# The Boston Mycological Club

# Bulletin

Summer 2024 Volume 78 Issue 2

CONTENTS

# In This Bulletin



Gary Gilbert took the photograph of the *Hortiboletus campestris* on the cover, as well as the photos on pages 8 (*Mycena inclinata*), 13 (*Omphalotus*), and 24 (button mushrooms).

## Contribute to The BMC Bulletin!

The Bulletin is a place for our members to share their creativity and experiences. Our editorial team encourages you to submit stories, articles, experiences, artwork, poetry, and photos of your finds. Please send all questions, concerns, comments, and contributions to editor@bostonmyco.org.

Beryl Lipton, Editor — editor@bostonmyco.org
Andrew Cameron, Assistant Editor — andrewcameron634@gmail.com
Susan Goldhor, Contributing Editor — susangoldhor12@gmail.com

*Andrew is off to graduate school at Emory University this semester, and he will be stepping back from his responsibilities to The Bulletin. Andrew has been an awesome member of our team, and we're sad to see him go! He'll surely do great things in his career, and we're wishing him the very best!*

# Springtime Cup Fungus and a Mycological Mentor

THOMAS BERNARD

In early May of this year on a walking trail in Biltmore Forest North Carolina, elevation 2100 feet, I noticed on either side of a fallen hardwood log groups of ink-black mushrooms, shaped like goblets and cups. These fungi were nearly covered over by the forest litter of hardwood tree leaves and pine needles. The flat cups averaged three cm in diameter and six cm in height. The majority of cup margins were folded inwards, speckled with small fissures. Both inner and outer areas of the cups had the same flat black color.

The tapering hollow stipe of one specimen measured 13 cm in length and the base of the stipes seem to attach along the deep surface of the log.

When removed, the specimen felt rubbery to touch and had this same consistency when cut with a razor blade for microscopic examination. There was no noticeable odor. The inner and outer surfaces of the pileus felt smooth. Under a dissection microscope thin sections of the pileus were obtained for staining and trinocular compound microscopic examination. Digital images were obtained with a 3.1 Megapixel camera.

*Urnula craterium* is commonly called "Devil's Urn." It is in the class Peziziomycetes, order Pezizales, which includes truffles, morels and fleshy ascomycetes. Most of the fruiting bodies in this group have open or nearly open apothecia. The genera *Galiella, Gyrometra, Helvella, Morchella, Peziza*, and *Urnula* are in the family Sarcosomataceae. These fungi are all saprotrophs and are found on rotten or

*(Top) Cup shaped fungi attached to a fallen hardwood log. The margins of the pileus turned inwards in some specimens. (Bottom) Goblet shaped detached specimen with a long stipe.*

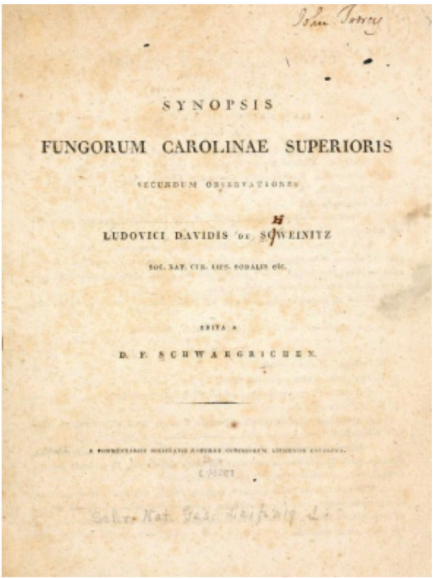
*(Above left) 100X KOH. Multiple asci with elongated ellipsoid shaped spores. (Above right) 400X KOH. Spore measures 23.60µm in length and 8.72µm in width. (Middle left) 400X Melzer's reagent demonstrating details of the ascus and spores. (Below right) 1000X oil immersion spore with verrucose features.*

buried wood. *Urnula craterium* usually appears early in the springtime after the appearance of morels.

The first description of *Urnula craterium* is attributed to Lewis David de Schweinitz, considered by some to be the "Father of North American Mycology." As a member of both the Boston Mycological Club and the Asheville Mushroom Club, I must relate an interesting connection between North Carolina, Massachusetts, and Schweinitz.

Schweinitz was born February 13, 1780 in Bethlehem, Pennsylvania. He attended a boy's school in a Moravian community in Nazareth, PA, where his lifelong interest in botany and fungi began.

At the age of 18, his family moved to Leipzig, Germany, near the Polish border, where he entered the Theological Seminary of Niesky. It was there that he began collecting and identifying fungi


SYNOPSIS

FUNGORUM CAROLINAE SUPERIORIS

SECUNDUM OBSERVATIONES

LUDOVICI DAVIDIS DE SCHWEINITZ

EDITA A

D. F. SCHWAERGRICHEN


*(Left) After this work was published, Schweinitz created the largest private herbarium in the United States which included 23,000 species. (Right) Images from the "Harvard Icones" Upper left: unidentified gilled mushroom. Upper right: "Cort decoras" "(48)". Centre: Agaricus (Lepiota) carcharias. Lower left: Agaricus (Lactifluus) testaceus. Lower right: Agaricus (Gymnopus) psittacinus*

of the Niesky region with his botanical associates. Schweinitz was a gifted artist and his watercolor drawings and plates of fungi were compiled into five volumes, *Fungorum Nieskiesium Icones*.

Schweinitz returned to the United States in 1812 and lived in Old Salem, North Carolina, where in 1822 he published *Synopsis Fungorum Carolinae Superioris*, which listed 1373 North Carolina fungal species with 320 being newly-identified ones.

In 1993, Professor Donald H. Pfister, Emeritus Curator of the Farlow Reference Library and Herbarium at Harvard University, was gifted a book named *Icones Fungorum Niskiensium*, which included watercolor paintings of fungi. Professor Pfister immediately recognized the name "Niskiensium" and saw similarities between the scripts of the page numbers and fungal names that matched the handwriting samples of Schweinitz in the collections of the Farlow Reference Library. He determined that this gift was an authentic and unique collection of Schweinitz's watercolors, which Pfister then referred to as the "Harvard Icones," noting that they were not a part of Schweinitz's five-volume set *Fungorum Nieskiesium Icones*.

*For references, visit bit.ly/bmcreferencessummer2024*

ACTION ITEM

# Legalize It

DAVID BABIK

Massachusetts State Parks offer a great system of trails and a multitude of diverse habitats. However, those of us who want to legally pick mushrooms in these public lands have faced an uphill battle. Statutory regulations promulgated often over 100 years ago are severely out of date with the current knowledge about fungi. In addition, the rules are randomly applied from one park to the next. The main issue mycologists face is restrictions on removal of "plants" from state parks. When these rules were first introduced, little was actually known about fungi. We now are aware that mushrooms are not "plants" and are not even closely related. However, many park rangers and the Massachusetts Department of Conservation and Recreation (DCR) still are under the impression that removing fungi falls within this restriction.

People all over the state regularly forage for edible mushrooms in state parks without incident. I have even seen articles in both magazines and local papers featuring stories about chefs foraging for mushrooms on DCR properties (occasionally to serve in their restaurants). These activities go unnoticed, but the same cannot be said when the BMC arrives with lots of people carrying baskets. When I put together our yearly walk schedule, I make sure that we have permission from the landowners. Of these entities, it has been the most difficult to secure permission from the DCR. Just to request a permit to hold a mushroom walk entails filling out a lengthy application, paying a filing fee to submit the form and documenting a substantial amount of insurance coverage. Even if this is all done, the application is often ignored for many months and, in many cases, eventually denied.

This situation has an unfair impact on people living in the inner city, since many of the larger greenspaces around Boston are controlled by the DCR. Those who rely on mass transit are also disadvantaged. Several years back, an organization called "Friends of the Blue Hills" asked if I would give a mushroom walk and lecture to their non-profit. They asked me to request a permit from the DCR. After complying with the required forms, it was several months before I received any communication from the DCR. They told me that the walk was approved, as long as we did not touch the mushrooms but just took photos. I'm sure that most of you know what a pointless experience this would be.

I finally decided that something had to be done. I approached Representative Carmine Gentile and asked him if it might be possible to file some legislation to address this situation. He generously agreed to help out and sponsor the bill. Most states in the Northeast already have updated park rules to correct this situation but not ours. New Hampshire allows foraging for mushrooms but does not al-

low cutting them off trees. This unique rule is an attempt to address harvesting of Chaga, which is fairly prevalent in NH and brings a good price online. New York allows residents to, for a small fee, secure an annual pass to forage in state parks. Pennsylvania has signs at the trailheads that read "foraging for berries and fungi is permitted for personal use." We tailored our bill, one Rep. Gentile eventually sponsored, based on a statute passed in Connecticut several years ago.

The bill states that: "The commissioner shall authorize any person to take mushrooms from any state parks, state forest recreation areas and state reservations under the control of the commissioner provided such taking is for personal use only. The commonwealth shall have no liability to any person or their heirs or assigns of any such person who engages in the taking of mushrooms from any state parks, state forests recreation areas and state reservations under the control of the commissioner."

The bill was introduced in 2019. With the help of many BMC members, we managed to secure multiple legislators as co-sponsors. The bill was assigned to the committee on Environment, Natural Resources and Agriculture. On April 23, 2019, myself, David Hibbett, Marsha Browne, and other BMC members testified at the state house in support of the bill. The committee had many questions and gave the bill a favorable vote allowing it to move onto the next step in getting passed. However, you may remember in 2019, the world went into a tailspin when COVID-19 came on the scene and the bill never made much progress.

Unfortunately, if a bill is not passed in the same legislative session, you have to start all over. So, in 2021, Rep. Gentile suggested we try again. So try we did. This time we managed to get 21 representatives to co-sponsor the bill. Due to Covid restrictions, testimony this time was done in a Zoom session. Once again, it "died in committee." I can't even say why it did not succeed in 2021. There never appears to be any opposition to the bill.

This year, we once again approached Rep. Gentile and asked if we should give it another try. He was optimistic, since restrictions had eased and business was more or less back on track. Carmine filed the bill once again. He asked for BMC members and any interested parties to write directly to the committee in support of the bill (currently known as H.817) and to ask the committee to give it a favorable report so that leadership could bring it to the floor for a vote. Many of you did send great letters helping to educate the committee and to support the bill. Alas, in April, I was informed that the bill was sent for "further study." This means they did not vote it through to the floor.

Our club has almost 1500 members. If we keep writing to our representatives and the committee, sooner or later we will succeed. Aside from just being able to explore these wonderful greenspaces, the data that can be collected will help us document the diversity of fungi in our state parks and is also an invaluable tool for helping us understand environmental issues such as the effects of pollution and climate change. Let's not give up! Write letters to your representatives and senators (it's easy to find their contact info online) asking for them to support foraging!

# A Mushroom's Love Song

ANDREW CAMERON

I don't know how I'd carry on
Except as a dikaryon,
For safe's no side for erring on
When love lies underground.

My cells atime were all my own
Mononucleate and all alone.
Well selfhood's good for growing clones,
But making spores takes more.

Then in the soil you came to me,
Our hyphae fusing silently.
In passionate plasmogamy
We sealed our secret bond.

I'll clamp-connect my cells for you
Till there's no me distinct from you.
Amid the twining worms and roots
Will bloom our double-self.

So let us grow then, you and I,
Profuse in love and nuclei,
For one will do for muddling through
But mushrooms are a task for two.

# Mystical Spectacle

ARI STAMATIOU

In shadowed woods where secrets lie,
Mushrooms glow beneath the sky.
Like stars they twinkle, softly gleam,
In midnight's cloak, a whispered dream.

Their luminescence, ethereal hue,
Guides lost souls, both meek and true.
Amidst the darkness, they dance and sway,
A mystical spectacle, night turns to day.

Beneath the canopy, where moonbeams play,
Mushrooms as stars, a celestial display.
They light the path for wanderers bold,
Through forests ancient, and stories untold.

In their glow, magic does reside,
A realm where wonders never hide.
So, let us marvel at nature's art,
Mushrooms that glow, a celestial heart.

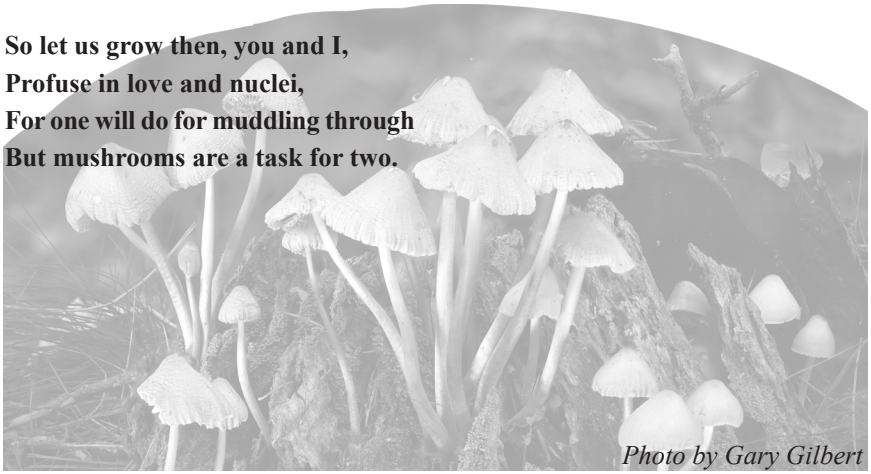


*Photo by Gary Gilbert*

# Mushroom Soup: Two Ways

SUSAN GOLDHOR

I love reading about food, and I recently finished the massive and brilliant book, "Dirt" by Bill Buford, which is a seriously deep dive into what makes French food French. Most of the book is dedicated to describing the rigid traditions of French food, maintained by the restaurants, the chefs, the cooking schools and, perhaps most importantly, the public school lunches eaten by all French students. But the book starts with a description of a chef named Michel Richard, who used his restaurant, Citronelle, in Washington, D.C., to develop recipes based on traditional French recipes but with radical takes on both the ingredients and the final dish. Perhaps the most extreme recipe of Richard's that Buford describes is a dish listed on the menu as cappucino:

"It (the cappucino) was actually mushroom soup, except that it wasn't, not actually, because it had been made without water, or stock, or any other liquid. It also had no mushrooms. Mushrooms sweat when heated; the 'soup' — which calls for fifty kilos of various fungi — was, in effect, nothing but the sweat. It was brilliant, and unheard of, and very concentrated — I would eventually try it at home and spend hours trying to put monstrous dark gobs of leftover mushroom goo to some kind of second use only to give up — it started to harden into a black crust — and, with a thud, threw it into the trash."

If Richard's take is fantastical and never to be repeated, here's the simplest mushroom soup I know, which is rich and delicious, and invented by my friend Maxine Stone — a great forager, cook, and past president of the Missouri Mycological Society:

> Sauté two cups of onion in a tablespoon of butter (medium heat). Add three cups of sliced hen of the woods, 1/2 cup vegetable stock or water, 1 tablespoon Tamari, and 1-2 tablespoons Hungarian paprika; cover and simmer for 15 minutes. Melt 2 tablespoons of butter. Whisk in 2 tablespoons of flour (Maxine suggests 3 but I preferred less) and cook for a few minutes while continuing to whisk. Stir into the mushroom mixture along with 1.5 cups stock or water, 2 teaspoons lemon juice, salt & pepper to taste, and simmer for about 10 more minutes.

That's it. If you want, you can add a dollop of Greek yogurt or sour cream to each serving. Add a salad and bread and you have a great dinner for four or five good friends.

# Getting to Fungi on the MBTA Commuter Rail

SIMON GURVETS

I live in Somerville without a car — is looking for wild mushrooms the right hobby for me?

Yes, in great part due to the MBTA commuter rail offering reliable, regular, and cheap access to great forests. Most of the locations I'm recommending are a 10-20 minute walk from the station. Factor that into when you leave for the train, or be ready to hustle. Most of my exploring has been along the Fitchburg line, which runs through Porter Square and North Station.

Some practical notes on using the commuter rail for foraging:

- There is a weekend pass for $10 that offers unlimited rides. Even one roundtrip for 10 bucks is pretty good, but two round trips for that price is a triumph. The weekday rates are higher and the cost depends on how far you travel. For more details, check out mbta.com.
- Get the app, mTicket.
- On the weekends, trains only run every 2 hours. The schedules are different for inbound/outbound and it's definitely worth planning ahead. Many stations have restaurants nearby, which can help kill time after a nice polypore made you miss the train.

**Waverly:** Walk down Moraine Street to Beaver Brook Reservation. Alternatively, go behind Star Market into a long park, leading to Lone Tree Hill.

**Kendal Green:** Head to Cat Rock Park along Drabbington Way. You'll see a lot of beautiful dogs, along with beautiful mixed pine trees.

**Lincoln:** The Mass Audobon Drumlin Farm has some nice wooded paths, as well as a working farm and livestock.

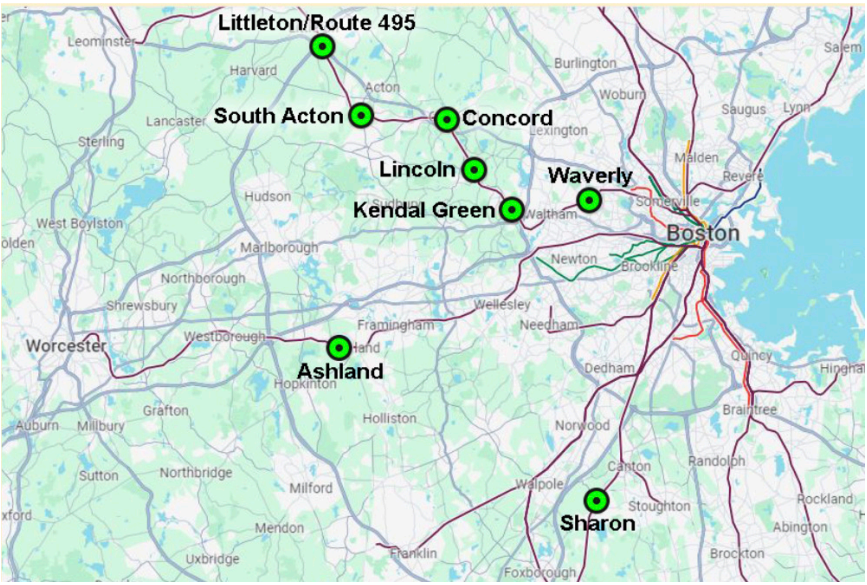
**Concord:** Walk down Thoreau Street to Hapgood Wright Town Forest. Unlike Walden Pond just to the south, I've only seen a couple of locals in the woods. The Fairyland Pond is beautiful and there are swathes of pine trees. Last Fall was oozing with *Suillu*s in the woods and *Hygrocybe* in the more swampy areas.

**South Acton:** Walk along School Street to the Great Hill Recreation Area. BMC did a foray here last year that I missed because of a hangover. It's nice that mushrooms stick around all day, so you don't have to be out at the crack of dawn, like those sad bird people.

**Littleton/Route 495:** Go along Foster Street to Balsam Lane. Turn left and you're in the Littleton Town Forest.

**Providence/Stoughton Line, leaves from South Station:**

**Sharon:** Mass Audubon's Moose




*Map by Andrew Cameron via Google Maps*

Hill Wildlife Sanctuary. Check out a trail map. You can duck into the forest after a real short walk along Moose Hill Parkway, which is right around the corner from the station. Terrific white pine forest.

**Ashland:** Take Cordaville Road up to Winter Street, which brings you to the Ashland Town Forest. A great northeastern mixed forest, as the dominant trees shift from oak to pine to maple and back again as you walk along the trails.

And that's it! Please reach out at @sgurvets on Instagram or sgurvets@gmail.com if you have any questions or want to meet up for mushroom action.

**NORTHEAST MYCOLOGICAL FEDERATION 2024 FORAY**
**Friday, October 11 – Monday, October 14**
**Cape Cod Emerald Resort and Conference Center, Hyannis, MA**

The Northeast Mycological Federation is devoted to promoting knowledge about fungi in the Northeastern North American region. It comprises over two dozen mushroom clubs from Quebec to New Jersey and Pennsylvania to Maine, representing over 10,000 beginners, amateurs, and professional mycophiles.

The NEMF Planning Committee is seeking volunteers for various roles. If you're interested in helping, please email nemfsecretary@gmail.com.

PERSPECTIVE

# Deer, Fungus, Soil, Tree

JULIAN MOLL-ROCEK

It filters through your nose, passing along your olfactory nerves into your brain. Every cell recoils. Disgust. Evolutionarily programmed aversion to the toxic process of decay.

A deer has died. Bloat sets in as the gut flora begin to digest the deer's inner tissues. Wafting vapors of putrescine and cadaverine assail your senses. Fat white maggots wriggle among buzzing flies. Weeks pass, rains come and go. Putrefaction sets in as the body's tissues turn to black goo, releasing precious nitrogen, phosphorous and potassium into the soil.

In time, a curious fungus pushes its hypha into the soil enriched by the deer's diminishing corpse. Gliding through on digestive enzymes, inquisitively probing. Ah! Nitrogen, that most scarce and satisfying protein-flavor. The mycelium spreads, each Spitzenkörper, the delicate tips of individual hypha, weaving through the mound of transformed muscle. At each growing tip, information is being taken in, along with the pre-digested food stuffs of organic decay. The fungal senses are dispersed, like the sensitive arms of an octopus, informing a decentralized organismic intelligence. This information is integrated, unlike the brain of an octopus, throughout the distributed network of fibers that make up the fungal body. The ingested nitrogen has become incorporated into the proteins and cell membranes of the growing fungal filaments.

Tracing the winding net further into the soil you encounter other soil denizens: bacteria, protozoa, nematodes, and large lumbering earthworms, beetles, and other insects. Here and there, the cavernous tunnels of mole or gopher careen pompously through this dark underworld. Yet another group of soil fungi plays an integral role in knitting the weave of the soil food web together: the glomeromycota. By producing a sticky substance known as glomalin, these fungi provide the glue that binds the micro-aggregates of soil particles into the clods of vital living earth.

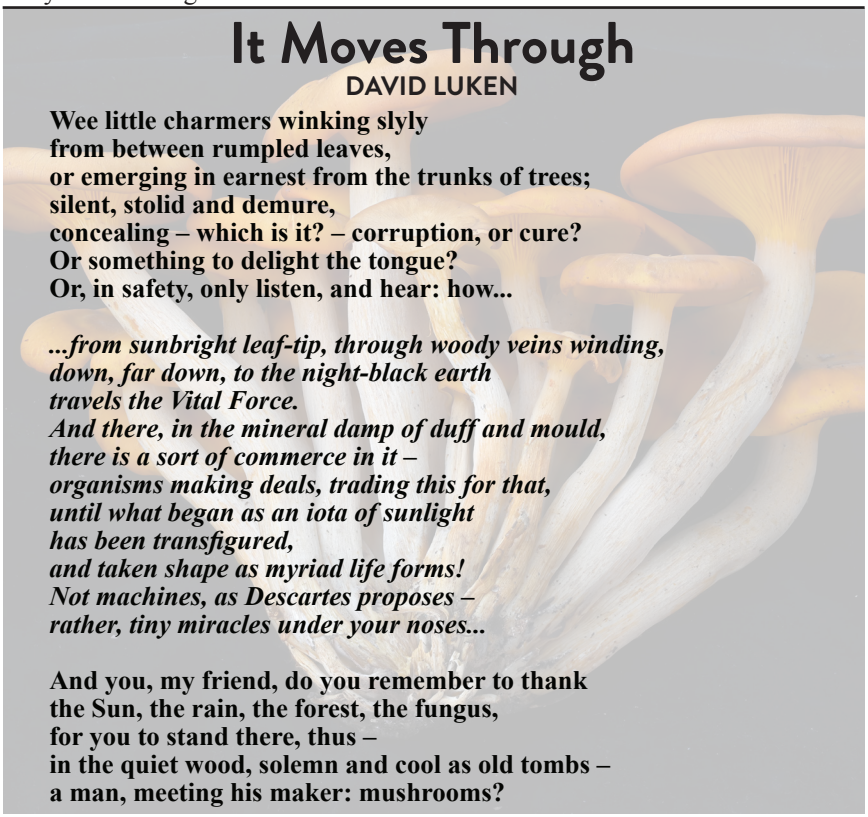
Down the soil horizons, the color changes from a rich black to a pale red. Hyphae extend to the mineral parent material, releasing powerful acids to leach out minerals. Unruly children sucking nutrients from the earth mother. Constant movement, humming with life. The minerals begin their winding journey along corridors of fungal cells. Up! Up! into the arbuscule — the tree-shaped interface thrumming inside the root tip of a massive mutual aid network — the mycorrhizal "wood wide web." Here, in the woody halls of Oak's finest fingertips is something incredibly sweet: Sugars, distilled from air and sunlight are sponged up by the fungal arbuscule. And, in exchange, a sum greater than its parts, the miner-

als from so deep down flow into the woody tissue of Oak. Life begets life.

A chill in the air. Frost laces the outlines of leaf veins. The dark green curtains of chlorophyll begin to retract, leaving behind the red anthocyanin, yellow xanthophyll, orange carotene, and brown tannins of Fall's splendor. These sun-protective pigments take their final chance to exult their beauty, as the nitrogen-rich chlorophyll is pulled back into the woody bodies, for winter storage. A gentle breeze releases a burst of colorful leaves, spiraling to the earth. Here, they lie, protective as a skin on the earth. Another hyphal thread curiously noses through the leaf litter.

You pause, taking in the smells of decay, sweet now, with leaves crunching underfoot. And strangely, the thought comforts you, maybe for the first time: when you die, you too will re-enter the recomposition of life, orchestrated by delicate fungal threads, like puppet masters of nutrient cycles. And what once appeared to be the linear arc of an individual life, reveals a spiraling shape in its collective form: as of a fiddlehead — an intricate spiral of syntropic life.

*For a glossary of terms, visit bit.ly/bmcreferencessummer2024.*



# It Moves Through

**DAVID LUKEN**

**Wee little charmers winking slyly**
**from between rumpled leaves,**
**or emerging in earnest from the trunks of trees;**
**silent, stolid and demure,**
**concealing – which is it? – corruption, or cure?**
**Or something to delight the tongue?**
**Or, in safety, only listen, and hear: how...**

***...from sunbright leaf-tip, through woody veins winding,***
***down, far down, to the night-black earth***
***travels the Vital Force.***
***And there, in the mineral damp of duff and mould,***
***there is a sort of commerce in it –***
***organisms making deals, trading this for that,***
***until what began as an iota of sunlight***
***has been transfigured,***
***and taken shape as myriad life forms!***
***Not machines, as Descartes proposes –***
***rather, tiny miracles under your noses...***

**And you, my friend, do you remember to thank**
**the Sun, the rain, the forest, the fungus,**
**for you to stand there, thus –**
**in the quiet wood, solemn and cool as old tombs –**
**a man, meeting his maker: mushrooms?**

# Porcini on Your Plate

DAVID BABIK

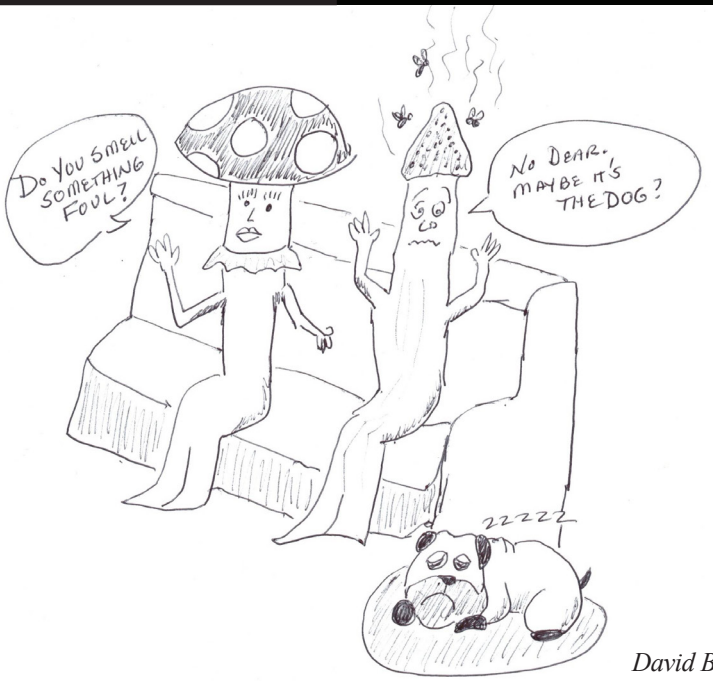
**There once was a hungry cook**
**For Porcini he did look**
**He searched by oak**
**He searched by Pine**
**He rolled down hill on a steep incline**

**No tender morsels did he find**
**Even an old Suillus crossed his mind**
**But then he spied the elusive Bolete**
**A tasty fungal unami treat**

**He rushed it home**
**He cooked it well**
**But reticulation color he failed to check**
**So his feast turned out a bitter wreck**

**So think about his nasty meal**
**And take your time when in the field.**
**If you see pink pores and dark netting**
**It's just a Tylopilus you'll be getting!**


*Danielle Lynch*




*David Babik*

# Fantastic Fungi by Paul Stamets

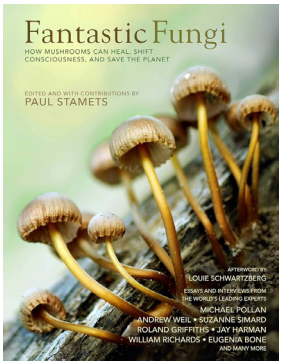
DAVID BABIK

I'm sure most of you have watched the incredibly popular documentary "Fantastic Fungi." As a follow up to the film, Paul Stamets has collected together an amazing array of articles covering all things fungi. The book is "Fantastic Fungi: How Mushrooms can Heal, Shift Consciousness, and Save the Planet." Divided into three sections, this work will bring you up to speed on the latest research and breakthroughs in the fungal sphere.

The first section gives a great overview of some of the latest developments and uses of fungi to help the environment and heal the planet. It features articles on the "Wood-Wide Web," wearable fungi, fungi activism, and myco-remediation. Authors include Paul Stamets, Tradd Cotter, Nik Money, and many others.

The articles in section two, "For the Body," cover health benefits of mushrooms, cultivation, cooking (with recipes), urban foraging, and mushrooms in ancient history. Some of the authors include the late Gary Lincoff, mushroom ambassador and esteemed author Britt Bunyard, Andrew Weil, Eugenia Bone, Elinoar Shavit and William Padilla-Brown.

Section three, "For the Spirit," focuses on the uses of mind-altering fungi. Articles cover the latest developments in psychedelic therapies, micro-dosing, and the mystical experiences these fungi can offer. Michael Pollan, author of "How to Change Your Mind," leads off the section with an article entitled "The Renaissance of Psychedelic Therapy." Other contributors include Dennis McKenna, Nicholas Cozzi and Franz Vollenweider.




Paul Stamets has done an incredible job of compiling a great collection of articles representing the cutting edge of the latest developments in our quest to embrace the Fungal Kingdom. Aside from the educational value, this makes a great coffee table book as it is filled with spectacular photography. Those of you who were lucky enough to make it to the 2023 Duff Sale to watch Taylor Lockwood's latest video will be captivated by some of his photos. The BMC was fortunate to have Taylor visit Boston a few years back and people still talk about his amazing work. Many of his incredible close-up photos are featured throughout the book.

"Fantastic Fungi" is available through Earth Aware Editions for $35, in hardcover at https://insighteditions.com/products/fantastic-fungi.

# Learning about Myxomycetes with Dr. Steve Stephenson

JANA HARRIS

When you join any of BMC's walks or forays, you'll notice a diverse array of organisms gracing our ID table, not limited to fungi alone. Among these participants, one prominent group often includes plasmodial slime molds or acellular slime molds, known scientifically as "Myxomycetes." These Myxomycetes, frequently mistaken for fungi or mushroom fruiting bodies, can easily captivate the attention of myco-enthusiasts as well as professional mycologists.

As a volunteer walk leader for BMC with a fondness for exploring the depths of the fungal kingdom, I recognized the need to expand my knowledge into the domain of slime molds. Motivated by this curiosity, I applied for a scholarship to attend a Slime Mold lecture offered by the Eagle Hill Institute in Maine. My primary objective was to acquire a comprehensive understanding of slime molds and later share this newfound expertise with fellow BMC members as a walk leader.

With the generous support of BMC, I had the privilege of participating in "Myxomycetes (Slime Molds): Taxonomy, Ecology, and Moist Chamber Culturing," a five-part online mini-seminar led by the esteemed expert on Myxos, (as he affectionately called them) Dr. Steve Stephenson. Currently serving as an Affiliate Professor in the Department of Biological Sciences at the University of Arkansas, Stephenson's illustrious career spans decades. Prior to his tenure in Arkansas, he spent 27 years as a Professor of Biology at Fairmont State College (now University) in West Virginia.

Dr. Stephenson's dedication to studying Myxomycetes has taken him to every continent, where he has explored examples of every major terrestrial biome. His contributions to research are extensive, with authorship or co-authorship of Now more than 20 books and over 500 book chapters and papers in peer-reviewed journals (plus 11 science fiction novels). Notably, his book "Myxomycetes: A Handbook of Slime Molds," published in June 2020 by Timber Press Oregon, remains the most comprehensive publication on slime molds available. A new edition of this book is coming out very soon, as per Dr. Stephenson.

During the mini-seminar, we delved into a wide range of topics surrounding Myxomycetes, covering their historical study, biology, systematics,

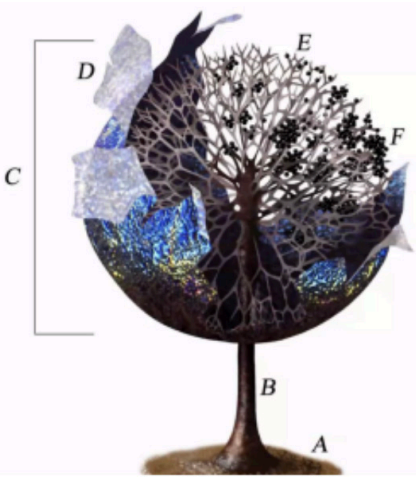
Lycogala epidendrum *a.k.a. Wolf's Milk slime mold. Photo by John D.L. Shadwick*

morphology, ecology, and global distribution. Additionally, we explored practical aspects such as field collection techniques and the cultivation of specimens in moist chamber cultures for research purposes. Surprisingly, I found that the process of creating moist chamber cultures to grow and observe Myxomycetes up close is much simpler than I had previously imagined. A moist chamber could simply be any "plastic container with a lid" and the process can take only up to a week. No fancy equipment is necessary. More on that topic in a future BMC bulletin.

With the guidance of Dr. Stephenson, I came to understand that Myxomycetes constitute a fascinating group of fungus-like organisms, with only around 1000 species known worldwide. Some plasmodia can grow to significant sizes, yet individual specimens are minute compared to most fungi. Despite their ecological significance, these organisms remain largely overlooked, largely due to their diminutive size and their unattractive common name—"slime molds." Regardless of the fact that some slime molds captivate the human eye and cameras alike with their vivid colors, subtle hues, and even shimmering surfaces, I also learned that slime molds are not poisonous or toxic to humans. *Fuligo septica* (Dog vomit slime mold) is actually consumed in parts of Mexico, where it is collected and scrambled with eggs in a dish called "caca de luna" (I'll let you guess the meaning of this).

Myxomycetes are most commonly found outdoors during the months of May through October, inhabiting microhabitats such as leaves, tree bark, herbivore dung (never omnivore), aerial litter, coarse wood debris, large herbs, submerged plant debris, soil, and succulent plants.

Based on Dr. Stephenson's lecture, it became evident that humans took quite some time to notice and even longer to describe the first Myxomycetes. The first record dates back to 1654, when German botanist Thomas Panckow documented the *Lycogala epidendrum*,




*This image, extracted from Dr. Stephenson's lecture, illustrates the primary anatomical components of myxomycete fruiting bodies. A - Hypothallus (base covering). B - Stipe. C - Prototheca. D - Peridium (cover of sporemass). E - Capillitium (Elongated structure). F - Spore mass (different color from peridium "D"). Picture by Dmytro Leontyev.*

*(Above)* Tubifera ferruginosa - *Raspberry slime mold; Photo by Malcolm Storey (Below)* Hemitrichia serpula *aka Pretzel slime mold; Photo by Alain Michaud*

commonly known as "Wolf's Milk." This globally distributed slime mold typically thrives on aged trees. Specifically, it colonizes tree trunks that have undergone significant decomposition, with the bark worn away and wood debris exposed. Wolf's Milk consists of small, pink to brown cushion-like blobs. They may ooze a pink "paste" if the outer wall is broken before maturity. When mature, the color tends to become more brownish.

One reason why slime molds are frequently confused or mistaken for fungi is their striking similarity in appearance and growing location. Although the majority of them are considerably smaller than mushrooms, they possess numerous anatomical features that are reminiscent of fungi. The primary anatomical components of myxomycete fruiting bodies crucial for accurate identification, much like the identification process for fungi.

The fruiting bodies of Myxomycetes are categorized into the following groups: Sporangium (biggest group) , Plasmodiocarp (short branched form), Aethalium (only few), Pseudo Aethalium (has fused sporangium).

Additionally, Myxomycetes are traditionally classified into various orders, each with distinct characteristics: Ceratiomyxales (e.g. *Ceratiomyxa fruticulosa*), Echinosteliales (e.g. *Echinostelium minutum*), Liceales (e.g. *Lycogala epidendrum*, *Tubifera ferru-*

*ginosa*), Trichiales (e.g. *Hemitrichia serpula*), Stemonitales (e.g. *Lamproderma*, *Stemonitis splendens*), Physarales (e.g. *Physarum polycephalum*).

Similar to fungi, identifying Myxomycetes requires attention to specific features. Dr. Stephenson advises closely examining:

- Spore color (visible without the need for a spore print)
- Presence of lime on the stem (resulting from lime absorption by Mmyxomycetes)
- Presence or absence of a stalk or stipe
- Substrate preference (e.g., wood debris, aerial debris, dung, trees with lichens)
- Capillitium (filamentous structures aiding in spore retention)
- Spores (microscopic feature) dispersed by air currents for growth into new slime molds.

Taking this course prompted me to ask a question: "What role do slime molds play in nature?" In essence, they contribute significantly to the complex nutrient cycle in soil. While bacteria tend to retain nutrients, Myxomycetes consume these bacteria, thereby releasing nutrients for other organisms. As a result, healthy soil abounds with Myxomycetes, providing sustenance for a range of creatures including beetles, flies, slugs, and birds. In addition, Myxos exhibit a fascinating behavior of feeding on certain fungi using enzymes. For instance, the yellow spots observed on the gills of mushrooms are plasmodium formations of *Physarum polycephalum*.

In conclusion, this lecture mini-series provided a fascinating exploration

Physarum polycephalum *growing on fungi (that is, consuming it). Photo by D. Crens*

into Myxomycetes, led by Dr. Steve Stephenson. Participants gained insights into taxonomy, ecology, and cultivation techniques, highlighting the importance of these often-overlooked organisms. As we deepen our understanding of slime molds, we recognize their significant role in soil ecosystems and the broader natural world. Armed with newfound knowledge, we're poised to appreciate and study slime molds more effectively in the field, reaffirming our commitment to biodiversity preservation.

I want to express my appreciation for the BMC leadership that allowed me to attend this online seminar and to Dr. Steve Stephenson for the use of his media and fascinating lectures.

*Learn more about available grants and funding on the BMC website: bostonmyco.org/grants-and-scholarships.*

RESEARCH

# Love in the Time of Massospora

ANDREW CAMERON

*Soon to die*
*Yet showing no sign*
*The cicada's voice*
— Matsuo Basho, translated by William George Aston

To witness the emergence of the North American periodical cicadas would be impossible to get used to even if it weren't so infrequent: once every 17 years for a given brood (or 13 years for a few species). They time their appearance with uncanny coordination—when the appointed year arrives, within a few short weeks billions of cicada nymphs crawl out from their subterranean tunnels, climb the nearest tree (or leg, if you're in the wrong place at the right time), and molt into their adult forms. And once they have molted, they sing.

In hearing their fey and deafening cries rising from the trees in unearthly chorus, one would be forgiven for ascribing to the song some diabolical annunciation: "We are Legion, for we are many." In truth, a more biologically apt translation for the song of the cicada (as of birds and boy bands) might go as follows: "Where the ladies at!?"

The cicadas' brief time in the sun (typically less than a month) is one of frenzied activity. Males must eat, sing, and mate with as many females as possible. Females must eat, find a suitable mate, and then insert her fertilized eggs into a tree branch using a saw-like ovipositor. Then the adults die, the chorus falling silent as abruptly as it roared to life and the insectile Bacchanalia leaving no trace but drooping tree branches and cicada carcasses littering the ground by the billions. A few weeks later, now in the fullness of summer, the tiny first-instar nymphs emerge from the tree branches in which they were laid, drop to the ground, and burrow into the soil. They will spend the next 17 (or 13) years underground, feeding on the xylem fluid of deciduous tree roots, growing larger, and counting the seasons until their time in the sun has come again.

Scientists describe this bizarre life strategy of synchronized, periodical mega-emergence as "predator satiation." When the cicadas emerge, birds, squirrels, and any other organism that wants to eat cicadas can eat their fill (including some intrepid humans, of which I'll admit to being one). However, the overwhelming numbers of the insects ensures that such predation barely puts a dent in the brood's numbers, and for all the billions of cicadas eaten, billions more will mate and deposit their eggs

before dying. Due to the infrequency of their appearances, no predator has evolved to take full advantage of this rare glut of available food. No predator, that is, except for one.

I speak of the entomophthoralean fungus *Massospora cicadina* (Phylum Zoopagomycota). The cicada's peril begins even before the nymphs are out of the ground: *Massospora* resting spores, waiting in the soil since the last emergence so many years ago, infect surfacing cicada nymphs on contact. This "Stage I" infection grows inside the cicada as it pupates and grows to adulthood, then causes the terminal end of the cicada's abdomen to fall off, revealing in its place a chalky white mass of fungal tissue, bristling with infectious haploid conidiospores. One might expect the loss of up to a third of one's body to be traumatic, but the cicadas don't seem to mind. On the contrary, despite lacking genitalia, Stage I-infected cicadas are thrown into a sex frenzy. They vigorously chorus and attempt to mate with other cicadas, peppering their bewildered partners with *Massospora conidia* in the process. Stranger still, Stage I-infected males will mimic female sexual behavior, flicking their wings in response to male mating calls in a gesture which invites other males to mount them.

Cicadas unlucky enough to have fallen for the advances of these diseased sex-fiends quickly become infected themselves, and within a matter of days they too will lose their abdomens to a chalky mass of *Massospora*. This fruiting body, however, produces diploid *Massospora* resting spores. These

Massospora cicadina *on a Brood X periodical cicada I found in Washington, D.C.*

Stage II-infected cicadas don't exhibit the satyromania of their erstwhile bedfellows but seem to spend relatively more time flying around. As they fly, the fruiting bodies on their abdomens rain down resting spores onto the soil below. The emergence ends, the next generation of cicadas safely oviposited inside tree limbs and the ground carpeted with the remains of adult cicadas (some notably lacking abdomens). But beneath this grimly tranquil tableau lie the *Massospora* resting spores, patiently waiting as long as they must for the next generation of periodical cicadas to begin the cycle again.

Many fungi, especially among the Entomophthorales, make a living by

infecting insects and using their bodies for spore dispersal. *Massospora*, however, is one of very few entomopathogenic fungi that utilize "active host transmission," keeping their victims alive and active during spore dispersal. More broadly, *Massospora* represents one of the most remarkable instances of a parasite modifying the behavior of its host for the parasite's benefit that Nature's come up with so far. Beyond the obvious allures of a cicada sex zombie fungus (which have made *Massospora* somewhat of a star among popular science publications), scientists have increasingly taken note of this peculiar parasite.

Evolutionary theorists have long discussed the possibility of parasitic manipulation of host behavior as an adaptive "extended phenotype" of the parasite. This concept broadens our understanding of an organism's (or gene's) phenotype to include all effects it has on its environment—including a parasite's effect on the behavior of its host. At the most indirect level, one can imagine the way in which *Plasmodium* parasites render their human hosts weak and sedentary during the infectious stage of Malaria as being potentially adaptive, in that such sedentary humans are easily preyed upon by mosquitoes, which can then pick up the *Plasmodium* gametocytes for further transmission. In this framework, *Massospora* appears to represent an extreme and idealized example: a parasite that dramatically alters the behavior of its host in an exquisitely complex manner (causing male cicadas to mimic female sexual behavior), and in a manner that clearly only serves the evolutionary interests of the parasite (i.e. it can't be written off as a simple disease pathology unrelated to parasite fitness, or as an adaptive host response to infection). There may be much to learn here, both about the nature of parasitism and about evolution more broadly.

So how does *Massospora* do it?

The short answer: we don't know. However, recent research led by Professor Matt Kasson of West Virginia University has offered a tantalizing clue. After performing a chemical analysis of infected periodical cicada abdomens, one analyte stood out: cathinone. Cathinone has been consumed by humans for thousands of years, especially in the Arabian peninsula and Horn of Africa, as a strong amphetamine stimulant (structurally, it is just one functional group away from being plain old amphetamine). The shrub *Catha edulis*, known locally as "khat," contains high concentrations of this alkaloid, and plays a large role in the culture of Yemen and the surrounding areas. It is not, however, something anyone expected to find in a fungus.

In the same publication, Kasson announced the discovery of a second unexpected chemical in *Massospora*, and one which readers are likely to be familiar with: psilocybin. This discovery constitutes the first time this famed active ingredient of "shrooms" (*Psilocybe* spp.) has been found in an organism other than a basidiomycete. Worth noting, however, is that psilocybin was found in a different species of *Massospora — M. levispora*, which infects annual cicadas. *M. cicadina* does not ap-

pear to produce appreciable quantities of psilocybin (contrary to the claims of several popular science publications), nor does *M. levispora* appear to make much, if any, cathinone.

This discovery, understandably, prompted enormous public interest. Many of the popsci articles written following the report leapt to the conclusion that this must be it: these cicadas are amped out of their minds on fungal uppers and/or psychedelics, explaining their hypersexual behavior. Comparisons to a cicada Burning Man naturally come to mind.

There are some issues with this conclusion, however. Firstly, the behavioral changes induced by *M. cicadina* and *M. levispora* are very similar, despite each producing very different psychoactive compounds. Secondly, these compounds were detected in both Stage I and Stage II-infected cicadas, but only Stage I-infected cicadas display the hypersexualization behavior. Lastly, it's not well understood how these drugs actually affect cicadas. While both chemicals have been demonstrated to alter insect behavior, these behavioral disturbances vary greatly across species, and our assumptions about how these drugs may affect insect brains drawn from how they affect human brains are likely to be misleading. That the production of these two chemicals plays important adaptive roles of some kind for *Massospora* appears self-evident, especially considering that metabolomic work has demonstrated that both chemical synthesis pathways evolved in *Massospora* independently of the organism for which each drug is famous (the Khat plant and *Psilocybe* mushrooms). "Stoned Ape" speculations aside, most scientists believe that psilocybin production evolved in mushrooms to antagonize would-be insect predators, much as other psychoactive metabolites including cathinone, caffeine, and mescaline. It's possible that these chemicals play a similar role in *Massospora*, rendering the infected cicadas noxious to potential predators. It's also possible that they play a partial role in cicada hypersexualization behavior or serve completely different ends altogether. In that well-worn refrain of scientific writing: more research is needed.

The mechanism of *Massospora*'s sex-zombification seems to elude us still, but as is often the case in biology, further research on this organism has shown it to be far more complex and mysterious than anyone could previously have imagined. In the great periodical cicada emergences of this year (including the synchronous and geographically-overlapping emergence of a 17-year and a 13-year brood—an event occurring once every 221 years!), scientists, including Kasson, took to the woods to observe and collect *Massospora cicadina*. Their ongoing work, we can hope, will further elucidate the ecology of this fearfully fascinating fungus, the means by which fungal parasites manipulate host behavior, and how evolution may operate in ways and on planes yet unplumbed.

*For references, visit bit.ly/bmcreferencessummer2024*

# The Lowly White Button Mushroom

GARY GILBERT

The common White Button Mushroom is probably the most famous fungal fruiting body of them all. It is found in virtually every grocery store in the world. Eaten raw, or cooked, it is an essential culinary delight, though substantially flavorless, unless cooked, as compared to its wild cousin, *Agaricus campestris*. It goes by a huge variety of common names though its accurate species name is *Agaricus bisporus* with common names including: Pink Bottom, Meadow Mushroom, Swiss or Roman Brown Mushroom, Hot-Bed Mushroom, Field Mushroom or the French "Champignon de Paris."

So, what is the difference between the varieties of it we see in the stores; the Cremini, Baby Bella and Portobella mushrooms? Well, they are all simply "varieties" of the exact same species of fungi. That means they have different macroscopic features, or simply ages of growth, but still contain the same DNA. As they say in Thailand "Same, same, but different!"

Crimini and Baby Bellas are the same species but slightly different strains than the Portobello. They are harvested when the cap is still closed, or slightly opened, which keeps their flavor a little less intense. For me, this is a good thing because their flavor can hit you like a steamroller. Their gills have started to mature and produce spores so they will be less pink and start to get that nice chocolate brown color that Portobello's have. Their flavor is stronger than the white Button Mushroom, but not as strong as their heavy hitting cousin, the Portobello. Portobellos are large, fully mature *Agaricus bisporus*. Their gills are a dark chocolate brown and their flavor is nutty, almost meaty, so they work very well as a meat substitute in, for example, a vegetarian hamburger. Because of their large size they are also quite versatile to be stuffed or grilled and can fill up a dinner plate quickly.

*White button mushrooms as shelved at the supermarket.*

If anyone thinks that mushrooms are inconsequential in terms of nutrition, think again. Button mushrooms provide protein as well as vitamins B, C & D along with iron, magnesium, phosphorus, potassium, sodium and zinc. That's more than most vegetables will give you.

White Button Mushrooms are grown in dark warehouses, caves and tunnels. Historically, they were grown in the catacombs of Paris. Being decayers, or saprotophic fungi, they need nutrient rich soil, or substrate, to grow in. Actually, they are a second stage decomposer meaning that they do not decay the substrate directly like Shiitake or Oyster mushrooms, but require substrate that has been first broken down by other organisms.

The company I interviewed grows Button mushrooms as a 6 stage process:

First, they make long rows of organic material about six feet high and let bacteria digest it for a week or two. These piles heat up like your back yard composting bin would do. They are turned and aerated while the heat generated pasteurizes the soil and kills anything that could contaminate the spawn.

Next, they move the substrate to trays to allow it to cool a bit further and flush out any ammonia vapors. All of the ammonia has to be gotten rid of in the end or it will kill the *Agaricus* mycelia once it is introduced into the substrate.

Third, the substrate cools further and the mushrooms are introduced having been started at a separate facility on sterile grain. Growers can get all sorts of subtle variations of *Agaricus* strains, those that produce white, off-white, cream or brown-capped fruiting bodies. The heat and humidity are controlled to keep things moist and warm, but not hot, as well as the carbon dioxide levels. A week and a half to three weeks will pass as the mycelia grow throughout the substrate.

Fourth, an inch or two of topping soil is added which locks in the soil moisture and starts the growth of the fruiting bodies called 'pinning'. This takes only a few days to occur and high humidity and very little light are the key to this stage.

Fifth, the temperature is decreased as are the levels of carbon dioxide and the mushrooms begin to grow. This takes about two to three more weeks.

Finally, the huge dense flushes of fruiting bodies grow to maturity in cycles of about three to five days each. The substrate is exhausted after about three to five flushes of fruiting bodies have been produced from it and it can be recycled once again or used as garden compost. Most Button mushrooms are picked while their caps are still closed and attached to the stem, hence the term 'button'. The complete process can take about three and a half months.

For any of the forms of the White Button mushroom, other than the overpowering Portobello, I suggest sautéing them initially on a low temperature with a cover on the pan. This allows them to sweat and cook without needing to add excessive oils or fat. As they start to dry out I add butter and uncover the pan so they can finish cooking and singe a bit. A slight crispness, with a good bit of salt, on most mushrooms really brings out their flavor. Try making an omelet with some prepared mustard mixed into the eggs, some grated gruyère cheese, crisp sautéd Button Mushrooms, salt, pepper and a touch of tarragon and voilá!

# Unlocking the Art of Mushroom Preservation

JANA HARRIS

During my recent trip to Slovakia, I encountered a captivating book: Dr. Juraj Humenansky's "New Atlas of Fungi / Delicious Recipes." This intriguing publication seamlessly combines a field guide with a cookbook. Between mushroom foraging expeditions with my family, I acquired a copy, and as I explored its pages, I discovered numerous unconventional methods for preserving mushrooms, many of which remain widely unknown by the majority of individuals in the USA. This article draws inspiration from Humenansky's wonderful book, and I am also including knowledge passed down to me from my family and friends in the Czech Republic and Slovakia.

Preserving mushrooms is a time-honored tradition that has been refined over generations in regions blessed with abundant mushroom harvests. In this article, I will provide a brief overview of some common and lesser-known techniques for preservation through drying, butter incorporation, fermenting, and even alcohol. Yes, you can use mushrooms to make delicious alcoholic beverages and maybe add them to cocktails for your friends or family, and I recommend that you craft these unique spirits for anyone who will listen to more of your mushroom stories.

**Drying/Dehydrating**

Drying mushrooms is a widely practiced method worldwide, especially popular for species like Bolete and Chanterelles. When preparing mushrooms for drying, it's important not to wash them; instead, simply brush off any dirt and remove any parts unsuitable for consumption. Each mushroom should then be sliced into 1/5-inch thick slices. These slices can be placed in a dehydrator and dried at a temperature of 40 degrees Celsius (104°F) until they snap easily like a potato chip. In Central Europe, traditional methods are often used, including stringing techniques where mushrooms are threaded onto strings and hung in well-ventilated areas to air dry. When drying mushrooms in the oven overnight, try to maintain a temperature as close as possible to 40°C (104°F), and ensure the oven is left open for venting during the process. Once fully dried, the mushrooms can be stored in Mason jars and kept in a dry, dark spot for years to come.

**Mushroom butter**

Bolete species are ideal for enhancing your mushroom harvest with this preserving technique, which happens to be one of my personal favorites. Not

*Mushroom butter ready for freezing and later enjoyment. Photo by J. Harris*

only is it efficient, but it also yields exceptional flavor. You can elevate the taste of butter by incorporating either fresh or dried mushrooms. For every pound of fresh mushrooms, approximately 2 and ½ sticks of butter are recommended. Begin by cleaning fresh and high-quality mushrooms as usual, then dice them into small cubes. In a hot non-stick pan, melt 2 tablespoons of butter and add all the mushrooms. Sauté them over high heat for about 3 minutes, then reduce the heat and continue cooking for an additional 5 minutes. Turn off the heat and allow the mushrooms to cool before mixing them with the remaining butter in a bowl. The butter-mushroom mixture is then spread onto pieces of wax paper and rolled into tube shapes. These butter tubes can be stored in the refrigerator for up to 10 days or in the freezer for about 8 weeks. Other preferred mushroom varieties for this technique include *Cantharellus*, *Lactifluus hygrophoroides*, Morels, and Black Trumpets. Mushroom butters like these can be used just as regular butter when you are preparing meat, fish, making sauce or soups. Your mushroom-mania options stretch as far as the eye can see!

**Fermenting**

An unconventional yet incredibly flavorful method of preserving mushrooms involves lacto-fermentation, a technique predominantly practiced in regions formerly part of the Soviet Union. Despite its obscurity elsewhere, it's worth noting that lacto-fermentation produces lactic acid, which is notably easier for human digestion compared to the acetic acid typically found in vinegar-based preservation methods.

In the Northeastern United States, where this technique is less common, certain mushroom species excel in fermentation, including *Lactarius, Lactifluus, Armillaria*, and *Pleurotus ostreatus*.

For the fermentation process itself, it's crucial to use only stone and glass vessels, meticulously cleaned, rinsed, and sterilized with hot water to ensure a successful outcome. These materials provide an ideal environment for the fermentation process to take place, preserving the mushrooms while allowing their flavors to develop and deepen.

**Cold fermenting raw mushrooms**

The process of cold fermenting raw mushrooms is a meticulous and rewarding endeavor, resulting in intensely flavored delicacies reminiscent of sauerkraut.

Begin by cleaning the mushrooms, focusing on the caps, which will be the main part used in the fermentation. Caps of milky mushrooms can skip the soaking process, while varieties like Honey mushrooms and Oysters require soaking in slightly salted water for 3 to 5 days, changing the water twice daily to maintain freshness. Keep the mushrooms in a cool place during this time.

In a fermenting vessel, start by layering grape leaves, dill, allspice berries, bay leaf, and cloves. Once the mushrooms are adequately soaked, arrange them in the vessel, caps facing down, in layers no more than about 10cm (4 inches) deep. Repeat the layering of grape leaves, dill, allspice berries, bay leaf, and cloves on top of the mushrooms.

Cover the mushrooms with a clean cloth and weigh them down with a stick topped with a heavy rock. Avoid using bricks or metal objects for weighting, as they may react unfavorably with the fermentation process.

After 3 or 4 days, a layer of liquid should form atop the mushrooms. Remove this liquid, as the mushrooms will shrink and settle towards the bottom of the vessel. Additional mushrooms can be added, following the same preprocessing steps.

If no liquid appears after 4 days, increase the weight on top of the mushrooms to ensure proper fermentation. The fermentation process typically takes anywhere from 10 to 40 days, depending on environmental factors.

Once fermented, the mushrooms can be stored for several months in the fermenting vessel, as long as the top layer remains covered in a layer of salty water. For extended storage, transfer the mushrooms along with the liquid into clean glass jars, seal tightly, and sterilize through the canning process. Cook the sealed jars in a water bath for 40 minutes at a temperature of about 100 degrees Celsius (212°F) to ensure proper preservation.

*(Top) Mushrooms ready for fermentation. (Bottom) Mushrooms after a few days of fermentation. Photos by Figaro Shakes*

**Warm fermenting cooked mushrooms**

Begin by washing the mushrooms and cooking them in slightly salted water. Honey mushrooms should be cooked for 25 minutes, while Milky caps can simply be blanched. Once cooked, allow the mushrooms to drip off any excess water and cool to room temperature. The process for warm fermenting mirrors that of cold fermenting. Layer the cooked mushrooms onto the bed of spices inside the fermenting crock, ensuring they are evenly distributed. Sprinkle salt over the mushrooms, then add another layer of herbs and spices on top. Weight down the mushrooms and cover the crock as with the cold fermenting method. Fermentation typically takes 10 to 30 days, during which time the flavors intensify and develop.

For longer-term storage, transfer the fermented mushrooms into clean jars and seal them tightly. Process the sealed jars in a water bath for 30 minutes at about 100 degrees Celsius (212°F) to ensure proper preservation.

Optional: Some cultures add onions and black pepper to the fermentation mixture. If desired, cook and cool the onions along with the mushrooms, then layer them into the crock alongside the mushrooms. The fermentation process remains the same, with the onions adding an additional depth of flavor to the final product. Fermentation time may vary but typically ranges from 10 to 40 days.

**Preserving in alcohol:**

A favorite method for preserving mushrooms in alcohol involves using

*Chanterelles in vodka. Photo by J. Harris*

aromatic species like *Cantharellus* and *Craterellus*, known for their fruity fragrance. With these Chanterelles, you can craft a delightful and aromatic "aperitif" that tantalizes the senses.

Begin by gathering 0.5 liters of your favorite vodka and approximately 100 grams (3.5 ounces) of the freshest Chanterelles available. Clean the mushrooms, removing any debris, and place them into bottles with caps and wide mouths for easy insertion.

Pour the vodka into the bottle, ensuring the mushrooms are completely submerged. Seal the bottle and place it in a dark area. Allow the mushrooms to infuse into the vodka until they sink to the bottom of the bottle, typically taking 2 to 3 weeks.

Once the mushrooms have settled, carefully drain them from the infused vodka. The resulting aperitif will boast a delightful taste and aroma reminiscent of apricots. Store the infused vod-

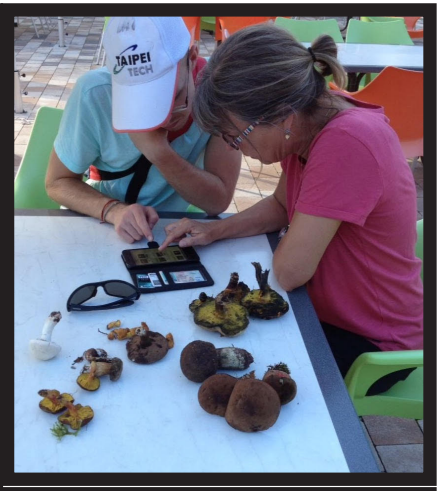
ka in a cool place until ready for consumption, and enjoy its unique flavor profile at your leisure. Serve cold!

We hope this journey has sparked your curiosity and inspired your culinary adventures. If you're eager for more recipe tips or excited to share your own mushroom preservation creations, we'd love to hear from you! Reach out to us to continue the conversation and share your delicious discoveries.

Until then, may your kitchen experiments be filled with the delightful aromas and flavors of perfectly preserved mushrooms. Happy preserving and bon appétit!

*For more tips on how to preserve your foraging finds, visit bit.ly/bmcreferencessummer2024*

*Photo courtesy of Emily Ziemski*




*(Opposite) Spike Mikulski and two students inspect a find on a fallen birch tree during a recent wild mushroom certification courts in Rhode Island. Photo by Natalie Bowers (Above) "Toad Stool," a photo by Natalie Tessicini (Top right) Individuals identify their bolete finds. Photo by Florian Termin. (Right) Oskar excitedly shows off a chicken of the woods while on a walk. Photo provided by Jana Harris*