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MICROBIOLOGY IN SCHOOLS ADVISORY COMMITTEE
50th Anniversary Articles

The fundamentals of science: What can we learn from Beatrix Potter?

Roy Watling

Beatrix Potter is well-known throughout the world for her illustrated children's books incorporating various animal characters such as Peter Rabbit. It is not so well-known that she was an exceedingly good naturalist; the animals she depicted are anatomically sound, and were based on her noting the movements of her pet rabbit and captive animals, and the dissection of dead animals. It is even less well-known that she was an excellent mycologist, often ahead of her time, but was not recognised as such by the scientific community. There has been considerable discussion why this was so, but the focus of this article celebrates the fundamental discipline of all biologists demonstrated by Beatrix: accurate observation.

In the 1890s Beatrix Potter grew fungi from spores in the family kitchen, recording their development from spores to mycelia and in some cases to their asexual state. Only a handful of people at that time knew that mushrooms have such asexual states and even today the topic is not fully appreciated. Potter's Illustrations, made at regular time intervals, may be found in the archives of London's Victoria and Albert (V&A) Museum. She even submitted a fully illustrated manuscript to the Linnean Society of London and although it was well received it never saw the printed page, until rediscovered a few years ago. The fungus she had observed most carefully was *Agaricus velutipes*, now *Flammulina velutipes* (the Velvet Shank mushroom). She had also kept this fungus in a box without daylight and when she opened the container she thought that the long, sinuous structures she found therein represented a new species. They were, in fact, the etiolated fruiting bodies so characteristic of this species when denied light, a feature exploited in its commercial production as 'Enoki', the popular edible fungus.

On the Potter family holidays in Dunkeld, Scotland, Beatrix met the well-known amateur naturalist Charles McIntosh (who is thought to be the inspiration for Mr McGregor in her children's stories). Their correspondence included a microscopic cup-fungus which Beatrix had observed and recorded; it had a white, fluffy outside and a bright orange disc and was found both on piles of conifer twigs and on living Larch trees around Dunkeld. She observed that the latter were always associated with swellings and lesions on the trees. Through discussion with McIntosh they concluded that these were very probably different species, the first being a saprotroph on conifer twigs and the latter introduced into the Larch by infection caused by plant-sucking insects, possibly aphids, thus damaging the host-bark.

The two were indeed separate species, something which was demonstrated at a much later date. The beauty of Potter's illustrations is that she made accurate observations and records from which she drew conclusions and was uninfluenced by opinion at the time. In her journal, she indicated how she had to struggle with the British Museum of Natural History lichenologists when she questioned whether lichens were two organisms or one. Her argument was partly supported by her illustrations of various lichen spores, now in the V&A London, which appear to produce fungal spores. We now know that lichens are a partnership between fungi and algae.

Beatrix's interest in lichens lead her to investigate, with the help of McIntosh, a crust-fungus which we now know as *Aleurodiscus amorphus,* (**Figure 1**) which apparently grew as different forms, a foliose (leaf-like) structure reminiscent of lichens and some gelatinous structures. Beatrix illustrated these in her figures (collection of Beatrix Potter illustrations at the Armitt Museum, Ambleside, Cumbria) with beautiful representations of

basidia, the spore 'guns' and basidiospores, some of which were germinating (**Figure 1**).

But were there two fungi involved or was it a lichen? Also illustrated on the plate are some small, rounded, yeast-like cells. It remained a mystery to Beatrix. It took a Canadian mycologist who was visiting me many decades later to solve the issue. He wished to see the Armitt plates to identify what Beatrix had depicted. He gasped with delight when he saw the illustrations. The yeast-like cells were those of *Tremella simplex* (**Figure 1**), a fungus parasitic on the *Aleurodiscus,* which formed the gelatinous structures also illustrated on the plate. This was the missing part of the puzzle. The jelly fungus was growing on the fruiting bodies of the crust fungus and because Beatrix accurately illustrated it, the parasite was easily recognized but the fungus itself was not described as new to science until nearly 50 years later!

What does this tell us about this incredible lady who also noted in her scrapbooks observations on butterflies, beetles and fossils? It tells us something which is just as important today as it was then, whether you study ecology, laboratory experiments or molecular sequence inter-pretation. It is to carefully observe and record the structures or processes accurately, uninfluenced by current thoughts. If students of all ages from primary school onwards are introduced to these simple but essential techniques of scientific method then strides can be made in biological science. Many of the so-called cutting edge 'discoveries' made today through molecular technology might actually be hidden in archival publications and illustrations. The molecular techniques are tools in our hands which often support these early observations and give them a more scientific credibility. Based on this kind of experience, one is then in a position to ask the demanding questions of science.

Who would have thought that Beatrix, in an age where women were not recognised as scientists, would have even considered such demanding questions if she hadn't made meticulous observations of the actual fungi in the field.

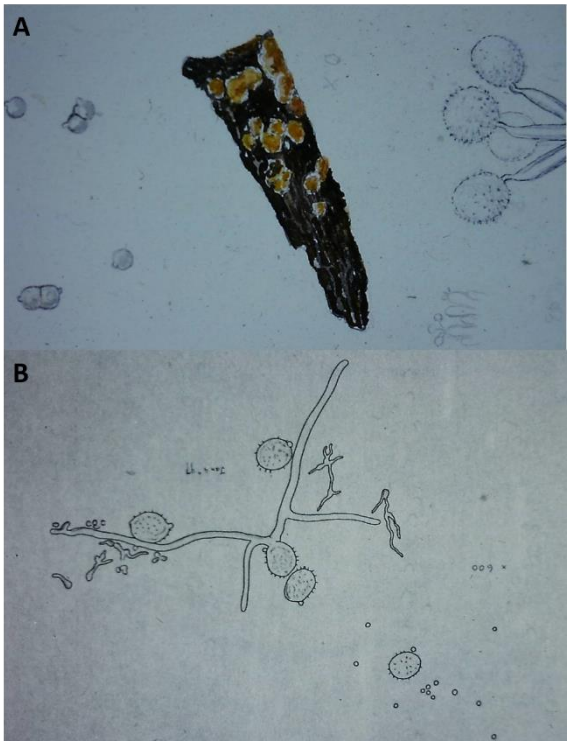

Figure 1. Beatrix Potter's illustrations of *Aleurodiscus amorphous*. Top panel (A): on wood, with accompanying drawing of a basidium with four basidiospores. Lower Panel (B) germinating spores (with spikes). The small yeast-like cells in the lower panel are of *Tremella simplex*, a gelatinous fungus parasitic on *Aleurodiscus*. Credit: The Armitt Museum, Ambleside, Cumbria

AUTHOR PROFILE

Professor Roy Watling MBE FRSE was Head of Mycology & Plant Pathology and acting Regius Keeper at the Royal Botanic Garden, Edinburgh, for many years. He also held the positions of Chair of the Scottish branch of the Royal Society of Biology and President of the British Mycological Society. During a lifetime of studying fungi he has travelled extensively teaching, mentoring students and carrying out field work in many parts of the world. He has won many honours and awards for his services and published several books, scientific and popular articles and contributed to media broadcasts on mycology.

This article is one of a number invited as part of the MiSAC 50th anniversary celebrations. The articles are written by experts and are both up to date and relevant to microbiology in schools. MiSAC is grateful to all contributing authors.