SPORE PRINTS

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HOW DO FUNGI COMMUNICATE?

Michael Hathaway & Willoughby Arévalo

MIT Technology Review, April 24, 2023

Enzo Pérès-Labourdette/*The New Yorker*

Although most of us think of fungi as "mushrooms," these spore-producing bodies are just the reproductive organs of mycelium—decentralized, weblike bodies of branching tubes. Though usually microscopic, these structures can be enormous; the largest known example is a honey mushroom (*Armillaria*) that covers almost 10 square kilometers (3.7 square miles) and has lived for millennia.

As organisms living in complex relations to other life forms, fungi could not exist without communicating. And while they've traditionally been viewed as sessile, or permanently fixed in place, mycelia move by extending the tips of their tubes through a substrate, which could be a patch of soil or a fallen log.

As fungi grow, they are constantly sensing, learning, and making decisions. Fungi are like polyglots: they both "speak" and understand a wide range of chemical signals. They release and respond to chemicals that float through the air and flow through water. Fascinatingly, fungi not only perceive but actively interpret a chemical's meaning depending on the context and in relation to other chemicals.

Studies of how fungi communicate lag way behind research on communication of plants and especially of animals. Most are based on several "lab rat" species, so knowledge about other types is limited, but here we summarize what's known about three realms of communication: within a fungus, between fungi of the same species, and with other organisms.

Within a Fungus

Each growing tip has both autonomy from and accountability to the whole organism, akin to the relationship of social insects to the hive. Between the cells within every mycelium flows a stream of chemicals, nutrients, and electrical impulses. Their movements act to keep the whole informed about happenings and coordinate actions across the network. Research by Andrew Adamatzky, a professor of unconventional computing at the University of the West of England in Bristol, suggests that they influence the mycelium's internal bioelectrical signals, which may form a sort of "language." While a mycelium neither is nor contains a nervous system, mycelia share much in common with these systems. Both have branched structures, reinforce or prune pathways as needed, and use some of the same amino acids to transmit information.

Between Fungi of the Same Species

Many fungi are sexual and must mate to reproduce. They send out pheromones and "sniff" out those of others, and then they grow toward those that seem attractive (based on whatever it is fungi are attracted to). Whenever two mycelia meet, they communicate to negotiate their relationship, which can range from fusion (to form a reproductive or nonreproductive partnership) to indifference to physical exclusion and even chemical antagonism. Each mated mycelium negotiates the physical dynamics of fusion, and of life in partnership thereafter.

With Other Organisms

Fungi "talk" and respond to many other beings. Through mycorrhizal mutualisms, they may share water and food with plant partners. Parasitic fungi produce a myriad of plant growth regulators, modifying plants to suit their needs. Some fungi, such as truffles, mimic animal sex pheromones to attract mammals and insects that act as "sporinators," the fungal equivalent to pollinators. Other fungi are prey to roundworms (also known as nematodes). When they detect a nematode nearby, they can produce defensive compounds to ward it off. Other fungi hunt nematodes by detecting their chemical presence.

Mycorrhizal fungi are central in current debates about the "wood-wide web," but many representations unfairly present fungi as living fiber-optic cables that allow trees to "talk" to each other. Fungi are more than just passive wires; they are, in fact, actively perceiving, interpreting, and signaling themselves. They do this constantly, with a wide range of beings. How mushrooms create and interpret these signals in a cacophony of chemical and electrical noise remains a fascinating mystery.

MUSHROOMS AS MEDICINE

Daniel Winkler

Fruits of the Forest, a Field Guide to Pacific Northwest Mushrooms, 2023

How come fungi offer so many interesting compounds of known or suspected medicinal value? While mushrooms are usually protected from weather and predation by a skin-like tissue, the mycelium underground consists of unskinned tubular hyphae, or mycelial strands, one cell wide. The mycelium is constantly seeking out and growing into new food sources, supplying molecular "building blocks" to its growing tips while absorbing nutrients from the accessed environment. Visualize fungi digestion as a stomach turned inside out, releasing enzymes to break down biomass that the fungi then absorb as nutrients. In stark contrast to humans and other animals, which have protective skins and closely monitor what they ingest,

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CALENDAR

May 6	Field trip (see PSMS website)
May 9	Membership meeting, 7:30 pm, CUH
May 13	Field trip (see PSMS website)
May 15	PSMS board meeting, 7:30 pm, CUH
May 20	Field trip (see PSMS website)
May 26–28	Field trip, volunteers only, registration required
May 30	*Spore Prints* deadline
June 3	Field trip (see PSMS website)
June 13	Membership meeting, 7:30 pm, CUH

BOARD NEWS — Carolina Köhler, Secretary

Greetings, all!

The Board of Trustees held its monthly meeting on April 17th, and it was the first official meeting for newly elected officers (President Colin Meyer and Secretary Carolina Köhler) and trustees (Marion Richards, Sandra Ruffner, Pei Pei Sung, and Kelsey Hudson).

The meeting was chock-full of information regarding past and pending items that the board has been discussing, ranging from tax forms and financial reports to technological advances and IT matters.

Among the items discussed was improving the Zoom experience for future membership meetings, which includes the possibility of additional cameras and microphones that would make it easier to follow the speaker. So, if you have been encountering a few hiccups with the virtual meetings, rest assured that we are working on it!

As far as speakers are concerned, if you have a wish list of guests or topics you'd like to hear, Scott Maxwell is always happy to make note of it. You can email him at vicepresident@psms.org.

Finally, our June fundraising event is approaching! This event replaces our former Survivor's Banquet that used to take place in March, and will be a members-only, cocktail-social of sorts. Stay tuned for more details!

Our Spring field trip season is about to start, so we wish you all happy mushrooming and hope to see you on the trails!

MEMBERSHIP MEETING — Scott Maxwell

The general membership meeting on May 9, 2023, will once again be a hybrid including both in-person and Zoom at the Center for Urban Horticulture. We will start letting in-person attendees in at about 7:00 pm and Zoom attendees at about 7:20 pm.

Jeremy Faber

This month Jeremy Faber will be presenting on a topic entitled "There is More to the Forest than Just Mushrooms." Given Jeremy is a broad-scale forager for forest edibles, you may understand this tongue in cheek title. This just means, that in addition to mushrooms, we will likely learn about a whole host of edible botanicals and fungi that present themselves during the Spring season. You may know that Jeremy has presented at PSMS before and has also made contributions to our annual show in the form of mushrooms that we, in turn, have shared with the public at our mycophagy display.

Jeremy discovered his love for the woods at an early age. After studying forestry at the University of Vermont, he attended the Culinary Institute of America to pursue another passion—cooking. After moving to the West Coast, he worked his way up through Seattle's dining scene and became the sous chef at the renowned Herbfarm Restaurant. While there, he supplied the restaurant with wild edibles and also started his business "Foraged and Found" Edibles. Foraged and Found supplies wild edibles to many restaurants in the Seattle area and across the United States. Given the Spring season has begun, I am certain Jeremy is very busy right now, but has graciously agreed to share his passions with us at PSMS.

PSMS BRIDLE TRAIL SURVEY RESUMES

F. Luise Asif

The Bridle Trails survey will resume this month, May, under the continued leadership of Daniel Winkler. Current participants have been notified via email. Any PSMS member interested in participating in this study at Bridle Trails State Park located in Kirkland is welcome. To participate, have the iNaturalist app on your phone. If interested, sign up at the May 9th PSMS membership meeting. I will be there to add you to the notification list.

MYCOPHAGY COMMITTEE NEWS

Marcus Sarracino & Molly Watts

Are you ready to explore the world of fungi through cooking? In 2022, all our classes sold out quickly, with lots of eager people left on the waiting list. Join us for mycophagy cooking classes at The Pantry, back again in 2023 with an all-new menu! The classes will be held at The Pantry in Ballard on May 22nd and May 26th, 2023, at 6 pm. Registration is on a first-come, first-served basis, and attendance is limited to 18 people per class. The cost is $140 per person.

Spend an evening with your fellow PSMS members for a night of hands-on cooking fun, feasting, and fungi cooking. Chef Laura Pyles, a talented chef passionate about the savory side of the kitchen, will guide us through creating a four-course meal, using mushrooms in each course. All guests will receive copies of the recipes, wine, and a communal meal at the end of class. Please note that dietary restrictions **may not** be able to be accommodated as the menu is established.

The classes will be held at the lovely professional kitchens of The Pantry, in the Ballard area of Seattle. There is neighborhood street parking in the surrounding blocks so please plan accordingly.

Guests may be required to wear an N95 or a KN95 mask during instruction, depending on the local transmission rate at the time of class. Safety first!

We had a blast in last year's cooking classes, and we are looking forward to another year of mycophagy, so get ready to savor the flavors of the fungi kingdom!

SCIENTISTS HAVE DEVELOPED A "LIVING PC" MADE FROM MUSHROOMS

Cal Jeffrey

https://www.techspot.com/, Mar. 6, 2023

Wetware, the concept of merging hardware and software with living tissue, has been science-fiction fodder for decades. We've seen it in TV shows like *Star Trek* with the blind character Geordi La Forge's visor that allows him to see and in video games like the Deus Ex franchise, where all sorts of electronics can be fused to those who can afford it.

Much of science fiction is just an imaginative extension of scientific reality—wetware is nothing new. Neural interfaces and other devices have been in development for decades. Some of them even

Adamatzky's motherboard mock-up.

work to an extent. A primary obstacle has been getting solid-state components to communicate with organic material. The two are so dissimilar it's challenging to create a way to translate one to the other, but what if electronics were made from organic matter?

That's what researchers at the Unconventional Computing Laboratory at the University of the West of England want to discover. The scientists there have developed a mushroom computer.

According to lead researcher, professor Andrew Adamatzky, mushrooms are an ideal organism to experiment with because their mycelium acts much like the human brain. Mycelia are thin hair-like parts of a fungus's root system that can transmit electrical impulses, not unlike synapses. In fact, mushrooms connected to the same network of mycelia underground can sometimes communicate with electrical signals over substantial distances.

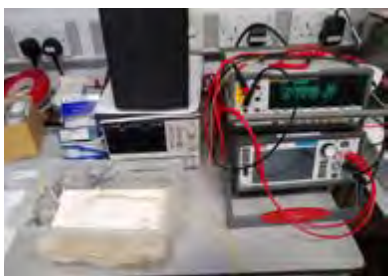
This trait allowed the scientists to use mushrooms as motherboard component analogs. Spikes of electrical activity, or the lack of them, are translated into ones and zeros, respectively, mimicking the ingrained binary language of computers.

"We found actually that mushrooms produce action potential-like spikes. The same spikes as neurons produce," Adamatzky told *Popular Science*. "We're the first lab to report about spiking activity of fungi measured by microelectrodes, and the first to develop fungal computing and fungal electronics."

As you would expect, mushroom computers cannot compare to traditional hardware. While Adamatzky maintains that stimulating the fungus at two separate points increases conductivity for faster and more reliable communication, it's not near the speed of solid-state electronics. However, it does allow the mushrooms to establish memories. Adamatzky equates it to how the human brain forms habits.

"Right now, it's just feasibility studies. We're just demonstrating that it's possible to implement computation, and it's possible to implement basic logical circuits and basic electronic circuits with mycelium," Adamatzky explained. "In the future, we can grow more advanced mycelium computers and control devices."

The research may also lead to advancements in machine/brain interfacing, which has applications in the fields of prosthetics and behavior control disorders like Alzheimer's and Parkinson's disease.



Unlike the mock-up, the real mushroom computer resides in a plastic container.

UKRAINIAN POSTAGE SHOWING FUNGI

Brian S. Luther

Introduction

With the devastating, senseless, and criminal Russian military attack on the independent democratic country of Ukraine, I thought you might be interested in seeing their official postage showing fungi issued so far, which I've documented below in the following table. I only recently discovered the 2002 and 2006 stamps after studying Ukrainian postage in detail under magnification, and neither of these are listed in any other mycophilatelic catalogs.

In the following table, M=mushrooms or fungi as the main stamp illustration; MID=mushrooms or fungi in the design of the illustration, background, border, or selvage, but not the primary illustration; s/s=a souvenir sheet having all the stamps on it together, usually forming an overall scene; FDC=a first day cover, an envelope (cover) with the stamps affixed and cancelled on the first day of issue, often with a cover illustration (=cache) of the same theme; maxicard=a postcard showing an illustration of the stamp(s) with the stamp(s) affixed and also cancelled on the day of issue, just like an FDC. All catalog numbers are from the Scott Postage Stamp Catalogue.

Mycostamp Issues from Ukraine

Date of Issue	*Value*	*Scott Cat. No.*	*Type*	*Subject*
12/15/1999	30 k	364a	M	*Armillariella mellea*
"	30 k	364b	M	*Paxillus atrotomentosus*
"	30 k	364c	M	*Pleurotus ostreatus*
"	40 k	364d	M	*Cantharellus cibarius*
"	60 k	364e	M	*Agaricus campester*
5/24/2002	40 k	464a	MID	*Trametes versicolor ?*
"	0 k	464b	"	"
"	80 k	464c	"	"
"	250 h	464d	"	"
7/14/2006	70	639d	MID	*Trametes versicolor?*
"	70	639e	"	"
10/14/2013	3.30 h	941d	M	*Boletus edulis*
"	n/a	n/a	MID	Button mushrooms

Discussion

The 1999 set of five stamps was issued on a s/s showing a large broken off tree stump with projecting roots. The three wood inhabiting (lignicolous) fungi are growing from the top of the stump and the other two are on the ground. Each has the Ukrainian common name with the scientific name in cursive at the bottom, and all are perforated with gum. Scott 364e should read *Agaricus campestris*, not "campester." Also, the 2011 Scott Catalogue incorrectly lists 364c as *Pleurotus* "ostratus." Scott 364a is now *Armillaria mellea*. All are edible fungi, except for Scott 364b, which is now in the genus *Tapinella*. I have not seen either FDCs or maxicards issued for this set.

Brian S. Luther

Ukraine 1999, Scott 364a–e.

The 2002 set is a WWF (World Wildlife Fund) s/s (Scott 464 a–d) with four stamps showing four different snakes, but all have a portion of the fungus fruiting (with 15 or so pilei) on a tree trunk. The WWF insignia is directly over the center of this fungus. This could be *Trametes versicolor* (Turkey Tails), but because we can't see a view of the hymenium, this can't be confirmed, so it could also be something unrelated. Most of the fungus shown is located in the lower right corner of Scott 464a, with some extending to the adjacent corners of all the other stamps.

Brian S. Luther

Ukraine 2002, Scott 464a–d.

The 2006 s/s for Scott 639a–e is titled Fauna of Shatskyi National Park, with five stamps. Two of these (Scott 639d features a frog & Scott 639e a weasel) show a portion of a fruiting of a Turkey Tail-like fungus having five caps (pilei). Again, confirmation of the species is not possible.

Brian S. Luther

Ukraine 2006, s/s for Scott 639a–e.

Brian S. Luther

Ukraine 2006, close up of Scott 639d & e showing a fungus on the stump.

The colorful 2013 s/s is titled Autumn, and has a gorgeous overall scene with a woman covered in, and surrounded by, beautiful flowers and fruits of the season. It has four stamps on it, one being Scott 941d showing four *Boletus edulis*. This stamp lists the Ukrainian common name and the scientific name and is perforated with gum. The upper part of this s/s also shows what appear to be some *Agaricus* button mushrooms directly above the carrot, along with several fruits and vegetables; these are not on one of the stamps, just in the overall s/s scene and are somewhat obscure. Again, I have not seen FDCs or maxicards issued for these stamps.

Brian S. Luther

Ukraine 2013 s/s, Scott 941a–d.


Brian S. Luther

What appear to be some button mushrooms right above the carrot in s/s for Scott 941a-d.

Mushrooms as Medicine, *cont. from page 1*

fungi are open to the environment, though the hyphae are in control and will absorb only desired metabolites.

Excepting the aboveground fruiting bodies, the bulk of most fungi grows underground amid millions of other hungry microorganisms, many of them ready to devour the protein-rich fungal tissue. Fungi need a strong immune system to defend and hold their ground against hostile microorganisms. To do so they have developed antibiotic, antiviral, and antibacterial powers. These powers have long been harnessed for human health. Modern medicine focuses on *Penicillium* (a mold, also a type of fungi) and related allies, losing sight of more complex fungi. These often-overseen mushrooms offer a much richer cocktail of powerful compounds that aid the human immune system and are nutritious. *Fruits of the Forest* shines some light on known medicinal benefits of species, although many of these insights are so far based only on *in vitro* lab work and lack human trials.

ROBOTS WITH ULTRA-BRIGHT LIGHTS DEPLOYED IN FIGHT AGAINST DEADLY FUNGUS

Jacob Geanous

https://nypost.com/, April 22, 2023

At least half a dozen New York City area hospitals are using $100,000 robots that deploy high-intensity light to combat a deadly drug-resistant fungus spreading across the country and state.

Xenex UV LightingStrike Robots have a 99 percent success rate in stopping the spread of *Candida auris*, the potentially fatal drug-resistant fungi first identified in Japan in 2009, according to a study by Netcare Hospitals.

Last year, New York State saw record number of cases of *Candida auris*—a "diabolical" fungal infection that can cause sepsis if it enters the bloodstream.

Xenex Disinfection Services—which told *The Post* it has disinfecting robots in local hospitals and at least 130 veterans hospitals nationwide—applied for approval from the Federal Drug Administration earlier this year for the device that uses xenon light, which is commonly found in vehicle headlights.

The light is 4,300 times more intense than the standard bulb, and kills germs more quickly than mercury-based UV bulbs in other machines, according to the company.

"It's the difference between a Porsche and a [Ford] Model A," Morris Miller, the company's CEO said.

The company said the robots are currently being put into use at local hospitals including Memorial Sloan Kettering Cancer Center, which has locations around the New York City area, North Shore University Hospital in Long Island, and Phelps Memorial Hospital in Sleepy Hollow.

Miller also said that the robots were designed by two epidemiologists.

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Robots vs *Candida auris*, *cont. from page 5*

Morris said that his company's robot can be used to disinfect a hospital room in about 10 minutes.

"On an ultra-serious and scary pathogen your talking about 15 minutes [on the] left [side of the room], 15 minutes [on the] right [side of the room], you're done," Morris said.

World Satellite Television News

The Xenex LightStrike Germ-Zapping UV robot iin use. According to a study, it is more than 99 percent effective at deactivating the fungus Candida auris.

Dr. Donna Armellino, an infection prevention specialist at Northwell Health, said that she and her colleagues use UV devices, including Xenex robots and similar devices from Leviant Inc, on top of traditional cleaning methods.

Armellino said the robots are also used in the neonatal intensive care units.

Armellino added that the federal government has yet to set standards regarding UV devices and there is still more to learn about the devices, as well as the best ways to use them.

"There needs to be more literature and controlled studies," she said.

ATHLETES TURN TO MAGIC MUSHROOMS TO TREAT TRAUMATIC BRAIN INJURIES

Loukia Papadopoulos

https://interestingengineering.com/, April 22, 2023

A new report published Friday on *ESPN* is highlighting how injured athletes are taking an unusual road to treat their traumatic brain injuries. As Western science has failed them, they are turning to magic mushrooms.

The mushrooms and therapy sessions are provided in Jamaica in the Good Hope Estate, a sugar plantation turned exclusive resort that claims to help those that prescription medication cannot.

The program is run by a Canadian company called Wake Network.

"When you're in pain and you're stuck in a corner, you'll do anything to get out of it," a former boxer and visitor of the new treatment center Mike Lee said.

Meanwhile, Riley Cote, a former enforcer with the Philadelphia Flyers and now a psychedelics evangelist who is an adviser to Wake, also shared his story.

"I fought everyone and their brother in my career," Cote said. "I would pick out the biggest guy I could find and challenge him. It was how I survived, how I made a name for myself. I was inflicting all this pain and inflammation on myself, always getting punched in the face, and I had to keep up with this macho type of personality, like, 'Oh, you can't hurt me. You can't hurt me.' "

Cote however has now changed thanks partially to psychedelic mushrooms which he credits with bringing him back into the light.

"The world is in a crisis, a mental health crisis, a spiritual crisis," Cote said. "And I think these are spiritual medicines, and I just feel like it's the right path for me. I don't think of it as anything more than my duty, my purpose on this planet is to be sharing the truth around natural medicine."

However, scientists do state that the research on the substances is still at its early stages and practitioners should proceed with caution.

Lee, on the other hand, did find his way at the resort.

"I came away from it kind of realizing that I have all the tools to heal myself," he told *ESPN*. "That's huge. Because, especially for guys who have had concussions or athletes or what have you, you feel kind of isolated, you feel alone, you feel hopeless. So it kind of gives you a sense of hope."

THE MYSTERIOUS WORLD OF MYCELIUM

Jonathan Kranz

Pioneer Valley Myco. Assoc.

via *Mycena News*, Myco. Soc. San Francisco, April 2023

Mike Ostrowski

Open any mycology book, attend any introductory fungal lecture, and among the first lessons comes the understanding that the mushrooms we seek are merely the fruiting bodies of the fungi we can't see: the metabolism of this creature, its day-to-day living, growing, eating, exploring, and ultimately, dying, are fulfilled invisibly within a thready, cobwebby network of hyphae called, "mycelium."

Jessie Evans

Fungi thrive in the underworld, hidden within the dark recesses of plant tissues,

Hohenbuehelia mastrucata with mycelium.

dead or dying wood, and that simultaneously ordinary and extraordinary substance, soil. Most of the time, we mushroom hunters see nothing of this life beyond the few threads that cling to the base of freshly harvested specimens or an ivory mycelium spread thin, damp, and lacy on the underside of a freshly turned log.

We know that fungi, like animals, are heterotrophs that must consume other life in order to live. But unlike animals that ingest food and excrete waste, fungi live "inside-out," excreting the chemistry necessary to liberate nutrients they can then absorb. With so much activity outside itself, where does its body end and the environment begin?

How do we imagine such a porous, ambiguous creature? What would be its shape, its texture and form? If we had a superpower that would allow us to picture the mycelium distinct from its context, what would we see? Would it resemble clouds or pillows, neural networks or explosive nebula? Does each individual (and what does individuality mean for a being so widely spread out?) maintain its own distinct turf with discrete boundaries or can the hyphae of many individuals intertwine, creating a three-dimensional tapestry of multiple species underground?

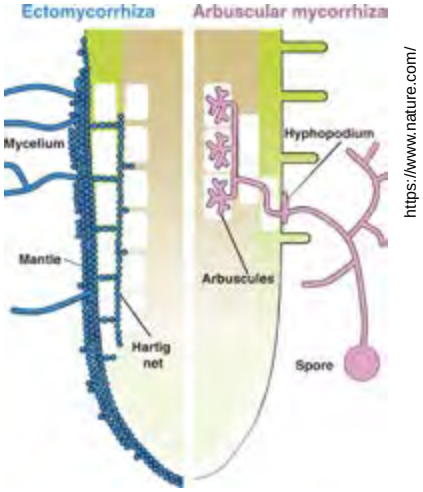
According to David Hibbett, PhD, Professor of Biology at Clark University, and a good friend of both the PVMA and BMC, "different fungi have different forms." The saprobes that feed on dead wood—the brown and white rotters—for example, are "more homogeneous than the soil [dwellers]." These will indeed defend distinct territories often defined by the spalting favored by woodworkers.

Wood showing examples of spalting, or the different zones of wood rot fungi.

"But the three-dimensional [spread] of ectomycorrhizal mycelia?" says Hibbett. "We don't know."

That large "not-knowing" became the underlying theme of my pursuit of the underworld. Serita Frey, PhD, Professor of Natural Resources, and the Environment at the University of New Hampshire, concurs: "We simply don't know what's going on below ground." In a time when the recently deployed James Webb Space Telescope seems to be producing near daily insights into galactic systems millions of light years away, we have significantly less understanding of the natural dynamics of soil systems literally under our feet. The reasons why are not obscure: it's dark down there and the complex interrelationships of so many organic and inorganic variables are difficult if not impossible to recreate in the lab.

Here's what we do know. First, among the fungi that live symbiotically with plants, we must distinguish the endomycorrhizal arbuscular fungi (AM) that associate with 85 percent of all plant species from the ectomycorrhizal fungi (ECM) that associate with merely 5 percent of terrestrial plants, including many of our familiar forest trees: oaks, birches, pine (but not, sadly, maples). The hyphae of the former, AM fungi, actually penetrate into the root cells themselves, creating arbuscules—ranched, tree-like organs—for the exchange of nutrients/water for life-giving sugars. AM fungus activity is essential for life on Earth, but their mycelia do not create mushroom fruiting bodies. The ectomycorrhizal fungi are less prevalent, but more significant to us mushroom hunters because of the bounty they create on the forest floor. Underground, their hyphae do not penetrate plant cell walls, but do create a Hartig net between the epidermis and cortex to facilitate exchanges. An examination of tree rootlets, even with relatively minor magnification, will reveal a hyphal "wrapping" that bonds plant and fungus together.



https://www.nature.com/

Illustration of root colonization structures in ectomycorrhizal (blue) and arbuscular mycorrhizal (pink) interactions. The ectomycorrhizal fungus surrounds the root tip with a thick mantle of closely appressed hyphae, whereas the Hartig net develops around epidermal cells (green). In the case of arbuscular mycorrhizas, the root tip is usually not colonized. Hyphae develop from a spore and produce a hyphopodium on the root epidermis. Intraradical colonization proceeds both intra and intercellularly and culminates with the formation of arbuscules, little fungal trees, inside inner cortical cells (brown).

Mike Ostrowski

Mycelia binding.

In either form, AM or ECM, the mycelia extend beyond their symbiotic root foundations to explore for water and nutrients they can exchange for carbohydrates. According to Frey, the reach of this hyphal extension is "not well documented and depends on the species and growth habit, with some hyphae extending a significant distance from colonized roots."

Yet, oddly enough, despite the overwhelming number of plant/fungi relationships and the oft quoted statistic of 1–40 miles of hyphae per teaspoon of soil, "only 1 to 2 percent of soil surface area is occupied by microbes," says Frey, "leaving lots of room for mycelia to explore without bumping into each other."

Mycelia may not be colliding, but the soil environment remains profoundly crowded. Dr. Frey estimates that some two to three thousand different fungal species, active and resting (i.e., spores, sclerotia), can inhabit that same teaspoon of soil. That's why, Hibbett suggests, biologists are exploring "metagenomics," "metatranscriptomics" and "metaproteomics" (DNA > RNA > proteins) to find "clues to the physiological potentialities of an environment beyond the genome of any one organism."

If the ultimate nature and form of mycelia remain frustratingly inconclusive, we can take comfort in knowing that its activity

cont. on page 8

Mycelium, *cont. from page 7*

—like the search for quantum gravity or the nature of black holes—is as mysterious to our best scientists as it is for us lay mushroom enthusiasts. We end where we began, but perhaps with more humility and awe; for every mushroom we pick and study, there is a secret world of mycelium that, like the dreams in our heads and the stars in the sky, reward us with an even greater capacity for wonder.

A CAUTIONARY TALE: MAGIC MUSHROOMS AND HIKING DON'T MIX

Adam Roy

https://www.backpacker.com, April 13, 2023

Every hiker has had a bad trip before. But a group of hikers in England's Lake District gave the term new meaning last week, when they got so ill from taking magic mushrooms that they needed rescue.

On April 8, the Keswick Mountain Rescue Team received a number of calls from walkers who had encountered "a group of young adult males who had taken magic mushrooms." The psychedelic experiment apparently hadn't gone as planned. According to a post on the team's site, two of the hikers, including the one who had driven the group to the trailhead, were "feeling unwell." Rescuers located the group and then walked the stricken psychonauts out, after which they were "given advice by the team medic regarding the timing of their onward travel," which we presume is a nice way of saying "told to please not drive until the trees stopped pointing and laughing at them."

Hikers occasionally do drugs on the trail, a fact that will shock no one except for my grandparents. That's been true since there were hikers, drugs, or trails and continues to be true today. Backpacker's adopted hometown of Boulder, Colorado, is both a hiking town and a college town, which means that on any given weekend you're likely to notice someone on the trail who's just a little too invested in how pretty the wildflowers are and a little too oblivious to everything else.

Just because hiking in an altered state of mind is common doesn't necessarily mean it's a good idea. While the individuals in last week's incident walked out without trouble, some psilocybin-curious hikers have met much grimmer ends. In 2022, a 25-year-old hiker drowned during a hike on Washington's Wallace Falls Trail after allegedly taking mushrooms. British Columbia's North Shore Rescue has responded to a laundry list of injuries and incidents involving hikers on psychedelics, including one who had to be evacuated by helicopter following a bad acid trip and a pair who fell 200 feet into a ravine while on mushrooms and marijuana.

The problem isn't so much the drugs as the environment in which the hikers took them. After last year's death on Wallace Falls Trail, Dr. Nathan Sackett, a medical researcher at the University of Washington, told Seattle's King 5 News that while magic mushrooms are generally safe on their own, "accidents are prone to happen" when people take them in a wilderness area where natural hazards abound.

"As psychedelics become culturally more normative, it's really important that people know they should do them in a controlled environment," Sackett told the station. "Hopefully, one day, people won't have to hide in the woods to experience them."

So, aspiring psychonauts, consider this a cautionary tale: Trails and magic mushrooms don't mix. Find a safer space for your chemical experimentation—or at least find someone sober to hold onto the car keys

Try 'em

There are mushrooms that can kill you.
Some will nauseate or chill you.
And there's others that will fill you
with delight.

Some are simply unhygenic.
And a few hallucinogenic
Which will land you in a clinic
in a fright.

So the thing to do is fry them.
Get the wife and kids to try them.
Then it's easy to identify them.
Right?

—Ralph Nolan

MUSHROOM ASTROLOGY

Bob Lehman, LAMS

Taurus (Apr. 20 – May 20): You enjoy the aesthetic and sensual qualities of mushrooms—their forms, colors, textures, aromas, and flavors—and you prepare tasty dishes from the edible ones. You insistently search for particular species that meet your qualifications, although you also may fill your basket with mushrooms that you never use. You like the idea of living off the land and not having to pay for your food. You are protective about your favorite hunting place.

Gemini (May 21 – June 20): You enjoy the mental challenge of figuring out when and where mushrooms are going to fruit—making calculations about rainfall, temperature, humidity, season, mycelial activity, and fruiting patterns. Having made your calculations you may get distracted by some other interest and never actually do any mushroom hunting, but you can check your calculations later by asking what other people found. You are good at mushroom identification, which is like a game to you, and you like taxonomy—especially all the name changes that drive other people crazy.