

The book cover features a vibrant, stylized illustration of a forest floor. In the background, there are dark, silhouetted trees against a red sky. The ground is covered with a variety of mushrooms, including large white ones with grey gills, red ones with white spots, and several dark brown ones. The foreground is filled with green grass, clovers, and fallen autumn leaves in shades of orange and yellow. The overall style is colorful and artistic.

BRITISH WILDLIFE
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1

Mushrooms

Peter Marren

BLOOMSBURY

Mushrooms







Mushrooms

The natural and human world of British fungi

Peter Marren

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Dedication

To my mentors in field mycology:
Roy Watling, Malcolm Storey and Ted Green.
Peter Marren



A donation is made to Plantlife for every copy sold.

Frontispiece: Honey Fungus in the New Forest *Bob Gibbons*

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Foreword

Mushrooms have never been more popular than they are today. Fungus forays are firmly on the autumn agenda – not just for specialists but for anyone with the slightest interest in mushrooms. Mine attract people of all ages, from wide-eyed young children to their parents and grandparents. Conservation organisations now talk about their plans and research programmes for fungi, while restaurateurs routinely serve ‘wild mushrooms’ which, at least in some cases, are genuinely wild and not cultivated. We have also become much more conscious of the dark world of fungi, even if we notice them only for a few weeks in the autumn when they push their bald heads through the lawn, or sprout in tiers and fans from wood piles and logs. There is, in my experience at least, an eager audience for tales of mushroom magic, whether factual or fable, whether impersonally biological or concerned mainly with the kitchen. There are, indeed, two ways of looking at fungi. One is through scientific inquiry, aimed at establishing the truth about how they grow and reproduce, the habitats they exploit and the means by which they compete for resources. The other is concerned with what might be called their cultural value, from the different perspectives of the gardener, the walker, the cook, the land manager, in fact, anyone with a view.

In this book, I have tried to combine both the cultural and scientific approaches in a narrative that takes us from what fungi are, and what they do, to the ways in which we use or take delight in them. This is not a field guide. There are several excellent guides to identification in print and it is not my intention to add to them. Nor is it a textbook on the science of mycology. I have aimed instead at writing a personal account of the wonderful world of fungi in which I have been sometimes a bystander, sometimes a participant, since my boyhood half a century ago. Hence, I begin unconventionally with my own fungal autobiography. From there, the narrative introduces the fungi in all their glorious diversity, the often unexpected ways in which they survive in a deeply competitive world, and the pleasure they give to so many of us. There is no glossary. I have avoided technical terms except where they are absolutely necessary, and in such instances have explained them on the spot. Nor are there any keys, graphs or tables of data. I have used

English names and scientific names together. And, above all, I have done my best to make use of my own resources and experience as a natural-history writer. I hope this book will be a pleasure to browse through and read, and that it may even make you smile from time to time.

It is a pleasure to thank the many friends and colleagues who have helped me with this book. The following have found intriguing items in the press or have donated ideas and images: Jill Butler, Bryan Edwards, Sandy Coppins, Sue Everett, Liz Holden, Ted Green, Bruce Ing, Geoffrey Kibby, David Mitchel, George Peterken, Dave Shorten, Brian Spooner, Fred Stevens, Malcolm Storey, Des Thompson, John Wright, Mark Wright and the image libraries of Plantlife and the Royal Botanic Gardens, Kew. I thank the contributors to Wikimedia Commons for their selfless policy of allowing their images to be used free of charge. Scottish Natural Heritage generously allowed us to make use of the excellent images taken by David Genney. Similarly, my old friend Bob Gibbons came to our aid with his own marvellous images, many of them taken on our field trips together. The publisher would also like to thank Paul Sterry and Barry Hughes of Nature Photographers Ltd for allowing access to their wide ranging collection of excellent images.

I am very grateful to Peter Roberts for reading and commenting on the entire text, and to Martyn Ainsworth for his perspective on two of the chapters. And I must express my warm appreciation of the contribution of Victoria Chester and Plantlife International, a body that helped to establish fungi in the conservation agenda, not least by bringing all the main players together in a forum.

For this book I had the advantage of working with the founders of British Wildlife Publishing, who are also old friends. Thank you, Andrew and Anne Branson for producing a beautiful book.

The responsibility for any mistakes is, of course, solely my own.

Peter Marren
Ramsbury, 2012



A fungal autobiography

For as long as I can remember, fungi, especially mushrooms and toadstools, have been part of the landscape of my life. They were rarely centre-stage, and the passion has taken different forms over the years. To begin with, it was just a wide-eyed fascination for the strange growths with smudgy gills that appeared towards the end of the school holidays, along with the rain and the fallen leaves. I liked the way they seemed to come from nowhere, as though they were not so much living things as upheavals of the earth. I tried to identify them with my *Observer's Book of Common Fungi*, and later (and with more success) with the first Collins field guide, universally known as Lange & Hora. My passion for fungi has never been particularly academic. Rather, I love them for their own sake, intellectually engaging in their difficulty, of course, but also delighting in their myriad colours, shapes and scents. They brighten up the autumn in every sense, just when the natural world seems to be going to sleep.

My first awareness that there were such things as fungi probably took place in the kitchen. My father enjoyed field mushrooms for breakfast – not the soppy little supermarket buttons but flat, black-gilled wild ‘mushies’ picked from the airfield, with their scents of ink, earth and decay. I remember the fleshy discs sizzling in the pan, and thought to my six-year-old self that they were a funny thing to want to eat. Even odder was my father’s queer taste for baker’s yeast (another fungus, although very unlike a mushroom), which he kept in a paper packet and swallowed by the spoonful after a brush with nephritis. He never ate any other kind, although my mother vaguely remembered blewits, or ‘blue-tails’ as she knew them, sold at the market in Leicestershire when she was a girl.

◀ **Dreaming of Fly Agarics.**



▲ **The Observer's Book of Common Fungi**, the beginner's mushroom book for the generation born in the 1950s and 1960s.

Dad's breakfast aside, my grand inaugural meeting with wild fungi came when we lived in the Peak District at a bleak and terrible place called Harpur Hill. We inhabited an RAF married quarter near the top of the hill, where the bitter wind flapped the washing lines and the trees grew straggly and partly horizontal. Beyond the stone wall that marked the end of the bit of hillside which we called a garden lay a further rise to a rocky hilltop. We called it Barker's Hill. It was a wonderful place to roam, high above the village with views over quarries, crags and vales. In September, the sheep-cropped grass suddenly sprouted colourful mushrooms the consistency of candle wax, red, yellow and orange, some shaped like umbrellas, others like little yellow rockets. They were waxcaps, not that I knew it at the time. But I thought them pretty cool, with their strange waxen skins, like fungal sweets.

My Observer's Book, by Elsie Wakefield (a real auntie name), failed on the waxcaps, but it did unfold a wonderful parade of puffballs, stink-horns and all sorts of other mushies, some 'edible and good', others 'not edible' or even downright 'poisonous'. There was one of those right at the beginning of the book, clearly a top fungus, called the Death Cap. If you ate it you died in horrible agony over several days, and *there was no known cure*. Wow! I longed to find a Death Cap, and even more so its red, spotty neighbour, the Fly Agaric (it became a family joke, this name, which my father insisted was pronounced *argh-grick*). At the age of six you have had little experience of life outside the home, and no ability to contextualise knowledge. What you do have in spades is curiosity and its helpmate, imagination. What naturalists have in common, I think, is the eagerness, or stubbornness, to hang on to these precious things in later life. We retain a child's eye for wonder, we bug-hunters and bird-spotters. One day, I told the hidden companion inside my little head, I would find a stately troop of phantasmagoric Fly Agarics in some magic woodland dell, perhaps with toads squatting on top, and would feel like a conjurer.

My relationship with fungi did not develop much further until my early teens. My family lived peripatetically, usually based somewhere near an airfield, and moving on every two years or so with each RAF posting. Although most of our homes were more comfortable than the wretched Harpur Hill, none of them were as productive for fungi. Eventually, like most RAF officers' boys of the day, I was sent to boarding school. Cut off from nature for most of the time, I could only day-dream about it. There was school biology, of course, but, apart from



a few trips to ponds and streams, it was of the indoor kind. And there was no mycology at all. ‘I can tell you the names of about 500 species of fungi,’ I boasted to the biology teacher. I don’t think he asked me to prove it.

Then, as a fresher at Exeter University in the autumn of 1969, I suddenly found myself in a mycological environment. That first weekend, the department had organised a fungus foray. By happy chance, the new Professor of Biological Sciences was that rare and now practically extinct being, an academic mycologist. John Webster (always Professor Webster then) was a plain-speaking Yorkshireman, an upright man who all too clearly disapproved of all the long hair and late 1960s licentiousness around him. To add to his frustrations, only three of our year’s intake of scruffy student biologists opted for the botany course, which included mycology. I was one of them. I had gone to Exeter to read zoology and geology, but Webster’s course on fungi turned my head. It was a ray of light in a course that seemed to have been hijacked by maths freaks and biochemistry nutters. Webster was different. He was interested in living things and the way they worked. He studied the way fungi projected their spores into the air, lassoed tiny worms for dinner, and ate their way through plant tissue and heartwood. Admittedly, he seemed to be more interested in mildews and moulds than proper fungi with caps, gills and pores, but he possessed a genuine artistic talent and drew his tiny subjects with great technical skill, using a mapping pen on white artists’ paper. His book, *Introduction to Fungi*, is crammed with them. Webster was the man for me. Besides, I had grown tired of doing unkind things to frogs.

Professor Webster’s abiding passion was for certain microscopic mildews that live in streams, known as aquatic hyphomycetes. They had been discovered 30 years earlier by his friend and academic hero, C Terence Ingold. He fished for them in the foam left behind by bubbling brooks, and under the microscope the fungi would reveal their amazing spores, shaped like bananas, anchors, sputniks or crescent moons. A few, notably the ones named *Ingoldia* in honour of Webster’s mentor (and trust him to bag the best one), even looked like little animals. Webster wanted to know how and why these fungi produced such odd-looking spores. In my final year he offered me a research project, working alongside a PhD student, which meant, in effect, acting as his lab assistant. The work was fiddly and, to be honest, not a lot of fun, consisting mainly of isolating and measuring spores – an authentic



▲ **John Webster**, first of my mentors, Professor of Biological Sciences at Exeter University from 1969 to 1990, and author and illustrator of *Introduction to Fungi*.



▲ **Friends of fungi:**
Roy Watling, *mycologiste extraordinaire*, and Jane Smart, then chair of the Fungus Conservation Forum.

glimpse into the tedium of academic research. My proudest moment came when the Prof, eyeing my latest batch of measurements, pencilled the single word ‘significant’. I think they suggested to him that the faster the current, the longer were the anchor-lines of the spores. They suggested to me that I should stick to stuff I found on forays.

In 1977, I joined the Nature Conservancy Council in Scotland as their man in Aberdeen. One of the perks of the job was an annual, all-expenses-paid trip to Kindrogan Field Centre, in Perthshire, to study a subject of one’s own choosing. I naturally chose fungi, and there I met Roy Watling. Like John Webster, Roy is a Yorkshire polymath. But his main interest lies in the larger fungi, and above all agarics and boletes, in other words, the sort of things you find on forays. Roy is a great forayer. He has followed the fungal trail from the arctic to the tropics, and closer to home has explored the fungi of the Scottish mountains and glens, and many of the islands too, including the Hebrides, Orkney and Shetland. He identifies poisonous fungi for the medical profession, including the one that nearly killed the author of *The Horse Whisperer*. He has written lots of books. He has championed the fungal art of Beatrix Potter. And he has run a famous field course at Kindrogan since the 1960s. Quite rightly, there are fungi named in his honour, such as *Conocybe watlingii*, a fungus collected ‘on discarded household material mixed with pony dung’. Roy was the first person I had ever met who could put a name to pretty well any fungus one found, peering at it with intense interest, and tending to address it, rather than you, and loudly, too. Unlike Webster, who says ‘fung-i’, Watling says ‘funge-aye’.

I attended one course at Kindrogan where Roy put on a double act with the photographer, Heather Angel. While Roy told us what the fungi were, and all about them, and, as I say, loudly, Heather showed us how to take their picture. We learned how to hold a muslin sheet over the mushroom to soften the harsh sunlight and create a warm, soap-ad glow around it. We used Kit Kat wrappers as mirrors to illuminate the parts where the sun rarely shone. *Don’t* use flash, implored Heather, be imaginative, use natural light, and always carry a good tripod. Hers was a cast-iron Benbo weighing as much as a set of golf clubs, but that week at least, there was always someone willing to carry it for her. In some ways, mushrooms are ideal subjects for photography. Unlike animals, they do not run away, and unlike plants they do not sway in the



wind. But, given their awkward shape, it is hard to pack all the diagnostic features into a single snap. A proper mycologist will therefore show several specimens, laid out at different angles. Admittedly, that ruins any attempt at naturalness, which is perhaps why mycologists rarely win photo competitions.

We saw some wonderful fungi that week, including one or two that Roy said might be new to Scotland. There was, for instance, *Lactarius repraesentaneus*, a big, shaggy, yellow milkcap that bleeds violet juice, *Cortinarius violaceus*, deep purple and scaly, like an exotic lizard, and *Russula illota*, a fawn-coloured brittlecap with curiously dotted gills and a strong whiff of Cherry Laurel. There is a good case for placing scrubby Highland glens near the top of the list of the best places for fungi. Roy addressed each specimen gravely, through hooded eyes. It is good to witness a great naturalist at work, in his element.

Back home in Aberdeen, I helped to organise fungus forays for the parent-teacher association, for local schools and for natural history outings. One quickly learnt that this kind of popular foraging is a very different thing from those organised by the British Mycological Society. The smiling parents and their scampering children know nothing about fungi (why should they?). They are looking forward to nothing more than a nice walk with a purpose, in other words, to some wildlife entertainment. They do not expect you to bombard them with Latin names, nor do they care about the subtle distinctions between various little brown jobs which are obviously all the same. But they appreciate amusing tales from the backwoods, are interested in the fungi you can eat and concerned to avoid those which are thrillingly deadly. Hence, our gatherings tended to end up not in the herbarium but on the plate. For a few years I did a double act with Neil Bayfield, a Morris-dancing ecologist. I would put on a slide show while Neil, being the better cook, conjured up a medley of wild fungi, served in a sauce on fingers of

▼ **A tooth fungus,** probably a species of *Phellodon*, top-shaped, with spines in place of gills, taken by the author under the supervision of Heather Angel.



▼ **Ted Green** displaying the war-zones of fungi inside a slice of timber.

toast. I like to think we were ambassadors for the fungal tribe, planting little sparks of interest and affection among those whose lives had been blighted by golf, gardening and television.

One soon discovers that children are the real stars on these ‘people’s forays’. For a start, they are better at finding things, maybe because they are closer to the ground. They are also more willing to experiment with fungal smells and flavours than their stolid, head-shaking parents. When you see their eager little faces fill with wonder or amusement, you feel, just for a moment, that a teacher’s life might not be entirely, irredeemably awful. But then some cheeky lad, urged on by his mates, dumps a slimy, rotting bolete in your lap, and you come back to your senses.

Better field guides and colour printing meant that, by the 1980s and 1990s, you stood a much better chance of naming your mushroom than before. Until then, if you wanted to get on in the fungal world, one was reduced to collecting off-print keys, or Roy’s price-shattering fungus flora, or, if the passion took you that far, spending hard-earned money on expensive foreign tomes. It helped that, by then, the hitherto fluid taxonomy of larger fungi was settling down. Today, practically every group of larger fungi has an expert among the fraternity of field mycologists. My own reluctance to use a microscope prevents me, alas, from ever becoming one of them. When something starts turning into hard work and ceases to be fun, I find you might as well do something else.

There have, indeed, been long periods in my life when I hardly looked at a fungus. Such was the mid-1980s, after I had moved from my lovely pristine Scotland to the polluted hell of Peterborough, with its dead-end streets and boring toadstools. I began to recover after meeting another grand mycological personality, Ted Green. Ted was then a ranger of some kind at Windsor Great Park, with one foot in the

Crown Estate and the other in the Nature Conservancy Council. Like Roy, Ted has a tendency to pronounce, loudly and with absolute conviction, on every fungal topic under the sun. He is a man of certainties, without in-built doubt or the nervous qualifying of a lesser naturalist. He is a man of a different sort, a visionary, an autodidact tub-thumper, a kind of mycological preacher. He knows his



fungi, of course – it was Ted who supplied Roger Phillips with many of the specimens for his groundbreaking book. But he is equally immersed in the role of fungi in woodland, how they assist trees to feed and grow, and recycle waste into soil. One of Ted's great ideas is that fungi go on 'helping' trees in old age by reducing their weight and vulnerability to wind and drought. He has helped to turn such once wacky notions into mainstream orthodoxy by sheer persistence. And so, after an entertaining, thought-provoking, and slightly exhausting day out with Ted at Windsor, and another in the New Forest with him and the late Derek Reid of Kew, fungi entered my life again. Indeed, inspired by Ted's gastronomic adventures, I started a new and secret little hobby, sampling as many edible (or at least non-poisonous) kinds as I could, cooking them in various unimaginative ways.

After a wandering youth and a maturity spent in the north, south and middle of Britain, I have washed up in the Kennet valley of Wiltshire. I continue to lead forays, when asked to, in the local woods, downs and heaths, with occasional long-distance excursions into Berkshire, Dorset and the New Forest. For a while I was a member of the Cotswold Fungus Group, ably led by Dave Shorten (another keen mycological gastrophile). But mostly I foray with a few friends, or with a local group such as the Wiltshire Botany Group, which I take to the woods once a year with a real expert, Malcolm Storey (he does most of the names, I do the stories). Among our regular beats are Savernake Forest, much of which is dull but with little nodes of diversity inside, like nuts in a choc-bar, certain churchyards noted for coral fungi and waxcaps, and the woods around Greenham Common which, being full of damp hollows and corners, tend to produce something of note even on a dry day. In recent years the uncertain weather has been a problem. September, formerly the second-best month (and in Scotland, it was *early* September), is now often barren (although not in 2010, when it was the *best* month). In some seasons we have to wait until November, when low light hinders visibility.

In the 1990s, my mycological life took a new direction. As I will explore in a later chapter, the idea of conserving fungi is new, and mycologists are not very good at it. Conservation bodies would probably ignore fungi, even now, were it not for pressure from European bodies. The 'Earth Summit' at Rio, in 1992, came to the rescue of mushrooms and toadstools by obliging governments to do something. Specifically, it set us on the course of conserving declining species and habitats through



‘action plans’. The British Mycological Society, with a bit of prompting, provided a short list of fungi. As a fairly experienced and now free-lance conservationist who had dabbled in mycology, I was in a position to contribute. Through the charity Plantlife (which includes fungi in its remit as ‘honorary’ plants), I was commissioned to find out as much as I could about an exotic mushroom called the Devil’s Bolete *Boletus satanas*, which was being considered for protection. Boletes are among my favourite fungi. I love their stumpy, homely shapes and rich colours, and they don’t come any more colourful than the Devil’s Bolete which is red, white, orange and yellow, and turns pale blue when cut (it feels intriguingly heavy, too, when weighed in the hand). Fortunately, that year, 1997, was a good one for Devil’s Boletes, which is to say, it turned up in a few places in numbers greater than double figures. After due investigation, I felt I had enough evidence to suggest that the bolete was not rare at all, nor necessarily declining, but just badly recorded. I felt rather smug, I admit, at being able to recommend no particular ‘action’ at all. But pride goes before a fall, and soon afterwards I was caught with my pants down. The Post Office asked me, as the notional expert on Devil’s Boletes, to endorse a picture of the bolete for use in a presentation pack of a set of stamps on endangered species. It was a poor photograph, and I said I wasn’t sure, but that was as good as a thumbs-up so far as the Post Office was concerned. It turned out to be the wrong bolete. The only thing to do on these occasions is to keep your head down and pretend ignorance.

On the heels of *Boletus satanas* I was involved in another project on another bolete, this time an actual protected species, Royal Bolete *B. regius*. The problem here was different, in that many of the records for this stately crimson and yellow mushroom were doubtful. Nearly all the preserved material turned out to belong to a recently discovered look-alike, *B. pseudoregius*, which I christened The Pretender. The latter, too, is quite rare, but not rare enough to warrant any special conservation action, even if we had a better idea of its requirements. I will return to this interesting case towards the end of this book in the chapter on conservation.

My third and last project of this kind was largely a desk job. This was a survey of the status of the ‘stipitate hydroids’, or hedgehog fungi. There was special interest in these curious fungi, which have spines instead of gills, and they had been added to the Biodiversity Action Plan *in toto*, largely on evidence from the Continent, where they are

► The Devil’s Bolete

Boletus satanas, in its habitat of Beech woodland on chalk or limestone, often among snagging roots.





declining. I was able, mainly through the contributions of others, and especially Gordon Dickson, the British authority on the group, to suggest that they too were vastly under-recorded, but that there was good evidence that they were confined mainly to old woodland on undisturbed soil. After that, I moved on to other things. The coming man in conservation was Martyn Ainsworth, who worked on a variety of projects for English Nature before becoming our first full-time conservation mycologist in 2010.

Conservation depends on adequate data about distribution, habitats and threats. Without it, the planners, who tend not to be mycologists, and sometimes not even naturalists, are building castles in the



air. I cannot pretend that I added much original research in my three reports. We know as much as we do because there are experts out there beaver away, collecting records, sorting out the entangled taxonomy, and investigating promising habitats. For boletes, the top man is Alan Hills, a one-man industry, who maintains meticulous records, pays proper respect to microscopic work, and keeps in touch with experts on the Continent. He has been rewarded by the discovery of several new species in Britain. For hedgehog fungi, it is Gordon Dickson, who I met for the first time on that distant day on Roy's course at Kindrogan. For *Inocybe*, it is Alan Outen, for *Mycena*, Ernest Emmet, for cup fungi, Brian Spooner. All-rounders such as Geoffrey Kibby, Alick Henrici and Malcolm Storey seem to know everything. There are many more. These are the quiet men who make it possible for conservation to be a practical reality, and, on behalf of the conservation industry, I pay them tribute.

My last big mushroom job with Plantlife was 'Important Fungus Areas': a review of the best sites for fungi in Britain. This was my idea, based partly on Plantlife's ongoing work to identify the best areas for plants in Britain and Europe, and partly on the old Nature Conservation Review of 1977, which identified the best examples of natural habitats in Britain. Of course, one could not attempt anything remotely comparable for fungi because the data simply was not there, but I thought it would be a good idea to see just how far we could go using the existing information. The result was inevitably patchy. With the help of Shelley Evans from the British Mycological Society and Martin Harper at Plantlife, we came up with some basic criteria for top sites (500+ species, 5+ scheduled species, or simply the best example of its kind in the area). We depended heavily on work by the local fungus groups, augmented by BMS forays and data from habitat surveys of dunes, grasslands and churchyards. In the end (the exercise took quite a long time), we were able to list about 500 sites that met our criteria, and we had a shot at grading their relative importance. It was a start, but it still tends to advertise the places that are forayed most regularly and so have built up long lists of species (on the other hand, there must be some link between objectively the best sites and the most often visited ones). Like the provisional Red List, it provides something to build on. Or, as my colleagues expressed it in their best official language, it can 'support, inform and underpin existing protected area mechanisms designed to conserve biodiversity in the UK'.



Perhaps my best-known contribution to field mycology are my articles on British fungi and regular news column in *British Wildlife*, which went on for 18 years, with between two and four contributions per year. It began as a one-off piece about bracket fungi in 1991, inspired in part by my wanderings with Ted. Andrew Branson, *British Wildlife*'s founder and editor, liked it and asked for more. So, over the years I added a series of mini-monographs about boletes, Amanitas, gasteromycetes, hedgehog fungi, *Agaricus* mushrooms, waxcaps and other topics, usually with the assistance of a real expert (my role was more that of a jobbing journalist). I had no illusions that I was necessarily the best man for the job, but, try as I might, I could not persuade anyone else to take it on. It was regarded, I believe, as my patch (although Graham Mattock, James Merryweather, Ted Green and others did help out with pieces of their own from time to time). In 2008, a real mycologist, Peter Roberts, just retired from Kew, agreed to relieve me.

I also, for reasons lost in the mists of time, write answers to questions about fungi sent in by the readers of *BBC Wildlife*. They used to describe me as 'a mycologist', which I found embarrassing, especially when a reader pointed out that I was *not* a professional mycologist (in the sense of thinking and working on fungi and nothing but fungi). I agree. I am a naturalist, and by extension a natural-history writer. Nature is too full, too interesting, to spend one's days peering at only one small part of it. But, still, I'm fond of mushrooms, and have managed to learn something about them over half a century or so. I only hope I can communicate something of their charm and mystery, and the pleasure I find in them, in this book.

There, by way of introduction, are my credentials. There is one more excuse to make and I am done. I am an inveterate communicator. I lead forays for the same reason that I write stories and books (this is my 20th), because I like nothing more than finding out about things, giving them shape and then writing about them. This will be a conversational book, full of stories that interested me, and I hope will interest you. Until recently, books about fungi tended to be rather technical or dedicated narrowly to the process of identification. I doubt you could identify anything from this book. On the other hand, I hope that it will stimulate, refresh and even amuse anyone who finds fungi even faintly intriguing.

And that is enough about me. It is time to meet the mushrooms.



Meet the mushrooms

Open any book about fungi and you will find yourself pitched straight into a strange world. We are used to plants that grow in an ordered way, with trunks and stems, branches and leaves, roots and flowers. But fungi do not segregate their various functions like that. Since they do not manufacture food by photosynthesis, like green plants, they do not need leaves or chlorophyll. Nor, since fungi simply absorb what they need through the walls of their tissues, do they have roots. They are, on the face of it at least, much more simple organisms. For much of their lives, fungi consist of no more than webs of matter we commonly know as ‘mould’. When free of obstructions, they tend to grow outwards in a circular manner, as with mould in a Petri dish or a neglected jar of jam. It is only when it is about to fruit that the fungus takes on a more individual and recognisable form. At this point, it puts on a spurt of growth. The webs coalesce, swell and seem to solidify, finally morphing into shapes like balls, cups or trumpets, or even more fantastical forms. The most familiar fungi are, of course, the mushrooms, with their broad, gilled caps surmounted on a stalk (or, strictly speaking, since it isn’t really a stalk, a ‘stipe’).

We associate mushrooms and other large fungi with damp and often shady places, but they all require light to stimulate the production of their fruit bodies. Many of them feed on rotting matter, which is most abundant in late summer and autumn as fallen leaves accumulate. The mushroom fruit bodies appear suddenly, and disappear just as quickly, within days, or in the case of smaller ones in just hours. Yet, we must remember, these fruit bodies are no more than apples on an invisible, underground ‘tree’. Many fungi live in the soil all year round, and in some cases for many years. We think of them as seasonal because that is when we see their fruits, just as plants seem to be seasonal because we notice them by their flowers.

◀ Red-belted Bracket

Fomitopsis pinicola, a distinctive, tough, hoof-shaped bracket of conifers and, less often, broadleaves. Although widely distributed and common throughout the northern hemisphere, it is comparatively rare in Britain.



Mankind came to an understanding of fungi not from casual encounters in the field but from the instruments of science: from studies using microscopes, stains and experimental cultures. It was biochemistry that revealed their true nature, the discovery that fungi are made not from cellulose, like plants, but mainly from chitin, like insects. That did not, of course, mean that fungi are insects, or even animals (although it does probably mean that fungi and invertebrates shared a distant common ancestor). Nor are fungi lowly forms of vegetable matter, as 19th-century botanists had assumed. They are not plants at all. Formerly herded together with mosses, liverworts and algae as spore-forming plants, or ‘cryptogams’, they are now considered to be as distinct from plants as they are from animals. They form a ‘third kingdom’ of life, a completely different form of existence. Yet we still treat them as if they were a peculiar kind of plant. Fungi are studied on plant courses and popularly regarded as part of ‘botany’. Mycologists are always complaining about this. There are, we point out, at least five species of fungus for every wild flower in Britain.

What is a fungus?

Under the microscope, the living web of a fungus appears as a dense mesh of hollow tubes known as hyphae. These are the building blocks of fungal life, just as cells are the basic units of animals and plants. Hyphae are less than a hundredth of a millimetre in diameter. When they coalesce they form a mass of ‘threads’ called a mycelium, which has the appearance of fine cotton wool. The advantage of this kind of construction is that it enables the fungus to absorb what it needs from its surroundings, whether that be rotten wood, damp earth, dung or a pot of jam, without any need for internal channels or organs. It also enables the fungus to grow indefinitely, or at least as far as the food source allows. They can grow fast, too. Some species can put on a spurt of 6mm an hour, well in excess of any plant. A popular fallacy has it that mushrooms pop up overnight. Hence, ‘mushrooming’ has become a byword for something that spreads with disconcerting rapidity. In fact, each mushroom has taken weeks to grow. The reason they seem to appear so suddenly is that in the final stage the little buttons simply swell, by absorbing air and moisture, taking just hours to reach their familiar mushroom shape. This is why mushrooms are 90% water, and why most of them need moist air and damp soil or wood.

Another fallacy is that mushrooms are short-lived. It is, of course, the fruit body that is soon eaten or rots away. The organism that produces



them, the mycelium buried in the soil, is capable of living a long time. There are 'fairy rings' – the marks in the grass left by the growing fungus – that are scores of metres in diameter and must be hundreds of years old. A single genetic individual can produce dozens of mushroom fruit bodies. In North America, evidence from DNA samples suggests that the mycelium of certain woodland mushrooms can cover several acres and must be hundreds, possibly thousands, of years old. Almost certainly fungi are among the oldest living organisms on the planet.

Fungi are an ancient form of life. They have had plenty of time to evolve and diversify. Their diversity is greater than the mind can easily grasp. In Britain, where they have been studied as intensively as anywhere in the world, we have about 12,000 described species, of which about 3,000 are larger fungi (macromycetes), easily visible to the naked eye. The rest are micro-fungi, requiring a microscope for identification. But that is not the end of it. New species are being discovered all the time, and the true figure must be well in excess of 12,000 species. Within Britain alone, some 460 new species were discovered between 1980 and 1989. At least 37 new species to Britain were recorded in 2010 alone (Kibby 2011). Throughout the world, an average of 1,500 species new to science are discovered *every year*. There may be 1.5 million species of fungus on the planet, perhaps more, and certainly not much less. But less than a tenth of that number has been described scientifically. In other words, perhaps 90% of the world's fungi are still unknown.

Even when we leave aside the micro-fungi, in Britain we are left with around 2,500 species that you might reasonably expect to find in the field. Getting to know that many species is quite a challenge. Don't worry! Hardly anyone does. There are much more manageable ways of getting to grips with fungi in the field. You can, for example, break them down into groups of related species. We can recognise a bolete from its pores, a brittlegill from its colour and chalky texture, or a milk-cap from the juice that drips from the gills or cap when broken. Even a beginner soon gets to know at least some of the common fungi in the field from their general appearance – the yellow, black-spored tufts of Sulphur-tuft, the stiff apricot trumpets of the Chanterelle, or the rude and smelly beacon of the Stinkhorn. You learn them as you go, bit by bit. There are perhaps 250 fungi that one can recognise instantly, and maybe the same number again that can be named with a little help from a field guide. Once you know the basics, this world, you might say, is your oyster mushroom.



How mushrooms live

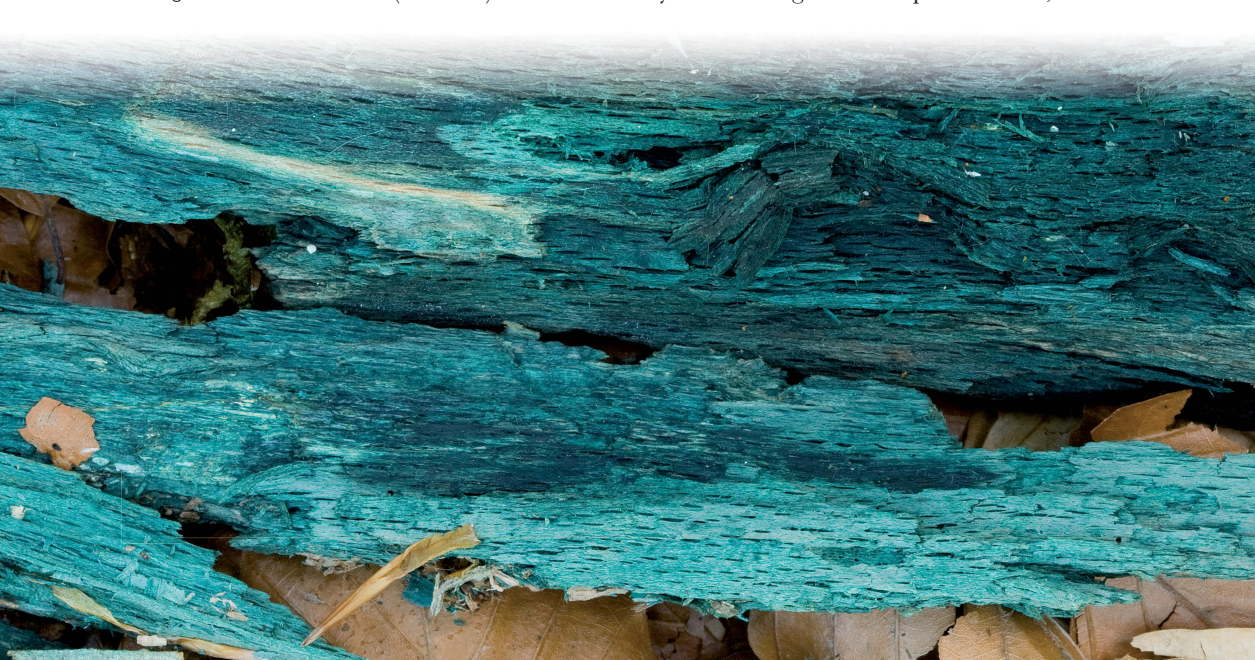
Fungi are often characterised as life's 'third way', inhabitants of the dark Third Kingdom. How does this alternative way of life work out in practice? Speaking very broadly, there are two kinds of fungi: those that live and feed by themselves, and those that do so by means of partnerships with plants (a third kind, fungal parasites, could be regarded as a partnership that has swung decisively in the fungus's direction). We digest our food internally. Fungi do so externally. With the help of a battery of biochemicals they break it down, and then absorb it. This is an economical way of life. You could think of fungi as guts without a skin – tiny, hollow tubes penetrating through the soil, rotting wood or living tissue, soaking up the juices as they go.

Let's take a closer look at the ways fungi live, starting with those that manage to get by on their own, the ones that recycle the annual deluge of fallen leaves and decaying wood.

Recyclers and rotters

Fungi are agents of decay. Theirs is a rotten world of decomposing waste matter: leaf litter, dead wood, dead bodies, dung and organic debris in the soil. The reason why all this debris does not choke the planet in short order is that it is recycled by fungi (with bacteria adding their ten percent's worth). From big bracket fungi to invisible moulds, they thriftily break down the waste and release the nutrients it contains. The amount of fungal activity needed to do this makes you gasp. An average wood produces about five tonnes of debris per hectare per year. The fungi get through this mountain of raw cellulose by sheer numbers. Fungi make up about 10% of the weight of living matter (biomass) in a wood. They are the weightiest component of all, bar the

▼ **Wood stained green** by the Green Elf-cup fungus *Chlorociboria aeruginascens*.





Meet the mushrooms

◀ Collared Parachute

Marasmius rotula, a common rotter of dead twigs above or below ground.

▼ A small army of Twig Parachutes

Marasmiellus ramealis on old raspberry canes.



trees. You would require a convoy of dump trucks to remove the fungi of just a small copse. Yet all we see of them are their scattered fruit bodies in autumn.

Not that the lives of rotting fungi are all the same. Each wood has its quota of generalists and specialists. Many of the small brown mushrooms which you see poking their heads above the leaves have their mycelium in a damp layer close to the surface. Pick up a handful of leaves and you will often find they are stuck together with hyphae, and have bleached where the fungus has broken down the cell structure within. Among the commonest are species of *Collybia*, tough-shanked, tan-coloured mushrooms of the forest floor. An even larger number of species subsist on dead wood, from hard, dry, standing stumps to scraps of buried wood. Roughly a third of the larger fungi found in the forest subsist on wood. Managers who remove that component are subtracting a significant part of the wood's natural biodiversity – not only the fungi but all the myriad invertebrates and animals that depend on them.

Other fungi specialise in particular micro-habitats. Small species of *Marasmius* and *Micromphale* (both called 'parachutes') and, above all, *Mycena* ('bonnets' or 'fairy bells'), will sprout from individual leaves. Some are leaf-generalists, while others are restricted to a single species of plant, such as Beech or Common Reed. Our pair of British *Micromphale* species are Beech leaf-and-twigs specialists. *Marasmius buxi* takes the risky course, in Britain at least, of growing only on the decaying leaves of Box, of which there is only a small supply, in the wild at least.





▲ **Ever wondered** what happens to discarded horns? Meet the Horn Stalkball *Onygena equina*.

Mycena belliae occurs on Reed stems and *M. pterigena* on Bracken fronds. *M. seynesii* occurs only on pine cones, as do all three species of *Strobilurus* and the Conifercone Cap *Baeospora myosura*. The little brown *Flammula carpophilus* is a beechmast specialist. The twiglet *Tubaria dispersa* subsists on half-buried haws beneath hawthorn bushes. Acorns have a small suite of specialists, including the yellow goblets of Nut Disco *Hymenoscyphus fructigenus*, rather unfairly classed as a disease by foresters, since decaying acorns will never turn into oak trees.

Fungi can break down almost any natural material that contains carbon. Plant cellulose presents no problem to them (only a few animal stomachs can utilise it as efficiently). Certain bracket fungi also rot down lignin, one of the hardest structures in the natural world, the internal scaffolding that allows trees to soar to 30m or more without flopping over. There are even fungi that can break down oil, much to the annoyance of the petroleum industry. *Amorphotheca resinae*, also known as the creosote fungus, can ‘eat’ diesel and jet-fuel, growing so fat on its diet of explosive hydrocarbons that it blocks filters and pipes. Another, the Scaly Sawgill *Neolentinus lepideus*, enjoys the taste of creosote in railway sleepers and telegraph poles.

Some fungi scavenge animal remains. The soft tissues of animal corpses are stripped and broken down mainly by carrion-eating insects and bacteria. The great chance for fungi comes once the body has been stripped of soft tissue, leaving behind the bones, horns, claws, feathers and fur. They are gradually degraded and consumed by microscopic fungi. The best-known corpse fungus – because we can see it and enjoy its freakishness – is the stalkball, *Onygena*, which produces scores of little white matchsticks on rotting horns. There are two species, Horn Stalkball *O. equina*, which grows on the curly horns on a dead sheep’s fleshless skull, and the Feather Stalkball *O. corvina*, which prefers damp, rotting feathers and is often found in old birds’ nests. Both species are dining out on keratin, the fibrous protein that forms the toughest non-bony tissues of birds and animals.

Another feather-eating fungus, *Arthroderma curreyi*, has found a new habitat, courtesy of mankind – tennis balls. The balls need to go soft and green first, but at a certain point they turn white and mouldy as the fungus digs in. Apparently, *Arthroderma* will even attack plastic balls. Perhaps this is the answer to the mystery of why lost tennis balls are rarely found again.