SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 619 February 2026

MYSTERIOUS GIANTS COULD BE A WHOLE NEW KIND OF LIFE THAT NO LONGER EXISTS

Mike McRae

https://www.sciencealert.com/, Jan. 22, 2026

Loron et al., Science, 2025

Artist's conception of Prototaxites.

Ever since their discovery more than 165 years ago, massive fossilized structures left by an organism known as *Prototaxites* have proven impossible to categorize.

Researchers in the UK have suggested in a recently published study that there's a very good reason these oddities don't fit neatly on the tree of life—they belong to a branch all of their own, with no modern equivalent.

Some 400 million years ago, the swamps of the late Silurian period would have sprouted a mix of horsetails, ferns, and other prototype plants that look positively alien today.

Among them stretched 8-m (26-ft) tall towers that defy easy identification. Wide and branchless, these organisms may have been a form of algae or ancient conifer, researchers suspect, based on what little evidence remains.

Fossils found on the shores of Gaspé Bay in Quebec, Canada, were initially considered by geologist John William Dawson to be the remains of rotting trees, leading to his naming it "first conifer" back in the 1850s.

Though the name stuck, confusion over the fossil's classification continued until National Museum of Natural History paleontologist Francis Hueber confirmed in 2001 that *Prototaxites* was indeed most likely an enormous fungus.

That conclusion was backed up years later in 2017 by a subsequent analysis of a fossil fragment assumed to be from the peripheral region of a smaller *Prototaxites* species named *P. taiti.*

The 2017 study claimed to identify textures that resembled the fertile structures of today's Ascomycota fungi.

Not everybody is convinced, however, given the possibility that the distinct fragments might not have even been connected.

"In the books and books of anatomy written about living fungi, we never find structures like that," University of Edinburgh paleobotanist Alexander Hetherington told Erik Stokstad at *Science Magazine*.

Hetherington co-led a study on three different *P. taiti* fragments, concluding there's insufficient evidence to conclude *Prototaxites* is a fungus at all.

Neil Hanna/PA

Prototaxites fossil found in Aberdeenshire.

Through a review of microscopic anatomy and chemical analysis of its tubular structures, the team of researchers systematically eliminated each and every candidate group, leaving no modern organism with which it might share some kind of ancestral relationship.

Fungi? Rejected thanks to the unique way its anatomy connects.
A plant or algae? Not likely given its chemical composition.
A mix of the two, such as a lichen? Not with that anatomy.
Some bizarre animal? Cell walls say no chance.

"Based on this investigation we are unable to assign *Prototaxites* to any extant lineage, reinforcing its uniqueness," the researchers claim.

"We conclude that the morphology and molecular fingerprint of *P. taiti* is clearly distinct from that of the fungi and other organisms preserved alongside it in the [Devonian deposit], and we suggest that it is best considered a member of a previously undescribed, entirely extinct group of eukaryotes."

What might have happened to this long-dead group of organisms is anybody's guess. Further reviews may even return the mystifying group back to its box among ancient fungi.

Without similar specimens to relate them to, *Prototaxites* may simply remain a fossil anomaly—a reminder that evolution is a constant experiment, one littered with far more failures than we may ever have realized.

Researchers (R to L) Sandy Hetherington, Corentin Loron and Laura Cooper at the National Museums Collection Centre with sample fossils of the species Prototaxites.

Spore Prints

is published monthly, September through June by the
PUGET SOUND MYCOLOGICAL SOCIETY
Center for Urban Horticulture, Box 354115
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CALENDAR

Feb. 10	Membership meeting, 7:30 pm, CUH
Feb. 16	Board meeting, 7:30 pm, CUH board room
Feb. 17	*Spore Prints* deadline
Mar. 8	Election deadline

BOARD NEWS — Valerie Costa

The board is reviewing 2025 financials and creating the 2026 budget. Revenue in 2025 was flat. Membership revenue decreased but it was offset by investment income.

Cindy and Megan Brewster will be presenting a detailed review of the 2025 financials and 2026 budget at the February membership meeting and asked the board for any insight about membership trends, including whether revenue is expected to decline, stabilize, or rebound.

In the following discussion, Shannon Adams offered to analyze historical data, including pre-2018 figures, to better understand the drivers behind recent trends. Membership Chair Pacita Roberts will also be consulted. The results will be shared with the board next month to inform decision making.

The Nominating Committee has been hard at work finalizing candidates for the upcoming board elections. The candidates for Trustee are Amy Foster, Austin Johnson, Clay Dawson, Laura Feinstein, Laurie Wu, and Pamela Pakker-Kozicki. The candidates for Vice President and Treasurer are Karen Dawson and Chuck Perkins, respectfully. Both do not meet the current bylaws requirements of previous board service and four years as a member, but the board voted to override these requirements given their strong qualifications and willingness to serve.

The Golden Mushroom Nominees will be presented at the June social, and the Ben Woo Scholarship deadline is set for April 1. A new version of the PSMS website is ready for testing and will go live soon.

Discussion of Mushroom Mania was tabled owing to challenges in recruiting and retaining volunteers, though there was enthusiasm for revisiting it in the future. PeiPei will represent the organization at the Explore the Outdoors Event at the Seattle Center. We also received invitations to join the Arboretum's Earth Day event and the Puyallup Plant Sale. If you can staff a table, please reach out to Marian Maxwell at outreach@psms.org .

This will be my last Board News. Peg Rutchik will be taking over my place as PSMS Secretary in February.

MEMBERSHIP MEETING — Joe Zapokosky

Dr. Brian A. Perry

The Puget Sound Mycological Society is pleased to welcome Brian A. Perry, Ph.D., as our February speaker at the Center for Urban Horticulture. Dr. Perry is a mycologist whose work bridges field biology, fungal systematics, and modern biochemical and genetic research—an approach well suited to this month's exploration of one of the most captivating phenomena in mycology: fungal bioluminescence.

Fungal bioluminescence has intrigued observers since antiquity. It was first noted by Aristotle more than two thousand years ago. Yet only recently have scientists begun to unravel the chemical pathways and genetic machinery that allow certain fungi to glow. More than 125 species are now known to produce luminescent mushrooms or mycelium, and new discoveries continue to emerge from forests, herbaria, and molecular laboratories alike.

Dr. Perry is Professor of Biology at California State University, East Bay, Director of the HAY Fungarium, and Associate Director of the Green Biome Institute. His research integrates field collecting, microscopy, fungarium-based study, and DNA analysis to better understand fungal diversity, evolution, and ecological function. This combination of perspectives is central to how we come to recognize and study phenomena like bioluminescence—linking glowing fruitbodies in the woods to preserved specimens, named species, and the underlying genes that make light possible.

For PSMS members, Dr. Perry's work highlights the enduring importance of careful observation and well-documented collections. Many luminescent species are poorly known, rarely col-

lected, or recognized only when someone takes the time to notice a faint green glow on a forest walk. Fungaria provide the long-term home for these discoveries, preserving specimens that allow researchers to confirm identifications, reconstruct evolutionary histories, and test new biochemical questions decades later.

We are excited to welcome Brian to the Center for Urban Horticulture and to offer PSMS members an evening that celebrates both the wonder of glowing fungi and the scientific pathways that allow us to understand them—from the forest floor to the fungarium, and now, down to the molecular level.

Brian's talk is open to all, and we welcome the general public to attend this exciting event.

Where: Center For Urban Horticulture, University of Washington

When: February 10, 2026. Doors open at 7:00 pm.

This event will not be broadcast live via Zoom. We will endeavor to record the presentation and make it available to PSMS members for 30 days following the presentation.

CALL FOR APPLICATIONS: 2026 BEN WOO SCHOLARSHIP FUND

PeiPei Sung

The Puget Sound Mycological Society is now accepting applications for grants from the 2026 Ben Woo Scholarship Fund, which supports projects that deepen understanding of fungi, with particular attention to mushroom-forming species that are central to PSMS's mission.

Amount. Scholarships of **up to $3,000** are available for work that benefits the Pacific Northwest mycological community.

Eligibility. Applications are welcome from students, independent researchers, educators, community scientists, and others engaged in mycological study or learning. Projects may include field exploration, documentation, laboratory analysis, ecological observation, or educational and community-based efforts that contribute to shared knowledge.

Applicants should clearly describe their project goals, approach, and how they plan to share what they learn with PSMS members and the broader community.

More information about eligibility, allowable costs, and application requirements is available at psms.org/scholarship.

Application deadline: Sunday, March 1, 2026, 11:59 pm.

About the Ben Woo Scholarship

The Ben Woo Scholarship is named in honor of Benjamin Woo, a founding member and first president of the Puget Sound Mycological Society. Ben believed strongly in learning through curiosity, mentorship, and service. He was also active in Seattle's Chinatown International District, where he supported community-led knowledge sharing and cultural continuity.

This scholarship reflects Ben's legacy by welcoming diverse perspectives and multiple ways of contributing to mycology, including formal study, independent inquiry, and community-based learning.

HE INVENTED MINI SAUNAS FOR FROGS—NOW THIS BIOLOGIST HAS BIG PLANS TO SAVE HUNDREDS OF SPECIES

https://www.theguardian.com/, Jan. 13, 2026

Standing ankle-deep in water between two bare cottonwood trees on a hot spring day, eight-year-old Anthony Waddle was in his element. His attention was entirely absorbed by the attempt to net tadpoles swimming in a reservoir in the vast Mojave desert.

It was "one of the perfect moments in my childhood," he says.

"Tadpoles: so cool. I wanted to get as many in my net as I could, and just look at them and admire them and understand," he says, recalling the moment. "I think metamorphosis is the one reason why kids bring tadpoles home. They want to watch that change."

Waddle has been through a metamorphosis of his own. He has gone from being a child obsessively clutching a binder full of animal trivia in a Las Vegas neighborhood, his parents barely scraping by, he says, to becoming the first person in his family to get a Ph.D., which he received from the University of Melbourne in 2022. Today, the 35-year-old is working in Australia to help save the species that fascinated him as a boy. Waddle is an award-winning conservation biologist on a mission to save frogs from the deadly chytrid fungus, which has wiped out 90 species and is threatening more than 500 more.

Frogs and other amphibians play a critical role in the planetary ecosystem, consuming many insects that transport human diseases. Their skin is considered an important potential source of new painkillers that may be less addictive than opiates and could help with antibiotic resistance. The fungus infecting them is almost always deadly, and can rapidly wipe out populations.

In an attempt to slow the march of the disease, Waddle began a novel experiment: building frog saunas. Working out of his lab in Australia during the pandemic, he and a fellow researcher began experimenting with masonry bricks for their perfect, frog-sized holes. Soon, stacks of bricks housing endangered green and golden bell frogs rose "like a Jenga tower, three levels of bricks with a greenhouse over the top" at the test site, Waddle says. They hoped that by raising frogs' body temperatures, the saunas would help stave off the chytrid fungus— which, like the flu, runs rampant in the winter months.

Macquarie University

Frog saunas.

cont. on page 4

Frogs in Saunas, *cont. from page 3*

The experiment worked. Frogs that spent the winters warmer in their new shelters were less likely to fall prey to the infectious fungal pathogen, which is temperature sensitive. They were also resistant when re-exposed. It was good news for frogs lucky enough to access these shelters, but Waddle wanted to look further, at solutions that could help save more amphibians at risk.

Frog in sauna.

The search for a scalable, multi-species solution took him into the world of immunization and synthetic biology. One of his larger projects involves raising and vaccinating hundreds of green and golden bell frogs, species slowly dying off, largely due to chytrid, for release into the wild.

When they are released, it will be "probably the largest input of frogs in that population in a decade," he says.

Not all species can be vaccinated, however. For those that can't, such as the critically endangered southern corroboree frogs that no longer breed in the wild, the team is experimenting with gene replacement to help support their reintegration.

"Yesterday we were making transgenic frogs together, the first ever experiment to make a transgenic frog in Australia," Waddle says from his lab, buzzing with excitement.

"We want to test it in as many Australian species as we can, with the idea that if it works in a lot of species in Australia that are at different conservation levels, different ecologies, it could be the solution, and we could share it around the world," he says.

Synthetic biology, in which organisms are "edited" by the introduction or deletion of genetic material, is an innovative but controversial discipline. Advocates say it can help add diversity to populations stuck in genetic bottlenecks, or help make vulnerable species disease resistant; critics raise ethical questions and the risk of unintended consequences. Debate surrounded the 2025 International Union for the Conservation of Nature decision to allow the use of synthetic biology for conservation purposes.

Some, including Waddle, think it can help. "We can't just be willy-nilly slapping genes into frogs, but at the research level we should be investigating synthetic biology." He says, "We're going to start using these methods in the wild for conservation."

Australian herpetologist and conservationist Dr. Jodi Rowley calls the work "a ray of hope in amphibian conservation. With the global plight of amphibian populations around the world so dire—over 40 percent of all species are threatened with extinction—we need these really innovative and cutting-edge strategies to help turn things around."

The challenges do keep him up at night, he says—but usually it's due to anticipation of possible solutions, rather than dread. "Usually if I can't sleep, it's something exciting," he says, grinning. "I can't wait to see what happens in that experiment tomorrow, if these frogs are going to have the gene. I didn't really sleep at all last night, so excited. But also ideas: I'll be sitting in bed, [thinking] oh, we can do that experiment. We can do this experiment."

Spore's Journey

On a breeze, a spore takes flight,
Through the day and into night,
A journey long, out of sight,
In search of soil, just right.

In the earth, it finds its place,
In hidden nooks, a tiny space,
Slowly grows with gentle grace,
In nature's arms, a warm embrace.

From tiny spore to mushroom crown,
In the woods, it settles down,
Part of earth's vast, living gown,

—https://engdic.org

Election Election Election

Election Instructions **Marian Maxwell**

Please read the following instructions carefully.

Elections are held electronically online. Voting is Sunday, February 1st, through Sunday, March 8th, at midnight. This year we will be voting for Vice President, Treasurer, and five Trustees for the years 2026–2028. Please read the following candidate profiles carefully. An email with the link to vote will be sent out on February 1 to those on the PSMS mailing list.

Those not opting into the mailing list will need to go to our website at www.psms.org and click on "Members' Page" under "Membership." Log in with your username and password.

On the page that opens, under "Engagement," click on "Elections." This opens the 2026 PSMS election ballot. Make your selections and be sure to click on "submit" on the bottom of the ballot when finished.

If you have forgotten your password, please fill out the section "Forgot your password?" at the bottom of the page and click on "Reset your password." If you cannot remember your username, contact Pacita Roberts at membership@psms.org or Marian Maxwell at outreach@psms.org.

Please note that some biographies in *Spore Prints* may have been abbreviated owing to space considerations. Online bios are as originally submitted. It will be helpful to have your *Spore Prints* issue with the candidates' photos and bios available to view when voting since there is no way to post photos in the online election area.

You may only vote once. There are two votes per family membership; each person must log in separately and use their individual user ID to vote. There is one vote for single and student memberships. Please direct questions about voting to elections@psms.org. Election results will be announced at the annual and general membership meeting on Tuesday, March 10th.

Officers

Karen Dawson *Vice President*

Karen Dawson has been a PSMS member for nine years and a guide for three. She is not a technical expert about anything mushroom-related but is willing and able to mine suggestions for interesting speakers and topics for the monthly meetings, the primary Vice-Presidential duties.

Treasurer **Chuck Perkins**

I have a Masters in accounting, and am a retired CPA. While new to mushroom hunting, I've enjoyed outdoor activities since my youth. My wife and I and look forward to serving the community where we can. My work experience has been in accounting, retail sales, and construction. My hobbies are travel, art, reading, mathematical problems, and now mushrooming. I would be happy to serve as your treasurer.

Trustees

Amy Foster

I have always been fascinated by fungi and their alienness. I have served as a Trustee on the PSMS board since 2024 and am also a member of the PSMS finance committee. I hope to continue in this role for another term and hope you will give me the opportunity to continue to assist in furthering the PSMS mission.

Clay Dawson

My wife and I have been PSMS members for 9 years. We have been guiding field trips for the past 3 years. I have volunteered at the mushroom show the past several years. This past year I served as an at-large member of the PSMS board. I would love to continue serving on the board.

Laura Feinstein

A member since 2021, I'm happiest on a scavenger hunt for mushrooms, boots deep in the woods and eyes on the forest floor. I love exploring the outdoors, cooking up fungal finds, and connecting with fellow foragers. I'm ready to work with the board to help PSMS fruit in all the right ways — learning, community, and fun.

Pamela Pakker-Kozicki

I've volunteered at fall shows, attended and hosted field trips, and learned so much since joining PSMS. My zoology degree taught me ecology, genetics, microscopy but not mycology! Now I want to give back and become a PSMS board member. My goal: every PSMS board decision should reflect our core mission, take into account all voices, and be totally transparent.

Laurie Wu

Over the past 2 years, I've attended 80% of PSMS events. In the past year, I've also attended board meetings as an alternate Trustee to learn the ropes. As a technologist who came from farmers and restaurateurs—and now a new PNW homeowner, I'm eager to give back to this community. Thank you to a past board member for suggesting I give it a try!

Austin Johnson

I am a mushroom enthusiast and love learning and teaching others about all things mycology. I have been a PSMS member for the past 4 years and especially enjoy volunteering at the annual mushroom show. I would like to help the club host more social and educational events for new members.

SCIENTIST WINS "ENVIRONMENT NOBEL" FOR SHEDDING LIGHT ON HIDDEN FUNGAL NETWORKS

Issam Ahmed

https://www.enca.com/, Jan. 14, 2026

WASHINGTON - Beneath the surface of forests, grasslands, and farms across the world, vast fungal webs form underground trading systems to exchange nutrients with plant roots, acting as critical climate regulators as they draw down 13 billion tons of carbon annually.

Yet until recently, these "mycorrhizal networks" were greatly underestimated: seen as merely helpful companions to plants rather than one of Earth's vital circulatory systems.

American evolutionary biologist Toby Kiers has now been awarded the Tyler Prize for Environmental Achievement—sometimes called the "Nobel for the environment"—for her work bringing this underground world into focus.

By charting the global distribution of mycorrhizal fungi in a worldwide Underground Atlas launched last year, Kiers and her colleagues have helped illuminate below-ground biodiversity—insights that can guide conservation efforts to protect these vast carbon stores.

Plants send their excess carbon below ground where mycorrhizal fungi draw down 13.12 billion tons of carbon dioxide—around a third of total emissions from fossil fuels.

"I just think about all the ways that soil is used in a negative way—you know, terms like 'dirtbag,'" the 49-year-old University Research Chair at Vrije Universiteit Amsterdam told AFP [Agence France-Presse] in an interview. "Whereas a bag of dirt contains a galaxy!"

Biological Marketplace

Kiers began studying fungi at 19, after writing a grant proposal that won her a place on a scientific expedition to Panama's rainforests, "and I started asking questions about what was happening under these massive trees in this very diverse jungle."

She still vividly recalls the first time she peered through a microscope and saw an arbuscule—the mycorrhizal fungi's tiny tree-like structure that penetrates plant cells and serves as the site of nutrient exchange—which she described as "so beautiful."

In 2011, Kiers published a landmark paper in *Science* showing that mycorrhizal fungi behave like shrewd traders in a "biological marketplace," making decisions based on supply and demand.

With filaments thinner than hair, fungi deliver phosphorus and nitrogen to plants in exchange for sugars and fats derived from carbon.

Using lab experiments, her team demonstrated that fungi actively move phosphorus from areas of abundance to areas of scarcity—and secure more carbon in return by exploiting those imbalances. Plants, in other words, are willing to pay a higher "price" for what they lack.

The fungi can even hoard resources to drive up demand, displaying behavior that echoes the tactics of Wall Street traders.

The fact that all this happens without a brain or central nervous system raises a deeper question: how fungi process information at all—and whether electrical signals moving through their networks hold the answer.

Debt of Gratitude

More recently, Kiers and her colleagues have pushed the field further with two *Nature* papers that make this hidden world newly visible.

One unveiled a robotic imaging system that lets scientists watch fungal networks grow, branch, and redirect resources in real time; the other mapped where different species are found across the globe.

That global analysis delivered a sobering result: most hotspots of underground fungal diversity lie outside ecologically protected areas.

With fungi largely overlooked by conservation frameworks, Kiers co-founded the Society for the Protection of Underground Networks (SPUN) to map fungal biodiversity—and argue for its protection.

To coincide with the prize, which comes with a $250,000 award, SPUN is this week launching an "Underground Advocates" program to train scientists in the legal tools they need to protect fungal biodiversity.

Her aim, she says, is to get people to flip how they think about life on Earth—from the surface down.

"Life as we know it exists because of fungi," she said, explaining that the algal ancestors of modern land plants lacked complex roots, and that a partnership with fungi enabled them to colonize terrestrial environments.

THESE ANCIENT INSECTS WERE FOUND IN AMBER—THEN SCIENTISTS SAW SOMETHING GROWING OUT OF THEIR HEADS

Sarah Jones

https://www.msn.com/, Jan. 3, 2026

A fossilized ant and fly preserved in 99-million-year-old amber have revealed one of the oldest known examples of parasitic fungi taking over insect hosts. The fungal growths protruding from the heads and bodies of the insects show the same gruesome tactics used by modern "zombie-ant fungi," suggesting that such behavior dates back to the Cretaceous period.

The discovery provides direct evidence that fungi from the *Ophiocordyceps* genus were already infecting and killing insects nearly 100 million years ago, altering their behavior before using their bodies to reproduce. These rare fossils were examined by researchers using microscopic and 3D imaging methods, allowing them to identify and describe two new fungal species previously unknown to science.

Fungi that Manipulate Their Hosts

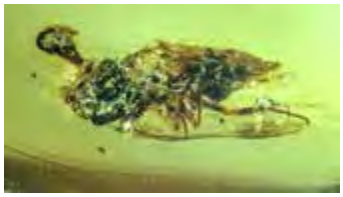
The fossils were uncovered in amber deposits from northern Myanmar, a region that has yielded several exceptional specimens in recent years. The study, published in *Proceedings of the Royal Society B*, was led by Yuhui Zhuang, a paleontology researcher at Yunnan University.

He described the fossils as "very rare, at least among the tens of thousands of amber specimens we've seen, and only a few have preserved the symbiotic relationship between fungi and insects."

Two Insects, Two Parasites

The fossilized fly and ant were each infected by a different newly identified species of fungus. In the fly, the parasite named *Paleoophiocordyceps ironomyiae* was seen growing out of the insect's head. In the ant, the fungus *Paleoophiocordyceps gerontoformicae* showed similar patterns. These growths are the fruiting bodies of the fungus, structures used to spread spores after the insect has died.

Nanjing Institute of Geology and Palaeontology; Chinese Academy of Sciences/NIGPA



A fungus is visibly sprouting from the head of a fly trapped in 99-million-year-old amber.

A piece of amber reveals an ant overtaken by a parasitic fungus.

According to Conrad Labandeira, a scientist at the Smithsonian Museum of Natural History who was not involved in the study, the ancient fungi likely infected their hosts in much the same way as their modern counterparts.

"It appears that ants, for some reason, were targeted early for zombification and currently are the major recipients of this parasitoid fungus."

A Complex Ancient Relationship

Scientists think this type of parasitism played a big role in prehistoric ecosystems. João Araújo, one of the study's authors, said the fossilized fungi are probably ancient relatives of today's zombie-ant fungi. He also pointed out how rare it is to find fossils of these insect-killing fungi, which makes this find especially valuable.

Thanks to the way the insects were preserved in amber, researchers got an unusually clear look at the moment the fungi were taking over. Zhuang's team suggests that the insects were likely infected and killed just before getting stuck in sticky tree resin, capturing the exact moment when the fungus started growing out of their bodies.

DENVER HEALTH DEPARTMENT PULLS PSILOCYBIN CHOCOLATES OFF RETAILER SHELVES, WARNS PUBLIC **Thomas Mitchell**

https://www.westword.com/, Jan. 20, 2026

Psychedelic mushrooms are decriminalized in Denver, but that doesn't mean you're allowed to shop for them.

According to a bulletin from Denver Department of Public Health & Environment (DDPHE), local health officials have removed PolkaDot brand chocolate bars that were infused with psychoactive ingredients from three different Denver retailers this month. The retailers were not named, but all three carried PolkaDot-branded chocolates that were found to contain psilocybin and psilocin, the psychedelic compounds found in magic mushrooms,

DDPHE

after the DDPHE had them analyzed by "a local laboratory certified to detect psychoactive compounds."

The tests also found 4-ACO-DET, 4-HO-DET, and 4-HO-MET, all of which are synthetically derived tryptamines that "can elicit psychoactive effects and are prohibited in retail food products."

BABY TEETHERS RECALLED AFTER BLACK YEAST FOUND DURING TESTS **Katie Nicholls**

https://www.snnewswatch.com/, Jan. 20, 2026

ONTARIO, CA - Disney- branded baby teethers are being recalled after a type of black yeast was found inside the item.

Health Canada is recalling two variations of the teethers, one is blue/teal with Mickey Mouse graphics, and the other is pink with Minnie Mouse. The affected Disney Baby Water Teethers have the model number 3121188, and were sold at Dollarama stores from November 2023 to January 2026.

According to the recall notice, Health Canada's sampling and evaluation program determined that the liquid filling is contaminated with the fungus *Rhinocladiella similis*. The fungus is usually harmless, but it may cause an infection in children if the teether is punctured and the liquid filling is ingested.

The notice also recommends that consumers immediately stop using the recalled Disney Baby Water Teethers and return the product to a Dollarama store for a refund.

As of Jan. 14, the company has received no reports of incidents or injuries in Canada of the over 15,000 teethers sold.

A NEW DYE FOR MUSHROOM MICROSCOPY **Dick Sieger**

Pouring through Marcel Lecomte's remarkable book *Microscopy & Fungi* (2024), I came across the account of a new dye for the microscopic examination of mushrooms. At least it's new to me. The product is call 2Tone.

2Tone stains teeth. The manufacturer says, "2Tone™ Disclosing Solution reveals both older and newer plaque with an advanced multicolored formula. 2Tone turns newer plaque red and older plaque blue, showing patients the areas they consistently miss while brushing." It is a combination of two water-soluble dyes: FD&C Blue #1 and D&C Red #28.

When mounting mushroom tissue for microscopic examination, people often use two dyes: Congo Red and Phloxine. Congo Red darkens cell walls and Phloxine colors cell contents pink. 2Tone alone does the same job. Basidia, basidioles, cystidia, and immature spores become pink; hyphae and mature spores remain unchanged.

2Tone is available online. Two fl. oz. in a squeeze bottle set me back $27, and there's plenty to share with friends. I transferred some to a dropper bottle (the squeeze bottle it comes in is way too generous) and tried it on a late blooming *Amanita muscaria*. The result was excellent.

GIFTS OF THE FUNGI

Susan Goldhor

FUNGI Magazine, Winter, 2025, Volume *18*(5), 11

Like all kingdoms, the fungi giveth and the fungi taketh away. Most folks focus on the fungal downside—the rusts and blights that wipe out crops and impoverish our forests; the pathogens that threaten frogs and bats and even the spaces between our toes, while we mycophiles see the upside—bread rising, beer brewing, wine fermenting, deliciously stinky cheeses, to say nothing of truffles and morels, porcini and matsutake, the mycelia moving nutrients through the forest floor. I could go on, but you know the litany as well as I do.

And since, if you're reading this, you're in that second category, you're probably aware of huitlacoche and the fungal role in producing chocolate, coffee, soy sauce, and (for a special treat) psilocybin. To say nothing of penicillin and a ton of other pharmaceuticals, plus, for us true believers, the *Amanita muscaria* connection to flying reindeer and the otherwise inexplicable Santa. But, here are three gifts from Kingdom Fungi that you might not know about: chili peppers, scent, and insulin.

[*Ed. Note: Because of space considerations, each gift will be presented separately, one per month.*]

Chili Peppers

Hot, spicy foods and hot climates are pretty common partners, and I've heard all kinds of arguments for why this is the case. Hot pepper is an anti-microbial and a preservative, keeping foods from spoiling in the heat. Spicy foods stimulate appetites depressed by heat. But these are human-focused results and rationales, not causes. Leaving humans out of the equation, why do hot, spicy foods tend to grow in hot climates?

There is only one genus of "hot" foods—chili peppers or *Capsicum* species—and only one class of chemicals—capsaicinoids—that causes that heat. But if all chilis are capable of making capsaicinoids, the fact is that the hotness of chili peppers is variable. Not just according to the species or variety of pepper (we've all heard of "ghost" peppers that are so hot they're dangerous), but within even the spiciest chili species or varieties, some fruits are hot and some are not. And while the proportion of hot to not-hot is variable and changes according to geography, in any particular place the two types may grow side by side. Why is this?

It turns out that the answer lies in the interactions of three different kingdoms: plant, animal, and fungal. The fungus wants to attack the chili fruit seed but can't penetrate the tough seed coat. The plant, having expended evolutionary ingenuity and energy on that coat, now needs to protect its seeds with its most powerful chemical weapon (capsaicinoids), but because weapon production is very expensive (see our national budget), it doesn't ramp up production unless there are beetles around, because the fungus in question—*Fusarium semitectum*—is introduced by beetles drilling through the tough seed coat.

Using a wild Bolivian species of chili (*Capsicum chacoense*), Tewksbury et al. (2008a) answered the question of variability in the proportions of hot to not-hot chili plants by demonstrating this three-way relationship and showing "that variation in hemipteran foraging pressure among chili populations predicts the proportion of plants in a population producing capsaicinoids." (How do the plants know how many beetles are around? I couldn't find that out.)

There are more twists to this story. The seeds of wild chilies like *C. chacoense* rely largely on birds who eat the fruits for dispersal. A problem faced by plants relying on animal dispersal is that the chemicals they produce to combat pathogens (like *Fusarium*) are often repellent to their potential dispersers. How brilliant of chilies to have developed (albeit at significant metabolic cost) a contra-fungal weapon that has no effect on seed dispersal, because birds lack a receptor for heat.

Well…there actually is a secondary effect on seed dispersal which increases the costs of capsaicinoid production; the coats of seeds from hot plants are less sturdy than those from the not-hot ones, and thus less likely to make it through the bird's digestive tract unharmed (Tewksbury et al., 2008b). But it's an overall win.

The fungus-capsaicinoid battle turns out to be a great example of the types of weapons and defenses developed during an evolutionary battle between a plant and a pathogen. And a great example of how, when you start pulling apart any biological relationship, it turns out to be connected to everything else. For example, how do capsaicinoids hold off fungal attackers? Well, one of their most impressive weapons is their ability to inhibit or destroy part of their enemies' mitochondrial enzymatic oxidative mechanisms. In general, this results in death. But, it turns out that fungal pathogens of chili peppers have evolved alternative respiratory pathways. Sure, this exacts a fitness cost, but it's still better than death. However, since the defense is costly, the fungi may have a counter-offensive; they seem to be able to synthesize enzymes that can break down capsaicinoids. I say "may" because these can be demonstrated in vitro, but we don't know how they work in vivo. And of course, the peppers turn out to have yet another weapon; it turns out that capsaicinoids can break down cell membranes. The victims may die but the arms race lives on (Adams et al., 2020)

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to be contued next month

A Happy Valentine to All