

SPORE PRINTS

BULLETIN OF THE PUGET SOUND MYCOLOGICAL SOCIETY
Number 565 October 2020



PSMS ANNUAL WILD MUSHROOM SHOW

Derek Hevel

Because of the Covid-19 pandemic, the 2020 PSMS Wild Mushroom Show on October 17th and 18th will be a virtual show. A normal, in-person show is just not possible this year, so the mushroom displays, identification, book sales, cultivation, vendors, and other activities needing close interaction will not take place. However, we will still have the opportunity to mycologically entertain and amaze virtually as we host lectures and activity videos online. Members will have free access to all the virtual offerings, and nonmembers will pay \$5 when registration is available in early October.

We plan to have live, virtual lectures on both dates. Our speakers on Saturday will be Daniel Winkler at 1 pm and Alana McGee at 3 pm. On Sunday, Noah Siegel will speak at 1 pm and Danny Miller will speak at 3 pm. Members will receive links to the lectures on Zoom, much as they have been for online monthly meetings this year.

In addition to lectures, we will offer pre-recorded on-demand videos for many of the popular activities we normally offer at the show, including a dyeing video, a cooking demonstration, and a cultivation video, to name a few. As we all become a lot more familiar with online mycology this year, our committee chairs have been hard at work to produce some great fun and educational videos.

Since the show will be virtual, there is far less need for volunteers, so more members can simply enjoy the virtual offerings. But you can still contribute to the show by using the personal Facebook banner that was sent out in mid-September to generate outside interest in the show.

Thanks for sticking with PSMS over this strange year. We can't wait to have you join the virtual show in October!



SCIENTISTS IDENTIFY NEW SPECIES OF CRYSTAL-ENCRUSTED TRUFFLE, THANKS TO BONOBOS

Halle Marchese

<https://phys.org/>, Sept. 22, 2020

Mushroom-munching bonobos in the Democratic Republic of the Congo have introduced scientists to a new species of truffle.

Commonly used by Congolese communities to bait traps for small mammals, *Hysterangium bonobo* is also savored by bonobos, an endangered species of great ape. Scientists say the truffle hints at vast reserves of undescribed fungal diversity in the region.

"Truffles aren't just for gourmet chefs—they're also for our closest relatives," said Matthew Smith, an associate professor in the University of Florida department of plant pathology and curator of UF's fungal herbarium. "There's so much to learn about this system, and we're just scratching the surface."

Edible mushrooms widely prized for their aromas, truffles are often ecosystem linchpins, and *H. bonobo* is no exception. Although it looks like a homely potato, it plays a key role in enabling trees to absorb nutrients from the soil and supports the diets of animals. Its irregularly shaped outer layer is also lined with microscopic crystal-encrusted filaments, possibly used for defense or aroma diffusion.

Although previous studies have reported bonobos eating truffles, this is the first such species identified.

Hysterangium bonobo may be a new species to science, but it's well known to local communities as "simbokilo," a Bantu name linked to a longer phrase roughly translated as "Don't let your brother-in-law leave because traps baited with this will bring in plenty of food."

"Kokolopori people have celebrated their interdependence with bonobos for generations," said Albert Lotana Lokasola, a graduate student at the University of Kisangani in northern Congo and a study co-author. "Our traditional knowledge of the diets of animals such as bonobos, duikers, and rodents that includes food items new to science should be valued, preserved, and protected."

The study was published in the journal *Mycologia*.



Alexander Georgiev

Hysterangium bonobo. Scientists discovered this previously undescribed species of truffle, thanks to bonobos, who savor them.



Spore Prints

is published monthly, September through June by the
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MEMBERSHIP MEETING

Marion Richards

Tuesday, October 13, 2020, at 7:30 pm.

The October meeting will be held Tuesday, October 13, 2020, at 7:30 pm. As in previous months, it will be through Zoom (online). The link will be available on the main page at psms.org.



John Michelotti

The speaker for October is John Michelotti, and the topic is “Oyster Mushrooms: Easy Indoor Cultivation.”

Learn to grow oyster mushrooms (*Pleurotus* sp.) indoors using low tech methods on house-hold materials like coffee grounds and cardboard. He will talk about the benefits oyster mycelium have in mycoremediation and ways to create basic experiments. He will also touch on its presence of oysters in the northeastern forests and highlight a few other fungi that occur in New York.

John Michelotti is the founder of Catskill Fungi which empowers people with fungi through outdoor educational classes, cultivation courses, mushroom art, and mushroom health extracts. John is a former president of the Mid-Hudson Mycological Association, where he co-founded the Gary Lincoff Memorial Scholarship. He served on the Mushroom Advisory Panel for Certified Naturally Grown to develop ecological standards in mushroom production. He was chosen by the Catskill Center as a “Steward of the Catskills” for his contribution to the environment. His goal is to educate and inspire people to pair with fungi to improve health, communities, and the environment.



welcoming organization where all people, especially those who are underrepresented in our organization and society at large, can enjoy mushrooms and all the activities associated with them.

We realize this will be an on-going conversation and are looking to our members for suggestions on ways to increase diversity, inclusivity, and welcoming experiences. Soon members will receive an online survey about helping to open up mycology to those future mycologists who may not have had the opportunity, resources, or comfort level to join us yet. Your suggestions and how you plan to help will be much appreciated.

Show Chairs Derek Hevel, Milt Tam, and Molly Swesey-Watts are working on finalizing this year’s Fall Mushroom Show. They will need your help with publicity and digital posters will soon be available.

The board is working on guidelines for PSMS book checkout and encouraging a more active use of our PSMS library.

Because all of the group camps and day use facilities are still closed owing to the COVID pandemic and large gatherings are still discouraged, there will be no fall field trips.

Stay well and in good spirits.

CALENDAR

- Oct. 13 Membership meeting, 7:30 pm, via Zoom
- Oct. 17–18 Annual Wild Mushroom Exhibit, via Zoom
- Oct. 19 Board meeting, 7:30 pm, via Zoom
- Oct. 20 *Spore Prints* deadline

BOARD NEWS

Luise Asif

With recent events across the nation highlighting racial inequality, the board has been working on and finalized the following inclusivity statement to be posted on the PSMS website:

For over fifty years, the Puget Sound Mycological Society (PSMS) has nurtured collaboration amongst its members for an understanding and appreciation of the wide diversity of mushroom species in the Pacific Northwest. We also depend on a diverse membership to support our mission to foster the understanding and appreciation of mycology as a hobby and a science. In recent months, as systematic inequality in U.S. society is revealed to a broader audience, it becomes clearer that inequality imposes barriers on marginalized groups to participation in a wide variety of activities. PSMS opposes all barriers that limit participation in mycology. PSMS and its board members support a more diverse, inclusive, and

VIRTUAL INTRODUCTION TO MUSHROOMS CLASS Danny Miller

We are now set up to offer a virtual version of our popular “Introduction to Mushrooms and Mushroom Hunting 101” class.

You can choose from two offerings:

The first offering is on four consecutive evenings from 7 pm to 9 pm from Monday, Sept. 28, through Thursday, Oct. 1 (you attend all four).

The second offering is a little more spread out. The four sessions will be from 7 pm to 9 pm on

Monday, Oct 5

Wednesday, Oct 7

Monday, Oct. 12

Wednesday, Oct. 14 (you attend all four).

All attendees must be PSMS members. This class will cover a wide range of topics on ecology, terminology, basics of identifying, edible and toxic mushrooms, poisoning syndromes, hunting, cooking, and cultivation.

WHAT THE FUNGUS? LANDLORD’S LEAKY ROOF GROWS MUSHROOMS IN UTICA GYM

<https://www.fox2detroit.com/news/>, Sept. 10, 2020

UTICA, Mich. - Most gyms have a weight room, but the Zellador Gym has a mushroom room. At most gyms, you can pump iron, but at this one, they’re pumping water.

“The city shut us down again because we have mushrooms growing on the floor in the gym,” said Liz Allen, the gym president. “You can see the roof has collapsed and pretty much caved in.”

Former customers have nothing but praise for the gym, which they consider special. That’s why, while patrons of most gyms across Michigan are back to exercising, the members at this gym are fighting back. Every afternoon gym members are outside protesting to get their gym back and against the landlord who, the gym operators say, won’t fix the roof.

“It’s just plain wrong and disgusting,” said Mary Lee, a gym member. “He needs to do the right thing.”

The Zellador Gym in Utica was opened by Liz Allen in 2014. But there have been problems. For years Liz says they’ve been plagued by a bad roof. Leaks have ruined equipment, created mold issues, and fungus. Fungus so bad, there are now mushrooms growing out of the floors of the gym.



It’s a gym floor, not a mushroom farm.

This isn’t the first time the city has deemed the building unsafe.

“June of (2019) the city shut us down because we had water pouring onto electrical wires in the gym and we had about two inches of standing water,” Liz said.

The landlord patched those leaks but didn’t do a very good job. “He’ll put a Band-Aid on a 9-inch stab wound,” Liz’s partner, Ty Battle, said.

The bleeding has continued—and they say the landlord just doesn’t care. “He doesn’t talk to me,” Ty said. “He ignores me.”

Their landlord is Shabbir (Sonny) Khatrim of American Property LLC. He owns the whole shopping center, and Liz isn’t the only one who says he is a bad landlord.

Barb used to run a bridal shop in Sonny’s plaza, and she says that for the five years she was in the building, Sonny was a nightmare. “I would tell him what the problem was and he’d say, ‘Oh we’re going to fix that, we’re going to take care of that,’” she said. “And then he’d leave and nothing ever happened.”

Barb says Sonny was one of the reasons she decided to close her shop and she supports Liz in her struggle against the landlord.

Last year, Liz filed a suit against Sonny and his company for neglect of the property. Sonny filed a countersuit. Both cases are currently pending.

UK’S FIRST “MEDICINAL” MUSHROOM BEER

Lucy Shaw

<https://www.thedrinksbusiness.com/>, Sept. 17, 2020

Mindful drinking consultant Zoey Henderson is due to launch a range of 0.5percent AVB craft beers made with “medicinal” mushrooms in the UK this month. Called Fungtn, the vegan and gluten-free beer brand includes an IPA brewed with Lion’s Mane mushrooms; a Citra Beer brewed with Reishi mushrooms; and a lager brewed with Chaga mushrooms.

Henderson, who discovered medicinal mushrooms during a trip to California, brought the brand to fruition during lockdown and is targeting Fungtn at “mindful” drinkers seeking low ABV drinks that both mimic the taste of alcohol and deliver functional benefits.

Medicinal mushrooms, called myco adaptogens, are a class of fungi known for their health benefits that have been used in medicine for centuries.

According to Henderson they are known for helping the body adapt to psychological stresses, restoring homeostasis, and supporting the immune system and endocrine system.

During the development process, Henderson found that the natural starchiness of the mushroom extract enhances the depth and body of the beer, helping to recreate the mouth feel of an alcoholic beer. The base ingredient also gives the beers an earthy, nutty flavor profile.

Lion’s Mane IPA is said to be an “earthy yet light IPA with notes of hay and caramel and a delicate bitter undertone from the Lion’s Mane mushrooms.”

The Chaga Lager is “a crisp and refreshing dark, European style lager with a full body, chocolate undertones and a toasted malt finish.”

Completing the trio is Reishi Citra Beer, “a cloudy and juicy beer with notes of tropical fruits and pineapple.”



All three beers have an ABV of 0.5 percent and are priced at £3.20. The trio will go on sale through the Fungtn website on 25 September.

Fungtn beer from three kinds of “medicinal” mushrooms.

**HISTORICAL NOTES ON PSMS FIELD TRIPS:
Crystal Springs Forest Camp** **Brian S. Luther**

With PSMS field trips currently on hold for the foreseeable future, I thought I'd share some memories of a typical field-trip site "in the old days."

Memories

Almost at the start of early PSMS field trips, one of our regular "go to" field-trip sites was Crystal Springs Forest Camp in Kittitas Co. off Stampede Pass Exit 62 on I-90. During the late 1960s through the mid-1990s, we often went there in both spring and fall, though at 2400 ft elevation, in the spring it was sometimes snowed in and couldn't be used as planned. It was convenient, being only a little more than 60 miles from Seattle, and even though technically in eastern Washington, it bridged both east and west habitats, being just nine miles over Snoqualmie Pass. The campsite was wonderful, on a bluff with sweeping views of the Yakima River just below, which originates from Lake Kachess just west of there.

PSMS went to this location fairly regularly once or twice a year (in spring and/or fall), but not every year. The first mention I was able to find of Crystal Springs as a field-trip site was Oct. 23, 1966 (*PSMS Bulletin 26*, October 1966). The last mention was Oct. 1, 2005, as reported by Hildegard Hendrickson (*Spore Prints 416*, 2005).

I have many fond memories of this site starting in the early 1970s, including all the mushrooms we found, the different members who attended over the years, the big potlucks, and the warm, comforting campfires we used to have in the big stone fireplace in the shelter.

Sadly, the old CCC (Civilian Conservation Corps) shelter built in the early 1930s is dilapidated now and hasn't been usable for 15 years. Even the sign for the campground has been removed. Fortunately I have several old photos to show you here what it was like.

One of our early members was Jennie Schmitt, our first woman PSMS President (1978–1980). She and her husband, Dave, were actively involved in helping with the field trips from the late 1960s into the 1980s. She had six large scrapbooks she put together over the years related to PSMS, along with other mycophile information, and I was fortunate that Dave gave these to me in the early 2000s before he died. The two older photos shown below came from her scrapbooks. Here's just one quote, in part, from her: "Sept. 21/22, 1968. Crystal Springs. 105 people reg., 34 for potluck. 112 mushrooms identified. We were on our way to the



Field Trip Chairman Paul Nestelle (left) with Jennie and Dave Schmitt inside of the old Crystal Springs CCC shelter when it still had a fireplace. May 4 or 5, 1968.



Original Crystal Springs Forest Camp entrance sign and a PSMS field-trip sign.

Foray at Priest Lake Idaho. We found and sampled for the first time Ponderosa (Matusaki) [Matsutake], Honey (*Armillaria mellea*)."

Pam used to drop me off there early in the morning on field-trip days, then go straight to the Cle Elum Bakery (23 miles further east on I-90) to pick up fresh goodies to bring back and serve.

One year, in either late September or October sometime in the 1980s or 1990s when I was doing field-trip ID, the whole parking lot by the shelter was covered with morels. Yes, you heard me right, morels in fall! There was no previous fire there; they were natural morels. I often found morels in East Tennessee in fall in the late 1970s. Mushrooms do occasionally get mixed up on their seasons.

I checked old *Spore Prints* to try to confirm the year, but was unable to find any mention of it. However, there were several years where no field-trip reports were written for outings at this location, for unknown reasons (June 13, 1987; Oct. 23, 1993; Sept. 25–26, 1999; Sept. 21, 2002; Sept. 20, 2003; May 22, 2004; Oct. 23, 2004).

Today

Pam and I recently went back to check the current condition of the campground and the old CCC shelter. We took many photos, some of which I show here. The road to the site is barricaded so it can't be accessed with a car, but you can walk in. The CCC shelter is still standing; in fact the structural beams and concrete floor are in pretty good condition. However, some of the roof is in disrepair, and the entire heavy stone fireplace and chimney were removed years ago, leaving a gaping hole on the north side. The campground is also not in bad shape. The camp sites are much as they used to be years ago, with numbered camp signs still posted. The individual fire pits are still fine. Some of the old picnic tables are intact and usable while others are partially or completely derelict.

It wouldn't take that much work for the US Forest Service to get it back into usable shape. It would have been great if it was possible to renovate the site and make it usable again.

Brian S. Luther



Current gated road to the old Crystal Springs Forest Camp.

Brian S. Luther



View of current Crystal Springs Forest Camp CCC shelter looking south. The large central opening is where the stone fireplace and chimney used to be.

Brian S. Luther



Side view of current shelter looking east.

Pam Luther



Shelter's structural beams, still in good condition.

It's Over

I discussed the possibility with Nancy Jones, a US Forest Service Information Assistant at the Cle Elum Ranger Station, who was one of the employees who installed the picnic tables at Crystal Springs Forest Camp and was intimately familiar with the site.

The sad reality is that's not going to happen, for several reasons. It had not been used much over the years, and thus there was little demand for keeping it open. It had frequent vandalism. Another wildlife crossing, just like the one west of there on I-90, is planned for the area. And probably most important, the campground is too close to the massive renovation of I-90 that has been on-going in that area for several years, as most Washington residents know when taking Snoqualmie Pass either direction.

So, the destiny of the campground has been sealed. But at least I was told, the historic CCC shelter will be preserved, with the details and future public access unknown at this time.

In summary, starting in 1966 we had field trips off and on to this location for 40 years, making it an important venue for our club over the years.

I hope you enjoyed this little walk down memory lane.

FOUR WAYS TO PAIR MUSHROOMS WITH WINE

Nils Bernstein

<https://www.winemag.com/>, Sept. 19, 2020

It shouldn't be a surprise that humble mushrooms are such a popular ingredient throughout many of the world's cuisines. After all, mold and yeast, two basic fungi, are responsible for turning milk into blue cheese, wheat into bread, and, of course, grape juice into wine. Mushrooms can have a similar transformative effect on food, lending a deep savory character to all sorts of dishes. This intangible quality is often called "meaty," but mushrooms have several distinct flavor components that make them a natural partner for wine.



Earthy

Few foods are as earthy as mushrooms, which often taste like the soil in which they grow. If this quality appeals to you, pick a wine that will tease it out, rather than overwhelm it. Red Burgundy from the Côte de Nuits is a great earthy expression of Pinot Noir with mushroom-like undertones.

Peppery

Many mushrooms, especially when raw, have a subtle peppery, throat-tickling quality akin to that of radishes. Tannins can accentuate this sensation in an unpleasant way, so try a rich white wine to smooth it out. As it ages, Rioja Blanco develops nutty, caramelized aromas and an almost creamy texture that match beautifully with mushrooms.

Umami

The so-called "fifth taste," umami describes an intense savoriness found in cured meat and aged cheese, as well as cooked and dried mushrooms. Washington State Syrah boasts ripe black fruit along with umami-rich notes of bacon, olive, leather, and game that play well with concentrated mushroom flavors.

Woody

Many varieties of mushroom, particularly porcini and matsutake, have gentle notes of pine tree and underbrush. Off-dry in style, with woody, dried-fruit, and citrus-peel flavors, Verdelho Madeira is both a good match for mushroom dishes and an excellent ingredient in mushroom-dominant recipes.

ANN ARBOR, MICHIGAN, IS CONSIDERING DECRIMINALIZING PSYCHOACTIVE MUSHROOMS

Connie and Fish

<https://mix957gr.com/>, Sept. 18, 2020

Last year, Denver, Colorado, became the first city in the United States to decriminalize psychedelic mushrooms and now Ann Arbor is considering doing the same.

According to a report by the Detroit *Metro Times*, "A resolution seeking to decriminalize entheogenic substances—like psilocybin mushrooms, ayahuasca, mescaline-containing cacti, and iboga—is set for introduction on the Ann Arbor City Council agenda on Monday, Sept. 21."

The push to decriminalize the substances was backed by the activist group Decriminalize Nature Ann Arbor, who are advocating for the substances to be used therapeutically.

Psychoactive substances have been a source of debate lately since studies have begun to show several health benefits when used in a controlled setting. In a 2018 paper published in the *Journal of Palliative Medicine*, it was concluded that "it is time to revisit the legitimate therapeutic use of psychedelics."

If the substances are decriminalized, it may have an effect on how police and prosecutors in the entire state view psychedelics.

MUSHROOM-BASED COFFIN ASKS HUMANS: "ARE YOU WASTE OR COMPOST?"

Sophie Hirsh

<https://www.greenmatters.com/>, Sept. 22, 2020

Wooden coffins? That trend is so dead.

With a goal of making the human burial—and decomposition—process more environmentally friendly, a company has invented the Living Cocoon, a coffin made from mushrooms that returns the deceased to the earth while enriching it.



Loop coffin.

Invented by Delft University of Technology researcher Bob Hendrikx and his Netherlands-based company Loop, the Living Cocoon (aka the Loop Cocoon) claims to be the first "living coffin" on Earth. Loop makes the cocoon out of mycelium, a part of living fungi that

naturally grows underground amongst the roots of trees, plants, and grass. Not only is mycelium biodegradable, but it also has a few special powers—it provides nutrients to the plants growing around it, it can neutralize toxic substances, and it can clean up soil by converting waste products into nutrients.

When buried in a traditional coffin, human bodies typically take at least 10 years to break down. The Living Cocoon typically composts and disappears in just 30 to 45 days, and the body inside breaks down in two to three years.

And unlike the traditional coffin burial process, which pollutes the soil because of the chemicals used to preserve the body, the non-biodegradable materials buried, and more, the Living Cocoon actually provides nutrients to the surrounding soil.

cont. on page 6

Mushroom-Based Coffin, cont. from page 5

Annually, U.S. cemeteries use 827,060 gallons of embalming fluid (including carcinogenic formaldehyde) to preserve bodies; 2,700 tons of copper and bronze and 30 million board feet of hardwoods for caskets; and 1,600,000 tons of reinforced concrete and 14,000 tons of steel for vaults, according to the Funeral Consumers Alliance of Minnesota via the Minnesota Pollution Control Agency.

“The Living Cocoon enables people to become one with nature again and to enrich the soil, instead of polluting it,” Hendrikx said in a statement.

A limited first run of the Living Cocoon is currently available for purchase on Loop’s website to buyers in the U.S. and Europe, for €2,000.00 (\$2,343 USD).

Many states do not allow for green burials, so if you are interested in the Living Cocoon, you’ll have to research if you are even legally allowed to use it where you live. And if you happen to live in the Netherlands, Loop is displaying the Living Cocoon at the (Re)Design Death exhibition in the Cube Design Museum in Kerkrade, from Sept. 21, 2020, through Jan. 24, 2020.

SCIENTISTS SEQUENCE GENOME OF ALEXANDER FLEMING’S ORIGINAL PENICILLIN-PRODUCING FUNGUS

<http://www.sci-news.com/>, Sept. 24, 2020

*A team of researchers from Imperial College London, the University of Oxford, and the Centre for Agriculture and Bioscience International (CABI) has successfully sequenced the genome of Alexander Fleming’s original fungal strain behind the discovery of penicillin, now classified as *Penicillium rubens*, and compared it to those of two “high producing” industrial strains of *Penicillium rubens* and the closely related species *Penicillium nalgiovense*.*

Alexander Fleming famously discovered the first antibiotic, penicillin, in 1928 while working at St Mary’s Hospital Medical School, which is now part of Imperial College London.

The antibiotic was produced by *Penicillium rubens*—named at the time as *Penicillium notatum*, and until recently as *Penicillium chrysogenum*—that accidentally started growing in a Petri dish.

“We originally set out to use Alexander Fleming’s fungus for some different experiments, but we realized, to our surprise, that no-one had sequenced the genome of this original *Penicillium*, despite its historical significance to the field,” said Professor Timothy Barraclough, from the Department of Life Sciences at Imperial College London and the Department of Zoology at the University of Oxford.

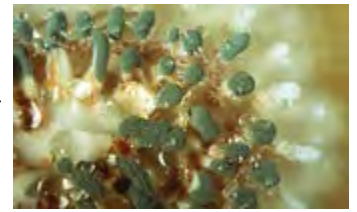
Although Alexander Fleming’s mold is famous as the original source of penicillin, industrial production quickly moved to using fungus from moldy cantaloupes in the United States.

Penicillium rubens regrown from Alexander Fleming’s frozen sample.



From these natural beginnings, the *Penicillium* samples were artificially selected for strains that produce higher volumes of penicillin.

Professor Barraclough and colleagues regrew Fleming’s original *Penicillium rubens* from a frozen sample kept at the culture collection at CABI and extracted the DNA for sequencing.



Penicillium rubens close up.

The resulting genome was compared to the previously published genomes of two industrial strains of *Penicillium rubens* used later in the United States.

The researchers looked in particular at two kinds of genes: those encoding the enzymes that the fungus uses to produce penicillin and those that regulate the enzymes, for example, by controlling how many enzymes are made.

The regulatory genes had the same genetic code in all strains, but the U.S. strains had more copies of the regulatory genes, helping those strains produce more penicillin.

However, the genes coding for penicillin-producing enzymes differed between the strains isolated in the United Kingdom and the United States.

“This shows that wild *Penicillium* in the United Kingdom and the United States evolved naturally to produce slightly different versions of these enzymes,” the scientists said.

“Molds like *Penicillium* produce antibiotics to fight off microbes, and are in a constant arms race as microbes evolve ways to evade these defenses.”

“The UK and U.S. strains likely evolved differently to adapt to their local microbes.”

“Our research could help inspire novel solutions to combating antibiotic resistance,” said Dr. Ayush Pathak, a researcher in the Department of Life Sciences at Imperial College London.

“Industrial production of penicillin concentrated on the amount produced, and the steps used to artificially improve production led to changes in numbers of genes.”

“But it is possible that industrial methods might have missed some solutions for optimizing penicillin design, and we can learn from natural responses to the evolution of antibiotic resistance.”

The team’s results appear in the journal *Scientific Reports*.

FUNGI CAN DEVELOP DRUG RESISTANCE WITHOUT GENETIC CHANGES

University of Edinburgh, Sept. 9, 2020

The management of fungal infections in plants and humans could be transformed by a breakthrough in understanding how fungi develop resistance to drugs.

It was previously thought that only mutations in a fungi’s DNA would result in antifungal drug resistance. Current diagnostic techniques rely on sequencing all of a fungi’s DNA—their genetic code—to find such mutations.

Scientists from the University of Edinburgh have discovered that fungi can develop drug resistance without changes to their DNA.

The new research, published in *Nature*, finds that resistance can emerge in fungi without genetic changes. Instead the fungi exhibit epigenetic changes—alterations that do not affect their DNA—suggesting that many causes and cases of antifungal resistance could have been previously missed.

Each year fungal diseases affect billions of people globally, causing an estimated 1.6 million deaths.

Infections resistant to treatment are a growing problem, particularly in patients with weakened immune systems such as those with HIV. Few effective antifungal drugs exist.

Overuse of agricultural fungicides is also leading to increasing resistance in soil-borne fungi. Fungal disease results in the loss of up to a third of the world's food crops annually.

A team of scientists from the University of Edinburgh's Wellcome Centre for Cell Biology studied the emergence of resistance in a yeast, *Schizosaccharomyces pombe*, by treating it with caffeine to mimic the activity of antifungal drugs.

The team discovered that the resulting resistant yeast had alterations in special chemical tags that affect how their DNA is organized. Some genes became packed into structures known as heterochromatin, which silences or inactivates underlying genes, causing resistance as a result of this epigenetic change.

This discovery could pave the way for new therapies to treat resistant infections by modifying existing epigenetic drugs or developing new drugs that interfere with fungal heterochromatin.

Improved fungicides to treat food crops could limit agricultural losses and also reduce the number of resistant fungal strains in the environment that continue to fuel increased infections in humans.

Sito Torres-Garcia, Darwin Trust of Edinburgh funded PhD student and first author of the paper, said: "Our study shows for the first time that fungal cells can develop drug resistance by altering how their DNA is packaged, rather than altering their DNA sequence."

NEW UC BERKELEY CENTER WILL TRAIN "PSYCHEDELIC GUIDES" IN USE OF MAGIC MUSHROOMS

<https://www.thecollegefix.com/>, Sept. 16, 2020

UC Berkeley can now launch its UC Berkeley Center for the Science of Psychedelics after an anonymous donor gave \$1.25 million to start the center.

The new center at the public university promises to research the possible medical benefits of psychedelic drugs, such as magic mushrooms and the chemical compound psilocybin.

Part of its public education effort will include training "psychedelic guides" alongside the Graduate Theological Union to explore the "cultural, contemplative, and spiritual care dimensions of psychedelics," according to a Sept. 14 news release from the university.

The Graduate Theological Union is made up of eight theology schools in the area and has a relationship with UC Berkeley that allows students to take classes at the university.

"Initial experimental studies will use psilocybin, the principal psychoactive compound in magic mushrooms," the release stated.

The *Daily Cal* campus newspaper reports the psychedelic research center "aims to reevaluate the value of psychedelics for helping to treat mental illness."

"The center's main goal is to make discoveries about the human brain with the help of psychedelics and to add to existing knowledge on the way the mind works," it reported.

Michael Silver, an optometry and neuroscience professor, will lead the new center as its director.

"This is a pivotal time in history for a discussion about psychedelics and under what circumstances they should be used," Silver said in the news release. "This has obviously been a very polarizing topic, but I think people's minds are changing."

It will not be the only psychedelic research center in the country, however.

Investigators through John Hopkins medicine launched its own Center for Psychedelic and Consciousness Research in January 2020, though the researchers have been investigating psychedelic drugs since 2000.

The Johns Hopkins researchers have looked at the role of psilocybin on anxiety, depression, and tobacco use, a news release stated.

The January press release from Johns Hopkins said researchers have planned for studies on using the psilocybin in opioid addiction treatment and the treatment of post-traumatic stress disorder. Other planned research included investigations on alcohol use and one on Alzheimer's.

Another study "will explore psychedelics in the treatment of emotional and behavioral symptoms of post-treatment Lyme disease syndrome," according to the university.

Californians that want to learn more about psychedelics can also apply for a certificate program in "psychedelic-assisted therapies and research" at the California Institute of Integral Studies.

FUNGAL HIGHWAYS LET BACTERIA TRAVEL IN EXCHANGE FOR THIAMINE

University of Tsukuba

<https://phys.org/>, Sept. 24, 2020

Tiny organisms head out on the highway, looking for adventure like they've ridden straight out of the 1960s rock hit "Born to Be Wild." Researchers from Japan have discovered that while perhaps not as thrill-seeking, bacteria do indeed travel on fungal highways and pay a toll in return.

In a study published this month in *Life Science Alliance*, researchers from the University of Tsukuba have revealed a mutual bacterial-fungal relationship that lets bacteria travel in exchange for thiamine.

Thiamine (vitamin B1) is essential to the health of almost all living organisms, and is synthesized by bacteria, plants, fungi, and some protozoans. Free thiamine is scarce in the environment, and organisms appear to have developed numerous ways of obtaining it.

"Some species have developed mutually beneficial strategies that allow them to coexist," says lead author of the study Professor Norio Takeshita. "But few strategies that satisfy the need for nutrients

cont. on page 8

and physical niches have been documented. So, we examined the interaction of a fungus and a bacterium to investigate strategies that meet those needs.”

To do this, the researchers used transcriptomic analyses (i.e., examining all the RNA molecules of an organism), as well as genetic, molecular mass, and imaging methods, including live imaging. Stable isotope labeling was used to investigate thiamine transfer from bacteria to the fungus.

“The bacteria cultured with the fungus traveled along fungal filaments using their flagella,” explains Professor Nozomu Obana, senior author. “They dispersed farther with the expansion of the fungal colony than they would have otherwise, suggesting that the fungal filaments supply space for bacteria to migrate, disperse, and multiply.”

The fungus in this study is a type that can synthesize thiamine on its own, but it used thiamine produced by the bacteria. Because these bacteria synthesize thiamine extracellularly, neighboring bacteria and fungi in nature could uptake it and use it, saving them the cost of synthesizing it themselves.

“We’re proposing a new mutualistic growth mechanism in bacterial-fungal interactions, in which the bacteria move along the

fungal highway and pay thiamine as a toll to the growing fungal filaments,” says Professor Takeshita.

This research and future studies will contribute to an understanding of selective microbial communication, and live imaging could be used to screen for affinities between bacteria and fungi. Research in this area could be applied to a range of settings from fermentation, biomass degradation, and the promotion of plant growth, as well as plant and human pathogenesis.

Song of the Mushroom King

*I am the Cep—the Mushroom King.
My praises mushroom pickers sing.*

I am so easy to discover.

I look like me—not any other.

I’m very tasty fresh or dry

To you and to the mushroom fly

So pick me when I’m firm and young.

Just finding me is HALF THE FUN!



—Joe Lenart

The *Sporeprint*, Los Angeles Myco. Soc., June 2002

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