central Scotland. By 1897 she was very conversant with the British species of larger fungi, probably more so than the members of the staff then at the British Museum, and was confident enough to identify this same fungus for Charles McIntosh, the famous Dunkeld naturalist who helped her so much in her early career.

"..... The fungologist at Kew said he had only seen it once – in the summer of '95 – when he found any quantity in a wood near Watford....." (The only signed letter from Beatrix Potter to C. McIntosh and dated January 22, 1897; the fungologist at Kew would have been George Massee, who was a Fellow of the Linnean Society).

In her collections of illustrations there is one in which she figures the fruiting body, ascus and ascospores – some germinating of a small discomycete which is now called *Lachnellula willkommii* and is the causal organism of canker in larch; on the same page she also illustrates the closely related *L. occidentalis* which is confined to old, fallen twigs. In her notes Beatrix indicates the difference between these taxa based on observations in Scotland, the Lake District, Gloucestershire and Surrey all places where the family spent holidays. The microscopic differences were only demonstrated many years later but in correspondence with Charles McIntosh she discussed his idea of a possible connection between the canker forming fungus and aphids.

" Thank you very much for your interesting letter about the larch disease. I have taken note of it in the Lake District but never saw any aphid but of course it is a disadvantage not to be able to examine the trees at different seasons. I should think if a tree is weakened by one parasite it is less able to withstand the attack of another; or possibly the peziza spore may get into the larch through the blister and bleeding caused by the aphid. The peziza mycelium is very vigorous and spreads in the red lower layer of bark, I have seen it come out in that layer on a broken dead branch at several inches from the fungus. I quite came to the same conclusion about the bleeding of resin, – that it is the peculiar constitution of the larch which does the mischief; I think the fungus does not penetrate at all deeply but that the scar, being open, eats into the trunk. It is so bad in Westmorland that one does not find a straight stem in 500. The woodmen think that it is caused by replanting without cleaning up, and if the fungus is the cause they are right to some extent, because it breeds to an extraordinary extent on heaps of sticks. There is something odd about that particular fungus, supposing it is the cause of the disease for others like it seem harmless. I have seen

one very like it in Gloucestershire & Surrey but the live trees were scarcely diseased at all". (Letter to Charles McIntosh, dated Jan 22nd, 97; 2, Bolton Gardens, S.W.).

Little did she know that years later there would indeed be an important disease of beech caused by the union of woolly aphid and an until then saprotrophic *Nectria*. Beatrix actually figures on the same plate as the *Lachnellula* a *Nectria* and from the spore characters and habit it can only be *N. cucurbitaria*, so although she did not realise the significance of this small perithecial fungus she illustrated it accurately enough to allow identification.

This shows parallelism with her plate of *Aleurodiscus amorphus* known to Beatrix as *Corticium*, and which Charles McIntosh (who is very probably the model of her character Mr McGregor in the Story of Peter Rabbit) was asked to collect for her.

".....Do you think you could get me a fungus called *Corticium amorphum*? It grows on fir bark and looks at first like *Lachnea calycina*, but afterwards sticky like *Dacrymyces*....." (Letter to Charles McIntosh dated Jan. 12th, 97; 2, Bolton Gardens, S.W. The *Lachnea* referred to is *Lachnellula* noted above, the epithet being preoccupied).

In this illustration, in addition to the fruiting bodies, she showed the basidium and basidiospores including one germinating, the first time as far as we can tell, that this had been achieved. In addition there are germinating spores of *Alternaria*, a common *air spora*, and some small, hyaline globose bodies. In her letter to McIntosh she describes accurately that the fungus becomes like *Dacrymyces*, gelatinous in age; her illustrations allow us to identify this gelatinization as being caused by a parasitic *Tremella* on *Aleurodiscus*.

This is the first record of *Tremella simplex* for Britain. Following this interesting observation examination of herbarium material in Edinburgh and in Kew was undertaken (the latter by Peter Roberts) and the results indicated that the fungus is rather widespread wherever the rare *Aleurodiscus* is found. It was on the occasion of the European Congress in Ambleside that Dr. Jim Ginns from the Canadian Agricultural Services, having examined Beatrix's original painting, brought this possibility to the attention of mycologists after seeing the 'small, hyaline, globose bodies' mentioned above. Why ask specifically for *Aleurodiscus*, a rare fungus at the best of times, to carry out her studies? After all, there are many other fungi in which to study spore germination but not many with a distinctive mycoparasite growing with it!

As indicated in this same letter and in other later communications Potter had become quite familiar with the discomycetous fungi and had put on record through her illustrations some unique observations on germination; obviously she wished to do more –

".....I should be glad if any pezizas, Mr Masee at Kew Gardens can name them from dried specimens. He says they have been drawn less than agarics and advised me to keep to one division of fungi. I find plenty of microscopic pezizas but no large ones yet....." (Letter dated Aug 20, 96; 2, Bolton Gardens, S.W)

From her journal and letters we learn that Beatrix Potter visited the British Museum, which was only a short walk from Bolton Gardens, on several occasions wishing to get to grips with the idea of the dual origin of lichens. She had read extensively and attempted to

cultivate both the spores of what we now call the mycobionts and cells of the algal partner. She illustrated extensively her experiments and many can be seen in the collections of her works in the Victoria and Albert Museum. Although she encountered many contaminants in her work there was still enough information which led her to support this then rather unfashionable hypothesis. Her searching questions as to whether the algal partner had spores, whether the partners were symbiotic and how the two partners came together etc., and her persistence, had people running from her. Mr George Murray '*fled and so did Miss Smith the librarian*'. She was one of the small band which believed in the dual organism theory, a group which was to become larger when more and more studies were carried out; we now know that these organisms are indeed mutualistic and are termed lichenized fungi; they are even classified within the fungi.

In a letter she writes

".....My difficulty about lichens is to find ripe spores for experiments, I scarcely know what to look for. I have succeeded in growing spores of *Cladonia*, but larger spores would be more convenient. You see we do not believe in Schwendener's theory, and the older books say that the lichens pass gradually into hepatics, through the foliose species. I should like very much to grow the spore of one of those large flat lichens, & also the spore of a real hepatica in order to compare the 2 ways of sprouting....." (dated Jan 22nd, 97; 2, Bolton Gardens, London S.W.).

All this activity in germinating spores of as wide a range of her finds as possible made her realise that many fungi had 'mould' states and she indicates in her letters to McIntosh that it should be more universally appreciated that agarics had conidial forms, something which was not widely known except by those who had read the volumes on fungal biology by the German mycologist Oscar Brefeld. Beatrix considered his work not thorough enough, referring to him as a *Dacrymyces*, a genus mycologists know as producing a jelly-like and polymorphic unstable fruit-body – see the above discussion on *Aleurodiscus*.

".....What I have been doing is to sort out the 'Hyphomycetes' which in great part are not real 'species' at all, which has been suspected for a long time, but it was not previously known that they belonged to Agarics as well as to pezizas..." (Letter to Charles McIntosh dated Feb 22nd, 97).

and

".....I am trying to work out the moulds = conidial forms, of the mushrooms; exceedingly difficult to grow...." (Letter to Charles McIntosh dated Sept. 21st, 97)

This was a quite startling revolution. The present author and Professor Kendrick revealed at the Kananaskis conference in 1978 how important these stages are in the biology and taxonomy of the larger fungi. Nor had she given up her work with fungi after the Linnean meeting as often supposed; she was still asking McIntosh to supply *Aleurodiscus* in her continual search for an understanding of mutualism – she actually labelled in pencil the *Aleurodiscus* 'lichen' on the back. Was she thinking (what we know now) that some jelly fungi are mycoparasites and form in the field compound structures involving two organisms?

It was the work on germinating basidiospores of agarics which was the subject of her

paper presented to the Linnean Society in April 1897 and entitled 'Germination of the spores of the Agaricineae '

".....I have grown between 40 & 50 sorts of spores, but I think we shall probably only send in *A. velutipes*, which I have grown on twice and Mr. Massee has also grown according to my direction at Kew."..... (Letter dated Feb 22nd, 97; 2, Bolton Gardens S.W. *A. velutipes* refers to the fungus now known as *Flammulina velutipes*; see below).

She had taken a considerable amount of time over the preparation of the paper with much heart searching and even worked over Christmas of the previous year and into the New Year holidays.

"..... My paper was read at the Linnean Society and 'well received' according to Mr. Massee, but they say it requires more work in it before it is printed" (Letter to Charles McIntosh dated Sept. 21st, 97).

Alas, we do not have the manuscript. Although her results were accepted by biologists such as George Massee, we cannot judge what modifications were necessary; the additional work required was never completed and so sadly the paper never appeared in print. Massee was antagonistic at first towards her results, incidentally, but subsequently realised the significance of her studies.

Flammulina velutipes grows well in culture and produces a white fluffy mycelium; the spores do not require any prior special treatment, which was just as well as Beatrix Potter worked in her kitchen. Although she was very successful, such primitive working conditions would not be tolerated by mycologists today.

She writes in her journal and letters that her uncle Sir Henry Roscoe had read an early version and made suggestions. The only legacy of her outstanding work in this field is to be found in the folios of illustrations found in the Armit Trust, Ambleside, Perth Museum, and in The Victoria & Albert Museum.

As indicated earlier, although Beatrix Potter had worked on many subjects the major part of her work was based on using *Flammulina velutipes*, the supply of fresh material for which she relied in part on Charles McIntosh.

"...The last plants were particularly beautiful, *Agaricus variabilis* is almost like a pansy, and *A. velutipes* also very handsome. A curious thing has happened to the piece of broom on which the latter was growing, it was put away in a tin canister and forgotten, and now another species of fungus has sprung up. It is pale straw colour, grown entirely in the dark, and there are nearly 100 fingers, the longest measures 1.25 inch. Miss Potter wonders whether it grows out of doors at this season or whether it is brought out by the heat of the room? it was about this size (sketch) when first observed but being moved into a hot cupboard near the kitchen chimney, it puffed out in a very odd shape. The last shoots that have grown are the same size all the way up....." (Letter with sketches to Charles McIntosh dated Dec. 10th, 92; 2, Bolton Gardens, S.W.)

In fact the excentricities of fruit-body development she illustrated were of the very same fungus, *F. velutipes*; it is rather surprising she did not realize this. When the canister was opened there was an etiolated cluster of basidiomes. Little did she appreciate that fifty or so years later very much bigger, etiolated fruit-bodies of this same fungus would be on our supermarket shelves for sale as food. The Chinese,



Flammulina velutipes – watercolour on paper.

Japanese and others in S.E. Asian countries have long been growing this fungus to produce long, pale yellow straws under the name of Enoki. The fruit-body when found in the field is edible, although rather tough and gelatinous and said to contain compounds thought to aid one's health. As etiolated specimens, however, they are considered a delicacy. The idea that these elongated basidiomes might be a different fungus was confirmed by her finding it again in Jan. 1897:

"I think I have found the new fungus again, I can hardly describe the difference, it is drier than *velutipes*, both pileus & gills, rather broader & shorter and a peculiar smell, gills a deep yellow when old, also inclined to become discoloured in patches....." (Letter to Charles McIntosh dated Jan 22nd, 97; 2, Bolton Gardens, S.W. London).

Beatrix Potter spent some time at Coldstream and it was probably there that she pondered more extensively the question as to whether there are hybrids amongst the larger fungi, especially the boletes. The Border County of Scotland is a wonderful place to study members of the genus *Leccinum*, the rough-stalked boletes. There probably was an array of taxa then fruiting and because they look so alike with the characters appearing to run one into another this question was paramount.

"...Have you ever suspected that there are intermediate species amongst Agarics & Boleti? We are strongly of opinion, for certain good reasons, that there are mixed fungi – that is to say – either growing actually upon a mixed network of mycelium, or else hybrid species which have originated in that way. I do not express any opinion which way only that they are intermediate.

Of course such an idea is contrary to the books, except for lichens but I would be curious to hear whether you had had difficulty in naming any of the sorts which I suspect. Have you noticed whether fungi described as 'varieties', are constant in type?....." (Letter to Charles McIntosh dated Jan 12th, 97; 2, Bolton Gardens, S.W.)

These various morphologically separate but close species have been placed for generations under two names *Boletus* (= *Leccinum*) *scabrum* and *versipelle*. Charles McIntosh wrote to Beatrix in 1896 that:

"*B. scaber* & *versipelle* are very like I dare say one would need to see them pretty often to be able to know the differences easily".

The present author has been at pains over the years to demonstrate that they do represent truly different species and that hybridization is not involved. Recent DNA work supports the multitude of species. It is true that some hybridization has been demonstrated in a few pleurotoid fungi which, although considered distinct species in virtue of their distinctive DNA fingerprints, do occasionally mate, although the phenomenon is rare. Beatrix obviously realised the potential of using culture work to decide whether hybrids might form or not.

"...If I am right it will be possible to work out which of the Boleti are hybrids but it will take many years at the present rate..." (Letter to Charles McIntosh dated Sept 21st 97).

The 'we' in the letter dated Jan 97 must refer to Sir Henry and herself but nowhere is there evidence of any further discussion or expansion of this subject which is unfortunate for it has interesting possibilities.

The letter discussing the concepts of hybridization never seems to have been finished. Why we will never know. In fact Beatrix Potter's interest in mycology appears to finish also with this letter and although she illustrated fungi as part of her stories they only take from then on a very minor role. She had other interests and many personal hurdles to overcome. Perhaps she just became fed up and wanted to move on. Many years later she did just that with children's stories, becoming disillusioned and seeking new challenges – she moved on to rearing prize sheep! Surprisingly she also lost all

contact with Charles McIntosh as though wishing to keep the various compartments of her life separate. She was, after all, greatly indebted to McIntosh for the supply of fresh collections, discussion and guidance.

The original letters on which this paper has been based are deposited in the National Library of Scotland, with photocopies in the libraries of the Royal Botanic Garden, Edinburgh, the Armitt Trust, Ambleside, Perth Museum and Art Galleries and the Linder Trust at the Victoria and Albert Museum, London and the personal collections of Dr Mary Noble and myself.

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Beatrix Potter's fossils and her interest in geology

Beatrix Potter became interested in fossils in her late twenties as a consequence of a visit to her cousins, the Hutton family, who lived at Harescombe Grange, near Stroud, Gloucestershire in June 1894.

The Hutton family had strong geological connections. The maternal grandmother, Sophia Holland of Dumbleton, near Evesham, was a renowned collector of Liasic fossils, particularly insects and fishes, while Robert Hutton of Putney Park was keenly interested in the earth sciences. Mary Hutton was a committed geologist whose collection of fossil sponges and Bryozoa from the Jurassic and Cretaceous was eventually donated to the British Museum of Natural History on her death in 1937.

Harescombe, a small village deep in the heart of the Cotswolds, is situated on the Inferior Oolite (the lower part of the Middle Jurassic). Much quarrying, both for building stone and for road metal, has gone on in the area. Consequently, there are numerous fossiliferous quarry faces to be scoured.

Although in her diary Beatrix only mentions fossil collecting on two occasions during her first ten day visit, Mary and Caroline Hutton took her to the most important Lower Limestone quarry on Huddinknoll Hill, some 350 yards east of Harescombe Grange.

"We went up on the common above the copse after dinner and picked up fossils"

and to the very much larger quarry on Scotescuar Hill:

"On Wednesday in the morning we went after fossils"¹

By the time of her second visit to Harescombe Grange on Saturday, June 8th 1895, Beatrix had become an ardent fossil collector. After ten days she had not only collected many fossils, but had also photographed and painted a selection of them.